

# Nutrition and an Active Life



**From Knowledge to Action**

Wilma B. Freire, Editor

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## PREFACE

This book, written by leading international public health experts from the Pan American Health Organization (PAHO) and its collaborating institutions, demonstrates how research in nutrition and the promotion of active lifestyles has informed action in the development of public policies and in the design, implementation, monitoring, and evaluation of programs.

All of us are the beneficiaries of this science and its applications. Different types of interventions are presented, targeting mothers and children, the economically active population, older adults, and all age groups whose sedentary lifestyle favors the development of noncommunicable diseases such as cardiovascular disorders, diabetes, and various types of cancer.

The collected contributions discuss a broad range of issues. These include actions targeted to individuals, such as those stressing the importance of breast-feeding and the prevention of micronutrient deficiencies, poor nutrition, overweight, and obesity. At the more complex and intersectoral level, the discussion highlights the effect of rapid urbanization on epidemiological profiles, the benefits and limitations of social communication and marketing in encouraging better nutrition and a more active lifestyle, and the role of urban planning and structure in creating healthier behaviors and achieving recommended levels of physical activity. Finally, the book explores the synergistic impact on human health and the quality of urban life that can result from the creation of close partnerships between the public health and urban development sectors, who, together, can increase road safety, reduce urban crime and violence, protect the environment, and preserve public spaces.

From remote rural villages to the world's largest metropolises, *Nutrition and an Active Life: From Knowledge to Action* embraces a diversity of Latin American settings and successful, well-integrated strategies. In each case, the physical, social, cultural, and economic determinants of health, particularly as these relate to nutritional habits and physical activity levels, are described, as well as how the creation of healthy public policies and evidence-based interventions can improve both health status and quality of life at the individual and population levels.

The Millennium Development Goals (MDGs) adopted by the United Nations in 2000 have brought the idea of investing in people's health to the very center of the global development agenda. The health-related MDGs have been established as the critical underpinning for PAHO's technical cooperation efforts over the next decade. The series of research findings presented in *Nutrition and an Active Life: From Knowledge to Action* aim to provide support to the Organization's Member States in the form of effective and practical working tools as these countries strive to bring national health plans and priorities in line with the MDGs.

Five of the eight MDGs receive special attention in this book. They are: MDG-1, dealing with the eradication of extreme poverty and hunger; MDG-4, focusing on the reduction of child mortality; MDG-5, improving maternal health; MDG-7, ensuring environ-

mental sustainability; and MDG-8, forging a global partnership to promote socioeconomic development.

The Millennium Development Goals are important milestones for progress in human development which incorporate relevant indicators of the effectiveness of health systems in addressing key health problems amenable to intervention. By encouraging social participation and increasing health literacy regarding relevant health issues, PAHO seeks to empower a global community to work together in achieving the MDGs. In this sense, *Nutrition and an Active Life: From Knowledge to Action* is an important contribution that should be of particular interest to practitioners and researchers working in health promotion and community education, nutrition, maternal and child health, physical activity, public policy design and planning in health and urban development, and social communications.

Mirta Roses Periago  
Director  
Pan American Health Organization

# ACKNOWLEDGMENTS

The goal of the Pan American Health Organization (PAHO) is to bring together in this book the scientific output and successful experiences of recent years in the Americas in the areas of nutrition and the promotion of active lifestyles and to disseminate the lessons learned to countries in this Region and in other regions of the world. This undertaking was very well received from the outset, and we owe a tremendous debt of gratitude to the authors who supported the project and enthusiastically contributed chapters to it. Together, these contributions offer a body of knowledge and experience of enormous value that can help guide the design and execution of similar policies and programs and reduce the high prevalence of nutritional and chronic disease disorders.

Secondly, we wish to offer special thanks to Dr. Gina Tambini, Manager of the Area of Family and Community Health of PAHO, for backing this effort to share the experiences and work in nutrition and physical activity in Latin America through a book geared toward researchers, academicians, students, policymakers, and program directors. We trust that this publication will be very useful in this group's research and education activities, as well as in the execution of different policies and programs.

We also express our special thanks to Judith Navarro and her team in the PAHO Area of Publications, who placed their competence and dedication at the service of this project, so that the book could be published in a timely manner.

Wilma B. Freire<sup>1</sup>  
Editor

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# INTRODUCTION

In recent years, the health situation in the Americas has improved considerably thanks not only to better living conditions and greater access to health services, but also to the implementation of far-reaching nutrition policies and programs. However, nutritional deficiency disorders persist, and are now, moreover, accompanied by overweight and obesity, problems resulting from poor eating habits and unhealthy lifestyles. Nutritional deficiency disorders and problems of excessive caloric intake are seen in virtually every country. While children under 3 continue to suffer from malnutrition, with stunted growth and anemia, overweight and obesity are on the rise not only among adults, but children as well.

Stunting rates range from 10.5% in Brazil to 46.4% in Guatemala, with the highest prevalence rates recorded in Bolivia, Ecuador, El Salvador, Haiti, Nicaragua, and Peru. Low weight-for-age is more prevalent in Ecuador, Guatemala, Haiti, and Nicaragua, with levels ranging from 11% to 24%. Both micronutrient deficiencies and problems of overweight and obesity are the product of improper diet and are found especially in young children and pregnant women. Anemia in children under 5, measured by low hemoglobin levels, is present in all the countries, with levels of approximately 20%. Prevalence rates in pregnant women are above 30%, and are 25% among women of childbearing age. At the same time, prevalence rates for overweight and obesity in women of childbearing age exceed 30% and are found in the majority of the countries, with the exception of Haiti; school-age children are also among those affected.

Notwithstanding, in recent decades several nutritional disorders have been brought under sufficient control that they have ceased to be a public health problem. These achievements are the result of the application of effective strategies that have demonstrated the feasibility of fighting these problems and reducing their devastating consequences.

This book details programs and policies implemented in the Region that have helped to improve the overall health of the population by reducing the high prevalence rates of nutritional disorders and promoting healthy lifestyles. It is hoped that these experiences will serve as examples that may be replicated in other communities and nations inside and outside the Region of the Americas.

Not all the experiences described in this book have been subjected to a rigorous evaluation of their effectiveness. Nevertheless, after careful analysis of the programs considered successful, we have decided to include them for the following reasons: they offer programming lessons because they were conceived with highly innovative vision; they have been implemented using viable processes and were able to elicit broad multisectoral participation; and they have raised awareness among the target populations of their right to good health and nutrition. Readers will be able to readily identify and appreciate these elements and will find in these programs a source of information, guidance, and reflection.

The chapters in the book are divided into four sections: the first consists of a review of scientific evidence, and the second focuses on successful interventions in the area of micronutrients. The last two sections encompass strategies adopted at the local and national levels to address issues related to nutrition and the adoption of healthier, more active lifestyles. The four sections are followed by a chapter summarizing the book's most salient messages and offering conclusions based on these.

The first section consists of two chapters. In the first of them, Martorell examines the long-term consequences of early malnutrition and how research findings may help shape better policies and programs. The chapter is based on lessons learned from a series of longitudinal and follow-up studies conducted by the Institute of Nutrition of Central America and Panama and Reynaldo Martorell. It analyzes research launched in the 1960s and still under way. The studies are unique, in the sense that they begin with interventions during early childhood whose effects are followed into adulthood and the next generation. The second chapter, written by Victora, Albernaz, and Lutter, also reviewed studies conducted in Latin America in the second half of the twentieth century and their contribution to the design of policies related to infant feeding. This review focuses on the role of research findings by demonstrating the impact of breast-feeding on child health and growth.

The second section presents effective strategies utilized by micronutrient programs and consists of four chapters. The first, by Freire, Vanormelingen, and Vanderheyden, describes the successful experience of a program to control iodine deficiency disorders in Ecuador. This program set a true milestone by clearly demonstrating that salt iodization is the most effective and least costly measure for combating iodine deficiency disorders in the Americas. The second chapter, by Dary, Martínez, and Guamuch, focuses on vitamin A sugar fortification in Guatemala, an initiative that not only managed to reduce cases of blindness from vitamin A deficiency, but also decreased infant morbidity and mortality by improving immune response. This experience led other countries to adopt similar programs, as was the case in El Salvador, Honduras, Nicaragua, Nigeria, and Zambia. The chapter summarizes the evolution of sugar fortification in Guatemala from 1988 to 2005 and its vicissitudes, updating and complementing works previously published on the subject. The third chapter, by Mora, Navas, Bonilla, and Sandino, describes the experience of a program to control vitamin A deficiency in Nicaragua and discusses the lessons learned, so that others may take advantage of them. Nicaragua, like other countries facing this issue, recognized the important role played by vitamin A in the health and survival of children and decided to adopt a national control plan to improve intake utilizing the most effective and least costly supplementation and fortification strategies that could be implemented at the national level. The fourth chapter, by Hertrampf, describes the successful Chilean experience of wheat flour fortification as a way of decreasing the incidence of neural tube defects, for it has been shown that food fortification is effective in preventing these malformations. This strategy has had particular impact in countries where a food staple suitable for fortification could be readily identified. Hertrampf reviews the role of folates in the metabolic process and then presents the epidemiological and clinical characteristics of neural tube defects and effective strategies to prevent them. She concludes with an overview of the Chilean experience, demonstrating the benefits of fortifying wheat flour with folic acid.

The third section analyzes integrated strategies adopted at the local level and includes four chapters. The first one, by Rea and Araújo, describes the Brazilian experience in effectively promoting the practice of exclusive breast-feeding during the first six

months of life and, following the introduction of complementary foods, continued breast-feeding until the child reaches 2 years of age or older. Among the most noteworthy of the strategies employed are wide-reaching social mobilization and multimedia campaigns and the establishment of a national network of human-milk banks. The second chapter, by Benavides, describes the Best Buy Project developed by the Peruvian Institute of National Research in partnership with grassroots organizations (community kitchens), the mass media, the private sector, and the international community. The project periodically monitored food prices in Lima, the country's capital, with a view to identifying foodstuffs available in local markets containing the most cost-effective units of energy and protein. This information was used to design and develop nutritionally sound recipes in community kitchens at prices within the economic means of low income population groups. Messages promoting "best buy" foods and recipes incorporating them were distributed through the mass media and in face-to-face educational activities. Evaluation of the program showed that it is possible to improve access to highly nutritious foods after only a five-month period. The third chapter is about a successful model for promoting active lifestyles, the Agita São Paulo Program. This experience demonstrates the effectiveness of forging partnerships with national and international organizations and of having political backing and a strong scientific foundation. The chapter describes the history and key characteristics of the program, emphasizing its multisectoral essence. This section ends with a chapter by Montezuma on the link between the urban environment and an increase in physical activity. The author describes the transformation of Bogotá, Colombia, a process which helped to counteract a trend of growing dependence upon individual motorized transportation. The increase in vehicular use is related to the growth of sedentary lifestyles, a factor that contributes to rising overweight and obesity among urban dwellers. The Bogotá experience shows that the structural design of cities directly and indirectly influences many behaviors related to physical activity and a sedentary lifestyle among the population and that positive changes in the physical environment have a greater potential for increasing physical activity than do policies targeting individual behavior alone. These changes include greater access to means of mass transportation, and the creation of public spaces for pedestrians (such as plazas, sidewalks, and pedestrian-only streets), bicycle paths, and urban parks.

The fourth section deals with integrated strategies adopted at the national level and consists of three chapters. The first one, by Rivera, shows that mission-based research in public health makes it possible to improve the population's health status by applying scientific method to the study of different objects and levels of analysis. The author demonstrates that this methodology facilitates an in-depth analysis of the population's health using a multidisciplinary approach to generate information and can improve the organized social response, resulting in better designed policies and programs to prevent and control poor nutrition. The chapter also presents evidence of how the use of scientific research findings has led to actions with high impact and promising indications for the future of malnutrition prevention and control policies and programs in Mexico. The second chapter, by Vio and Uauy, describes the history of nutritional problems in Chile and how the adoption of policies targeting priority issues, the reallocation of resources, and changes in program execution have enabled the country to bring a number of nutritional problems under control. The experience gained within this national institutional framework has led to the search for other interventions to counter the emerging problem of overweight and obesity. Finally, Jacoby and colleagues

present a chapter on this same topic in which they analyze a situation common across urban landscapes in the Americas: lack of personal safety, violence, gang activity, stress, physical inactivity, and social disintegration. These factors are recognized as a high risk to the population's health and are responsible for the epidemics of cardiovascular diseases, mental health problems, and obesity that together account for nearly 60% of all deaths in the Region. Jacoby and colleagues observe that unlike the public health approach, which focuses on the individual, the urban planning mindset seeks to address problems from a collective perspective, setting as its priorities the improvement of urban quality of life, securing a healthy environment, and providing efficient public infrastructure, such as transportation systems and appropriate urban land use. The authors highlight the potential value for human health of creating a more active synergy between the public health and urban development sectors.

We are proud to present this book to our readers in the certainty that they will discover strategies, tools, and perspectives useful in addressing the health and nutrition challenges in their communities. As its pages show, there is no magic bullet. Yet significant progress can be achieved through selection from a highly diverse set of actions, depending on the problem's nature and the environment in which change needs to occur. While there exists no single prescription, starting with scientific evidence and reviewing experiences that have been successful elsewhere can provide reliable clues for a given intervention's viability and adaptability to local circumstances in your own community or region.

Wilma B. Freire

# **The Contribution of Science to Action**



# THE POLICY AND PROGRAM IMPLICATIONS OF RESEARCH ON THE LONG-TERM CONSEQUENCES OF EARLY CHILDHOOD NUTRITION: LESSONS FROM THE INCAP FOLLOW-UP STUDY

Reynaldo Martorell<sup>1</sup>

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## INTRODUCTION

Child malnutrition is a major public health problem in Latin America and the Caribbean, according to the United Nations System Standing Committee on Nutrition's *5th Report on the World Nutrition Situation (1)*. For example, 11.8% of preschool children in this region are projected to be stunted by the end of 2005. Anemia rates in young children are reported to be alarmingly high; half to three-quarters of preschool children were found to be anemic (< 11 g/dL) in Bolivia, Haiti, and Peru according to estimates from recent national surveys (1).

Child malnutrition is an even greater problem in Africa and Asia, where 34.5% and 25.7% of preschool children, respectively, are projected to be stunted by the end of 2005. However, there are pockets in the Latin American and Caribbean subregions where the problem of child malnutrition is as extensive as in Africa and Asia. Estimated levels of stunting for the year 2005 in preschool children are 7.4% for the Caribbean, 9.6% for South America, and 18% for Central America. Countries with low levels of stunting in preschool children include Chile, Cuba, and Costa Rica, with 1.5%, 4.6%, and 6.1%, respectively. At the other extreme, the countries with the highest levels of stunting in

preschool children are Guatemala, Honduras, and Bolivia with 46.4%, 29.2%, and 26.8%, respectively; levels similar to those found in many sub-Saharan African countries. The 1998–1999 national nutrition survey of Mexico found that 17.8% of preschool children at the national level were stunted; however, there was considerable variation at the subnational level, and this was associated with variations in regional economic development (2). The regions of the north, center, and Mexico City had levels of stunting of 7.1%, 14.5%, and 13.2%, respectively; lower than levels for the poorer and more indigenous south, where 29.2% of preschool children were found to be stunted. In southern Mexico, levels were 17.8% in urban areas but 42.4% in rural areas.

Economic development, like stunting, varies across regions and countries. Latin America had a gross national income (GNI) per capita of US\$ 3,610 in 2001, compared to US\$ 519 and US\$ 449 for the regions of sub-Saharan Africa and South Asia (which includes India), respectively (3). The least de-

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veloped countries, a group made up of the world's poorest countries that includes only one American country, Haiti, had a GNI per capita of US\$ 295. The country with the highest prevalence of stunting in the Region of the Americas, Guatemala, had a GNI per capita of US\$ 1,670.

Several observations may be made about child malnutrition and national incomes based on these data. The levels of child malnutrition in the Americas are incongruous with the level of national economic development the Region has achieved. Most countries, Guatemala and Mexico, for example, possess the resources to significantly lower their high rates of child malnutrition, but first they must make this goal a national priority. Second, countries need to implement cost-effective policies and programs to address child malnutrition. To achieve this, policies and programs must be guided by the best available scientific evidence, and programs must be monitored and evaluated to improve their functioning and maximize their impact on child nutrition.

The objective of this chapter is to review the contributions to policies and programs of a collection of studies unique in the history of child nutrition research in the world, the INCAP Longitudinal and Follow-up Studies (4). These studies, conducted by the Institute of Nutrition of Central America and Panama, a scientific and technical center of the Pan American Health Organization based in Guatemala City, began in the 1960s and continue to this date. They are unique because they began with a nutrition intervention in early childhood whose effects are being traced to adulthood and the next generation. Results from this body of INCAP studies show convincingly that there are short- and long-term positive consequences of improving nutrition in early childhood (5), which thus provide fuel for advocacy for those interested in convincing policymakers to invest in maternal and child nutrition and also inform program managers about how best to design nutrition interventions.

Three sections follow: a description of the original longitudinal study and its key findings, a review of the characteristics and key findings from the 1988–1989 follow-up and other subsequent studies, and a discussion of the contribution of the INCAP studies to policies and programs.

## THE INCAP LONGITUDINAL STUDY AND KEY FINDINGS

The INCAP studies began in four villages of the department of El Progreso in eastern Guatemala. This is an area of the country rarely visited by tourists; the environment is dry and dusty, and the population is ladino (i.e., Spanish-speaking mestizo). The villages were selected after a long and careful process from which two pairs of similar villages were identified; then, one village from each pair was chosen randomly to receive a nutritious supplement and the remaining two villages a control drink.

### Nutrition and Medical Interventions

Detailed descriptions of the INCAP studies are found elsewhere (4). The longitudinal study began in 1969 and lasted until 1977. Its main purpose was to assess the effect of improving protein intakes on the mental development of preschool children. At the time, protein deficiency was believed to be the major cause of much of the child malnutrition in the world. The “treatment” drink was formulated as an *atole*, or a type of hot gruel consumed in Guatemala, and was made from Incaparina, a vegetable protein mixture developed by INCAP, with dry skim milk, sugar, and flavoring. The *atole* delivered 11.5 g of high-quality protein per cup (180 ml). It also contained energy (163 kcal/cup) as well as vitamins and minerals, but was not a good source of zinc. The intent of the study was to provide this nutritionally potent drink to women and children and then to measure its impact on mental development

by comparing test results in the treatment and control villages.

The *atole* was provided in a supplementation center twice a day, in mid-morning and mid-afternoon in order to minimize possible influences on meal patterns at home. Attendance was open to all villagers, but was recorded only for pregnant and breast-feeding women and for children 7 years or younger. A cup was given to each subject, but more was given if desired. Intakes were recorded carefully, after subtracting leftovers from the amounts given.

The control drink was devoid of protein and had only a small amount of sugar and flavoring; it was called *fresco* and was similar to local drinks served at room temperature. The *fresco* provided 59 kcal/cup. Fear of "empty calories" and a desire to further isolate the contrast in protein between the two drinks led to vitamins and minerals being added to the *fresco* to achieve similar concentrations as those found in the *atole*.

The psychologists in the project were concerned that the social interaction resulting from attending the supplementation center could, by itself, influence child development. For this reason, procedures in *atole* and *fresco* villages were similar, including the layout of the supplementation centers and the measurement of attendance and intake.

Another important change was the establishment of medical clinics offering preventive and curative services run by auxiliary nurses under the supervision of a physician. These services were free and not tied to participation in the study.

## Dietary Impact

Home diets of mothers and children were measured using 24-hour recall surveys and, by analyzing dietary and supplement intake data, it was possible to estimate the net impact of the supplements on total nutrient intakes.

The supplementation program was designed to create a large difference in net pro-

tein intakes between subjects in *atole* and *fresco* villages, and this was achieved in women and children. However, unexpected differences were produced in other nutrients because patterns of consumption of the supplements in women and children differed between *atole* and *fresco* villages. Women drank larger volumes of *fresco* than *atole*, such that the energy contribution of the *fresco* and *atole* was similar despite the drinks' different energy densities. This also meant that intakes of vitamins and minerals among women were greater in *fresco* than in *atole* villages because they were present in equal concentrations in the supplements.

On the other hand, in children less than 3 years of age, supplement intakes were much lower in *fresco* compared to *atole* villages, such that intakes of protein, but also energy and other nutrients, were greater in *atole* villages. The home diets of young children were measured every three months until 36 months, beginning at 15 months and every three months thereafter, for a total of eight times over this interval. Using these data and information about daily supplement intakes, average daily total protein intakes (home diet plus supplement) were 9 g greater in *atole* compared to *fresco* villages (Table 1) (6). Average daily total energy intake was 90 to 100 kcal greater in *atole* villages. Children consuming the *atole* may have decreased their home dietary intakes slightly as evident by the greater home dietary intakes in *fresco* villages. Also, intakes of vitamins and minerals were greater in young children from *atole* villages (not shown in Table 1). Finally, in children 3 to 7 years of age, as in women, a greater volume of *fresco* was consumed than *atole*.

These patterns of consumption probably reflect the nature and appeal of the drinks. Mothers and older children could drink larger amounts of the *fresco*, a light drink, than of the hot and denser *atole*. Mothers, on the other hand, may have viewed the *atole* as a food and the *fresco* as a refreshing drink, and they may have been more motivated to

**TABLE 1. Contribution of the supplements to total energy and protein intakes in children 15–36 months of age.<sup>a</sup>**

|                | Males                             |                                    |      | Females                           |                                    |      | Pooled <i>s</i> |
|----------------|-----------------------------------|------------------------------------|------|-----------------------------------|------------------------------------|------|-----------------|
|                | <i>Atole</i><br>( <i>n</i> = 128) | <i>Fresco</i><br>( <i>n</i> = 135) | Diff | <i>Atole</i><br>( <i>n</i> = 118) | <i>Fresco</i><br>( <i>n</i> = 104) | Diff |                 |
| Energy, kcal/d |                                   |                                    |      |                                   |                                    |      |                 |
| Home diet      | 785                               | 814                                | –29  | 718                               | 756                                | –37  | 213             |
| Supplement     | 156                               | 26                                 | 130  | 150                               | 2.3 <sup>b</sup>                   | 127  | 79              |
| Total intake   | 941                               | 840                                | 101  | 868                               | 779 <sup>c</sup>                   | 89   | 226             |
| Protein, g/d   |                                   |                                    |      |                                   |                                    |      |                 |
| Home diet      | 20.1                              | 22.5 <sup>b</sup>                  | –2.4 | 19.3                              | 21.0                               | –1.7 | 5.9             |
| Supplement     | 11.0                              | 0.0                                | 11.0 | 10.5                              | 0.0 <sup>b</sup>                   | 10.5 | 5.4             |
| Total intake   | 31.1                              | 22.5 <sup>b</sup>                  | 8.6  | 29.8                              | 21.0 <sup>b</sup>                  | 8.8  | 7.5             |

<sup>a</sup>Home diet values are averages of as many as eight recall surveys conducted at 15 mo and every 3 mo thereafter until 36 mo.

<sup>b</sup>*p* < 0.001.

<sup>c</sup>*p* < 0.01.

**Source:** Martorell R, Habicht JP, Klein RE. Anthropometric indicators of changes in nutritional status in malnourished populations. In: Underwood B, ed. *Proceedings, Methodologies for Human Population Studies in Nutrition Related to Health*. Washington, DC: US Department of Health and Human Services, National Institutes of Health; 1982:96–110. (NIH Publication No. 82-2462).

offer the *atole* to young children. Thus, the “protein” design was complicated by perceptions and behaviors of the subjects. In women, both supplements contributed nearly similar amounts of energy, but only one had protein. In young children, the contributions to diets were along a broad front and were not limited to protein.

## Key Findings

One of the major findings from the study was that food supplementation improved birthweight (7). However, this analysis could not be done using the randomized design. Comparison of mean birthweight for newborns of women consuming *atole* during pregnancy to those corresponding to women consuming *fresco* showed a small but insignificant difference in favor of *atole* villages. However, other analyses were carried out that showed that consumption of the *atole*, and unexpectedly, of the *fresco* as well, improved birthweight. The analyses also showed that energy, rather than protein or other nutrients in the supplement, best explained the relationship between supplement intake during pregnancy and improvements in birthweight. The analyses to

support this claim were made possible by the overlapping ranges in supplement energy intakes during pregnancy in *atole* and *fresco* villages. Since the energy contributions from the supplements were similar in both types of villages, by virtue of women consuming more of the less energy-dense *fresco* than the *atole*, intent to treat analyses could not show a difference between *atole* and *fresco* villages. However, comparisons of high- and low-consumption groups suggested improvements in birthweight. Specifically, women who consumed more than 20,000 kcal from the supplements during pregnancy (about 111 kcal/day if ingested during the last six months of pregnancy), whether in *atole* or *fresco* villages, had half the risk of delivering a low-birthweight baby (< 2,500 g), compared to those who ingested less than 20,000 kcal. Care was taken to control for potentially confounding factors, much needed because these analyses no longer used the experimental design.

The key outcome of the study was mental development. Physical growth was an important outcome for the study, but largely because confirmation was needed that the *atole* was biologically efficacious in order to properly interpret effects on mental develop-

ment. For example, lack of an effect on growth might indicate that the nutrition experiment was ineffective and cast doubt on any possible conclusion about effects on mental development. As it turned out, the *atole* had a substantial effect on growth, but only in the first 3 years of age (8). The reasons for an effect during the first 3 years, but not from 3 to 7 years of age, include greater growth rates, greater relative nutritional requirements, and more frequent and severe diarrheal diseases in younger children. Patterns of growth failure in study subjects support the greater vulnerability of young children; growth failure was particularly acute in children younger than 18 months. By about 24 months, children grew in length at rates not unlike those of children in developed countries (9). Thus, although growth failure occurred before 2 years of age, children in Guatemala retained some capacity to grow better up to their third year of life in response to improved nutrition.

A simple analysis true to the randomized design was used by Habicht, Martorell, and Rivera (10) to examine the effect of the nutrition intervention on child growth. This analysis used village as the unit of analysis and compared *atole* and *fresco* villages in terms of length at 3 years of age before and after supplementation (Table 2) (6). The baseline information came from a cross-sectional survey of children carried out in 1968, one year before

the beginning of the study. The similarities of the four villages at baseline are evident and reflect the care with which the villages were matched; the differences between the large *atole* and *fresco* villages were 0.15 cm (*atole* larger), and the corresponding differences for small villages were 0.75 cm (*fresco* larger). Similarly, the mothers of children exposed to *atole* in early life were 148.9 cm tall, nearly identical to mothers from *fresco* villages who were 149.0 cm tall, with a pooled standard deviation of 5.3 cm (11). Children exposed to *atole* throughout their lives were 3.25 cm and 2.55 cm taller in the large and small village, respectively, whereas those exposed to *fresco* changed little, increasing by 0.70 cm and 0.20 cm, respectively. The small change in *fresco* villages may be attributed to chance, but could be due also to energy and other nutrients in the *fresco*, to the effects of *fresco* on birthweight, to the medical care program, or to any combination of these factors. The differences in net change (*atole* differences minus *fresco* differences with respect to baseline values) were 2.55 cm in the large villages and 2.35 cm in the small villages. The mean of these differences was 2.45, and the standard deviation was 0.10 cm. Despite having only two degrees of freedom, the *t*-test was 24.5, with a two-tailed probability of  $p < 0.005$ . Because the analysis used the randomized design, the potential effects of confounding factors were incorporated into the probability

**TABLE 2. Length<sup>a</sup> of 3-year-old children before and after supplementation by village size and type of supplement.**

|                      | Large villages |               | Small villages |               |
|----------------------|----------------|---------------|----------------|---------------|
|                      | <i>Atole</i>   | <i>Fresco</i> | <i>Atole</i>   | <i>Fresco</i> |
| After <sup>b</sup>   | 86.70          | 84.00         | 85.95          | 84.35         |
| Before <sup>c</sup>  | 83.45          | 83.30         | 83.40          | 84.15         |
| Change               | 3.25           | 0.70          | 2.55           | 0.20          |
| Difference in change | 2.55           |               | 2.35           |               |

Overall difference in change: mean =  $2.45 \pm 0.10$ , *t*-test = 24.50,  $p < 0.005$  (two-tailed probability; *df* = 2).

<sup>a</sup>Means of sex-specific data calculated from Table 3 in Martorell, Habicht, and Klein (6).

<sup>b</sup>Born between 1969 and 1973.

<sup>c</sup>Measured in 1968.

**Source:** Habicht JP, Martorell R, Rivera JA. Nutritional impact of supplementation in the INCAP longitudinal study: Analytic strategies and inferences. *J Nutr* 1995;125(Suppl 4):1042S–1050S.

statement as was the medical care program. Few other analyses published from the study have used the randomized design because power becomes very limiting, even though it is reassuring that the evidence for an effect on child length is robust.

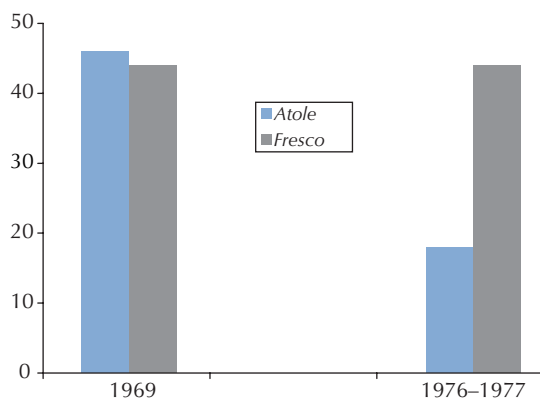
A better sense of the public health significance of the findings is presented in Figure 1 (12), which gives, by supplement type, the percentage of children who were severely stunted (defined as more than 3 standard deviations below the median in the WHO/NCHS reference population) for 1969, when the study began, and for 1976–1977, the tail end of the study. In the reference population, about one in 1,000 children would be this short; about the same proportion as found in Mexican-American preschool children measured in the 1982 to 1984 Hispanic Health and Nutrition Examination Survey (HHANES). The prevalence of severe stunting in the study villages was extremely high in 1969, when the study began, around 45%; but similar in *atole* and *fresco* villages (Figure 1) (12). Since the racial ancestry of Mexicans and Guatemalans is similar (i.e., mixed European and indigenous), the unusual shortness of the study children cannot be attributed to ge-

netics. At the end of the study, the prevalence of severe stunting was reduced by half in *atole* villages but stayed at about the same level in *fresco* villages. Trends by year groupings (1969, 1970–1971, 1972–1973, 1974–1975, and 1976–1977) are presented elsewhere (12). The analyses of these data showed statistically significant declines in severe stunting in *atole* villages ( $n = 451$ ), to a greater extent in girls, but not in *fresco* villages ( $n = 429$ ).

There were other biological effects beyond physical growth. Infant mortality rates were markedly reduced; compared with rates between 1949 and 1968, infant mortality from 1969 to 1977 declined by 66% in *atole* villages and 24% in *fresco* villages (13). While the number of days children were ill with diarrhea was not reduced by the nutrition intervention, diarrhea did not retard physical growth in children consuming *atole*, but did so in children consuming *fresco* (14). A similar protective effect of nutritional supplementation has been reported in a study of Colombian children (15). Children who were wasted (i.e., very thin) regained normal weight-for-height proportions sooner after ingesting *atole* than they did with *fresco* (16).

The effect of *atole* on mental development was minor, certainly much less than anticipated in the 1960s when the study was conceived. Pollitt et al. (17) reviewed the extensive battery of psychological tests administered during infancy and the preschool period. A Composite Infant Scale was used to assess mental and motor development at 6, 15, and 24 months, employing adaptations from well-known scales and adjusting these to the local setting. The preschool battery consisted of 10 tests administered annually to all children 3 to 7 years and an additional 12 tests administered annually to all children 5 to 7 years. The battery was designed to test traditional indices of cognitive development as well as Piagetian concepts. Again, tests were adapted to the local situation. Performance on the preschool battery correlated with village adults' judgments of the

**FIGURE 1. Percentage of 3-year-old children with severe growth failure (> 3 standard deviations below the reference median) in 1969, when the study began, and in 1976–1977, when it ended, by supplement type.**





“brightness” of particular children and also with their ability to carry out chores, suggesting validity for the local context.

The Pollitt et al. study (17) reviewed previous efforts by INCAP researchers to relate the nutrition intervention to child development and concluded that despite the variety of approaches followed, with differences in the analytic design, sample sizes, and outcome variables, the results of the various studies all showed small, but consistent, positive effects of *atole* supplementation. The authors also reanalyzed the INCAP data, using factor analysis in the case of the preschool battery in order to reduce the information contained in the large number of tests to one or more factors. *Atole* exposure in the first 24 months was related to better motor performance, as previous analyses had shown. Also, the results with the preschool battery were consistent with prior findings, such that the authors concluded that: “The results of previous analyses as well as the reanalyses presented here indicate that there were a few moderately beneficial effects from exposure to the *Atole* supplement” (17).

The results were disappointing to the psychologists who participated in the INCAP longitudinal study. Despite widespread acknowledgment that all that matters for scientific progress is that important questions be posed and answered rigorously, it is human nature to desire dramatic findings. The latter are more likely to advance careers and to be accepted for publication in leading journals.

## FOLLOW-UP AND OTHER STUDIES

As matters stood at the end of the INCAP longitudinal study in 1977, the conclusion was that improving the diets of preschool Guatemalan children reduced growth failure dramatically during the first three years of life, but only modestly influenced mental development. The INCAP longitudinal study might have been largely forgotten had its use-

fulness not been notably enhanced by follow-up studies that are tracing to this day the ripple effects of the nutrition intervention of the 1970s. The follow-up studies have permitted us to ask whether the benefits found in early childhood persist into adulthood. A novel contribution is that of allowing examination of functional effects that can only be measured later in life, thereby extending the horizon for evaluating nutrition interventions.

### The 1988–1989 Follow-up Study

The first study follow-up was carried out in 1988–1989 when the subjects were 11 to 26 years of age (4). The intent was to test the hypothesis that “Better nutrition during early childhood leads to adults with a greater potential for leading healthy, productive lives.” The use of the word “potential” was deliberate as many of the subjects were then adolescents, many were still growing, some were still in school, and many were not yet married or working in their chosen occupations. Productivity, therefore, could not be measured in 1988–1989; only potential could.

The subjects of the study were all former participants in the INCAP longitudinal study who had been born between 1962 and 1977 (4). Migrants were included, but only those who had migrated to Guatemala City or to the provincial capital near the study area. The target sample in the four study villages consisted of nearly 2,000 subjects, and the coverage rate was 72%. Excluding migrants, the coverage rate was 89%. The data collected included body size and composition; skeletal age; physical health; strength; work capacity and physical activity; fertility; school attendance and migration histories; and intelligence, reading, numeracy, and other functional performance tests.

Data were collected for many functional outcomes, but in this brief overview of results, only four aspects will be emphasized: body size and composition, work capacity, fertility milestones, and intellectual performance. All four areas are very important,

and improvements in one or all would be seen as contributing to human capital formation.

Three aspects of the body size and composition results stand out. First, adolescents who were exposed to the *atole* during the first three years of life were taller and had greater fat-free masses than those who received *fresco* (11). However, there was some attenuation of the effects observed at age 3 caused by slightly greater growth from 3 years to adulthood in *fresco* villages compared to *atole* villages. It is interesting to note that the greatest anthropometric effects were observed in women. The cutoff point of less than 149 cm, equivalent to a height of 4 feet 11 inches, is often used as a criterion of obstetric risk in women. In women who were exposed to the supplements from birth to 3 years of age, 49% of *fresco* subjects had very short stature compared to 34% of *atole* women (18). Differences in fat-free mass also stand out. Women from *atole* villages had 2.1 kg more in fat-free mass than women from *fresco* villages, or about 0.5 standard deviation units (11); what Cohen, the author of a popular book on statistical power (19), would define as a medium effect.

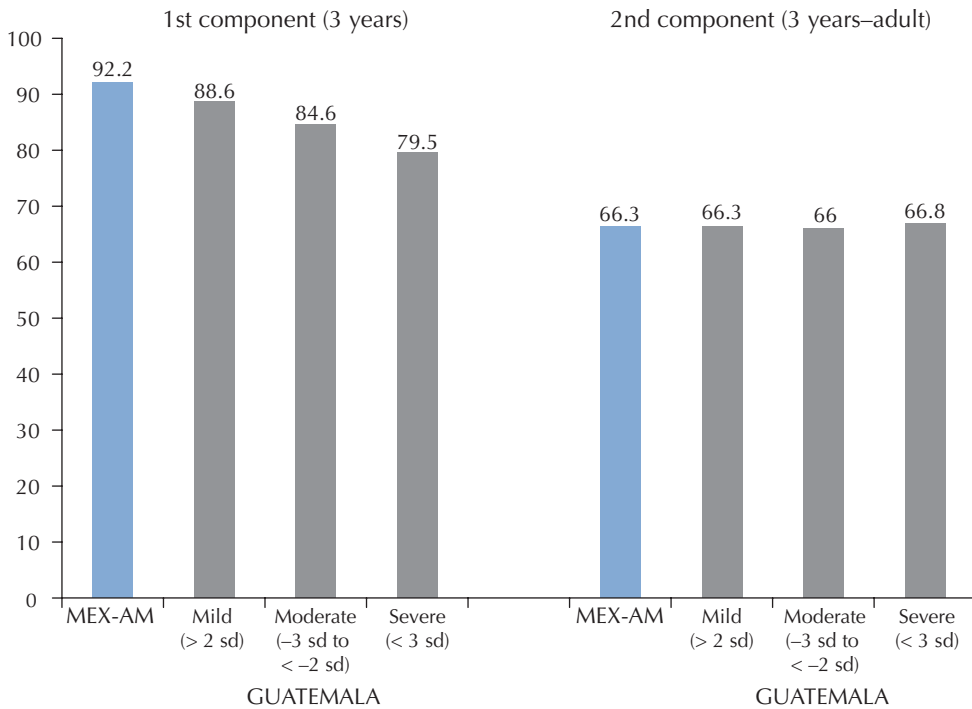
The follow-up study suggests that the characteristic short stature of Guatemalan adults is largely due to growth failure in early childhood (20). This analysis starts by dividing the women of the follow-up into three groups according to the level of stunting at 3 years of age: mild (above the cutoff point of  $-2$  standard deviations below the WHO/NCHS reference mean), moderate (between  $-3$  and  $-2$  standard deviations below), and severe (below  $-3$  standard deviations). The mean values for height at 3 years of age (1 cm was subtracted from length values) for the three Guatemalan groups are designated as the first component of height (Figure 2). Data are also included for Mexican-American children from the 1982–1984 HHANES survey earlier mentioned. Mexican-American children have similar heights prior to puberty ( $\sim 12$ – $13$  years) to

the U.S. general population, but end up at the 25th percentile of height at adulthood. These patterns have not changed in recent U.S. data. It is unlikely that the deviation that occurs in adolescence is due to nutrition or health; rather, the cause may be genetic in origin (20). Mexican-American children have similar ancestry, a European-indigenous admixture, and may be an appropriate reference for assessing growth during puberty in our Guatemalan sample. One can ask whether there was a catch-up in growth from 3 years to adulthood (18 years of age or older), designated as the second component of height in Figure 2. Clearly, there was no catch-up in growth. All three Guatemalan groups grew the same from 3 years to adulthood, and their growth was similar to that of Mexican-Americans. Similar results were found in men as in women. These data suggest that the period of early childhood is the only period of growth failure in the Guatemalan population.

Work capacity was significantly improved in subjects exposed to the supplements in their first three years of life, but only in men (21). *Atole* men had maximal oxygen consumptions ( $\text{VO}_2$  max) that were 0.38 L/min greater than those of the *fresco* men. The difference is equivalent to about 0.7 standard deviation units, approaching what Cohen (19) would call a large effect size. Another interesting finding is that the larger working capacity of *atole* men could not be explained by differences in fat-free mass (i.e.,  $\text{VO}_2$  max/kg of fat-free mass was still greater in *atole* villages). The nature of these qualitative tissue differences between *atole* and *fresco* subjects is unclear.

Exposure to the *atole* did not lead to earlier menarche (22), but did lead to hastening first intercourse and first birth by about a year; however, the nutritional effects on fertility milestones were smaller in comparison to the delaying effects of schooling (23). The median age at first birth was more than four years later for those who completed primary school compared to those who did not.

**FIGURE 2. Components of adult stature (cm) in Guatemalan women in comparison to Mexican-Americans, by level of growth retardation at 3 years of age.**



**Source:** from data in Martorell R. Overview of long-term nutrition intervention studies in Guatemala, 1968–1989. *Food Nutr Bull* 1993;14(3):270–277.

A feature of all analyses carried out to date with respect to measures of intellectual performance is that they control for years of school because the villages differed in patterns of school attendance since before the study began. This analysis may underestimate effects on intellectual performance if the intervention also influenced school attendance. One of the fascinating discoveries was that intellectual performance was more affected during adolescence and adulthood than during early childhood (17). The *atole-fresco* differences found in children were less than 0.2 standard deviation compared to differences of around 0.6 standard deviation found in adolescence using a summary variable of intellectual performance (i.e., a factor score that combines literacy, numeracy, general knowledge, Raven's Progressive Matrices, reading, and vocabulary). To use

Cohen's labels, the effects found in children can be described as small, while those found in adolescents can be called medium to large. There are also strong indications that the effects in adolescence were found only in those cohorts exposed to supplementation during pregnancy and the first two years of life. Examination of the subcomponents making up the summary variable shows that effects were found in four of six tests. Effects were found in both men and women.

### The Birthweight and Generational Studies

In addition to the follow-up study, studies were carried out in the 1990s that monitored the birthweights of newborns of the female subjects of the original longitudinal study; also, a longitudinal study of growth and de-



velopment in the first three years of these children was carried out between 1996 and 1999. Unfortunately, these studies did not include migrants, and the longitudinal study was restricted to women who had children less than 3 years of age during the study period.

The nutrition intervention improved growth significantly in the first three years, as shown in Table 2, and the 1988–1989 follow-up study showed that this resulted in larger adult body sizes. In women, exposure to *atole* compared to *fresco* led to a small but consistent improvement in the growth of their children, with this effect being mediated through greater maternal body size. Unpublished analyses show that newborns born to women exposed to *atole* in early life were heavier (60 g) and longer (0.23 cm) at birth. Postnatal growth was improved as well. Children of mothers receiving *atole* as children were on average 0.80 cm taller than children from women who received *fresco* (24).

The 1996–1999 longitudinal study included updates of schooling histories and of intellectual functioning in women, which made it possible to reconfirm the findings of Pollitt et al. (17) from the 1988–1989 follow-up a decade later (25). Five tests of educational achievement (reading, vocabulary, comprehension, numeracy, and general knowledge) were combined into a single score with possible values of 0 to 100 (median was 71, Table 3). Li et al. (26) found a highly significant interaction between treatment and schooling on the educational score. The median scores for educational achievement are given in Figure 3 for the four groups involved in the interaction: women who did not finish primary school (< 6 years of schooling) and who were exposed to *atole* or *fresco* in the first two years of life and women who finished grade school and were exposed to either *atole* or *fresco*. The *atole* effect was –1 point when women did not finish school, but 9 points when they did. The impact of completing primary school was very pronounced; it was 13 points without exposure to *atole*, but 23 points when women

**TABLE 3. Summary measure of educational achievement.<sup>a</sup>**

| Tests                      | Points     |
|----------------------------|------------|
| Reading <sup>b</sup>       | 20         |
| Vocabulary <sup>b</sup>    | 20         |
| Comprehension <sup>b</sup> | 20         |
| Numeracy                   | 20         |
| General knowledge          | 20         |
|                            | <u>100</u> |

<sup>a</sup>Range 10–95, median 71; divided into a 5-point ordinal scale for analyses.

<sup>b</sup>Illiterates receive a score of “0” in these tests. Vocabulary and comprehension are part of the Interamerican Reading Series test.

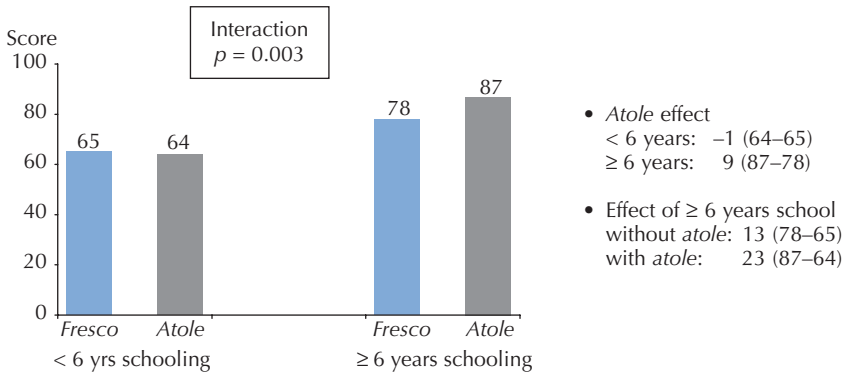
**Source:** Li H, Stein AD, Barnhart HX, Ramakrishnan U, Martorell R. Associations between prenatal and postnatal growth and adult body size and composition. *Am J Clin Nutr* 2003;77(6):1498–1505.

were exposed to *atole*. Thus, nutrition in early life is important for educational performance only when children go to school, and, also, the payout from completing school is magnified when preceded by improved nutrition in early life.

A cardiovascular risk factor study (1998–1999) provided the data to tease apart the relative importance of prenatal and early postnatal growth failure, defined by Li et al. (26) as birth to 2 years of age, for adult body size and composition of men and women. It was found that both prenatal and postnatal growth retardation were equally important determinants of reduced height, weight, and fat-free mass in adulthood; on the other hand, neither aspect was related to fatness or fat patterning (27). Similar analyses were carried out for educational achievement using data from the 1996–1999 longitudinal study (27). In contrast to the findings about body size, only the postnatal component was associated with educational achievement. Thus, prenatal growth failure affects adult body size and composition, but not educational achievement; postnatal growth failure, on the other hand, impacts on both size and educational achievement.

The relationship between early childhood nutrition and risk factors of cardiovascular disease in adulthood has also been investigated. The idea that poor nutrition in early

**FIGURE 3. Median scores for educational achievement (summary variable: 0–100 points) by schooling and type of supplement.**



**Source:** from data in Martorell R, Rivera JA, Schroeder DG, Ramakrishnan U, Pollit E, Ruel MT. Consecuencias a largo plazo del retardo en el crecimiento durante la niñez. *Archivos Latinoamericanos de Nutrición* 1995;45(1S):109S–113S.

childhood increases risk of the metabolic syndrome later in life, the so-called Barker hypothesis (28), has become a popular topic of study. As noted above, no relationship was found in our data between prenatal or postnatal growth and fatness or fat patterning in adulthood (27). Also, we do not find birth-weight to be related to the prevalence of cardiovascular disease risk factors, such as lipid levels, fasting glucose, and blood pressure (29). Similarly, the relationships between supplementation and cardiovascular disease risk factors were weak and inconsistent (30). Thus, contrary to the findings of others, we do not find that early childhood nutrition is associated with risk factors of adult chronic diseases of dietary origin. The study population is still relatively young, and this may not allow us at this time to uncover these relationships. However, such relationships have been found by others even at younger ages. Perhaps relationships between nutrition in early childhood and later disease depend on host or environmental factors we do not yet understand.

### The 2002–2004 Follow-up Study

A second cross-sectional follow-up study was carried out in 2002–2004 in the same

four villages as the 1969–1977 INCAP longitudinal study and in the places to which the participants in the original study had migrated. This time, migrants to all towns and villages in Guatemala, and not only to Guatemala City and to the provincial capital near the study area, were included. At the time data collection began for the 2002–2004 follow-up study the subjects were between 27 and 42 years of age. This recent follow-up gave us an opportunity to update life histories and establish current status for many of the aspects included in the first follow-up study. More importantly, we were able to focus on economic aspects, since all subjects were by then adults in their chosen professions. We were able to study marriage formation. Specifically, data were collected on household structure and composition; village characteristics, including facilities and services as well as village developmental histories; schooling history; intellectual functioning (Interamerican Reading Series test and Raven test); anthropometry; diet; physical activity; physical fitness; reproductive history; medical history and physical examination; blood test (lipid levels, fasting glucose, hemoglobin); marital history and assets brought by marriage; household consumption; current economic activity; occu-

pation and migration history; wage income; nonagriculture and own business activities; and participation in agricultural activities. Data were collected between January 2002 and April 2004, and at the time of this writing, data-cleaning and summary variable generation are nearly complete and analyses have begun. The 2002–2004 follow-up will extend our previous findings linking early childhood nutrition to human capital formation, measured by physical and educational capital, to income and wealth. This will permit a more comprehensive evaluation of the long-term significance of nutrition in early childhood.

### CONTRIBUTION OF THE INCAP STUDIES TO PROGRAMS AND POLICIES

The INCAP studies have important implications for policies and programs to combat child malnutrition. We first will review some of the salient lessons learned about how best to design nutrition programs, and then we will review how the findings can influence advocacy for investments in early childhood nutrition.

#### Implications for the Design of Nutrition Interventions

(1) *Effects can be achieved with relatively small amounts of food.* The first lesson learned is that improving the dietary intakes of women and children can have important effects on birthweight and on growth in length of young children. These effects can be achieved with relatively small amounts of food, the equivalent of about 100 kcal of *net* improvement per day in women and children. The successful Tamil Nadu Integrated Nutrition project (TINP) provided 140 kcal and 6 g of protein per day to children less than 2 years (31). The also-successful Progres program of Mexico provided 194 kcal

and 6 g of protein per day to children under 2 years of age (32).

It is important that care be taken to reduce replacement of food consumption at home. Many food aid programs provide larger amounts per person per day than the above programs, but leakage, substitution, and poor nutrient quality decrease the net nutrient contribution (33).

The Guatemalan experiment used food supplementation as the experimental manipulation because it could be delivered and measured easily. The findings should not be viewed to narrowly apply to only food supplementation; other interventions that effectively improve dietary intakes, including well-designed nutrition education programs, would also be expected to improve growth. The findings can be generalized to programs that effectively increase consumption of foods of better quality than those regularly consumed at home, as opposed to specific micronutrient interventions, such as supplementation or fortification, that have produced much smaller effects on growth. A meta-analysis of daily zinc supplementation and child growth found an average effect size of 0.3 standard deviation units (34). A recent meta-analysis found no effect from iron or vitamin A interventions and an effect of 0.3 standard deviations from multiple micronutrient interventions (35). Since the latter interventions all provided zinc, it is possible that zinc may be the only micronutrient that can improve growth. The INCAP food supplementation intervention found a difference of 2.6 cm at 3 years of age, or an effect size of 0.7, a large effect. The *atole*, it should be recalled, was not a good source of zinc.

It is encouraging that Progres, which used a food supplement in powder form that could be easily prepared by just adding water, found important effects on physical growth and iron status (32). As in the *atole*, milk was a main ingredient; the Progres supplement was fortified with micronutri-

ents of good bioavailability except in the case of iron, which was provided in the form of reduced iron. An improvement of 1.1 cm in length was found after one year in children less than 6 months at baseline and of low socioeconomic status. Despite not using a good source of bioavailable iron, anemia rates were better one year after supplementation (55% in supplemented vs. 44% in controls). TINP used a food specially prepared for toddlers, but that was plant-based and not fortified with micronutrients; however, TINP effectively reduced the extent of severe and moderate underweight (31).

(2) *The target of programs to eliminate child malnutrition should be children younger than 2 years.* A lesson from the INCAP longitudinal study is that the target of nutrition programs aimed at reducing growth failure and malnutrition should be children less than 2 years of age. Such programs need to improve birth-weight, promote exclusive breast-feeding in the first six months, and work very hard to improve complementary feeding of children 6 to 24 months of age. While the INCAP study found that there was a response to supplementation up to the third year of life, the effects were larger on children younger than 2 years. Also in most settings of malnutrition, including rural Guatemala, z-scores of length for age decline rapidly in infancy and reach stability by about 2 years of age, indicating that growth failure occurs before age 2.

TINP (31) and Progresá (32) are examples of programs that were designed to reach young children under 3 and 2 years, respectively. The targeting of young children may be a key reason why these two programs successfully improved growth while many other supplementation programs did not (34). Other reasons may be that nutritious foods suitable for young children were often not provided and that efforts to reduce leakage were either not undertaken or were ineffective.

Why are young children more responsive to improved nutrition, whereas older children are less so? The answer has to do with the greater rates of growth and greater relative nutritional needs of younger children and with their greater susceptibility to infections such as diarrheal diseases. The INCAP study demonstrated that the *atole*, while not preventing diarrhea, did negate the effects of diarrheal diseases on growth.

(3) *Implication for growth monitoring programs:* growth monitoring programs have traditionally focused on preschool children; that is, on children 5 years or younger. Growth monitoring programs often fail to reach the most needy children, including the poorest and those younger than 2 years of age. Combined with poor efforts at promoting better growth through health and nutrition education or through specific interventions, most growth monitoring programs of the past can be characterized as failures. Growth monitoring and promotion programs should be focused on young children and aim to increase rates of exclusive breast-feeding in the first six months and to improve complementary feeding, child care, and access and use of preventive and curative health services. In addition, such programs should be anchored on solid efforts to improve the nutrition of women during pregnancy and lactation. One can only speculate how much could be achieved by a program such as Progresá if it also included a strong educational component. TINP used a less nutritious supplement but did include a strong educational component. Thus, an important question, particularly for the portions of Latin America and the Caribbean which can afford to include foods in programs, is the extent to which the impact of nutritious supplements is enhanced by growth monitoring and promotion.

(4) *Implication for school feeding programs:* it is not unusual to hear proponents of school feeding programs argue that they are needed

in order to improve rates of growth and to reverse the growth failure incurred during early childhood. There is no evidence for these claims. We have seen how the INCAP studies show that children from rural Guatemala, who were very growth retarded at 3 years of age, were nonetheless able to grow from 3 years to adulthood as well as Mexicans living in the United States. The only periods of widespread growth failure that are known to exist in developing countries are intrauterine life and the first two years of life.

This is not to say that school feeding or school nutrition programs are not needed or are not useful. School feeding may be a cost-effective intervention to increase school attendance and to improve attention and learning. Foods or supplements, depending on their nutritional content, may reduce anemia and other micronutrient deficiencies, and in this way impact on learning.

### **Long-term Effects and Their Impact on Advocacy**

The INCAP studies demonstrate that nutrition interventions during the critical stages of pregnancy and the first two years of life have an immediate impact on such key outcomes as child survival, birthweight, child growth, and motor development. These findings have obvious uses in promoting maternal and child nutrition programs but are not unique to the INCAP studies. The uniqueness of the INCAP studies is that they provide information about the long-term significance of improving early childhood nutrition. Hence, emphasis is given here to the possible uses of this unique contribution for advocacy.

Examples of many long-term effects were presented, but only some need to be emphasized here. First, early childhood nutrition is directly related to adult body size and composition. The short stature that is often seen among people living in poverty in many Latin American and Caribbean countries, who are often more indigenous in ancestry than individuals of other socioeconomic classes, is

largely a product of poor nutrition and infection prior to 2 years of age. The INCAP study showed that improving the diets of mothers and children will improve adult body size and muscle mass. These effects have functional significance. Greater body size and increased fat-free mass among women will improve birthweight and postnatal growth of the next generation, as the INCAP studies have shown. Short stature is a risk factor for cephalo-pelvic disproportion and maternal obstetric mortality, and one would expect that early childhood nutrition programs would decrease future delivery complications and improve maternal survival.

The INCAP 1988–1989 follow-up study showed that improved child nutrition increased adult fat-free mass and work capacity. One would expect improved work capacity to result in increased productivity among those engaged in hard physical labor.

Not all effects of improved early childhood nutrition will be considered desirable by all readers. The INCAP intervention showed that improved childhood nutrition led to earlier age at marriage and earlier age at first birth, but it needs to be pointed out that this occurred in a population that had low rates of use of modern contraceptives. These findings speak to better biological potential to attract a mate and to conceive and deliver a child at younger ages and are not reasons to be against nutrition programs in early childhood. The obvious solution is to improve child nutrition while promoting reproductive health programs, including family planning.

On the other hand, the effects on intellectual functioning will be viewed as positive by all readers. One of the most interesting findings of the INCAP studies was the contrast between early childhood and follow-up results regarding effects on mental development. The influence of early childhood nutrition on psychological test performance in the preschool period was found to be small, whereas that on educational achievement in adolescence and adulthood was more sub-



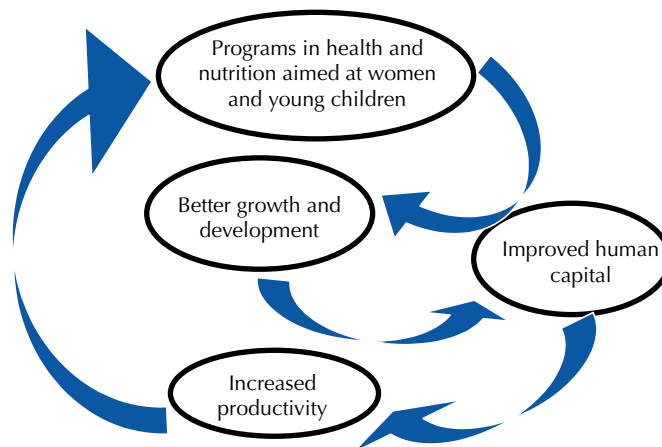
stantial. Of particular significance is that the intervention interacted with years of school. The data can be presented to ministers of education to convincingly argue that the returns to schooling can be magnified by investing in early childhood nutrition. The corollary is also true. Investments in childhood nutrition will never impact on intellectual functioning if children receive little or no schooling. The best outcome is provided by a good nutritional start in early life and the opportunity to advance beyond primary school. Skilled minds are valued by all societies and by parents everywhere in recognition that improvements in intellectual performance are bound to improve the capacity of individuals to function in a variety of settings. This allows us to consider two further suggestions. One is that such improvements might lead to better employment opportunities and greater earnings. Another is that better intellectually endowed adults will be better parents, by virtue of being better providers as well as by possessing a higher capacity to meet the developmental needs of their children. The data from the 2002–2004 follow-up and other newly funded studies will permit testing of these expectations.

## CONCLUDING THOUGHTS

The INCAP studies will be remembered for their unique contributions to programs and policies. They represent the only setting in which the effects of a nutrition intervention in early childhood are being traced throughout the life cycle. Their findings offer valuable input to program managers concerning the design of nutrition programs and provide persuasive evidence of the long-term benefits of nutrition interventions in early life. The 2002–2004 follow-up study will trace the influence of improved nutrition in early childhood beyond better human capital formation to increased income and wealth.

The rationale for maternal and child health programs may be approached from two perspectives. The first is that adequate health and nutrition are basic human rights. Governments have an obligation to meet these needs, and economic development itself should be ultimately justified and judged by the degree to which it improves the quality of life of populations. The INCAP studies, although incomplete at the time of this writing, are providing an additional, powerful rationale (Figure 4). Health and nu-

**FIGURE 4. Interrelationships among early child nutrition programs, the formation of human capital, and economic productivity.**



**Source:** data from Li H, Stein AD, Barnhart HX, Ramakrishnan U, Martorell, R. Associations between prenatal and postnatal growth and adult body size and composition. *Am J Clin Nutr* 2003;77(6):1498–1505.

trition programs aimed at mothers and children lead to enhanced human potential and should therefore be viewed as long-term economic development strategies because they may improve economic productivity. Ongoing analyses will test the missing piece of this cascade of effects and test the hypothesis that improved early childhood nutrition will lead to greater incomes and wealth through a greater accumulation of physical and educational capital.

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# THE ROLE OF RESEARCH IN THE FORMULATION OF INFANT FEEDING POLICIES IN LATIN AMERICA

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In this chapter we will review how research carried out in Latin America contributed to shaping regional and global policy regarding infant feeding during the last three decades of the twentieth century. In particular, we will address the role of studies showing how breast-feeding promotes infant and child health and growth. We will not address studies on the determinants of infant feeding practices, nor those on the benefits of breast-feeding for the mother. Latin America has also provided seminal research on how to best promote breast-feeding, which, in turn, has influenced global policy. These studies are covered elsewhere in this book (1).

Interest in breast-feeding research conducted within Latin America was influenced by the decline in breast-feeding rates observed in many countries during the first three-quarters of the last century, which resulted, by the 1970s, in the Region of the Americas presenting some of the shortest durations of breast-feeding in the developing world (2–7).

The prevailing trend at that time was to associate modern lifestyles with bottle feeding (2). This motivated several researchers from the fields of child health, nutrition, and public health to investigate the possible detrimental effects of artificial feeding on child health, resulting in a strong tradition of

breast-feeding research that has persisted until the current time.

In the next section we will highlight some of the key research findings from countries in Latin America which have helped shape regional and global infant feeding policies. To prepare this chapter, we conducted literature searches on Medline (since 1966) and ISI (since 1981) using the search terms “breast-feeding,” “breast feeding,” and “infant feeding,” in search of authors based in any of the countries of Latin America. In the ISI search, papers fulfilling these criteria were ordered by the number of citations. It should be recognized that both Medline, and, in particular ISI, are biased towards English-language articles appearing in a relatively small number of journals, and that these articles are not necessarily those which bring about policy changes at the national level. The literature search was therefore complemented with searches in the Latin American medical database, LILACS, and with a comprehensive re-

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view carried out by the Pan American Health Organization (PAHO) (8).

The Medline search resulted in eight papers published between 1966 and 1969; 58 from 1970 to 1979; 193 between 1980 and 1989; 366 from 1990 to 1999; and 194 between 2000 and mid-2004 (corresponding to just over 400 papers in the decade, assuming a constant rate of publication). Many of these papers refer to maternal effects of breast-feeding, or to breast-feeding determinants and promotion, but nevertheless, the sharp increase is remarkable. A similar search in the LILACS database (1981–2004) resulted in 820 publications, approximately the same overall total as the Medline search.

The remainder of this chapter is organized in chronological order, highlighting the main publications and their impact on policy.

### THE 1970s: BREAST-FEEDING REDUCES MORBIDITY

Starting around 1970, a number of pioneering studies came out by researchers affiliated with the Institute of Nutrition of Central America and Panama (INCAP), headquartered in Guatemala City, Guatemala. Leonardo Mata and colleagues described the intestinal flora of breast-fed and weaned infants (9, 10) and later documented the protection against diarrheal diseases afforded by breast-feeding (11, 12). Mata's study of the children of Santa María Cauqué remains a classical publication to this date (13).

Latin American researchers also started to highlight the role of breast-feeding in contributing to child nutritional status (14).

Evidence of a protective effect of breast-feeding against mortality also started to mount. Although studies from Europe and the United States, carried out in the first half of the twentieth century, already documented important mortality differentials related to breast-feeding (15), it was necessary to replicate these findings through local

studies. In rural Chile, Plank and Milanesi interviewed mothers who had given birth in the three years preceding a survey; their results showed that babies given bottles before the age of 3 months were three times more likely to die in infancy than those who were wholly breast-fed (16).

A number of reviews and commentaries also appeared in the mid-1970s by highly respected authors who worked in Latin America stressing the importance of breast-feeding and of influencing the attitudes of pediatricians and public health workers (17–19).

Some of the studies carried out in the 1970s, if judged by today's standards for epidemiological research, would be criticized for failing to address sources of bias, such as lack of representativeness and confounding or reversing causality (that is, an illness leading to the interruption of breast-feeding, rather than the opposite). Nevertheless, these studies played an important role in influencing policy, and most of their results were later confirmed by carefully designed studies.

### POLICY DEVELOPMENTS IN THE 1970s

The evidence accumulated during the 1970s, from Latin America as well as from other parts of the world, led to major policy breakthroughs. In 1979, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) organized a joint meeting on infant and young child feeding to address growing concerns about the global decline in breast-feeding. The recommendations from this meeting contributed to the preparation of the International Code of Marketing of Breast-milk Substitutes, approved in 1981 at WHO's Thirty-fourth World Health Assembly (20). The Code had as its objective "to contribute to the provision of safe and adequate nutrition for infants, by the protection and promotion of breast-feeding, and by ensuring the proper use of

breast milk substitutes, when these are necessary, on the basis of adequate information and through appropriate marketing and distribution." It has proven to be an essential tool for counteracting the strong pressure exerted by the infant foods industry on mothers and on health workers.

Three Latin American countries—Brazil, Cuba, and Guatemala—were represented at the 1979 WHO-UNICEF meeting. Latin American countries were also among the first to give effect to the International Code of Marketing of Breast-milk Substitutes, by incorporating the Code as a law (Brazil, Costa Rica, Dominican Republic, Guatemala, Panama, and Uruguay) or by having many of the Code's provisions incorporated as a law (Colombia and Mexico).

### THE 1980s: CAUSE-SPECIFIC STUDIES AND THE ROLE OF EXCLUSIVE BREAST-FEEDING

In the 1980s, the number of Medline-listed studies from Latin America on breast-feeding and related issues increased sharply to nearly 200.

Several authors investigated the role of breast-feeding in providing protection against diarrhea morbidity, both for the overall number of episodes (21, 22) or for those due to specific etiologic agents (23, 24).

Latin American researchers also reported that breast-feeding in infancy was associated with improved nutrition (25, 26), although other studies warned that children who were breast-fed for more than 12 months had lower weight for height than those who had already been weaned (27), possibly due to an inadequate intake of complementary foods (this is the fifth most-often cited paper from Latin America, with 58 ISI citations).

In 1984, Feachem and Koblinsky (15) reviewed the literature on breast-feeding and diarrhea. This was one of a series of landmark review papers commissioned by WHO to help identify priority preventive interven-

tions against diarrheal diseases. When quantifying the impact of breast-feeding on morbidity, the authors included studies from Colombia (12), Guatemala (28), and Costa Rica (29). They concluded that the existing evidence was highly suggestive of an impact by breast-feeding—particularly by exclusive breast-feeding—on diarrhea morbidity, but called for better-designed studies in general, and for cause-specific mortality studies, in particular.

A retrospective study, carried out in northeastern Brazil, confirmed the association between breast-feeding and overall child mortality (30). However, there was limited evidence on how much breast milk might protect against different causes of mortality. In 1987, Victora et al. published the first results of a case-control study carried out in southern Brazil investigating this issue, using a modern epidemiological approach—a population-based case-control design (31). Feeding patterns were investigated for cases (357 children who died due to an infectious disease) just before the onset of the fatal episode and for controls at a similar age. The odds ratios for diarrhea deaths were 14.2 for non-breast-fed infants and 4.2 for those who were partially breast-fed, relative to those who received breast milk as the only type of milk. The corresponding odds ratios were 3.6 and 1.6 for pneumonia deaths. For other infectious diseases, children who were fully weaned were 2.5 times more likely to die than those who were breast-fed. These differences were adjusted for several confounding variables. This paper became the most widely cited reference on breast-feeding from Latin America, with 234 ISI citations by mid-2004. In a second paper, the authors showed that adding herbal teas or water to the diet of a breast-fed infant resulted in a significant increase in diarrhea mortality (32).

Shortly afterwards, a group of researchers based in Peru and in the United States showed a similar impact of exclusive and partial breast-feeding on morbidity (33). Brown and colleagues showed that among children

aged under 6 months, diarrhea prevalence (% days ill) was twice as high—15.2%—in children who were partially breast-fed than among those who were exclusively breast-fed—7.1%. Children who were no longer breast-fed had a prevalence of 27.6%. A clear dose-response pattern with the exclusiveness of breast-feeding was identified. Similar dose-response gradients were also observed for upper and lower respiratory tract infections. This paper became the second most frequently cited breast-feeding paper from the Region, with 154 hits by mid-2004.

Both of these studies, as well as a third paper from the Philippines (34) which appeared in 1990, used modern epidemiological methods to document how the introduction of any fluids or foods in addition to breast milk led to an important increase in diarrhea incidence, severity, and mortality. The impact of these papers on global and regional policy is discussed below.

## POLICY DEVELOPMENTS IN THE 1980s

Inarguably the major advance in policy in the 1980s was the shift in emphasis from the promotion of breast-feeding to the specific promotion of exclusive breast-feeding. This was recognized by a major meeting held in Florence, Italy, in 1990, which resulted in what became known as the Innocenti Declaration (35). This highly influential document recognized that breast-feeding “reduces incidence and severity of infectious diseases, thereby lowering infant morbidity and mortality,” and that “recent research has found that these benefits increase with increased exclusiveness of breast-feeding during the first six months of life, and thereafter with increased duration of breast-feeding with complementary foods. . . .”

The shift from endorsing breast-feeding in general to the promotion of exclusive breast-feeding had wide impact on global and regional policies. As a follow-up to the Innocenti Declaration, in 1991 the Baby-friendly

Hospital Initiative (BFHI) was launched internationally by UNICEF and WHO as a strategic means to help achieve the breast-feeding goals for the 1990s (36).

Breast-feeding experts from Latin America were active in the planning and implementation of a series of international meetings leading up to the Innocenti Declaration, and seven countries—Brazil, Chile, Colombia, Ecuador, Guatemala, Honduras, and Mexico—were signatories to the Declaration. Both the Innocenti Declaration and BFHI galvanized action in Latin America. Between 1981 and 1986, Brazil implemented a media campaign, created the position of a national breast-feeding coordinator, and mobilized social and community action to foster breast-feeding (37). National efforts were also undertaken to educate health providers, implement rooming-in policies, and restrict the distribution of infant formula to new mothers. In Honduras, a national campaign implemented over a five-year period in the mid-1980s promoted breast-feeding through changes in hospital norms, training of health care providers, pre- and postnatal maternal counseling, educational talks in the community, and print materials (38). These efforts were complemented by a mass media campaign. Numerous other countries in the Region of the Americas also implemented highly successful media campaigns, certified hospitals as “Baby Friendly,” trained health providers, and developed print material.

A number of countries in Latin America also were active in monitoring the International Code of Marketing of Breast-milk Substitutes and disseminating their findings to health authorities, the media, and international organizations.

## STUDIES IN THE 1990s: OPTIMAL DURATION OF EXCLUSIVE BREAST-FEEDING

By the early 1990s, it was widely accepted that exclusive breast-feeding was the optimal

diet in the first few months of life due to the protection it provided against infectious diseases, particularly diarrhea. There was concern, however, about whether or not breast milk alone could provide all the nutrients needed by children aged 4–6 months, because studies from developing countries showed that exclusively breast-fed infants grew less rapidly in this age range than formula-fed infants (39), a finding that was confirmed in Latin America (40). However, during this time, international agencies did not agree on the recommended duration of exclusive breast-feeding: should it be “about six months,” as then proposed by UNICEF (41), or four to six months, as then recommended by WHO (42, 43)? The difference between the two recommendations may appear to be small, but a possible change in the WHO recommendation could have had an important economic impact on the marketing of industrialized infant foods (20) that would be no longer allowed in the age range of 4–6 months.

A study carried out in Honduras in the mid-1990s played a major role in helping solve this controversy. It was one of the very few randomized trials to report on the effect of breast-feeding on health and growth by addressing specifically the optimal duration of exclusive breast-feeding. Cohen and colleagues randomized mothers to either receive strong support to continue breast-feeding exclusively until the age of 6 months, or to receive hygienically prepared complementary foods, as well as breast milk, from the age of 4 months. Their results were negative: both groups did equally well in terms of growth (44). With 65 citations, this is the fourth paper in the ISI ranking of breast-feeding in Latin America. Additional publications by the same authors provided further details (45), and a second trial was later conducted among full-term low-birthweight infants, with similar conclusions (46). As will be discussed below, the Honduras studies had a major impact on WHO policy.

Many other studies from Latin America were reported in the 1990s. The effect of

breast-feeding against all-cause infant mortality was confirmed in analyses from Mexico (47) and Brazil (48), while the protection afforded against different causes of death was quantified by a meta-analysis of data from six developing countries coordinated by Brazilian investigators (49). The latter publication is ranked third in the ISI listing of breast-feeding papers from Latin America, with 106 citations.

Several other studies confirmed the protection provided by breast-feeding against morbidity due to diarrheal, respiratory, and other infections (50–58). Other Latin American studies contributed to the understanding of which components in breast milk may explain the protection provided against infections (59).

A particularly well-designed paper that appeared in the late 1990s was a randomized trial of breast-feeding promotion by peer counselors in Mexico that showed not only an effect on the duration of breast-feeding but also on diarrhea morbidity (60). This became the sixth paper from Latin America in terms of ISI citations, with 53 hits.

## THE 1990s AND AFTER: POLICY IMPLICATIONS

The intense debate over the optimal duration of exclusive breast-feeding mobilized the scientific and policy communities as a new century began. In 2000, PAHO organized a “Technical Consultation on the Recommended Length of Exclusive Breast-feeding: Scientific Evidence and Research Priorities,” and in March of 2001, WHO organized a “Technical Consultation on Infant and Young Child Feeding.” The background publication for the WHO meeting was a systematic review of the literature dealing specifically with exclusive breast-feeding and growth from 3–6 months (61). The results of the Honduras studies (44, 46) played a prominent role in this review, which also relied on other Latin American studies (49, 62–64).



The consultation led to the adoption, in 2002, of a Global Strategy for Infant and Young Child Feeding (65), developed jointly by WHO and UNICEF, which was approved at the Fifty-fifth WHO World Health Assembly. The Strategy states that “infants should be exclusively breast-fed for the first six months of life to achieve optimal growth, development and health.”

The majority of the Latin American countries had as a recommendation and norm exclusive breast-feeding for six months well prior to the WHO systematic review. Of 19 countries, only two continued to recommend the four-to-six-month period in 2000 (66), and most had changed their recommendation during the 1990s.

### CURRENT TRENDS IN BREAST-FEEDING: EVIDENCE OF SUCCESS

At the beginning of this chapter, we provided evidence of negative trends in breast-feeding duration in the Region of the Americas from the first three-quarters of the last century. If—as we argue in this chapter—research carried out in Latin America made a major contribution to global and regional policies, then one should expect these negative trends to be reversed. It is now evident that this indeed took place.

Several analyses, based on population-based surveys carried out since the 1970s, suggest that total breast-feeding duration has been increasing in the Region (67–70). Recently, Pérez-Escamilla analyzed data from 23 Demographic and Health Surveys from countries in the Region that had more than one survey conducted at different times (71). There was a definite trend towards increased durations of breast-feeding, particularly among more highly educated women, and the author suggested that the positive trend may be attributed to measures aimed at promoting, protecting, and supporting breast-feeding.

The possible impact of lactation promotion programs on mortality had already been

the subject of Latin American studies. In Costa Rica, a likely impact was reported in the 1970s by Mata and colleagues (72). Monteiro et al. estimated the impact of breast-feeding promotion on the reduction of infant mortality rate in São Paulo, Brazil, concluding that improved breast-feeding practices were estimated to account for one-quarter of the mortality decline between 1981 and 1987 (37, 73). In a recent analysis using a similar methodology, Betrán concluded that 55% of infant deaths from diarrhea and acute respiratory infections in Latin America are preventable by improving breast-feeding practices (74).

### CONCLUSIONS

Ongoing and future research on breast-feeding in the Region of the Americas is likely to have a continued impact on policies. One such example is the WHO Multicenter Growth Reference Study, a six-country project that includes one Latin American site (75, 76). This study will produce, by the end of 2005, new sets of growth curves for assessing the growth of children under 5 years, based on breast-fed infants and replacing existing references that are based on predominantly bottle-fed infants.

Latin American researchers have made essential contributions to regional and global infant feeding policies during the last three decades of the twentieth century. Improved policies have helped revert the downward trend in breast-feeding duration observed in the Region. Although there is still much room for improvement, particularly regarding the duration of exclusive breast-feeding, the present review has shown how research can be effectively translated into action for improving public health.

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# **Micronutrients: Successful Interventions for the Correction of Specific Deficiencies**



# CONTROL OF IODINE DEFICIENCY DISORDERS: THE CONTRIBUTION OF THE ECUADORIAN EXPERIENCE

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## INTRODUCTION

Iodine deficiency is one of the world's major public health problems in the area of nutrition. The nutritional disorders caused by this deficiency have tremendous health repercussions that directly affect the social and economic development of current and future populations.

Several decades ago, when the importance of iodine deficiency disorders (IDDs) began to be recognized, they only were perceived in their most visible manifestation—goiter—which today is considered the indicator of the severity of the deficiency. According to current information, IDDs range from impaired fetal development to irreversible, lifelong neurological damage, running the gamut from congenital abnormalities to increased perinatal and infant mortality, neurological cretinism accompanied by mental retardation, deaf-mutism, spastic diplegia, myxoedematous cretinism, and psychomotor developmental delays (1).

In the early 1990s, it was estimated that at least 1.5 billion people worldwide were at permanent risk of some iodine deficiency disorder (2). In the year 2000, 159 countries recognized IDDs as a public health problem and set goals for their reduction and control (3). At that time, all the countries considered

that simply ensuring sustainable universal access to iodized salt for the entire population would guarantee the control of IDDs.

Almost every country in the Americas launched effective salt iodization programs, and today, more than 80% of this population regularly consumes iodized salt. These achievements did not occur by chance, since it was precisely in Latin America, and in Ecuador in particular, where it was demonstrated that sustained control of iodine deficiency can be guaranteed with a very simple and inexpensive measure: adding iodine to salt.

Based on Ecuador's successful experience in controlling iodine deficiency, this chapter will show how it is possible to link scientific development with action. In the 1980s, when an intense debate arose between those who defended the use of a purely biological basis to solve the problems associated with iodine deficiency and those more inclined toward an epidemiological public health approach, Ecuador showed that shifting the paradigm for IDD

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management from a biomedical to a predictive approach would make it possible to control a public health problem and protect thousands of individuals and new generations (4).

Although it was already known that iodized salt was an excellent vehicle for ensuring the availability and daily intake of iodine, the Ecuadorian experience is one of the most significant contributions for demonstrating the effectiveness of the salt iodization strategy in controlling IDD, because it involved applying an operational methodology based on scientific evidence that guided the process from the characterization of the problem up to its management and control.

This chapter begins with a summary of the causes of IDD, then describes the Ecuadorian experience, and finally, briefly states the lessons learned.

## BACKGROUND

Goitrogenic geographical areas are characterized by soils poor in iodine. The greatest concentration of iodine in nature is found in the oceans. Iodine is absorbed by the atmosphere and reaches mountainous areas through rain, snow, and other factors; however, it then flows once more to the sea, transported by rivers. There is no balance between the iodine that reaches the mountains through the atmosphere and that which flows to the sea. Frequent rain and snow cause the iodine content of soil to be depleted at a faster rate, which means that the food crops grown in these soils contain little iodine. The lack of iodine in the soil is acute in these mountainous zones (5, 6).

This description is the case in Ecuador, whose narrow Andean valley corridor is poor in iodine. The rural population, much of which until a few years ago was concentrated in this mountainous zone, would consume food poor in iodine and seasoned either with rock salt, which is also poor in this nutrient, or refined sea salt that had lost its iodine content during cleaning and process-

ing. Thus, the problems stemming from iodine deficiency had existed since time immemorial, and their most obvious sign, goiter, was a condition very familiar to rural populations in mountainous regions (7).

Ecuador, like Peru and Bolivia, is one of the countries most affected by iodine deficiency disorders (5). Numerous studies have repeatedly shown that goiter used to be an enormous problem in the population of the highlands (8–10). A 1983 survey of schoolchildren in 10 highland provinces indicated that 36.5% of them had goiter. The reported prevalences ranged from 29.9% in Cañar to 48% in Tungurahua (Table 1). It was observed that the prevalence of goiter increased as the altitude increased and urinary iodine levels decreased. The survey results indicated that a very high proportion of schoolchildren living in the narrow Andean valley corridor, especially in rural areas, suffered from goiter, with 5% also suffering from neurological cretinism. This population was found especially in rural parts of the central Andes (11).

## THE ECUADORIAN-BELGIAN PROGRAM TO FIGHT ENDEMIC GOITER AND CRETINISM

In 1984, the Ministry of Health, with technical assistance and financing from the Government of Belgium, launched a pilot program known as the Bilateral Ecuadorian-Belgian Operational Project to Fight Endemic Goiter and Cretinism. This effort was joined by the International Council for the Control of Iodine Deficiency Disorders (ICCIDD), the United Nations Children's Fund (UNICEF), and the Pan American Health Organization (PAHO). This pilot phase, which lasted three years, was carried out in three provinces in the country's central region: Cotopaxi, Tungurahua, and Chimborazo. In 1987, the program was expanded to all of the Andean population (4).

During the program's execution, a partnership was established between the Min-



**TABLE 1. Prevalence of goiter in schoolchildren.**

| Province   | Prevalence of goiter (%) |
|------------|--------------------------|
| Carchi     | 39.0                     |
| Imbabura   | 40.0                     |
| Pichincha  | 30.0                     |
| Cotopaxi   | 43.0                     |
| Tungurahua | 48.0                     |
| Chimborazo | 30.0                     |
| Bolívar    | 37.0                     |
| Cañar      | 29.9                     |
| Azuay      | 36.0                     |
| Loja       | 33.0                     |
| Average    | 36.5                     |

**Source:** Rivadeneira M. Bocio y cretinismo endémicos en el Ecuador. In: Argüello S, Breilh J, Campaña A, Freire W, Granda E, Hermida C, et al. *Geografía de la salud en el Ecuador*. Quito: Instituto Geográfico Militar; 1991.

istries of Health and Education, which were the executing institutions. The Ministry of Health placed the program under an operational unit that received technical assistance from the Government of Belgium and the international organizations mentioned above.

In the 1970s, Ecuador, like the majority of the countries in the Region of the Americas, enacted legislation requiring the addition of iodine to salt for human consumption (12). However, these laws were neither universally nor routinely applied, which meant that a very high proportion of the population was at permanent risk for developing IDD. Moreover, the health authorities and the population in general were as yet unaware of the causes or the consequences of a lack of iodine, and even though they were accustomed to seeing people with goiter, they did not connect the solution of this problem to the application of so simple a measure as ensuring the consumption of iodized salt.

During this time, the national and international scientific community already had arguments for promoting salt iodization as an effective public health measure. The first studies, conducted in the U.S. state of Michigan (13) and Switzerland (14), showed that the administration of iodized salt could control goiter. In the ensuing years, Australia, Canada, New Zealand, and Norway, among other countries, obtained the same results. In

the Americas, Guatemala had succeeded in reducing the prevalence of goiter from 74% to 5.2% in the 1950s, figures similar to those obtained in Colombia; however, the absence of effective quality control systems and epidemiological surveillance led to reversals in these gains. Despite this, the information obtained from these experiences made it clear that it was both possible and necessary to expand activities to other countries (5, 12).

It was within this context that the Government of Belgium made a commitment to support a program for the elimination of endemic goiter in Ecuador, and the two countries signed an agreement for the eradication of endemic goiter and cretinism. Another objective of this joint initiative was to contribute to the design and implementation of nutrition education programs.

The program's success lay in the development and application of an operational risk assessment methodology that was fine-tuned during the execution of the program, the progressive adoption of control measures based on the level of risk, and the use of social marketing strategies targeted to population groups that could facilitate and support the program. At the same time, a system for the surveillance of iodine deficiency in the population was put in place, techniques to ensure quality control of iodized salt were applied, and support from the highest political authorities was obtained (4).

The operational methodology took shape during the pilot phase of the program. It began with a classical clinical diagnosis based on two indicators: palpation of the thyroid gland and urinary concentration of iodine. The data was used to confirm the presence of goiter and iodine deficiency; however, the methodology used was very expensive for use in the entire population. This consideration led to the adoption of an epidemiological diagnosis in which the type of salt consumed was taken as an additional indicator. There were two types of salt—that of industrial origin, known as refined salt; and crude, or rock, salt, obtained from mines.

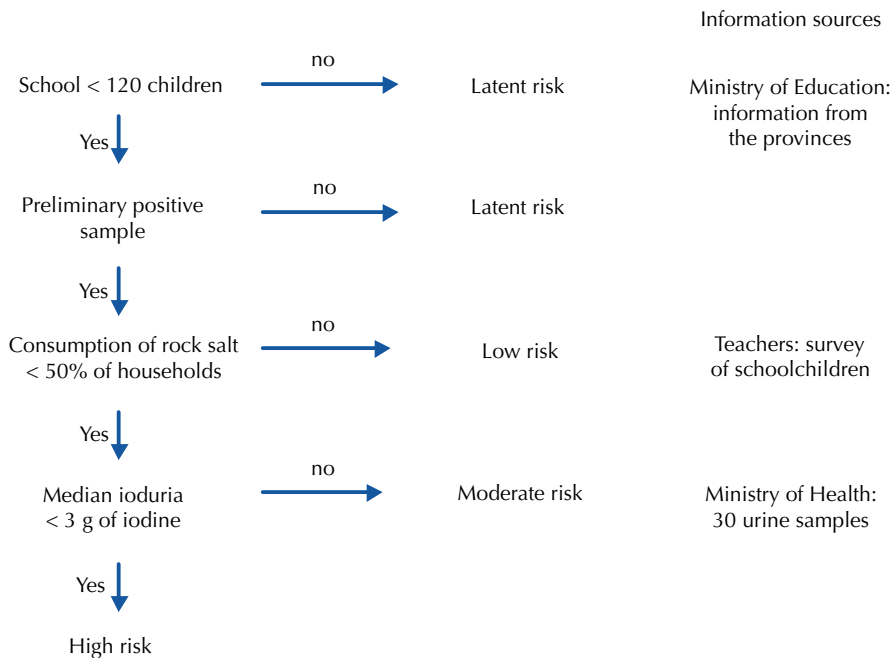
It was initially thought that, applied to the community, this indicator would permit better discrimination of risk levels in the population. However, while this methodology reduced costs and improved the specificity and negative predictive value of the indicator, it was not sensitive enough (4).

When the program was expanded nationwide, the indicators were refined and the process for selecting the populations at risk was simplified. To this end, once the collected information was analyzed, it was discovered that the most useful indicator for selecting communities was the size of primary schools in relation to the intake of uniodized salt. It was determined that if a school had more than 120 students, the probability that uniodized salt intake was less than 20% was 84%, with a sensitivity of 86%. Based on these indicators, a risk selection matrix was

created that divided communities into four risk levels: latent, low, moderate, and high, as observed in Figure 1 (4). Once the communities were classified, the intervention strategy was selected (Figure 2). The choices could range from the least complex measure (salt iodization) up to a package of four interventions: salt iodization, radio announcements, teacher education, and intensive community education (4).

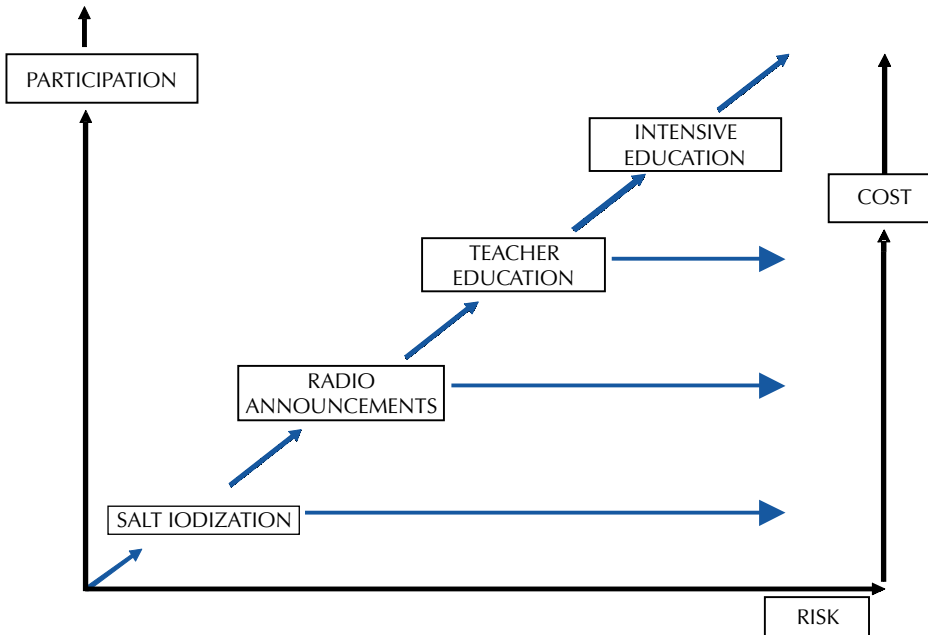
Salt iodization required the creation of opportunities for dialogue and negotiations with producers of refined salt to secure their agreement and commitment to add iodine to salt. This dialogue led to negotiations between the Government and private companies to reach an agreement on commitments, rights, and duties to ensure the iodization of all salt for human consumption. While the companies committed to iodizing salt, the

FIGURE 1. Selection strategy.



Source: From Vanormelingen K, Vanderheyden JM. *Innovative Aspects in Controlling Iodine Deficiency Disorders: The Case of Ecuador*. Quito: Pan American Health Organization; 1994. (PAHO/HPN/ECU 94-1). Adapted by Vanormelingen for this publication.

FIGURE 2. Progressive intervention strategy.



**Source:** From Vanormelingen K, Vanderheyden JM. *Innovative Aspects in Controlling Iodine Deficiency Disorders: The Case of Ecuador*. Quito: Pan American Health Organization; 1994. (PAHO/HPN/ECU 94-1). Adapted by Vanormelingen for this publication.

Government assumed responsibility for ensuring that all refined salt was iodized and reached the entire population. Thus, a quality control system for iodized salt was set up to identify producers who did not meet the commitments and obligations established by law, and when instances of this type occurred, a fine was imposed, and the manufacturer was publicly denounced in the media (4).

Radio announcements were prepared both in Spanish and in Quechua—this latter the native tongue of most of the rural population—for broadcast throughout the country. The announcements were developed with the assistance of experts, who used focus groups from the target population to collect information on beliefs, practices, and attitudes toward salt consumption and on problems stemming from iodine deficiency (4). In addition, two anthropologists were hired, who lived for several months in the

various communities of one of the affected provinces, Bolívar, and studied the symbolic and cultural value of salt in rural life. With this information in hand, the advantages and disadvantages of iodized and uniodized salt were studied jointly with the communities. This exercise yielded announcements containing information about the “new” advantages of salt iodization, which were used in the social marketing campaigns conducted in the various media. The announcements targeted specific population groups and were produced with participatory techniques that included using people from these communities to record the messages.

At the same time, health workers provided schoolteachers with training and information about the radio announcements in order to enable them to discuss what they had learned with their students in the classroom. Specific training modules were designed, one of which emphasized the use of

iodized salt to protect against goiter and cretinism (4). Teachers were given the task of conducting surveys on salt consumption in their communities; this was done by asking 30 children to bring salt from their homes to determine what type of salt they used: very fine-grained refined white salt or the dark, coarse-grained rock salt from the mines. This information alone had a tremendous impact on salt consumption patterns.

Similarly, health workers in charge of intensive community instruction were trained in communication techniques, and they were provided with audiovisual materials to facilitate their teaching activities and help foster changes in behavior in the families visited in the high-risk geographical areas (4). The education, communication, and information activities were based on the level of risk identified in the population. Thus, even when a population did not present latent risk, it was necessary to ensure that it had access to iodized salt. In low-risk populations, radio campaigns promoting the use of iodized salt were conducted in both Quechua and Spanish. In communities at moderate risk, teachers were given basic training so that they could convey the information during classroom instruction and during meetings with parents and other local groups. In high-risk populations, highly intensive educational activities were added at the community and household level. At the start of the program, intramuscular injections of iodized oil were administered in homes, an activity that became unnecessary when the communities were no longer at high risk (4).

In parallel with these activities, the quality of iodized salt was constantly monitored to ensure that it maintained the recommended amounts of iodine during production, distribution, and retail sale. A system was also set up to monitor program advances and provide follow-up, permitting timely adjustments with the rational use of resources and thus, substantial savings (4). This information was continuously communicated to the highest political authorities, who, convinced

of the benefits of salt iodization, continued to lend their support to the program, whose costs, moreover, were relatively low.

In 1993, a commission with representatives from PAHO, UNICEF, the U.S. Centers for Disease Control and Prevention, ICCIDD, Belgian Agency for Development Cooperation, Ecuadorian Ministry of Health, and other national and international experts evaluated the program. The evaluation team noted that around 1992, 90% of the salt for retail sale contained adequate levels of iodine, equivalent to 20 ppm, and that the median ioduria had increased from 8.6  $\mu\text{g}/\text{dL}$  to 15.6  $\mu\text{g}/\text{dL}$ , changes that reversed the high prevalences of goiter in the highlands of Ecuador (4).

The evaluation showed that it is feasible to control IDD's on a national scale and at a relatively low cost by means of a strategy based on the development and application of risk analysis, the use of nonbiological predictive indicators, and the adoption of progressively intensive control measures commensurate with the level of risk detected—all this combined with the diagnosis and measurement of impact and social marketing activities designed to guarantee support for the program (4). To this was added the use of an ongoing evaluation and feedback system to permit timely adjustments in the various diagnostic, intervention, and monitoring activities, in addition to lowering costs and producing measurable results with an impact on the population's nutritional status with respect to iodine.

## CONCLUSIONS AND LESSONS LEARNED

The iodine deficiency control program in Ecuador has not been the only successful salt iodization project. However, the extensive documentation that accompanied it from the outset helps distinguish what made it possible to obtain spectacular results. Vanormelingen's and Vanderheyden's (4) summary of

the project makes it possible to identify these aspects and demonstrates that scientific procedures can yield concrete solutions. The methodology was also based on the principle that the solution to the problem of IDD was not exclusively medical, but required the cooperation of other sectors, such as education and private enterprise, which had to assume specific responsibilities that were not the sole purview of the health sector.

The starting point was the characterization of the problem. The available information and the data obtained from a survey confirmed that the prevalence of endemic goiter was an enormous problem that particularly affected rural populations in the Andean valley corridor.

A second major element was the compilation of information on other countries' experiences, which showed that salt is an excellent vehicle for ensuring mass daily intake of basic quantities of iodine; however, it was necessary to collect data on local consumption patterns. From that information it followed that virtually all of the most affected population consumed uniodized salt, which is an unrefined, coarse-grained coffee-colored product.

The price of iodized salt was 2.5 times higher than that of the uniodized product and was therefore less accessible to the poorer population groups. Unrefined uniodized salt, in contrast, was sold retail in the markets of rural communities at accessible prices and was packaged in different volumes to meet customer demands (pounds, half-pounds, ounces, and portions). The way that iodized salt was distributed guaranteed that it would be more available in urban areas than rural areas. Based on these data, a dialogue was opened with refined salt producers to ensure the iodization of all salt for human consumption, in the recommended levels, and its distribution to rural areas. Negotiations were also held between the Government and salt producers on ensuring an adequate supply of iodine to guarantee the production of iodized salt so that salt dealers

could market the salt and the population could obtain it.

The negotiations concluded when, by mutual agreement, a permanent system was established for quality control and monitoring of the population's nutritional status with respect to iodine. All this was possible because information was also available on the infrastructure of both the industry and the health sector, the latter of which was responsible for ensuring that program implementation followed the established work plans. The salt producers numbered only nine in all, and one of them supplied 80% of the market, which facilitated the negotiations. The negotiations were buttressed by a monitoring system that imposed sanctions and informed the public about industry noncompliance with the law and its regulations.

A third element that contributed to the success of the program was the training provided to the staff of the Ministries of Health and Education responsible for educational activities at the central and local levels. In addition, the two ministries engaged in intersectoral efforts based on the principle that IDD was not just a medical problem, but one involving raising awareness among the general populace. To this end, a variety of ongoing training activities, using materials designed for this purpose, was carried out for all staff at the different levels of the program.

The fourth element was the use of social marketing techniques targeting various specific population groups, so that these would, in turn, facilitate and support the program. These techniques also served to keep the public informed about the progress of the program, to disseminate information about the advantages of consuming iodized salt, and to report producers who failed to meet their public obligations.

It was also very important to recognize that simple indicators were sufficient to measure the program's impact and to organize an inexpensive, easily implemented surveillance system to guarantee that salt is ade-

**TABLE 2. Components of a fortification proposal.**

|                                | Components   |
|--------------------------------|--|
| Reasons for the fortification  | Advantages<br>Opportunities<br>Limitations   |
| Target population              | Total population<br>Pregnant women<br>Children under 2<br>Adolescents                      |
| Selection of vehicle           | Food staples; low cost   |
| Definition of responsibilities | Legislative<br>Quality assurance<br>Epidemiological surveillance<br>Financing              |
| Infrastructure                 | Industrial<br>Health sector<br>Technology  |
| Selection of fortificant       | Cost<br>Availability and access<br>Effect on food preparation in the home<br>Acceptability |
| Communication                  | Promotion<br>Social marketing<br>Education   |
| Monitoring of the process      | At the industrial level<br>At the consumer level   |
| Impact assessment              | Population at risk<br>Total population<br>Sustainability                                   |

**Source:** Adapted from UNICEF/WHO Joint Committee on Health Policy. Strategic approach to operationalizing selected end decades goals: reduction of iron deficiency anemia. JCHP 30/95/4.5. Geneva: WHO; 1995.

quately iodized and reaches all population groups and to ensure that the iodine needs of the population are met (4).

Finally, it was fundamental to have a committed managerial component, consisting of a coordinating group highly skilled in promoting the program's work; in facilitating partnerships and securing agreements among the Government, private sector, and international organizations; and in securing the commitment of all the program partners, including political authorities at the highest level (15).

In short, execution of the IDD control program in Ecuador followed the recommended steps for a successful program, which are valid for any fortification program

(1). The design of a predictive model, the collection and use of data, and the flexibility to adapt the activities were key. Therefore, this and the other successful experiences in IDDs control can serve as the foundations for promoting micronutrient fortification programs in both the Americas and other regions of the world.

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# SUGAR FORTIFICATION WITH VITAMIN A IN GUATEMALA: THE PROGRAM'S SUCCESSSES AND PITFALLS

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## INTRODUCTION

Sugar is currently used as a vehicle for vitamin A in the form of retinol palmitate in El Salvador, Guatemala, Honduras, Nicaragua, Nigeria, and Zambia; for this reason, sugar has become the principal source of vitamin A for the people of these countries. Costa Rica, India, Malawi, the Philippines, and Uganda have specific plans for establishing similar programs. The origin of this practice dates back to 1975, when Costa Rica and Guatemala began to use the procedure developed by Dr. Guillermo Arroyave and colleagues at the Institute of Nutrition of Central America and Panama (INCAP) on a large scale. A few years later, both countries discontinued the program. Guatemala reinitiated it in 1988 at the urging of the Ministry of Public Health and Social Welfare and with the support of the United Nations Children's Fund (UNICEF) and INCAP. That year it became recognized worldwide that vitamin A is important in the reduction of infant mortality, since it improves not only eye function but also immune response. Since then and until the current time, sugar fortification has been uninterrupted, and Guatemala is the country most experienced in the application of such programs. This chapter describes the development and vicissitudes of sugar fortification

in Guatemala from 1988 to 2005 and complements and updates information found in earlier studies published on the subject (1, 2).

The addition of vitamin A to sugar was one of the recommendations of the report on the nutritional survey of the population of Central America and Panama of 1965–1967 (3) as a suitable measure for eliminating vitamin A deficiency, which represented a serious public health problem for these countries at that time. Sugar was selected because it is widely consumed by the population, generally in appropriate quantities (at that time, 20 to 40 g/day), and because its production was relatively centralized at only a few sugar refineries operating in the country. Other foods that could have been candidates were rejected for different reasons. Cornmeal flour, despite its high consumption by the population, was rejected because it was processed in hundreds of small mills. Wheat flour and oil were rejected because they were not part of the routine diet of the region's poorest sectors. Finally, salt was rejected because it was

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of poor quality and its price would increase greatly with fortification, in addition to being produced in hundreds of small marine salt flats.

Once the methodology for adding vitamin A to sugar had been developed, the Guatemalan Ministry of Public Health and Social Welfare and INCAP convinced health professionals of the viability and benefits of this intervention. With the backing of health professionals' associations, they promoted a law for compulsory fortification in Congress. The initiative was rejected in September 1973, but with the pressure brought to bear by the National Committee for the Defense of the Blind and Deaf-mutes of Guatemala and other social and health institutions, and with the example of a similar government agreement issued by Costa Rica, the law was approved in June 1974.

Sugar fortification with vitamin A began in 1975, together with a field study to verify its biological effectiveness. In several rural populations of Guatemala, it was shown that in less than six months, fortified sugar consumption had increased plasma retinol concentrations, retinol in breast milk, and liver retinol reserves in healthy people who died accidentally. In less than one year, vitamin A deficiency was under control (4, 5). Thus was born a classic example of a successful public nutrition intervention in the world.

### THE EVOLUTION OF THE TECHNOLOGY

Vitamin A is a liposoluble liquid, and sugar is a dry, crystallized substance that is soluble in water. The combination of both substances was possible thanks to the development of water-dispersible vitamin A compounds (75 g of vitamin per kg of product) that adhere to sugar grains in the form of solid microcapsules, or beadlets, by means of a vegetable oil coating. The premix of sugar with vitamin A is thus formed, which contains 15 g of vitamin A per kg of sugar in the form of retinol palmitate.

This dry premix is then added to sugar in a proportion of 1:1,000 to obtain an average theoretical content of 15 mg of vitamin A per kg of sugar. The original vitamin A microcapsules contained animal gelatin (250-CWS from Hoffman-La Roche and 250-CWD from BASF), but with the appearance of bovine spongiform encephalopathy, and for the purpose of extending this process to populations that do not consume animal products, gelatin was replaced with plant starches. The change was not easy, because the first plant microcapsules produced segregated (separated) from the grains of sugar, especially in refined sugar. Currently, INCAP recommends two plant products for fortifying sugar: 250-SN/B from DSM and 250-MS CWD from BASF.

When sugar fortification began in 1975, the premix was added manually to the centrifuges, just before the moist sugar was unloaded onto the conveyor belt to the drying turbines, and then it was transported to packaging hoppers. The drying and cooling turbines acted as large mixers. The system worked well, and the end product had a variation of 15% to 20%, although 20% to 30% was lost during the process. When the program resumed in 1988, many sugar refineries had been modernized and used closed automatic centrifuges. Consequently, feeders (dosifiers) that automatically dispensed the premix into the sugar during its transport from the centrifuges to the packaging area were incorporated. The engineer Leonel Anleu of the Sugar Producers' Association of Guatemala (ASAZGUA), with the support of Dr. Oscar Pineda of INCAP, designed several models, first vibratory and then vertical stainless steel hoppers that fed the premix with a variable speed winder (6). Dosing of the premix was controlled satisfactorily.

To reduce the loss of vitamin A during drying, the point of application of the premix was moved closer to the packaging hoppers. However, these changes increased the heterogeneity of the vitamin A content of the product (7). With the introduction of a mixing turbine—also designed by Leonel

Anleu—before packaging, homogeneity was recovered with a variation of approximately 30%. The invention of this machinery (feeders and mixing turbines) made it possible to separate the process of sugar fortification from sugar manufacture in refineries. Starting in 2002, ASAZGUA agreed that some packaging centers would begin to fortify sugar. The homogeneity and stability of the vitamin A content improve when fortification is carried out in packaging centers because they handle smaller volumes of sugar than refineries, and they use dry sugar. However, most sugar in Guatemala continues to be fortified in refineries because packaging centers are insufficient to meet demand and production costs are lower.

The cost of the equipment (feeder and mixer/blender) at each fortification site (refinery or packaging center) is approximately US\$ 35,000, which means that the country has invested about US\$ 800,000 in infrastructure for sugar fortification. Guatemala has invested around US\$ 4.5 million annually to fortify 0.5 million metric tons of sugar for a population of 12 million inhabitants, equivalent to US\$ 0.009 per kg of sugar or US\$ 0.37 a year per person, assuming that personal consumption is 45 kg/year or 120 g/day. This includes sugar added to the diet through industrially processed food, such as baked goods, soft drinks, desserts, and other similar products. The Nutritional Survey of Micronutrients conducted in 1995 (8) indicated that direct sugar consumption in the home was 24.6 kg/year or 67.5 g/day/person. The cost of fortification was equivalent to 1.8% of the retail price of sugar (US\$ 0.51/kg); the most expensive ingredient being the vitamin A compound, which represented 90% of the total cost.

## THE EVOLUTION OF TECHNICAL STANDARDS AND REGULATIONS

The Law of Sugar Fortification with Vitamin A of 1974 (Legislative Decree 56-74) was

applied in accordance with the provisions of the corresponding regulation (Government Agreement 105-74), which specified that sugar should contain 15 mg of vitamin A per kg, with a variation of 10% with respect to this value. In 1990, this measure caused conflicts between producers and food regulation officers at the Ministry of Public Health and Social Welfare of Guatemala because compliance was technically impossible in view of the usual variation of 30% in fortification in refineries.

In 1992, a General Foods Fortification Act (Legislative Decree 44-92) was passed, and in 1993, a new regulation for sugar fortification (Government Agreement 497-93) was issued that raised the range of vitamin A content by 33%; that is, from 10 mg/kg to 20 mg/kg. However, this standard failed to reflect the technical realities of the program because it did not take into account that vitamin A is lost gradually in a year in a proportion of 50%.<sup>4</sup> Thus, in 1998 a new regulation (Governmental Agreement 15-98) stipulated that sugar should contain a minimum of 5 mg/kg of vitamin A for the duration of its shelf life. Nevertheless, the criterion that sugar should contain 10 to 20 mg/kg in the refinery was kept, but without specifying that it was valid only at the time of fortification and during the first year of storage of sugar. Subsequently, to establish a reasonable criterion for homogeneity and safety, and taking into account variations in the process, it was recommended that the tolerable maximum level of fortification be 25 mg/kg. Despite the issue of many other regulations in subsequent years, this measure has not yet been adopted. To date, the criterion of 10 to 20 mg/kg has been followed for sugar samples obtained in the refinery, whether at the point of fortification or in the storerooms, which continues to generate

<sup>4</sup>Morales de Canahui E, Dary O, de León L. Retinol stability of fortified sugar in Guatemala. Abstract. In: IVACG Secretariat. *Report of the XVII International Vitamin A Consultative Group Meeting*. Washington, DC: IVACG; 1996:80.

conflicts between producers and food regulation authorities. The reasons for the frequent changes in regulations will be discussed later in this chapter in the section highlighting the sugar fortification program's various political and economic crises.

Guatemalan legislation in force requires vitamin A fortification of all sugar consumed domestically, regardless of its use. At one time an exemption for the sugar used in soft drink production was considered because most vitamin A is lost during processing (9); however, in light of the uncertainty that unfortified sugar would be effectively controlled and to prevent it from reaching consumers, it was decided that it would be preferable to assume the additional cost (30%) rather than endanger the quality of the entire program. To date, all food products prepared with fortified sugar contain vitamin A, including cookies, baked goods, candy, desserts, and other similar products, as earlier mentioned. More than 80% of the vitamin A in sugar is conserved in these products (10).

### THE EVOLUTION OF MONITORING (QUALITY CONTROL, INSPECTION, AND SURVEILLANCE)

As part of the process of sugar fortification, in 1975 INCAP investigators (11) designed an analytical method based on the Carr-Price reaction (12), which produces a temporary blue compound when the reagent reacts with retinol. The advantage of this method is that the amount of retinol present in sugar can be assessed visually, without need for any special equipment, by comparing the intensity of the color to a scale prepared from copper sulfate solutions of different concentrations. The procedure was reviewed in the 1990s to improve its analytical resolution, so that it could be used effectively as a semiquantitative method in sugar refineries (13). It was established that the determination should be performed with a so-

lution prepared with at least 10 g to 20 g of sugar, based on the fact that only one grain of sugar in each 1,000 bears vitamin A. In addition, a simpler alternative method was developed for rapidly determining the presence or absence of the vitamin around a fixed cutoff point. Levels of 3.5 mg/kg and 5.0 mg/kg were selected for use in screening tests in the surveillance activities carried out in homes and at points of sale, respectively. This cutoff point (3.5 mg/kg) was selected for homes because it ensures the supply of at least 200 µg of vitamin A with the usual sugar consumption of Guatemalans, which represents 33% to 50% of the recommended nutritional intake of this nutrient. The cost of the semiquantitative method is US\$ 1.00 per sample, and the cost of screening is US\$ 0.50 per sample.<sup>5</sup> The greatest advantage of this method is that a single person can process nearly 200 samples a day, in contrast with 20 to 30 daily samples with the semiquantitative method.

To support quantitative retinol measurements in sugar, INCAP designed a spectrophotometric method based on retinol extraction in hexane and its measurement by means of its absorbance at 325 nm (13). The quantification limit of this method is 1.5 mg/kg, and the cost is US\$ 3.00 per sample. The minimum amount of sugar to dissolve is 10 g for refined sugars and 20 g for direct white or sulfated sugars. However, to guarantee the reproducibility of results, the current practice is to dissolve 100 g, regardless of the sugar type.

At the same time that analytical chemical assays were developed, periodic sampling practices and reports were introduced for different stages of monitoring in the program. Monitoring includes quality control

<sup>5</sup>Calzia R, Martínez C, Domínguez P, Dary O. Qualitative method to determine vitamin A in sugar and other foods for fast screening in monitoring programs. Abstract W35. In: IVACG Secretariat. *Report of the XXI International Vitamin A Consultative Group Meeting. Improving the Vitamin A Status of Populations*. Washington, DC: IVACG; 2003:76.

and quality assurance by the refineries (external monitoring). Then, officers of the Ministry of Public Health and Social Welfare's Department of Food Regulation and Protection carry out inspection and auditing practices in production centers and customs for importation (external monitoring) and in centers of distribution and sale (commercial monitoring). The actions of the Government constitute regulatory monitoring and have legal connotations. The system is completed by sampling in households to establish the utilization and quality of the table product used by consumers (home monitoring).<sup>6</sup>

Every year, INCAP laboratory professionals have collaborated with ASAZGUA to provide training and continuing education courses for those responsible for quality control departments in the refineries of Guatemala. In 2002, ASAZGUA published a detailed manual on quality control of the sugar fortification program.<sup>7</sup> In short, the system consists of daily quantitative estimates of vitamin A content in the sugar premix. Regardless of production volume, refineries test the vitamin A content of the fortified sugar being produced every one to four hours—and more often if homogeneity is unsatisfactory. The semiquantitative colorimetric method is used, although some refineries have introduced the quantitative spectrophotometric method. Furthermore, each refinery prepares a daily composite sample that is sent to a reference laboratory. Vitamin A content is determined in the laboratory using the spectrophotometric method. At the time of fortification, the goal is to keep vitamin A content above 10 mg/kg. All the results are recorded at each refinery and, until 2003, a copy of the results was sent to the manager

of the ASAZGUA fortification program, who produced periodic reports on the results of all the country's refineries. Currently, control of the program is the responsibility of the Máquinas Exactas company, which is part of the sugar consortium. As an external control, sugar samples are sent to INCAP to corroborate the results of the internal quality audits.

During the sugar harvest, officers of the Department of Food Regulation and Protection have visited refineries to observe compliance with the process and to obtain samples to corroborate vitamin A content (external monitoring). Less systematically, samples have also been obtained at points of sale (commercial monitoring). These actions intensified after 2000. The National Laboratory of Health analyzes the samples using a spectrophotometric method.

Since 1995, UNICEF and INCAP have urged the Ministry of Education to participate in the home monitoring of food fortification programs. The system is known as Micronutrient Sentinel Schools and consists of obtaining 20 sugar (and salt) samples from the same number of students in 420 rural public schools throughout the country selected randomly from an official list. In the first year, one sample out of every four was analyzed—to lower costs and analysis time—but from 1996 to 2000, two composite samples were prepared by combining 10 individual samples per school, under the assumption that all the sugar of a community comes from the same source. Starting in 2001, the system was perfected. All samples began to be screened using a simple cutoff point method of 3.5 mg/kg. Then two composite samples per school are prepared with the individual samples that satisfy the cutoff point, and their vitamin A content is determined quantitatively using the spectrophotometric method.

The INCAP Laboratory of Nutritional Biochemistry has carried out this task. Screening is used to assess program coverage; that is, the proportion of samples with a vitamin A content above the cutoff point, while the

<sup>6</sup>Dary O, Martínez C, Alfaro C, Chinchilla D, Lacayo M. Quality control (QC)/quality assurance (QA) and monitoring system of the sugar fortification program in Central America. Abstract W60. In: IVACG Secretariat. *Report of the XXI International Vitamin A Consultative Group Meeting. Improving the Vitamin A Status of Populations*. Geneva: IVACG; 2003:83.

<sup>7</sup>ASAZGUA. Protocolo del Programa de Fortificación del Azúcar con Vitamina A.



quantitative data are used to establish the average vitamin A content of adequately fortified samples.<sup>8</sup> UNICEF published two reports with the results of this program in 1995 and 1999. Starting in 2000, the results of this activity have been included in the annual reports on food fortification programs published by the National Commission on the Fortification, Enrichment, and Comparison of Foods (CONAFOR), INCAP, and UNICEF. El Salvador, Honduras, and Nicaragua have also produced these reports, in which the name of the public health ministry appears instead of CONAFOR. This was not possible in Guatemala due to the conflict between the Government and national food producers, especially sugar refiners, which is described in the corresponding section below on the various economic and political setbacks experienced by the sugar fortification program.

Table 1 presents a summary of the available results of home monitoring. The complete system, including the sampling and analysis of sugar, salt (for iodine), and bread (for iron and vitamin B complex) samples for every five schools, and the production of the corresponding report, costs approximately US\$ 25,000 a year. This is financed by UNICEF and by funds from projects granted to INCAP by USAID, and by the Micronutrient Initiative sponsored by the Government of Canada.

Between 2000 and 2003, CONAFOR decided to implement a surveillance system at points of sale in tandem with official inspections by the Ministry of Public Health and Social Welfare, in light of fears that this might be insufficient to control the quality of imported unfortified products, which by law must be fortified before sale. The system,

called a "social audit," was the responsibility of the Consumers League and was also financed by UNICEF. In Table 2, the results of government inspection are compared with those obtained by the social audit. It is interesting to observe that the results coincide, except for the governmental data of 2002, which were much lower than the results obtained by the social audit and home monitoring the same year. This may be because sampling carried out by the Ministry of Public Health and Social Welfare focused that year on brands that were noncompliant with the standard.

The complete monitoring system established in Guatemala made it possible to determine that sugar at the time of fortification in the refinery contains an average of 12 mg of vitamin A per kg; upon reaching the point of sale, the content is 10 mg/kg, and on the table of consumers, it is 7.5 mg/kg. The technological process was designed so that sugar would contain 15 mg of vitamin A per kg, without considering any loss. This means that 50% of the vitamin A added in the refineries reaches the consumer, a result that coincides with the conclusions obtained in stability experiments carried out by INCAP. The gradual loss of vitamin A during storage is normal and occurs with any other food fortified with this nutrient. The results are acceptable, considering a sugar shelf life of one year, which is approximately when home monitoring is performed.

## THE BIOLOGICAL EFFECTS OF THE PROGRAM

Studies by Arroyave and colleagues (4, 5) clearly demonstrated the biological impact of the consumption of sugar fortified with vitamin A when the program was launched in the 1970s. Other studies of food fortification indicate that the vitamin A used in fortification is well absorbed, regardless of the food matrix (14). As a result, to predict effects on health, it is enough to measure the additional

<sup>8</sup>Domínguez P, Martínez C, Molina R, Dary O. Evaluation of a surveillance system for the program of sugar fortification with vitamin A at the household level. Abstract W59. In: IVACG Secretariat. *Report of the XXI International Vitamin A Consultative Group Meeting. Improving the Vitamin A Status of Populations*. Washington, DC: IVACG; 2003:83.



**TABLE 1. Evolution of the coverage and quality of the sugar fortification program in Guatemala at the household level.<sup>a</sup>**

| Year | Percentage of individual samples examined (n = 8,400) | Percentage of participating schools (n = 420) | Coverage (% reference criterion <sup>b</sup> ) | Quality [Vit. A] (mg/kg) |
|------|---|---|--|--------------------------|
|      |   |   | <b>&gt; 5.0 mg/kg</b>                          |                          |
| 1995 | 85  | 100   | 51   | 6.6                      |
| 1996 | —   | 42  | 79   | 7.0                      |
| 1997 | —   | 72  | 75   | 6.9                      |
| 1998 | —   | 65  | 76   | 6.9                      |
| 1999 | —   | 95  | 80   | 7.9                      |
| 2000 | —   | 100   | 79   | 7.5                      |
|      |   |   | <b>&gt; 3.5 mg/kg</b>                          |                          |
| 2001 | 64  | 100   | 77   | 9.3                      |
| 2002 | 23  | 43  | 68   | 7.4                      |
| 2003 | 36  | 75  | 85   | 9.5                      |

<sup>a</sup>Coverage means the percentage of samples that meet the specified minimum criterion, and quality refers to average vitamin A content in those samples.

<sup>b</sup>The criteria used were > 5 mg/kg and > 3.5 mg/kg. The criterion for coverage was changed from > 5 mg/kg of vitamin A to > 3.5 mg/kg because, starting in 2001, a method of screening individual samples began to be used, whereas in previous years the criterion was applied for composite samples formed by the combination of 10 individual samples. When that system was used, from 97% to 99% of the composite samples contained detectable levels of vitamin A (> 1.5 mg/kg).

**Source:** CONAFOR/INCAP/UNICEF; Informes Anuales de la Situación de los Alimentos Fortificados, 2000, 2001, 2002, and 2003.

vitamin A intake received this way to estimate the benefits of fortification.

The results of home monitoring (Table 1) and the data on usual sugar consumption in Guatemala—without taking into account sugar from processed food products made with fortified sugar—of 60 g/day to 120 g/day in adults and 30 g/day to 60 g/day in children suggest that Guatemalans receive between 60% and 150% of the recommended vitamin A intake. This means that sugar com-

plements the diet with regard to the daily vitamin A requirements. Sugar is providing more vitamin A than all other foods combined (15).

The Guatemala National Micronutrient Survey of 1995 (8) revealed that only 15.8% of preschool children (1- to 5-year-olds) had low plasma retinol levels (< 0.7  $\mu\text{mol/L}$  or < 20  $\mu\text{g/dL}$ ), meaning that vitamin A deficiency was under control. The International Vitamin A Consultative Group (IVACG) has

**TABLE 2. Comparison of the quality of fortified sugar in refineries and points of sale.**

| Year | Government inspection <sup>a</sup> |               |                  | Social audit <sup>b</sup> |               |                  |
|------|------------------------------------|---------------|------------------|---------------------------|---------------|------------------|
|      | n                                  | > 5 mg/kg (%) | [Vit. A] (mg/kg) | n                         | > 5 mg/kg (%) | [Vit. A] (mg/kg) |
| 2000 | 122                                | 75            | 9.8              | —                         | —             | —                |
| 2001 | 112                                | 82            | 11.1             | 264                       | 82            | 9.3              |
| 2002 | 430                                | 42            | 5.9              | 102                       | 84            | 10.9             |
| 2003 | 311                                | 81            | 13.3             | —                         | —             | —                |

<sup>a</sup>Data of samples collected in refineries and points of sale by personnel of the Ministry of Public Health and Social Welfare's Department of Food Regulation and Protection.

<sup>b</sup>Data of samples collected in retail sale sites in different geographical departments of the country by volunteers of the Consumers League and analyzed by INCAP.

**Source:** CONAFOR/INCAP/UNICEF; Informes Anuales de la Situación de los Alimentos Fortificados, 2000, 2001, 2002, and 2003.

suggested that a frequency of subnormal vitamin A levels in excess of 15% indicates that the nutritional status of this vitamin is inadequate in the population (16). Guatemala still appears to be in that situation. However, data from the survey cited were not adjusted for infections and inflammations, which reduce the protein that transports retinol (17) and, as a result, plasma retinol. It is to be expected, then, that the nutritional status of Guatemalan preschool children may be much better than suggested by the 1995 survey. On the other hand, only children under age 3 had frequencies of low plasma retinol levels of more than 15% (Table 3). Furthermore, the quality of sugar fortification is better now than in 1995 (Table 1). Perhaps only children under the age of 24 months who are not breast-fed by their mothers are in danger of receiving insufficient vitamin A. For this reason, Guatemala maintains a program of preventive supplementation with high-dose vitamin A every six months for children ages 6 to 35 months old.

An indirect verification of the positive effect of sugar fortification is the almost complete elimination of xerophthalmia (blindness caused by vitamin A deficiency) in the country. In recent years, very few cases have been found, and these cases have been associated with acute protein-energy malnutrition conditions that have affected some localities of the country. Table 4 shows the incidence of ocular perforation in children who suffer from vitamin A deficiency according to the hospital registries of the Na-

**TABLE 3. Prevalence of low levels of plasma retinol in boys and girls of Guatemala in 1995 (< 20 µg/dL or < 0.7 µmol/L).**

| Age (months) | Low levels of plasma retinol (%) |
|--------------|----------------------------------|
| 12–23        | 19.9                             |
| 24–35        | 17.7                             |
| 36–47        | 13.1                             |
| 48–59        | 11.9                             |

**Source:** Guatemala, Ministerio de Salud Pública y Asistencia Social. *Encuesta nacional de micronutrientes, 1995*. Guatemala: Ministerio de Salud Pública y Asistencia Social; 1996.

**TABLE 4. Incidence of ulcerations and ocular perforation in Guatemala associated with vitamin A deficiency.**

| Year              | Cases              |                     | Total |
|-------------------|--------------------|---------------------|-------|
|                   | Children < 4 years | Children 4–10 years |       |
| 1982              | 6                  | 3                   | 9     |
| 1985              | 3                  | 2                   | 5     |
| 1986              | 4                  | 2                   | 6     |
| 1987 <sup>a</sup> | 1                  | 0                   | 1     |
| 1988 <sup>b</sup> | 1                  | 0                   | 1     |
| 1989              | 1                  | 0                   | 1     |
| 1990              | 2                  | 0                   | 2     |
| 1991              | 1                  | 0                   | 1     |
| 1994              | 1                  | 0                   | 1     |
| 1997              | 0                  | 0                   | 0     |

<sup>a</sup>A national campaign to distribute vitamin A capsules was carried out in 1987.

<sup>b</sup>The sugar fortification program with vitamin A resumed in 1988.

**Source:** INCAP, Laboratory of Nutritional Biochemistry, unpublished data obtained from the hospital registries of the National Committee for the Defense of the Blind and Deaf-mutes of Guatemala in Guatemala City and Quetzaltenango.

tional Committee for the Defense of the Blind and Deaf-mutes of Guatemala in the two most populous cities of the country (Guatemala City and Quetzaltenango). It should be pointed out that ocular disorders due to vitamin A deficiency have disappeared almost entirely since the high-dose vitamin A supplementation campaign of 1987 and the reintroduction of sugar fortification in 1988.

## FUTURE TOPICS OF INTEREST IN PUBLIC HEALTH

In the 1970s, the idea of adding vitamin A to sugar was conceived based on the supposition that consumption of this product would remain unchanged; publicity based on the condition of fortification was prohibited. However, in the 1990s it was recognized that it was necessary that the consumer have information on the importance of sugar as a vitamin A vehicle in order to justify and defend the program's existence. This objective was achieved, and the general population

now recognizes that sugar should contain this nutrient. In the last 30 years, sugar consumption—both sugar consumed directly and sugar added to industrially processed food—has increased, and it is now more than 100 g/day per person. This behavior does not coincide with recommendations of the World Health Organization (18) that the consumption of simple sugars be restricted to 10% of daily calorie intake, which is equivalent to approximately 45 to 70 g/day of sugar. Fortification has probably had little influence on the increase in sugar consumption in Guatemala, but some entrepreneurs have begun to exploit the interest of the population in micronutrients and at their own initiative have launched sugar that also contains iron on the market. To date, information is lacking on the technical quality and true biological value of iron fortification, as well as its influence on the promotion of sugar consumption. Excess sugar consumption, potential excess vitamin A intake, and sugar fortification with other micronutrients are new fields of work in the public health area.

### THE POLITICAL AND ECONOMIC CRISES OF THE PROGRAM

The sugar fortification program of Guatemala enjoys national and international recognition. Guillermo Arroyave has been awarded the Order of the Quetzal, the most important medal of Guatemala, mainly for conceiving and promoting this program. In January 1998, he became the distinguished recipient of a Prince Mahidol Award conferred by the King of Thailand in recognition of his universally important contributions to the public health of humankind. In addition, in 1996 UNICEF granted public recognition to the Government of Guatemala and to sugar producers for achieving universal fortification of this product in the country.

However, despite the importance and prestige of the program and the positive ef-

fects that it has demonstrated, the first Cabinet Resolution of January 1998 (Governmental Agreement 01-98) repealed the resolution for compulsory sugar fortification (Governmental Agreement 497-93). The measure was designed to favor sugar imports in response to a 10% increase in the price of the product decided by producers in December 1997, which increased the price from US\$ 0.56/kg to US\$ 0.60/kg, equivalent to US\$ 1.00 per person a year, assuming a direct domestic consumption of 25 kg/year/person. The avalanche of protests from both Guatemalans and the international arena captured the front pages of all the country's newspapers and received broad coverage in other communications media. The fact that the program was backed by a Congressional decree issued in 1992 and the situation declared to be a national emergency caused other State agencies to intervene. Furthermore, the Law of Sugar Fortification of 1974, also passed by Congress, remained in force.

In view of the unanimous social opposition, the Government issued a new regulation on 13 January 1998 (Governmental Agreement 15-98) that restored mandatory sugar fortification. This regulation left open the possibility of importing unfortified sugar, but required its fortification with vitamin A before its distribution and sale. At the same time, producers agreed to turn back the price of sugar to the price in effect in December 1997. Given the international importance of the program for public health, the journal *Sight and Life* published a review by Solomons and Bulux (19) on the events in Guatemala.

Although the opportunity to import sugar into the country was opened, no company took advantage of it. Guatemala is the third-largest sugar exporter of Latin America, after Brazil and Cuba, producing 1.8 million metric tons of sugar per year, of which 1.3 million (72%) tons are exported and 0.5 million (28%) tons are allocated to supply the country's internal demand. Sugar is one of the country's principal sources of foreign exchange, in 2004 surpassing coffee in impor-

tance.<sup>9</sup> In 1998, sugar production in Guatemala was equivalent to the combined total production of the rest of the Central American countries. Furthermore, the local price of this product was the lowest in the region, with the exception of Belize, which subsidizes sugar production.

In December 1999, history repeated itself: producers raised the price of sugar from US\$ 0.48/kg to US\$ 0.54/kg (prices were lower than in 1998 due to the devaluation of national currency in relation to the U.S. dollar), and the Government repealed Agreement 15-98 and allowed the importation and sale of 10,000 metric tons (approximately 25% of monthly demand) of unfortified sugar for 30 days, the period in which the equipment needed for fortification was to be installed. On 15 January 2000 there was to be a change in government authorities, so the outgoing Government issued another regulation for sugar fortification on 7 January 2000 (Governmental Agreement 021-2000), which was similar to that of January 1998 but mentioned the exemption from fortification of the 10,000 metric tons which had been authorized. The technical specifications of this regulation have been in force until the time of this writing in 2005.

With the new Government, the conflict intensified and open confrontation with sugar producers began. A new Government Agreement (121-2000) authorized the tax-free importation of 218,922 metric tons of sugar (44% of annual national demand), of which 72,974 did not have to be fortified because it was destined for industrial use. The Government backed these measures arguing that Guatemalans were paying five times more for sugar, referring to the price of raw sugar on the New York Stock Exchange (US\$ 0.11/kg). Producers claimed that the price of white sugar was higher than that of raw sugar on the international market, which does not include the expense of transpor-

tation, storage, packaging, and marketing. They also publicized rates for the importation of sugar from other countries (30%–40%) and sugar prices, which highlighted the fact that, on the average, prices were 17% lower in Guatemala than in any of the other Central American countries and Mexico, with the exception of Nicaragua.<sup>10</sup> On this occasion, there was less civil protest in defense of the program, and the crisis focused instead on the possible harm that the decision would inflict on the national economy. After an intense campaign in the communications media and public manifestations by the sugar sector and associated industries, the Government and sugar producers agreed in April that the sugar price would return to the levels existing in previous years. The Government would authorize the importation of only 5,000 metric tons per year of fortified sugar, tax-free, an amount that could increase depending on need. Furthermore, fortified sugar could be imported freely with a 20% tax.<sup>11</sup> Agreement 121-2000 was repealed, and Agreement 151-2000 was issued.

In July 2000, the first lot (5,000 metric tons) of sugar from Cuba was admitted to the country<sup>12</sup> (additional lots from Brazil would enter later). This was unfortified sugar because, according to the importing company and the Government, it was destined for industrial use. Subsequently, it was revealed that it would be distributed on the market for direct consumption, after fortification in the customs warehouse.<sup>13</sup> This set off an advertising and legal battle between national producers and the importing company. The producers claimed that Agreement 151-2000 applied to the importation of fortified sugar, not unfortified sugar. In turn, importers and

<sup>10</sup>*El Periódico* 28 March 2000:25; *Prensa Libre* 5 April 2000:30.

<sup>11</sup>*Prensa Libre* 11 April 2000:3, National section; *Siglo Veintiuno* 11 April 2000:3.

<sup>12</sup>*Prensa Libre* 15 July 2000:17, Economics section.

<sup>13</sup>*Siglo Veintiuno* 9 August 2000:35; *Prensa Libre* 10 August 2000:41.

<sup>9</sup>*Prensa Libre* 20 July 2004, Economics section. Available at: [www.prensalibre.com](http://www.prensalibre.com)

the Ministry of Public Health and Social Welfare publicly accused national producers of violating the fortification requirement,<sup>14</sup> basing their complaint on data that emerged from the Ministry's inspection activities, which coincided with the official results presented in Table 2 for that year. In order to avoid damaging public opinion of the program, which was operating satisfactorily, CONAFOR had to clarify publicly this misleading and malicious statement.<sup>15</sup> After weeks of disputes, imported sugar began to be marketed in the country. Its price was US\$ 0.006/kg, lower than the domestic product, meaning a yearly saving of US\$ 0.15 per person for those who purchased this sugar.

In August of the following year (2001), Agreement 151-2000 was modified to allow the legal tax-free importation of 5,000 metric tons of unfortified sugar (Government Agreement 350-2001). National producers again reacted, threatening to stop fortification since it had not been guaranteed that the imported sugar would be fortified.<sup>16</sup> In turn, CONAFOR, in light of the uncertainty of the situation, created a social auditing system to monitor sugar quality in the Guatemalan market. Monitoring activities in 2001–2002 indicated that the majority of sugar samples of national brands were fortified and that only one brand of refined sugar produced nationally and one imported product were being distributed without vitamin A. The results of the social audit were made public in 2002, citing all the brand names analyzed. The Government reacted by confiscating refined sugar of the brand identified and sold in supermarkets of Guatemala City, but it did not take any action against the imported product. Furthermore, several national refineries were denounced

with government claims of noncompliance with fortification.

Tension continued, although lessened, until December 2003, when, after the presidential elections, producers raised the price of sugar from US\$ 0.48/kg to US\$ 0.53/kg. The Government repealed Agreement 350-2001 and issued Agreement 1-2004, which allowed the tax-free importation of 100,000 metric tons of unfortified sugar.<sup>17</sup> Producers asked the Court of Constitutionality to declare the agreement unconstitutional. The Court resolved in their favor.<sup>18</sup> When the new Government took power, Government Agreement 1-2004 remained definitively void, and it was agreed that the price of sugar would be left at a price between the previous and new value (US\$ 0.51/kg).<sup>19</sup> It is interesting to note that in September of the same year, the Ministry of Public Health and Social Welfare warned the population through the press that sugar imported from Brazil was being marketed without previous authorization by health authorities as required by Guatemalan law.<sup>20</sup>

This protracted period of crisis affected the program. Although it was maintained, the program's integrity deteriorated with regard to home monitoring, because samples were obtained from only 43% of schools in 2002 (Table 1), lacking samples even from metropolitan schools. In 2003, the situation began to improve, but performance was still inferior to that of 2001 and previous years. Social audits ceased to be made in 2003 due to lack of financing. Furthermore, the public's continuous exposure to messages about vitamin A in sugar created the impression that sugar fortification was an invention of national producers devised to protect their market and increase sales. The present opinion of the populace about the program is unknown.

<sup>14</sup>*Siglo Veintiuno* 1 September 2000:40; *Prensa Libre* 1 September 2000, Economics section.

<sup>15</sup>*Prensa Libre* 11 September 2000:37.

<sup>16</sup>*Prensa Libre* 10 September 2001:19, Economics section.

<sup>17</sup>*Prensa Libre* 3, 7, and 8 January 2004; Economics section.

<sup>18</sup>*Prensa Libre* 13 January 2004, Economics section.

<sup>19</sup>*Prensa Libre* 11 February 2004, Economics section.

<sup>20</sup>*Prensa Libre* 30 September 2004.



## THE ROLE AND IMPORTANCE OF CONAFOR

The Law of Food Fortification of Guatemala of 1992 created the National Commission on the Fortification, Enrichment, and Comparison of Foods (CONAFOR), an interinstitutional and intersectoral entity responsible for coordinating and supervising food fortification programs important for public health. CONAFOR consists of representatives of the Ministries of Public Health and Social Welfare; Agriculture, Livestock, and Food; Economy; and Government; as well as trade and food associations affected by the law (sugar, salt, and wheat flour) and the Consumers League. This Commission receives technical advice from the National University, INCAP, the Pan American Health Organization, and UNICEF. All members serve *ad honorem*, without economic incentive or remuneration for attending work sessions. CONAFOR has met systematically since its creation with almost monthly periodicity. Although the law that established the Commission did not specify a regulation for the distribution of positions, its members designated as president one of the representatives from the private sector (associations of sugar, salt, and wheat flour producers), a position which rotates every two years, while the Secretariat was assigned permanently to the Ministry of Public Health and Social Welfare.

Even in the midst of the conflicts that occurred between 1998 and 2004, CONAFOR was able to facilitate ongoing communication and cooperation among the technical personnel in the public and private sectors and with the country's international organization partners, thus proving its ability to serve as a valid and effective forum for discussing and resolving differences. Generally speaking, an atmosphere of cordiality reigns among members, even if at times it is disturbed by the pressures brought to bear on the Department of Food Regulation and Protection to increase its efforts to ensure that all

food brands on the market satisfy sugar, salt, and wheat flour fortification requirements.

CONAFOR has carried out promotional and educational activities on topics related to food fortification and targeted these to a variety of groups, including civil servants, food producers, and consumers. CONAFOR's work has made it possible to formulate wheat flour to include folic acid and to replace reduced elementary iron with ferrous fumarate. CONAFOR has also played an instrumental role in the preparation of a regulation requesting the addition of fluoride and iodine to salt for human consumption and is involved in efforts to achieve the fortification of cornmeal flour. Finally, it is important to note that another of CONAFOR's core functions is the preparation of proposals aimed at securing international financing to reinforce the monitoring, surveillance, evaluation, and educational activities of Guatemala's food fortification programs.

The conflicts between the Government and the national private sector have at times threatened the work and continuity of CONAFOR. At the most critical moments, representatives of the public sector have withdrawn, but they have subsequently returned at the first sign of lessening tension. There were times, however, when representatives of the Ministry of Public Health and Social Welfare expressed a wish that Congress modify the Law of Food Fortification to convert CONAFOR into a simple advisory body because they considered that program supervisory functions should be the sole competence of the Government. CONAFOR has also been attacked by private sector representatives who accuse it of being a tool for national producers of sugar, wheat flour, and salt to use for their own benefit. However, it can be claimed that the continuous and persevering work of CONAFOR since its creation has sustained interest in food fortification programs and that its participation has been crucial during times of crisis which threatened the very existence of these programs.

## DISCUSSION AND CONCLUSIONS

Between 1987 and 2005, the sugar fortification program in Guatemala has improved progressively. Its nature and characteristics are now better understood, so that the factors that condition effectiveness can be controlled better. Water-dispersible vitamin A microcapsules now contain plant ingredients instead of animal gelatins, favoring the introduction of this process in societies that do not consume animal products. The technological development of the sugar industry demanded the invention of automatic feeders and special mixers that not only have helped to improve automation and the homogeneity of the process in refineries, but also have made it possible to fortify sugar in packaging centers. This is important because it enables the fortification of imported or stored unfortified sugar. It has been determined that the variation in the process is 10% to 30% and is greater when fortification is carried out in sugar refineries. The stability of vitamin A in sugar is similar to that of other fortified foods. In the case of Guatemala, recovery is 80% in refineries, 67% at points of distribution and sale, and 50% in homes a year after sugar has been fortified. Taking all of these factors into account, the maximum cost of fortification is US\$ 0.009/kg to achieve a minimum vitamin A content of 3.5 mg/kg and an average vitamin A content of 7.5 mg/kg in the sugar that reaches the tables of consumers.

The case of sugar fortification in Guatemala illustrates the importance of specifying the nature of a program before issuing standards and regulations. Legislative instruments often demand specifications that are impossible to attain due to the technical characteristics of the processes. This incompatibility creates conflicts when food regulation authorities attempt to confirm compliance with specifications based on purely theoretical standards.

It has been concluded that it is better to specify a minimum level of fortification in-

stead of a margin of variation. The level is calculated after considering the variation in the process and nutrient loss during storage. In Guatemala, this level was set at 5.0 mg/kg, a value that ensures an average vitamin A content of 7.5 mg/kg or more, with which the Guatemalan population receives 60% to 150% of the daily nutritional requirements of vitamin A in sugar.

Vitamin A is one of the nutrients that has a maximum tolerable intake value (20, 21), which is 3,000 µg a day for adults (for other age groups, maximum tolerable intake is lower). To protect against a higher consumption than that, a maximum tolerable level of fortification should be established. This level depends on consumption and will decrease as consumption of the food vehicle increases. In the case of Guatemala, the maximum tolerable fortification level recommended is 25 mg/kg. The ideal fortification practice is that food should contain the nutrient of interest at a concentration higher than, but as close as possible to, the minimum level of fortification. The maximum tolerable level of fortification is important to guarantee that micronutrient content be as uniform as possible and always within safe levels.

The monitoring system (quality control, inspection, and surveillance) of the sugar fortification program in Guatemala illustrates that chemical and analytical support is essential and does not require the use of sophisticated tests or expensive equipment. Analytical tests should be selected in accordance with their purpose and the urgency with which the results must be known. For example, the analytical resolution can be reduced (as in the semiquantitative method used in refineries) to obtain rapid results, but always seeking a method with a satisfactory accuracy within the range of concentrations used for decision-making. On the other hand, discriminatory tests with a fixed cutoff point are useful for estimating coverage, while quantitative methods help to obtain a better idea of the amount of nutrient being supplied to the population. Knowing the



nutrient content of the fortified food is useful for estimating intake. An important aspect of monitoring is the presentation and dissemination of results. Documentation of the program and its processes in Guatemala has made it possible to narrate their history and thus to illustrate the program's evolution and discover when information is modified or misinterpreted for interests other than technical interests. The availability of this information has made it possible to defend the program when its quality has been under attack. It could even be speculated that had this information not been available, the program could have ceased to exist. The weak point of monitoring fortified sugar in Guatemala is that it has depended financially upon international cooperation entities. While its cost is not excessive, the governments of developing countries usually do not reserve funds for this purpose.

Another weakness of the program is the absence of a system of epidemiological and nutritional surveillance that would make it possible to assess on a fairly regular basis the quality of the diet and nutritional status of the population. The most recent information is from 1995, when it was determined that vitamin A deficiency was under control. However, it would have been useful to assess the food and nutrition situation in subsequent years, in addition to identifying potentially excessive levels of intake. This information is fundamental in view of the latent threat that the program will be interrupted. If this indeed were to happen, the most substantial argument for urging its restoration would be to discover a resurgence of vitamin A deficiency. The lack of surveillance systems is common in developing countries and has contributed to the adoption of many decisions relevant to public nutrition on the basis of assumptions, ideologies, and good intentions, rather than scientific tests and sensible deductions.

The role of INCAP in the Guatemalan program for sugar fortification has been vital from its inception. The process originated

thanks to research on nutritional epidemiology and on food technology conducted in that institution. The credibility, ability to convince, and prestige of INCAP favored the promotion, launching, and defense of the program. The experience acquired in the 1988–2005 period illustrates the importance of technical and scientific bodies. Food fortification programs are in continuous evolution, meaning that they require ongoing improvement of their technical, scientific, and regulatory aspects, especially monitoring and biological evaluation. No advance can be conceived and attained without independent centers for research and development. Furthermore, it may be impossible to sustain achievements without them. Herein lies the importance of ensuring that the technical and scientific services of centers like INCAP are sustainable and even strengthened.

The combination of excessive sugar consumption and high vitamin A levels implies the risk of surpassing the tolerable maximum intake value. If it is accepted that the permissible maximum fortification level is 25 mg/kg, then it would suffice for adults to consume 120 g of sugar a day to attain the maximum tolerable intake of 3,000 µg of vitamin A (21). This is highly probable in Guatemala, where the combination of high intake of sugar containing high vitamin A levels has already been reported.<sup>21</sup> The previous analysis was made without including other processed foods in the diet that also contain vitamin A in the form of retinol, the presence of which is increasing on the market. This situation indicates a pressing need to issue regulations to adjust the content of vitamin A in sugar to current consumption profiles, as well as to restrict the addition of this nutrient to any other processed food.

Sugar is an ideal vehicle for fortification in many countries like Guatemala because the populace consumes it regularly in sufficient quantities and because it is produced in a relatively few number of centers with accept-

<sup>21</sup>Noel W. Solomons, personal communication.

able levels of industrial development. This situation is attractive in the sense that it opens the door to the possibility of adding other nutrients to sugar. The idea, while a good one, nonetheless requires technological development, especially to avoid the segregation of nutrients from sugar crystals (solids of different sizes) and to prolong the nutrients' stability—in the case of vitamins—during the shelf life of the processed sugar.

For example, there is an initiative to add iron to sugar, but it still has to be shown that the nutrient remains adhered to the sugar grains, that the presence of iron is compatible with sugar uses, and that the amount of iron added has significant biological effects. Until concrete proof of these requirements becomes available, sugar fortification with iron—or with any other nutrient—will remain little more than a sales strategy devised by producers and marketers for commercial image enhancement. In any event, as sugar is a food whose consumption should be limited (18), any type of sugar fortification should be done following regulations and standards issued by the public health authorities of the individual country in question.

Guatemala became an experimental site for identifying the forces influencing food fortification programs for widespread consumption, which, as has been shown in this chapter, at times transcend the interests of nutrition and public health. Fortification involves costs that, although minimal, can originate large financial losses when extrapolated to food consumption volumes (the market share of a product may decline due to a difference of a few cents in price) or large gains (due to false statements that a product is fortified or to restrictions in competition). In this play of economic relations, governments may act on behalf of specific interests, and food fortification programs can become obstacles to the flexibility authorities seek to facilitate their decisions. Fortification is not a barrier to commercial competition if the rules and the criteria for their compliance are clear and applicable to everyone involved. How-

ever, for this purpose governments must have systems of food inspection and protection that are reliable, constant, and effective. Unfortunately, in many developing countries this requirement is rarely met due either to the lack of resources or practices that are vulnerable to corruption. Under these circumstances, the participation of consumers in the defense of their rights would appear to be an appropriate solution. For this reason, the promotion of social audits carried out by nongovernmental consumer protection organizations and bodies with relative independence for supervising the programs, such as CONAFOR, would likewise appear to be feasible control measures. While the work of these bodies can create friction with governmental food regulation authorities and at times with individual commercial producers, this is normal in any human society. What is important is to guarantee that these public health programs, which by definition involve the participation of economic production structures, can maintain their quality and sustainability in benefit of the general population whom they serve.

The vicissitudes experienced by the sugar fortification program in Guatemala during the 1998–2004 period highlight the fact that partnerships between the public and private sectors are more goals than realities. Relations are constantly shifting and require constant upkeep because the particular individuals involved change from moment to moment and particularly so with changes in government. The sugar fortification program implemented between 1975 and 1977 arose in response to pressure from the public health sector, but lacked unanimous support from the private production sector, which made it easy to find reasons for discontinuing it. Health interests also motivated its reinitiation in 1988, but on this occasion better collaboration and mutual respect were being developed gradually, especially between the technical personnel of both sectors. Once the sugar fortification program was constituted, it extended to spheres other than health, but

lost the attention of the health sector, especially when the latter's weakness in enforcing respect for the regulations became evident. In Guatemala, the situation was aggravated by the fact that fortification programs based on food products of major economic and political interest relegated public health objectives to a lower level of visibility. This highlights the lack of political support and recognition of the importance of the fortification programs displayed during this period and illustrates the need for a sustained defense of the public health benefits to be secured through the fortification program, as well as for permanent transparency and dissemination of the results of program monitoring and evaluation.

The creation of CONAFOR by a law of Congress as an independent body for the coordination and supervision of food fortification programs turned out to be a successful strategy because it increased the commitment and motivation of its members in relation to these programs. One of the limitations may have been the weak leadership of the Ministry of Public Health and Social Welfare since its representation was not delegated to high-level officials when the importance of CONAFOR required it. This drawback, however, can be easily resolved through the creation of a political commitment to stimulate the development of partnerships with the private sector. In any case, the importance of CONAFOR as an independent body was confirmed, and its existence would be justified by the mere fact that it was persistent in promoting food fortification programs across the board to Government workers, the business community, and consumers themselves.

In conclusion, food fortification programs are complex, require the participation of many institutions and sectors, and are vulnerable to economic interests and power struggles, but if they are structured adequately, they can produce major benefits at a very low cost to society as a whole. The evaluation, documentation, and continuous dissemination of the quality and achievements

of these programs seem to be the key to convincing all those involved of their importance in ensuring the well-being of society. It could be advantageous if international development agencies were to consider promoting social audits, home monitoring, and food and nutrition evaluations associated with these programs on an ongoing and permanent basis, since the benefits far outweigh the investment required.

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# VIRTUAL CONTROL OF VITAMIN A DEFICIENCY IN NICARAGUA

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## INTRODUCTION

The existence of subclinical vitamin A deficiency (VAD) in Central America was first documented in the mid-1960s (1). The fact that clinical signs were infrequent may have accounted for the relatively low priority then assigned to control VAD, which for a long time was seen mainly as an eye-related problem (2, 3). Some mass distribution of vitamin A capsules occurred in 1973–1974 in El Salvador (4) and in 1988 in El Salvador and Guatemala. By the mid-1970s, the Institute of Nutrition of Central America and Panama (INCAP) of the Pan American Health Organization (PAHO) had developed the technology for and demonstrated the impact of fortifying sugar with vitamin A as a means to reduce VAD (5, 6). Fortification was regarded as a more sustainable and far-reaching approach than pharmaceutical supplementation. Thus, sugar fortification was rapidly introduced in Costa Rica, Guatemala, and Honduras in 1977 by means of mandatory legislation. These programs, however, lasted only a few years. A long period with little or no action followed (7) except for resumption of sugar fortification in Guatemala and Honduras in the late 1980s.

By the early 1980s, it had become clear that even subclinical VAD was associated

with significantly greater risk of child morbidity and mortality from infectious diseases (8, 9). This was subsequently confirmed by results of field trials demonstrating the child-mortality-reducing impact of improved vitamin A status through either supplementation or food fortification (10). With the realization of the association between VAD, immunity, morbidity, and mortality in children, VAD gained recognition as an important threat to child health and survival. Since then, VAD has been assigned high priority as part of the health and nutrition plans in a number of countries where VAD is a serious public health issue, and periodic high-dose vitamin A supplementation has been promoted as a low-cost, highly effective means of rapidly improving vitamin A status, health, and survival of children; indeed, it has been portrayed as one of the most cost-effective child survival strategies available to public health planners and programmers (11–13).

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Following the recommendations of the World Health Organization (WHO), supplement distribution was later integrated into National Immunization Days (NIDs) in several countries (14). Despite ongoing VAD control programs, including high-potency supplementation in 85 countries, today VAD affects an estimated 127 million preschool children (15) and is sufficiently severe to result in death or blindness in over a million children annually (16). It is generally recommended that, in addition to supplementation, a food-based approach, including fortification and dietary diversification, should become part of an integrated strategy to effectively address VAD and its health and survival implications (17, 18).

When in 1993 the Nicaraguan Ministry of Health (MOH) confirmed VAD as a nationwide public health problem, advocacy efforts benefited from the results of child mortality trials and meta-analysis (10), and mass supplementation was thus the immediate emergency response. In 1995, a National Micronutrient Plan (NMP) was formulated, which included a well-defined VAD control component that has been successfully implemented over the past 10 years.

The purpose of this chapter is to describe the Nicaraguan experience in VAD control over the last decade and to highlight some of the principal lessons learned. Countries that are still affected by VAD may find the Nicaraguan experience useful in addressing their own situations.

## BACKGROUND

Nicaragua is the second-poorest country in the Latin America and Caribbean region after Haiti. In the twentieth century, the country passed from a long period of family-led dictatorship ending in the late 1970s to a decade of social and political turmoil followed by a transition to democratic stability in the 1990s. GNP per capita, which drastically declined in the 1980s, more recently has

modestly recovered. Most of Nicaragua's population of 5.5 million (2003 estimate) occupies the Pacific Ocean coastal half of the country, which lies midway along the Central American chain; nearly 60% of the country's residents live in urban areas. About one-third of the adult population is illiterate.

Infant and under-5 mortality have significantly declined from 140 and 209 per 1,000 live births, respectively, in 1960, to 31 and 40 per 1,000 in 2001. Coverage rates for immunizations have consistently reached > 90%, and the use of oral rehydration therapy for diarrhea amounted to 82% in 2001. Under the ongoing MOH decentralization process, the health sector in Nicaragua encompasses 17 districts, or Integrated Local Health Systems (*Sistemas Locales de Atención Integral en Salud*, or SILAIS), which enjoy high management and partial budgetary autonomy. MOH central units provide policy and technical guidance, training, and supervision to the districts. Nicaragua has a long tradition of community participation in health and nutrition initiatives.

In the mid-1960s, INCAP promoted and supported national nutrition surveys in most Central American countries, with the cooperation and assistance of the Nutrition Program of the United States Public Health Service (1). Several nutritional deficiencies were found to be widespread in the region. In Nicaragua, 600 families from 30 localities were covered, excluding the Atlantic Region. The regular diet of 68% of the families country-wide (75% in the rural area) met less than 50% of their vitamin A needs (5). Clinical signs of VAD were not found, but about 20% of the children under 5 years were subclinically deficient (serum retinol < 20 µg/dL). However, no specific action to control VAD was initiated as a result of the nutrition survey. By then, VAD was mostly considered as an eye problem, and ocular clinical signs were uncommon in most countries of the region (19). Except for establishment of salt iodination in 1978, few program and policy considerations regarding micronutrient defi-



ciencies were implemented in Nicaragua before the 1990s.

In 1993, twenty-eight years after the nutrition survey, in response to advocacy efforts by the United States Agency for International Development (USAID) and INCAP/PAHO, the First National Micronutrient Survey to assess the status of vitamin A deficiency and anemia was conducted by the MOH with assistance from the USAID's VITAL (Vitamin A for Health Field Support) Project (20). The survey covered a national sample of 1,791 families with children 1 to 4 years of age. Blood specimens were collected and analyzed at INCAP laboratories in Guatemala using a spectrophotometry method. A 24-hour recall dietary intake assessment was carried out in 900 families. Persistent VAD was confirmed as a problem of public health significance: 31.3% of the children had sub-clinical VAD (plasma retinol < 20 µg/dL), with no differences by region, and 7.9% showed severe deficiency (plasma retinol < 10 µg/dL). About 59% of the children 12 to 59 months of age and 71% of the families consumed less than 50% of the recommended amounts of vitamin A per day.<sup>5</sup> By then, among the 10 Latin American countries with national data, Nicaragua had the second-highest prevalence of VAD after El Salvador (19). Nevertheless, clinical signs of VAD were not found.

When the results of the 1993 survey were reported, there was growing evidence and international recognition of VAD as a serious threat to child survival. Meta-analyses of field trials demonstrating a significant impact of improved vitamin A status on child mortality had been widely publicized. As a result, advocacy for VAD as a problem deserving priority attention became more closely linked to the ongoing child survival movement.

It was in this scenario that the Nicaraguan MOH Nutrition Department developed and

put in operation a three-year micronutrient advocacy and action plan (1993–1996), which included an aggressive sensitization campaign to create awareness of existing micronutrient deficiency problems and their implications. During this period, it was thought that no sustained commitment to address micronutrient deficiencies could be elicited without aggressive awareness and sensitization efforts. The campaign targeted MOH technical personnel, politicians, academic institutions, health professionals, the food industry, NGOs, community groups, media networks, and the general population. The purpose was to generate political commitment to address VAD and other micronutrient deficiencies. Central messages on vitamin A stressed that “VAD is a serious problem contributing to child deaths from infectious diseases and reducing child survival”; “one of every three Nicaraguan children is affected by VAD”; “VAD worsens the severity and duration of infectious diseases in children”; “the problem requires priority action”; and “vitamin A supplements and fortified foods are effective in controlling VAD.”

The survey results were widely disseminated. Presentations were scheduled for MOH technical staff at the central and district (SILAIS) levels, food industry representatives, and academicians; press releases were repeatedly issued; brief technical documents on the three key micronutrient deficiencies were prepared and widely distributed; and frequent meetings were held with high-level officials from the MOH and other ministries. An assessment of the policy and program environment was conducted, as well as an inventory of the technical and institutional resources available that could be tapped to address the problem. Political commitment was generated at the highest levels of government.

As part of the three-year plan, the MOH decided that vitamin A supplementation be initiated immediately as an emergency measure to ameliorate VAD while universal forti-

<sup>5</sup>This estimate was based on a β-carotene-vitamin A conversion factor of 6:1.

fication of a food staple could be established. A stand-alone vertical supplementation program for distribution of only vitamin A was not considered warranted. The challenge was to secure high coverage of children 6 to 59 months. Despite some initial concerns about the sustainability of a campaign-type approach, the MOH decided that incorporation of vitamin A supplementation into the well-established and highly successful National Immunization Campaigns (NICs), or *Jornadas Nacionales de Vacunación*, offered the best programmatic option. Therefore, twice-a-year expanded National Health Campaigns (NHCs), or *Jornadas Nacionales de Salud*, spearheaded by immunizations, substituted for the NICs beginning in May 1994. At this time, concerns from the medical community regarding potential toxicity and long-term undesirable effects of high-dose vitamin A supplements were successfully addressed through technical meetings for the distribution and discussion of pertinent literature.

In order to secure high coverage, the scope of the NICs was expanded into an integrated package of preventive maternal and child primary health care services to be implemented twice yearly. In addition to distribution of vitamin A and iron/folate supplements, the package included routine immunizations, anti-helminthes medications, health education, oral rehydration salts, contraceptives, chloride for water treatment, and anti-lice medications. This required establishing a semi-annual cycle of district-level activities to improve facility usage for preventive services, as well as community outreach using school buildings and the households of community leaders and/or community health volunteers (*brigadistas*) as delivery posts. Universal vitamin A supplementation for children 6 months to 10 years through NHCs was then established and later (1997) retargeted to children 6 to 59 months.

In 1994, the high priority assigned by the central government to preventing and con-

trolling micronutrient deficiencies materialized in the creation of the National Micronutrient Commission (NMC), presided over by the MOH Vice Minister, to develop and coordinate the implementation of a five-year national micronutrient plan. The NMC is composed of more than 20 member institutions from the public, nonprofit, and private sectors, including the Ministries of Health; Education, Culture, and Sports; and Development, Industry, and Commerce, as well as international cooperation agencies (USAID, UNICEF, INCAP/PAHO), the Consumer's League, and the food industry (salt, sugar, and wheat flour producers).

### THE NATIONAL MICRONUTRIENT PLAN 1996–2000

A Task Force was designed by the NMC in 1994 to prepare a five-year National Micronutrient Plan to be implemented in 1996. The plan was completed in 1995 with assistance from USAID's Opportunities for Micronutrient Interventions Project (USAID/OMNI), UNICEF, and INCAP/PAHO, and in consultation with academic groups, the food industry, MOH technical personnel, and high-level decision-makers. Involvement of these individuals in periodic meetings and discussions throughout the process proved to be very useful and allowed for additional advocacy and reinforcement of political commitment. The NMP adopted an integrated strategy to primarily address vitamin A and iodine deficiencies as well as nutritional anemia, with vitamin A and anemia control programs becoming more systematically integrated.

The NMP became a blueprint to put into operation, as circumstances permitted, a series of specific micronutrient activities. These included: (1) vitamin A and iron/folate supplementation to children and pregnant and/or postpartum women, for immediate implementation; (2) fortification of food staples with vitamin A or iron and B-complex

vitamins, in addition to ongoing salt iodination; (3) information, education, and communications (IEC) to enhance awareness and promote demand for supplements and increased consumption of micronutrient-rich foods; (4) other public health measures such as periodic deworming of preschool- and school-age children; (5) training of health service personnel, health professional faculty, and students and community volunteers; (6) development of program monitoring and evaluation (M&E) and surveillance systems; and (7) operations research.

Instead of being launched simultaneously, NMP interventions were sequentially introduced; e.g., supplementation and deworming in 1994, food fortification in 1997 and 2000, and IEC in 1999. In a related effort in 1997–1998, with USAID/OMNI assistance, nutrition and micronutrient contents were developed and incorporated into the undergraduate curriculum of health professional schools (medicine, nursing, nutrition) with teaching manuals and prototype materials prepared in conjunction with INCAP. In 1998, USAID commissioned a mid-term external assessment and portfolio review of the NMP and micronutrient policies, programs, and opportunities for continued assistance. This exercise was extremely useful to identify strengths and weaknesses in NMP implementation, with emphasis on the VAD control program, and to evaluate the extent to which NMP goals were being reached, in order to set program priorities and define issues in need of immediate attention.

### THE VITAMIN A DEFICIENCY CONTROL PROGRAM

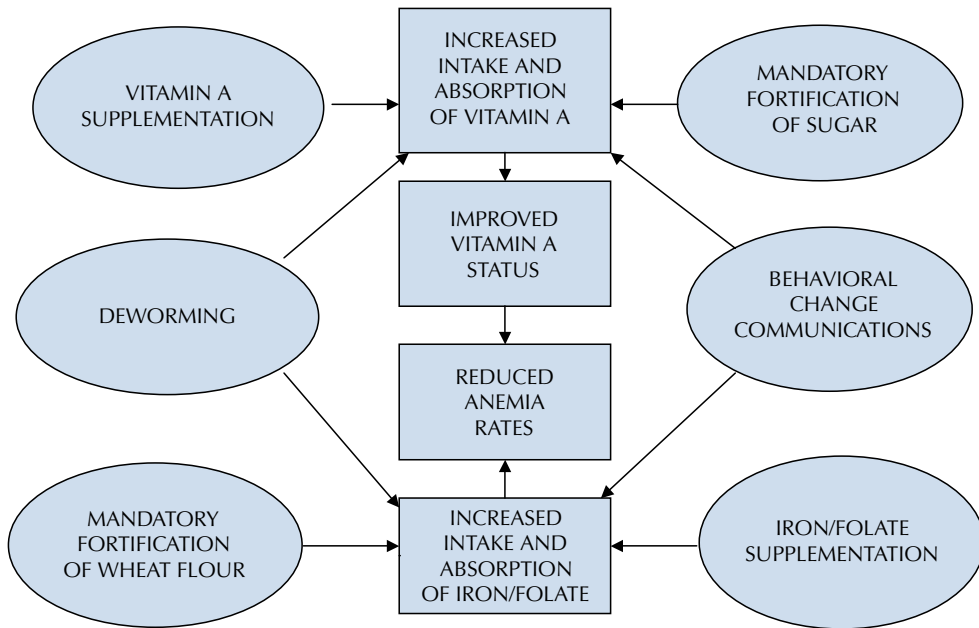
VAD was approached through an integrated strategy encompassing mass supplementation of children and postpartum women, fortification of sugar, IEC, periodic deworming, training, and program M&E. Program interventions were phased in gradually, with supplementation and deworming

introduced in 1994, and sugar fortification, training, and IEC in 1999–2000. While deworming was expected to contribute to control both VAD and anemia, training and IEC were conceived as comprehensive support systems cutting across specific programs, thus adopting an integrated approach to VAD and anemia control (Figure 1). Program monitoring and evaluation were progressively built up to the establishment of an integrated nutrition M&E system in 2002.

### Supplementation

The policy decision on vitamin A supplementation was made and began to be implemented early in 1994; thus, ahead of overall NMP development. In 1995, vitamin A supplements were officially included in the MOH list of essential medicines. Technical guidelines were developed for supplementation targeted to children and postpartum women, following WHO recommendations. Since the beginning, vitamin A supplementation became an integral component of the NHCs. Local health units are ultimately responsible for distribution of vitamin A and other supplements. Coordination of the implementation of NHCs is a responsibility of the districts. MOH central units are responsible for setting the stage for, coordinating, and supporting the NHCs' implementation twice per year (usually May and October) by securing sufficient supplies and providing training as needed to the districts and these, in turn, to the local health services.

District and local coordination committees arrange for participation of the different partners, identify service delivery posts (e.g., local health units, schools, the houses of community leaders and *brigadistas*), and coordinate district and local planning and implementation. Media communications support is also provided to districts in order to raise awareness and mobilize communities, and to enlist the long-established large cadre of *brigadistas* in support of the NHCs. During the NHCs, communities (particularly

**FIGURE 1. Integrated approach to VAD and anemia control in Nicaragua.**

women and children) are massively mobilized by engaging the media, municipal authorities, the church, and other community groups, with very active participation by primary school teachers, secondary school and university health sciences students, community volunteers, traditional birth attendants, the military, and NGOs. The need to take advantage of the variety of primary health care services provided at local health facilities and distribution sites is highly emphasized.

Each NHC may last one week in urban areas and as many as four weeks in rural isolated areas, where activities of this type are practically the local population's only contact with the public health system. Vitamin A supplementation is only one—albeit a very important one—of all the services provided. It is now targeted to children 6 to 59 months and postpartum women. While most immunization coverage is achieved in the first round of the year, the second round provides an opportunity for booster doses and for reaching children not covered in the first

round with the full set of primary health care services; both rounds are used successfully for vitamin A distribution. Each campaign is carefully planned jointly by the central MOH and the districts, and largely funded by international donors in addition to regular MOH budgetary allocations. In order to achieve the optimal coverage possible through the NHCs, the districts are encouraged to tap other opportunities for contacts with mothers and children to ensure additional supplement delivery through routine health services; however, coverage through routine health services has been low (< 1%).

A supervision and monitoring system has been established which, in addition to overseeing implementation, periodically provides information on population coverage achieved by each district through both NHCs and additional routine distribution. Supplement delivery is registered on each child's health card and recorded on immunization tally sheets that are compiled monthly at health units and submitted to the districts (SILAIS). These, in turn,

send the information to the MOH central units of the Expanded Program of Immunizations (EPI) and the Department of Statistics where it is entered in a computer database and processed to estimate both immunizations and vitamin A coverage. Semi-annual reports with coverage rates by age group and district are released and discussed at the central and district levels in post-campaign evaluation meetings where the coverage ranking of districts is examined and options for future improvement are discussed. Public and professional recognition encourages health staff to achieve high rates of coverage. No adverse effects of supplementation have been reported.

Guidelines were developed for supplementation activities to be implemented by the health units and health care personnel, including community health volunteers (*brigadistas*). Parallel efforts have been made to improve procurement, distribution, and logistics of micronutrient supplements, although a specific management logistics system has not yet been established. In practice, however, this has become a more important constraint for iron/folate than for vitamin A supplementation through NHCs. Annual budgetary allocations for procurement of most vitamin A supplements were made up to 1997. Since then, large-scale donations have been made by the Government of Canada through the Micronutrient Initiative (MI); the Governments of Japan, Spain, and Sweden; PAHO/WHO; UNICEF; the Wisconsin Lion's Club; and Friends of the Americas. The districts prepare periodic requests based on estimated needs. Timely supply of donated supplements and distribution to delivery points together with other supplies have been secured for NHCs but not for routine health services; indeed, a management logistics system for micronutrient supplements in health services beyond those offered by the NHCs remains a critical need.

In the late 1990s, PAHO provided technical cooperation to strengthen the supplementation monitoring system by incorporating supplement delivery in the child immuniza-

tion and maternal health cards and tally sheets, as well as integrating child supplementation with polio vaccine and postpartum supplementation with BCG. In 2001, PAHO documented achievements in 10 Latin American countries where vitamin A supplementation had been incorporated into immunization activities (21). Despite some progress, only five countries had country-wide programs, and a number of programmatic constraints precluded achievement of consistently high coverage among children. Nicaragua was an outstanding example. However, beginning in 2003 only one NHC per year has been implemented.

### **Sugar Fortification**

Policy dialogue and negotiations aimed at establishing mandatory fortification of sugar with vitamin A began in 1994. Sugar was regarded as a suitable vehicle based on production and consumption data: it was centrally produced in only seven privately owned plants, it was consumed regularly by more than 95% of all Nicaraguan families, and the domestic supply per person amounted to about 30 kg per year, or 80 grams per day. The small number of production plants and the absence of imported sugar would make government control of fortification less complex. The negotiation process was brokered jointly by USAID/OMNI, INCAP/PAHO, and UNICEF. Through participation of industry representatives in earlier awareness-raising events, channels of communications had been opened with the purpose of developing a public-private sector partnership. Sugar producers were made aware of VAD and the need for and benefits of sugar fortification for the population; however, they were cautious about making a firm commitment.

Despite industry awareness and the Nicaraguan Government's interest in this initiative, the establishment of a partnership was a cumbersome and time-consuming process. Getting a formal commitment by the industry was dif-



difficult since sugar refineries were still in the process of recovering from a long period of instability after nationalization by the government in the 1980s. The report of an independent technical and economic feasibility assessment commissioned by the National Committee of Sugar Producers (NCSP) in 1995 was positive, but some unresolved issues persisted. Major concerns for the industry were the cost of fortification, as well as the need for foreign currency and considerations related to the feasibility of transferring the cost of fortification to the consumer. The existing political and economic climate in a period of difficult political transition to democracy and slow economic recovery would make price increases a politically sensitive issue. An additional concern was the uncertainty regarding ownership of the sugar mills, which had been confiscated by the previous government, and the legal process surrounding devolution by the new government to the original owners had not yet been completed.

Throughout the initial negotiations process, which lasted four years, both the government and external cooperating agencies adopted a positive but cautiously optimistic attitude, carefully handling advocacy efforts as the circumstances dictated. At a point when the process seemed to be losing ground, fortifying vegetable oil was explored as a contingency option. Market, purchase, usage, storage, and consumption patterns for edible oil were assessed with promising results, but a market and economic analysis of the domestic oil industry revealed serious problems affecting the economic feasibility of fortification, and the idea was ultimately abandoned. During the entire process, a highly motivated and forceful NCSP executive secretary, the late Noel Chamorro, championed the cause of vitamin A and emphasized the social responsibility of the industry to collaborate with the government in fostering effective solutions to public health problems by reconciling industry and public health interests.

Negotiations with the sugar industry materialized in October 1998 when the NCSP exec-

utive director advised the government of the industry's readiness to go ahead with fortification and requested assistance in finding sources of financial support to cover the cost of fortificant supplies for the first year, estimated at US\$ 1.4 million. The largest sugar refinery in the country (San Antonio) was selected as the site for building the premix preparation plant. The industry request for government assistance in securing financial support (a low interest loan) was positively considered. A soft loan with a 10-year grace period was obtained from the Nordic Multilateral Development Fund (NMDF) and transferred to the industry. The MOH Office of International Relations acted efficiently in accelerating the lending process. A draft agreement was then prepared by which a government-industry partnership was formally established with the purpose of initiating sugar fortification in the 1999–2000 harvest. The agreement was officially signed in a special ceremony in February 1999 with the President of Nicaragua acting as an official witness.

Specific responsibilities for the government and the industry were defined in the agreement regarding legal regulations; government assistance in searching for financial support; free importation of fortification equipment and supplies; an eventual increase in the price of sugar to create a revolving fund to secure sustainability of the fortification program; an informational campaign to the consumer; training to establish industry quality control, government monitoring, and surveillance systems for fortified sugar; and joint development and implementation of a work plan with concrete steps to initiate fortification. Sugar producers pledged to cover the initial investment in equipment and local facilities.

A 12-month work plan was prepared and implemented jointly by the government and the sugar industry, with assistance from USAID's Micronutrient Operations, Strategies, and Technology Program (USAID/MOST), UNICEF, and INCAP/PAHO. The plan included six specific actions aimed at the estab-

lishment of universal sugar fortification by the 1999–2000 harvest: (1) securing start-up financial assistance, (2) setting technical regulations and standards, (3) training industry personnel, (4) installation of the premix production plant and mixing equipment, (5) a pilot test and adaptation of the fortification technology, (6) establishment of industry quality control and government monitoring systems, and (7) design and implementation of an informational campaign to the consumer. Training and technical assistance needs were also defined and resources allocated by cooperating agencies. Draft technical specifications and regulations for sugar fortification were prepared to be discussed with the industry. The draft was based on regional standard regulations developed by the USAID/OMNI-INCAP Central America Micronutrient Initiative early in 1998.

The World Bank acted as a fiduciary agent managing the NMDF loan for procurement of the vitamin A fortificant (retinol palmitate) to be shipped to the NCSP. However, since the initial disbursement of NMDF funds took longer than expected, the government and USAID contacted the Micronutrient Initiative of Canada for a donation to cover the cost of importing the fortificant for the first three months of implementation. The MI donated US\$ 350,000 to cover this initial fortificant supply until the NMDF loan became effective. The sugar industry covered all costs associated with the building and equipping of the preparation plant and with procurement of the mixing equipment (dosifiers) for the sugar plants, for a total of about US\$ 250,000. UNICEF donated the imported vitamin A fortificant that was used for the testing and adaptation of the fortification technology.

INCAP and USAID/MOST provided technical assistance and training on quality assurance and control (QA/QC) and monitoring systems for fortified sugar that had been developed and tested in neighboring Honduras. Since the late 1990s the MOH Food Control Division had operated a regulatory monitoring system for fortified foods (salt, wheat flour) through periodic inspec-

tions of production plants and retail outlets, to which sugar monitoring was added in 2000. Production of fortified sugar began in November 1999 with the annual sugar harvest of 1999–2000. The balance of unfortified sugar from the previous harvest continued to be marketed until early 2000, when the fortified product began to reach consumers.

By 2004 sugar fortification was a well-established program. By the end of this same year, total sugar production amounted to about 450,000 metric tons per year, of which 60% is exported unfortified, and 40%, or 180,000 metric tons, is fortified for domestic consumption as table sugar or added to commercial products (soft drinks, candies, bakery items, etc.). Estimated domestic per capita supply is 31.7 kg per year, or 87 g per day, of which about 65 g is consumed as table sugar.

### **Information, Education, and Communications (IEC)**

Dietary diversification was contemplated in the NMP as a long-term approach to address VAD primarily through a well-designed information, education, and communications (IEC) strategy. The objective of the strategy was to increase vitamin A intake from natural sources by means of promoting changes in the regular diet of women and children, in addition to encouraging supplement demand and acceptance. A formative research plan was implemented in 1997 to better understand the general population's knowledge, attitudes, and practices regarding feeding and supplementation of infants, children, and pregnant women. The plan also encompassed research on anemia and iron supplementation, and on the feeding practices of pregnant and lactating women and children less than 3 years of age. Methods used were in-depth interviews, focus group discussions, and trials of improved practices with women of childbearing age (pregnant, lactating, and others), fathers, grandparents, health care personnel, and



volunteer community health workers. Technical assistance from USAID/OMNI was provided through the Manoff Group.

Based on the results of formative research, an IEC strategy was developed in 1998 and discussed in a workshop attended by a multidisciplinary group which included public health authorities, academicians, personnel from the Ministry of Social Action,<sup>6</sup> and representatives of external cooperation agencies. The plan encompassed mass media and person-to-person education through the health services. Messages were designed and tested, and communication materials produced, tested, and reproduced for field use. Materials emphasized the importance and sources of vitamin A and iron, and the need for children to take vitamin A and iron supplements and to consume food sources of vitamin A and iron, including fortified foods. A baseline knowledge, attitudes, and practices survey was conducted in 1998 in a nationally representative sample of households, although further assessments have not been made. Unfortunately, the two communication components could not be implemented concomitantly due to budgetary constraints; the mass media campaign was launched early in 1999 by the Ministry of Social Action with funding from the USAID/PL-480 Title II Program, whereas training of health care personnel in the person-to-person education component was gradually carried out and extended throughout 1999 and 2000, with USAID support.

The IEC plan was revised in mid-2000, with the purpose of strengthening its effectiveness in inducing behavioral change. The revised plan provides a more integrated framework and approach to behavioral change communications, identifies specific behaviors to be changed, and takes into account environmental and other factors affecting these behaviors, as well as proposes concrete educational messages and proper means to deliver them, with special attention

to expected behavioral results. It also sets specific objectives for raising awareness and advocacy; the supply, quality, delivery, and utilization of services; and the knowledge, attitudes, and practices of the target population. Finally, it describes the different activities to be implemented in coordination, training, service delivery, community involvement, mass media support, and individual counseling, as well as monitoring and evaluation. Educational messages on vitamin A focus on the importance and benefits of vitamin A; supplements for children and postpartum women; enhancers of vitamin A absorption; supplement distribution through NHCs and routine health services; recording of supplement delivery in the child health card; foods naturally rich in vitamin A (breast milk, yellow squash, mango, papaya, yellow plantain); and recipes for preparation. As of this writing, implementation of the IEC plan has not yet been evaluated.

A mass media informational campaign through radio and television, supported by USAID/MOST and UNICEF, was implemented early in 2000 concomitantly with the launching of sugar fortification. This campaign emphasized the need to increase consumption of natural sources of nutrients in addition to commercially fortified foods, and informed the public that fortification of sugar was now mandatory and universal. The campaign introduced a special cartoon character named *Dulcito* ("little sweet") and emphasized that fortified sugar should be preferred but that excess intake would not be healthy. The importance for the child (and for the mother immediately after delivery) to get high-dose vitamin A supplements was stressed, together with guidance as to where to obtain them and the opportunity provided by the NHCs. No evaluation has yet been made of this campaign.

### Other Public Health Measures

These included interventions that are likely to directly or indirectly improve vita-

<sup>6</sup>This Ministry closed in 2002.

min A and anemia status; e.g., periodic administration of anthelmintic medications for preschool and school-age children (albendazole or mebendazole in single doses of 400 mg and 500 mg, respectively), and parallel actions to address iron deficiency anemia (iron/folate supplementation to pregnant women and children under 5 years, and fortification of wheat flour with iron and B vitamins). Since establishment of the NHCs, distribution of albendazole or mebendazole for children 2–5 years of age and for those attending elementary school has become part of the biannual standard package of services. In the early 1990s the overall prevalence of intestinal parasites in preschool children had reached around 60%. Beginning in 1997 deworming has been restricted to children 24–59 months of age.

## Training

A training plan was prepared for the person-to-person component of the IEC plan. As mentioned earlier, in the late 1990s, special efforts had been made to integrate general nutrition and specific micronutrient contents into the regular undergraduate curriculum of health professionals (medical, nursing, and nutrition schools). This generated a great deal of awareness and interest in micronutrients among new health professionals who are now more motivated and willing to collaborate in the implementation of nutrition programs, provide input to the NMC, and, eventually, increase their involvement in research projects and other field activities.

Beginning in 1999, public health staff (physicians, nutritionists, nurses, and auxiliary nurses), as well as university health professional faculty and students, were comprehensively trained in micronutrients through 50 two-day training workshops in the 17 health (SILAIS) districts. A training curriculum and manual were prepared. Technical guidelines were developed; e.g., on supplementation and on the use of the different communication materials. Training methods

that were used included slide presentations, practical exercises, group dynamics sessions, social dramas, and plenary discussions. Training sessions were systematically evaluated through pre- and post-tests. In 1999–2000, a total of 1,492 health care workers were trained in all aspects of micronutrient deficiency control (vitamin A, iron/anemia, and iodine), with emphasis on supplementation, food fortification, and behavioral change communications; e.g., the use of educational messages and materials. USAID/MOST and UNICEF supported training. Field staff from NGOs and private voluntary organizations were also trained. Additionally, refresher training has been provided yearly to newly graduating physicians enrolled in the one-year program of compulsory social service in rural areas.

## Program Monitoring and Evaluation (M&E)

Monitoring of the supplementation program has been integrated within the existing information system for EPI. Training activities emphasized the need for service delivery personnel to register vitamin A supplementation on the child's health card, which was modified for that purpose, as well as on the forms and tally sheets used for immunizations, which were revised to create a space for vitamin A. The flow of information goes from the local units to the districts and to the central MOH Department of Statistics where it is processed twice per year. The Department prepares a report with supplementation and immunization coverage after each NHC. The report is distributed to the districts and used by the central coordination team as a basis for twice-a-year evaluation workshops.

Critical to the success of the sugar fortification program has been the establishment of an effective QA/QC system by the industry, with periodic sampling and laboratory analysis by the sugar refineries, and a simple but workable monitoring system for fortified

foods by the government. The government monitoring system encompasses two components: regulatory system monitoring and household monitoring (22). Regulatory monitoring involves a system of periodic inspection visits and the collection of sugar samples from production plants and retail commercial outlets for laboratory analysis of retinol. Household monitoring is carried out by means of household visits for collection of sugar samples for retinol content at the point of consumption. The MOH Food Control Unit was granted overall responsibility for government regulatory monitoring of fortified foods (sugar, salt, and wheat flour) at production plants and retail outlets.

INCAP/PAHO and USAID/MOST provided assistance for establishment of the fortification QA/QC and monitoring system. Training on QA/QC procedures, sampling, and laboratory methods was provided to the industry. QA/QC by the industry has proceeded smoothly, since the sugar refineries are relatively well developed and had already maintained their own QA/QC system for other sugar quality standards; thus, the addition of a new test was not a major problem. Although with some financial restrictions (e.g., insufficient budgetary allocations for transportation and other expenses), regulatory monitoring has by and large proceeded as planned; e.g., periodic inspections have been made, and the anticipated number of samples have been collected. Household monitoring has been incorporated as an element of national surveys; e.g., the 2000 national micronutrient survey, the 2002–2003 Integrated Nutrition Intervention Monitoring System (SIVIN). Sustainability of periodic household monitoring, however, has become more dependent upon external resources, and it is foreseeable that this trend will continue at least into the short-term future.

Since the mid-1990s efforts have been made by the MOH, with assistance from external cooperation agencies, to improve and enhance the scope of information on health

and nutrition program indicators, including the incorporation of relevant nutrition data into Demographic and Health Surveys (DHS); e.g., strengthening of the supplementation information system attached to EPI and the collection of specific nutrition data through DHS in 1998 and 2001. With support from USAID/MOST, the Second National Micronutrient Survey (NMS-2000) was conducted with the dual purpose of assessing eventual changes in the prevalence of VAD, iodine deficiency disorders, and anemia since the first survey (NMS-1993) and of providing baseline information for future evaluations of the sugar fortification program. While specific nutrition and micronutrient surveys have been conducted, laboratory assessments of micronutrient deficiencies have not been regularly included in DHS.

In 2001, with technical and financial assistance from USAID/MOST, the U.S. Centers for Disease Control and Prevention (CDC), MI, UNICEF, and INCAP/PAHO, the MOH designed the SIVIN monitoring and surveillance system, which began to be established by mid-2002. SIVIN's ultimate objective is to contribute to improving the health and nutritional status of women and children through the periodic collection, processing, analysis, and use of relevant information on the process and outcomes of nutrition program implementation, as well as on biological indicators of nutritional status. The purpose is to optimize policy and program decision-making for increased effectiveness in reducing nutrient deficiencies.

SIVIN's specific objectives are to collect, analyze, and utilize M&E information on vitamin A and iron/folate supplementation for women and children in order to improve the provision, utilization, and coverage of supplements and enhance program effectiveness. In addition, it seeks to strengthen and integrate the existing system for M&E of universally fortified food staples with micronutrients to assess coverage and quality of the program at the household level, and to collect, analyze, and utilize information to track

trends in the nutritional status of population groups at risk of nutritional deficiencies, with emphasis on micronutrient deficiencies in women and children, in order to evaluate the impact of nutrition interventions.

SIVIN is a centralized, modular, integrated management information system for periodic M&E and decision-making in nutrition programs. Initial emphasis has been given to micronutrient programs (supplementation and food fortification), breastfeeding, and anthropometry indicators. Other nutrition-related programs may be integrated in the future. SIVIN encompasses both program process and outcome monitoring using performance indicators and impact evaluation using biological surveillance indicators. SIVIN relies on three sources of information: service statistics, which consist of data routinely gathered by the local health services (e.g., coverage of nutrition-related services such as vitamin A and iron supplementation); existing nutrition program monitoring systems (e.g., data from existing individual program monitoring systems such as the one for fortified foods); and a national

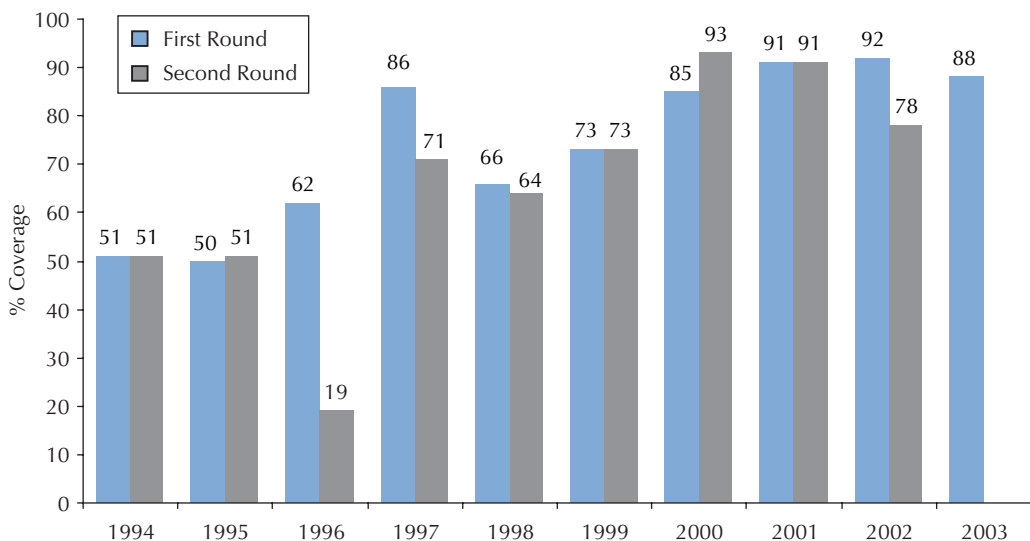
household survey, including the collection of biological specimens (blood, urine) and food samples. The modular system allows for the addition or deletion of specific information modules annually.

## MONITORING AND EVALUATION RESULTS

### Program Performance

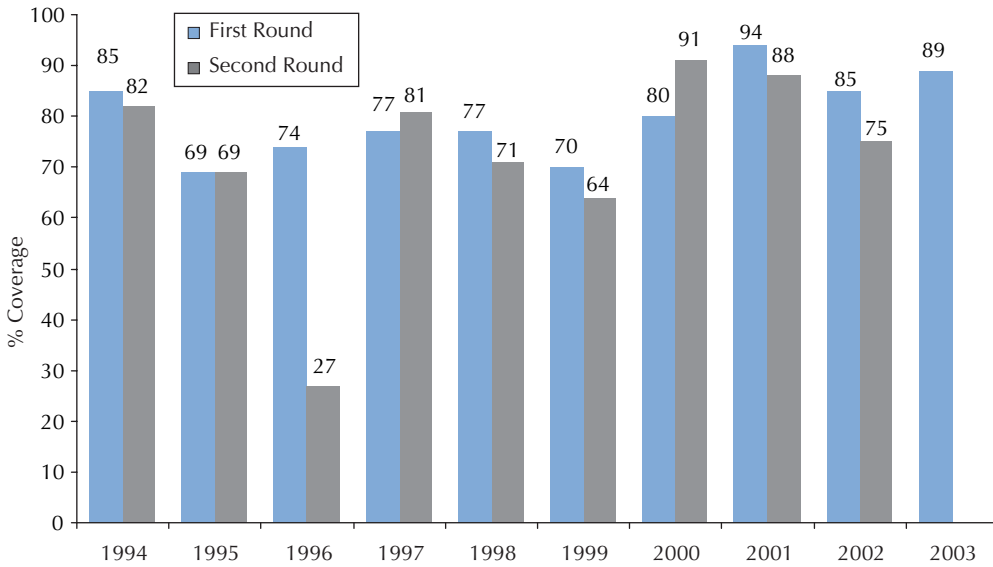
Supplementation coverage rates through NHCs for children from 1994 to 2003, by year and round (first, second), are shown in Figures 2 to 4. Coverage gradually has increased in both rounds since 1994, and levels higher than 70% have been sustained since 1999. Overall coverage of second rounds has been almost as high as that of first rounds (66% versus 74%); this is a remarkable achievement, given that reaching high second-round coverage rates is often a formidable challenge. Coverage of infants 6 to 11 months has been only slightly higher (73%) than that of children 12 to 59 months (70%); this should

**FIGURE 2. Coverage of vitamin A supplementation in children 6–59 months through twice-a-year NCHs, Nicaragua, 1994–2003.**



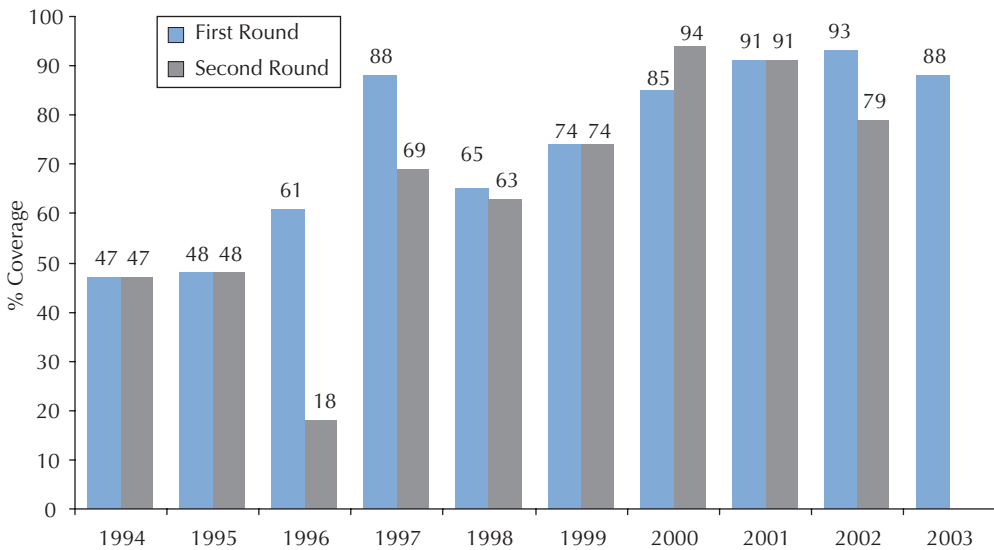
Source: Department of Statistics, Ministry of Health of Nicaragua.

**FIGURE 3. Coverage of vitamin A supplementation in infants 6–11 months through twice-a-year NCHs, Nicaragua, 1994–2003.**



Source: Department of Statistics, Ministry of Health of Nicaragua.

**FIGURE 4. Coverage of vitamin A supplementation in children 12–59 months through twice-a-year NCHs, Nicaragua, 1994–2003.**



Source: Department of Statistics, Ministry of Health of Nicaragua.

also be viewed as an outstanding achievement, since opportunities for health service contact with children commonly decrease with age (unless an NHC approach is used). Population coverage estimates are based on after-census projections; thus, they may be somewhat imprecise due to internal migration after natural disasters (e.g., Hurricane Mitch in 1998). Coverage rates in children by routine distribution through local health services are negligible (< 1%), and postpartum supplementation of women remains very low (12%). In 2001, a cross-sectional assessment of health care services throughout the country revealed that vitamin A supplements were available in 77% of the 1,011 public health facilities and 44% of the 203 private facilities, or a total of 55%.

According to sugar fortification technical guidelines, the addition of vitamin A in production plants is expected to range between 5 and 25 mg/kg of sugar, with an average near 15 mg/kg and at least 90% of the samples above 5 mg/kg. These levels were recommended by INCAP on the basis of expected losses of the vitamin throughout the production and marketing process in order to provide a significant amount to consumers, taking into account customary sugar intake. The monitoring system provides periodic information on the performance of sugar, salt, and wheat flour fortification. Main results for sugar from 2000 to 2003 are shown in Table 1. In 2000, six of the seven sugar plants fortified their product for domestic consumption (sugar for export is not fortified), with all samples containing more than 5 mg/kg and an average of 13.2 mg/kg. The small plant that did not initiate fortification in 2000 was under severe financial trouble (it exited the market in 2001), and a second small plant closed operations in 2002; thus, there are now five sugar refineries. At retail stores nearly one-fifth of the samples were unfortified, and 62% had > 5 mg/kg, for a mean of 7.3 mg/kg; however, these figures were not obtained from a representative sample of retail outlets.

**TABLE 1. MOH monitoring of sugar fortification, Nicaragua, 2000–2003.<sup>a</sup>**

|                          | 2000 | 2001 | 2002      | 2003 |
|--------------------------|------|------|-----------|------|
| <b>Production plants</b> |      |      |           |      |
| ≥3.5 mg/kg               | 100  | 100  | 96        | 100  |
| >5 mg/kg                 | 100  | 95   | 93        | 88   |
| Mean (mg/kg)             | 13.2 | 13.5 | 10.3      | 12.3 |
| <b>Retail stores</b>     |      |      |           |      |
| ≥3.5 mg/kg               | NA   | 70   | 72        | 97   |
| >5 mg/kg                 | 62   | 51   | 58        | 74   |
| Mean (mg/kg)             | 7.3  | 6.3  | 6.7       | 8.7  |
| <b>Households</b>        |      |      |           |      |
|                          |      |      | 2002–2003 |      |
| ≥3.5 mg/kg               | 73   | 90   | 69        |      |
| >5 mg/kg                 | 55   | 10   | 54        |      |
| Mean (mg/kg)             | 5.4  | 3.1  | 5.2       |      |

<sup>a</sup>Percent of sugar samples.

After discounting losses from the plants to the consumer, the mean vitamin content of sugar at the households was initially expected to reach at least 5 µgRE/gram; more recently, taking into account stability and “normal” losses of the vitamin under existing environmental conditions, a minimum of 3.5 µgRE/gram has been considered acceptable, as it would still meet a significant proportion of the intake gap. In Nicaragua, sugar production (concurrent with the sugarcane harvest) encompasses about 6 months of the year (November to April), and the interval between production and consumption in the non-harvest period may be as long as 6 months. In 2000, about 73% of the samples from households contained ≥ 3.5 µgRE/g, and the mean content reached 5.4 µgRE/g. With an average consumption of 65 g per person/day, table sugar provided an estimated 351 µgRE, thus meeting around 85% of the estimated average requirement.

Sugar fortification weakened in 2001. Despite samples from plants containing a mean of 13.5 mg/kg, only 51% of those from retail stores contained > 5 mg/kg, with an average of 6.3 mg/kg, and nearly 90% of the ones from households showed < 5 mg/kg (the average dropped to 3.1 mg/kg). This was apparently the result of the temporary use of a less stable vitamin A fortification compound.



In 2002 and 2003, 93% and 88% of the samples from plants, as well as 58% and 74% of those from retail outlets, contained  $\geq 5$  mg/kg, with an average content of 10.3 and 12.3 mg/kg in the factories, and 6.7 and 8.7 mg/kg at retail stores. In the same period, 54% of the samples from households contained at least 5 mg/kg, with a mean of 5.2 mg/kg.

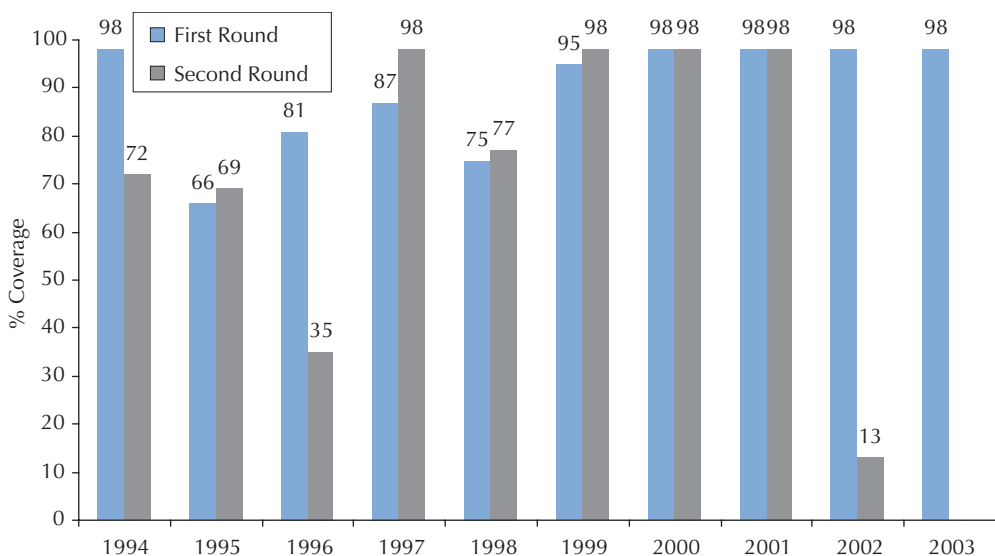
In 2002–2003 table sugar provided about 338  $\mu\text{gRE}$  per person/day. A mean level of vitamin A of 12.3 mg/kg at production plants resulted in an average of 5.2 mg/kg at the household (consumer) level, or about 42% of the original addition level. Sugar producers are currently shifting from 50 kg packing, which is repacked in retail stores with potential vitamin A degradation, to smaller sizes directly for consumers; e.g., 400 g and 2 kg. The goal is that in three years, only small labeled packages (1-lb. to 2-kg) would be available in the market. This is expected to improve vitamin A stability. Current consumer price is about nine *córdobas* (US\$ 0.55) per kg of table sugar.

Population coverage for periodic (twice-a-year) distribution of anthelmintic medications to children 2–4 years of age remained consistently high throughout the 1994–2003 period (Figure 5), with no significant differences per round. The coverage of anthelmintic medication in children ages 2–4 through NHCs averaged 81% (89% in the first and 73% in the second rounds). Coverage rates were particularly high (95% or above) throughout the second half of the period. As is the case with supplementation, estimated population coverage for deworming may be somewhat imprecise due to differences between 1995 census-based projections and the actual population as a result of internal migration.

### Program Impact

The impact of the VAD control program may be estimated on the basis of trends of VAD prevalence over time, provided that other plausible explanations for eventual changes in prevalence are taken into account.

**FIGURE 5. Coverage of anthelmintic medications in children 2–4 years, Nicaragua, 1994–2003.**





Although attribution may be more difficult, trends in infant and child mortality may provide indirect additional evidence of program impact. National household surveys may be used to evaluate the impact of VAD control programs on biological indicators (23). Impact would be expected on the levels of plasma retinol in children under 5 years of age.

The NMS-2000 carried out prior to the first NHC of 2000 revealed a dramatic reduction in the prevalence of VAD (plasma retinol < 20 µg/dL) in children 12 to 59 months of age from 31.1% in 1993 to 8.6% in 2000, and a significant increase in mean plasma retinol from 23.8 to 31.7 µg/dL (24). Severe VAD (plasma retinol < 10 µg/dL) dropped from 7.9% to 0.2%. Thus, program impact on VAD in children was first achieved in 2000, just before initiation of sugar fortification. Given the absence of other specific interventions between 1993 and 2000, the significant reduction of VAD was mainly attributed to the cumulative effect of periodic high-dose vitamin A supplementation with consistently high coverage. VAD in women was not found to

be a problem of public health significance (10% national prevalence).

According to conventional knowledge, most of the effect of a large dose of vitamin A on children is expected to vanish after 3 to 4 months (25); however, studies on the long-term cumulative impact of repeated supplementation rounds had not been reported in the literature. In Nicaragua, consistently high population coverage rates maintained over the six-year period preceding the survey may have gradually increased retinol liver stores and plasma levels over time. An alternative partial explanation would be a defined contribution of the modest to moderate improvement observed in some social and economic indicators as shown in Table 2. High-coverage deworming of children 24–59 months may have also contributed to improve vitamin A status; an MOH study in 1996 found that the overall prevalence of intestinal parasites had declined from 60% to 30% and that no severe infestations were found.

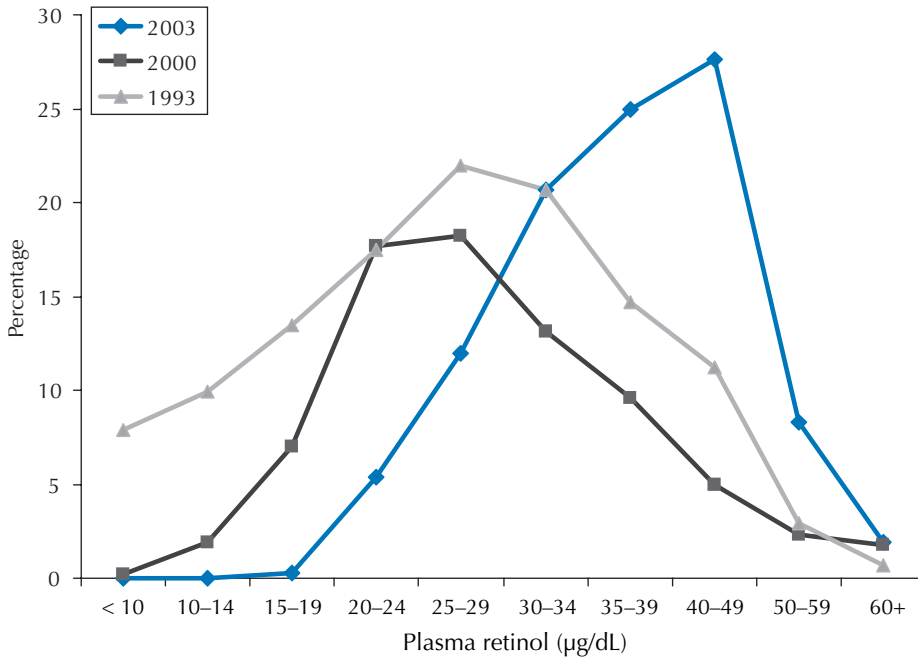
The most recent VAD assessment in children, conducted in 2002–2003 as part of SIVIN, shows that the plasma retinol distri-

**TABLE 2. Changes in selected social and economic indicators, Nicaragua, 1993 and 2001.**

| Indicator   | 1993             | 2001             |
|---|------------------|------------------|
| % households with access to piped water (urban/rural)         | 54 (76/21)       | 77 (91/59)       |
| % households with access to sanitary facilities (urban/rural) | 27 (30/16)       | 85 (95/72)       |
| % households in poverty (urban/rural)                         | 50.3 (31.9/76.1) | 45.8 (30.1/67.8) |
| % households in extreme poverty (urban/rural)                 | 19.4 (7.3/36.3)  | 15.1 (6.2/27.4)  |
| % ORT use   | 40               | 82               |
| % primary school enrollment (male/female)                     | 76 (74/77)       | 80 (79/80)       |
| % children enrolled completing primary school                 | 29               | 55               |
| % secondary school enrollment (male/female)                   | 38 (31/44)       | 60 (55/65)       |
| Gross population growth/1,000 population                      | 2.9              | 2.8              |
| Crude birth rate/1,000 population                             | 41               | 33               |
| Life expectancy at birth (years)                              | 66               | 69               |
| Global fertility rate per woman                               | 5.1              | 3.2              |
| GNP % growth previous 10 years                                | -4.4             | -0.1             |
| % inflation rate  | 584              | 45               |
| % government expenditures in:                                 |                  |                  |
| Health  | 11               | 13               |
| Education   | 9                | 15               |
| Defense   | 50               | 6                |
| Duration of exclusive breast-feeding (months)                 | 0.6              | 2.5              |
| % deliveries assisted by trained personnel                    | 73               | 90               |

**Sources:** 1993: UNICEF. *The State of the World's Children*; 1996.

2001: Encuesta Nicaragüense de Demografía y Salud (ENDESA); 2001.

**FIGURE 6. Plasma retinol distribution in children 12–59 months, Nicaragua, 1993, 2000, and 2003.**

bution has dramatically moved up to become perfectly normal, with 0.3% of the values < 20 µg/dL and an overall mean of  $36.8 \pm 5.5$  µg/dL, indicating that subclinical VAD in children and, presumably, in other groups of the population, is virtually under control (26). The prevalence of infection as indicated by high levels of  $\alpha$ -acid-glycoprotein (AGP) remained around 20% between 2000 and 2003, and an inverse relationship was observed between AGP and plasma retinol levels; however, the impact of infection was apparently not large enough to bring plasma retinol to deficient levels.

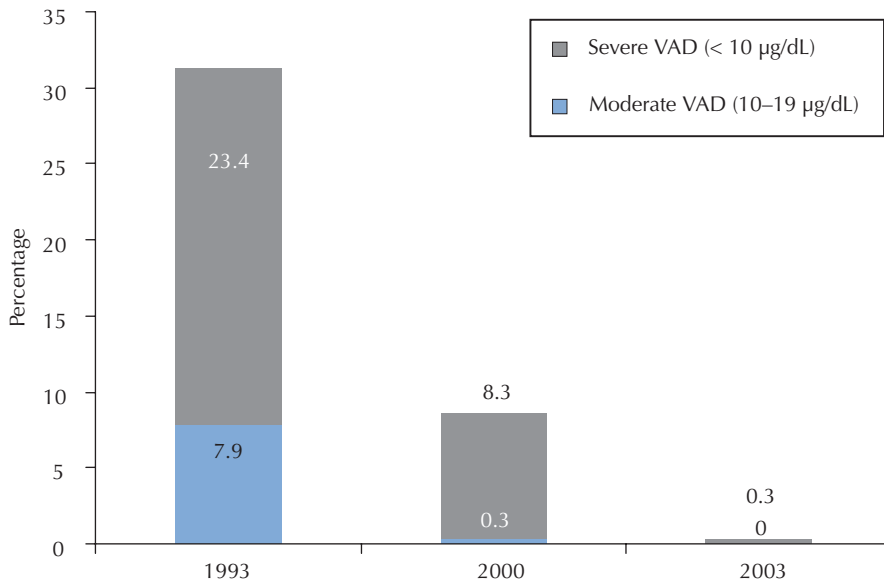
Changes in the distribution of plasma retinol in children from 1993 to 2003 are shown in Figure 6 and trends in VAD prevalence in Figure 7. The change observed between 1993 and 2000 could be attributed mainly to supplementation, whereas the dramatic acceleration from 2000 to 2003 is most likely to be largely the result of the combined effect of supplementation and sugar fortification, complemented by other measures (de-

worming, behavior change communications) and modest social and economic improvements. During the 1993–2003 period, the supplementation program regularly maintained high coverage rates twice a year and, since 2000, sugar fortification has been implemented with good quality and coverage (sugar is consumed by 99.3% of the country's families). A plausible indirect mechanism by which sugar fortification may have further contributed to improved vitamin A status in children is through increased retinol content of breast milk. This has been documented in a number of studies and would appear to hold true in Nicaragua, where post-fortification breast milk retinol in four rural communities reached nearly normal levels (67 µgRE/dL) despite the low coverage of postpartum supplementation.<sup>7</sup>

By 2003, in addition to a daily intake of about 329 µgRE from vitamin A supplements (two doses of 200,000 international units per

<sup>7</sup>Noel W. Solomons, personal communication.

**FIGURE 7. VAD prevalence (plasma retinol < 20 µg/dL) in children 12–59 months, Nicaragua, 1993, 2000, and 2003.\***



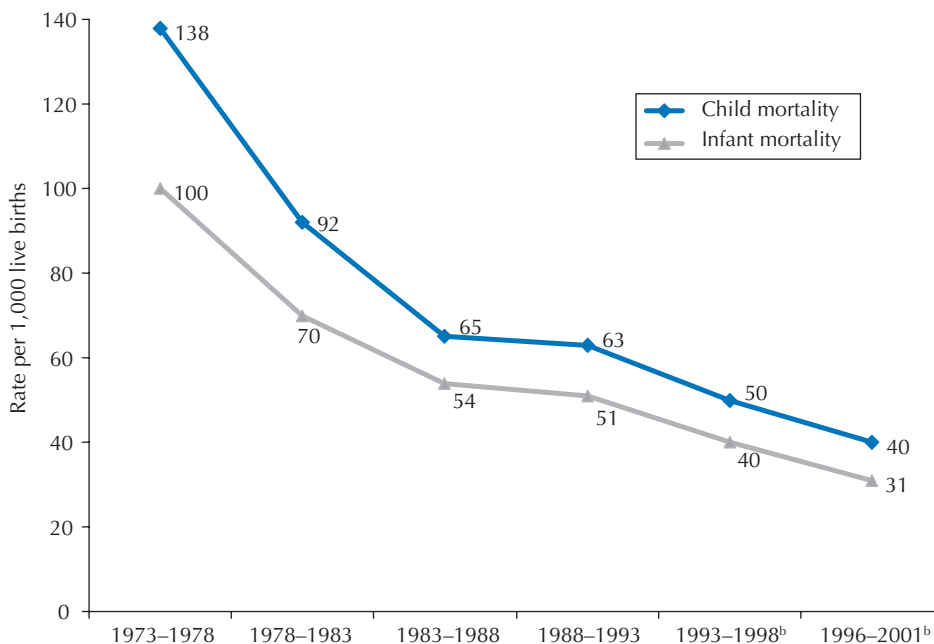
\*Excluding the Atlantic Region.

year), preschool children consuming 20 g of sugar per day would ingest about 104 additional µgRE from fortified table sugar (plus additional amounts of vitamin A from sugar-based commercially processed products) for a total intake above 433 µgRE/day, which would meet nutrient needs even taking into account the increased needs associated with common infectious morbidity. Additional supporting evidence for a significant impact of sugar fortification on vitamin A status is provided by a pre-post fortification study conducted by the University of Nicaragua in 2000–2001 in a group of 21 school-aged children from four rural Nicaraguan communities, which found twice as much vitamin A body stores (estimated by the deuterated-retinol-dilution technique) and liver vitamin A concentration, as well as a significant (19%) increase in plasma retinol levels after fortification.<sup>8</sup> Non-program factors associated with a moderate improvement in social and economic indicators, such as GNP

growth, inflation, health care coverage, exclusive breast-feeding, sanitary conditions, fertility, and poverty reduction (Table 2), may have also played a complementary role in reducing VAD.

Based on the results of experimental studies (10), a reduction in infant and/or child mortality would be expected as the result of the biological impact of supplementation, particularly in countries with serious VAD and high levels of child mortality. Interpretation of changes in infant/child mortality rates estimated from national surveys is complicated by methodological problems and by the many interrelated factors that may influence child mortality. Attribution of mortality trends to specific factors is particularly difficult in developing countries with a secular trend towards consistent decline in mortality rates, as is the case in Nicaragua. Estimated infant and child mortality rates by five-year periods from 1973 to 2001 are shown in Figure 8. Both infant and child mortality rates consistently declined by about 70% over the past three decades. The

<sup>8</sup>Noel W. Solomons, personal communication.

**FIGURE 8. Trends in infant and child mortality by five-year periods, Nicaragua, 1974–1998.<sup>a</sup>**

<sup>a</sup>Estimated from Demographic and Health Surveys.

<sup>b</sup>The last two DHS surveys were carried out in 1998 and 2001; i.e., a 3-year versus 5-year interval.

initially high speed of decline slowed down between 1983–1988 and 1988–1993, but resumed to higher drop rates in 1993–1998 and 1996–2001. Interestingly, this acceleration in the previously declining rate of mortality reduction coincides with the implementation of vitamin A supplementation and, although there might be other possible explanations, a contribution through vitamin A supplementation may be plausible.

### Program Costs

Unfortunately, information on program costs is far from complete. Policy and program development and implementation have been funded from the MOH's own budgetary resources as well as through external donors; e.g., supplement donations, technical cooperation, and program funds provided by international cooperating agencies. This group includes USAID—by far the largest source of

financial support through USAID/Nicaragua field support and MOST core funding—as well as MI, and, to a lesser extent, UNICEF, INCAP/PAHO, and the World Bank. The cost of household monitoring of fortified foods has been until now fully covered by external donors (MI, MOST, CDC).

During the 1998–2003 period, USAID field support to micronutrient programs in Nicaragua amounted to US\$ 1,149,000 (not including support to SIVIN), of which US\$ 468,700 covered technical cooperation and US\$ 680,300 direct support for program implementation. Approximately US\$ 300,000 was utilized to support the 2000 National Micronutrient Survey. USAID field support was provided to assist overall NMP implementation, of which VAD control was only one program component. For NMP implementation, VAD and anemia control were prioritized, and VAD control enjoyed the highest priority up until 2000, when it was

no longer considered to be a significant problem; since then, anemia control has been assigned the highest priority. Therefore, a reasonable assumption would be that about 50% of USAID/MOST field support assistance in the 1998–2003 period (about US\$ 575,000 or US\$ 115,000 per year) was targeted to the VAD control program, of which about US\$ 235,000 would have gone to technical cooperation and US\$ 340,000 to program implementation.

From 1994 to 1997, most vitamin A supplements were procured and funded by the MOH using regular budgetary allocations. Cost per dose ranged between US\$ 0.015 and US\$ 0.020. The average number of doses distributed to children 6–59 months was about 350,000 per round from 1994 to 1997 and around 450,000 per round since 1998. The total cost per year of the supplement amounted to approximately US\$ 14,000 up until 1997 and US\$ 18,000 since 1997. At the MOH estimated annual cost of US\$ 1.02 per child dosed (two rounds per year), including both supply and delivery costs, the total annual cost of the supplementation program for preschool children would have ranged between US\$ 714,000 and US\$ 918,000.

The cost of fortifying 180,000 metric tons of sugar for domestic consumption amounts to about US\$ 1,500,000 (procurement of vitamin A, amortization of initial capital investment, QA/QC, and government monitoring), or US\$ 8.33 per metric ton, most of which would be expected to be transferred to the consumer. The estimated cost of government monitoring is about US\$ 20,000 per year. Based on current consumption figures, the cost of sugar fortification for the consumer is about US\$ 0.26 per person/year, or about 1.5% of consumer annual expenditure in sugar (US\$ 17.46 per person/year).

## DISCUSSION AND CONCLUSIONS

VAD in children, and presumably in other groups at risk, has been virtually controlled in Nicaragua during the 10-year period of

1994–2003. This is largely the result of the Nicaraguan Government's commitment to control VAD, in collaboration with the private sector (NGOs, food industry) and external cooperating agencies, through an effective integrated strategy and policy and program interventions that are primarily aimed at improving vitamin A intake by the population at risk. Table 3 shows a chronology of VAD-related events in the 40-year period of 1965 to 2004. Successful programs accounting for virtual control of VAD have occurred over the last 10 years. As has been often the case in developing countries, initiation of micronutrient actions, including VAD control programs, was largely donor-driven; international agencies have played a major role in information dissemination, advocacy, and the raising of public awareness and have provided start-up and some ongoing funding. However, with strong political commitment, MOH institutional ownership and capacity have strengthened over time. Although external technical and some financial support for program implementation continues, VAD programs are currently self-sustaining to a large extent, despite the fact that a follow-up NMP after 2000 has not been formally developed by the MOH.

Increased vitamin A intake to meet the existing gap was achieved by a combination of pharmaceutical supplementation and fortification of sugar, complemented by IEC and periodic deworming of preschool children. Rather than concurrently launching the full set of program activities, a sequence of interventions was progressively implemented as time and resources permitted. Plasma retinol significantly increased in response to twice-a-year high-dose supplementation and deworming during the six-year period from 1994 to 2000, and subsequently reached normal levels after a combination of continued supplementation, deworming, and IEC activities, and the addition of sugar fortification since 2000.

Nicaragua appears to be the first VAD country reaching and documenting the

**TABLE 3. Chronology of VAD control-related events in Nicaragua, 1965–2005.**

| Year      | Assessment, monitoring, and evaluation                                    | Policy and program development   | Supplementation   | Fortification   | Other interventions   |
|-----------|---|--|---|---|---|
| 1965      | National Nutrition Survey: VAD significant problem.                       |  |   |   |   |
| 1965–1992 | No action.  |  |   |   |   |
| 1993      | Micronutrient survey: sub-clinical VAD in children a significant problem. | National Micronutrient Commission established.                                 |   |   |   |
| 1994      |   | Survey report released. Two-year plan launched. Intense consciousness-raising. | Policy and guidelines established. NHCs supplementation initiated.  | Negotiations with sugar industry initiated.   | Deworming integrated in NHCs.   |
| 1995      |   | National Micronutrient Plan prepared and approved.                             | Supplements included in official list of essential medicines.   | Technical and economic feasibility of sugar fortification assessed.   | Training of health personnel in micronutrients initiated.   |
| 1996      |   | NMP formally launched.   |   |   | Technical documents for health staff delivered.   |
| 1997      |   |  | Supplement donations started.   | Technical and economic feasibility of oil fortification assessed.   | IEC formative research conducted and reported.  |
| 1998      | USAID assessment and portfolio review of micronutrient programs.          |  |   | Inter-ministerial accord on sugar fortification. Plan prepared. Legislation passed.   | IEC plan formulated; messages and materials designed, tested, reproduced. BCC baseline conducted. |
| 1999      | Evaluation of vitamin A supplementation and polio coverage in children.   | National technical regulations on fortified sugar approved.                    | Supplementation registered in child health/immunization and women's health cards and tally sheets. Postpartum supplementation with BCG initiated. Supplements targeted to children 6–59 months. | Sugar fortification plan implemented, regulations issued, premix plant built, mixing equipment procured, financial assistance secured, MI donation granted, fortificant imported. | IEC mass media component implemented. Anthelmintic medications targeted to children 24–59 months. |



|      |  |  |  |
|------|--|--|--|
| 2000 | <p>Micronutrient Survey: VAD no longer a significant problem in children. VAD in women a mild problem. Monitoring of fortified sugar established. Pre-post sugar fortification plasma and breast milk retinol study.</p> | <p>Sugar fortification launched together with informational campaign. Monitoring system established.</p> | <p>IEC plan revised, training completed in 11 of 17 districts.</p> |
| 2001 | <p>NMS-2000 results discussed in technical group meeting. SIVIN designed.</p>  |  | <p>Training completed.</p>   |
| 2002 | <p>NMS-2000 report released. SIVIN field test and training completed. SIVIN formally launched.</p>   |  |  |
| 2003 | <p>SIVIN first year completed, data analyzed. VAD virtually under control.</p>   |  |  |
| 2004 | <p>SIVIN first-year report released. VAD under control.</p>  |  |  |
| 2005 | <p>SIVIN second-year report released. VAD under control.</p>   |  |  |

virtual control of VAD as a result of concrete actions to address it. The evidence clearly demonstrates that VAD can be controlled through a combination of sequentially implemented program interventions. The question remains as to whether supplementation alone at the high coverage rates achieved in the past 10 years might have been enough by itself to control VAD. A study conducted in Guatemala in the mid-1990s reported sugar fortification being significantly more cost-effective than either supplementation or dietary diversification through home gardening (27); however, rather than ranking the cost-effectiveness of individual interventions, the practical issue remains that of selecting the best combination of interventions that are feasible and potentially effective in a given setting.

The Nicaraguan Government adopted a sequence of interventions, beginning with immediate supplementation and deworming as short-term emergency measures, to be complemented and eventually substituted by staple fortification and IEC as a presumably more sustainable approach in the long-term. Negotiations aimed at fortification proved to be time-consuming, thus making supplementation necessary in the first place; however, once established, fortification has been shown to be highly sustainable in the current political, marketing, and trade context of Nicaragua. The VAD control intervention mix as adopted, properly planned, and implemented, was effective in producing the anticipated impact.

Nicaragua provides an outstanding example of the successive, periodic, active, institutionalized, and integrated distribution of vitamin A supplements to children, with high coverage maintained over a 10-year period. Integrating supplementation as part of a package of basic health services to be delivered twice a year through National Health Campaigns (Weeks or Days) has also been shown elsewhere to be a viable, affordable, and effective tool for achieving consistently high coverage rates (28). Program ownership

is reflected in systematic district level planning and implementation. NHCs would appear to be more readily accepted and endorsed by health authorities than isolated vertical campaigns for vitamin A distribution alone. As national immunization days are scaled down or phased out in many countries, NHCs offer an effective alternative strategy to sustain the delivery of vitamin A to young children at the coverage rates needed to realize its full potential to reduce VAD. Twice-a-year delivery of vitamin A supplements through synchronized NHCs distribution has yielded excellent results in Nicaragua.

Additional supplementation coverage through routine health services has remained negligible for children and very low for postpartum women. Although, in principle, integration of supplementation within regular health services is a desirable goal, this strategy alone has not yet proven itself to be effective in reaching high coverage rates. Health facility attendance for preventive services and contact opportunities tend to drastically decline after the 1st year of age, making it difficult to achieve adequate coverage of preschool children. The NHCs have been the most suitable vehicle for periodic high-coverage supplement distribution and other preventive actions such as immunizations. Whether or not twice-a-year NHCs continue in Nicaragua will be to a large extent contingent upon the government's sustained commitment and resource availability; the possibilities for this, however, remain high. Maintaining two rounds per year would be critical for other health and nutrition interventions as well, particularly for immunizations, deworming, and iron supplementation to young children. Given the strong long-term commitment of both the government and the industry to sugar fortification, supplementation may now be targeted to the youngest children who are not likely to get sufficient vitamin A from fortified sugar, although quantitative information on children's sugar intake is not available.

Development of a public-private sector partnership for fortification was made possible by an unprecedented degree of both government and industry commitment. Negotiations were consistently conducted with an open-minded attitude in a cooperative, nonconfrontational environment. Careful planning and implementation of the program were essential once agreements were reached. The government's firm commitment to meet its responsibilities is exemplified by its rapid response in assisting the industry with initial financial support and in the timely provision of legislation and regulations. Joint formulation of a preparatory work plan with concrete deadlines for securing launching of fortification proved to be critical, and both industry and the government honored their pledges. The industry built the premix preparation plant by the specified deadline, and the government provided proper training to industry personnel in a timely fashion.

The NCSP strongly advocated for universal mandatory fortification as a means to prevent eventual unfair competition from producers of unfortified imported sugar. Favorable conditions for sugar fortification currently exist in Central America, including Nicaragua, since the local sugar industry is protected by legislation imposing heavy duties on imported sugar, thus making imports unattractive despite the international price of sugar being significantly lower than the domestic price. To some extent, the NCSP's positive attitude towards fortification may be accounted for by the fact that universal mandatory fortification would provide an important health support basis for maintaining the status quo.

Attempts to remove import tariffs on sugar have threatened sustainability of sugar fortification in other Central American countries (29). Similar threats in Nicaragua, when the fortification program was in its early stages, generated a concerted effort by the central government, external cooperation agencies, and other groups against the leg-

islative proposal, which was eventually defeated. Throughout the first four years of sugar fortification, a few difficulties have arisen that have been associated with the government's capacity to monitor and enforce legislation. As an example, the government failed to enforce the law in 2000 when a small sugar refinery dropped out of the NCSP and did not abide by the fortification legislation. The problem eventually came to an end when the noncompliant refinery went out of business.

Deworming and, despite its relatively late implementation, IEC, may have contributed to improve vitamin A intake and nutrition status. Unfortunately, neither of these has been properly evaluated for impact in reducing parasite infestation of preschool children and in changing specific behaviors. An important constraint identified in the 2000 IEC revision was insufficient attention being paid to enhancing the communication skills of health care personnel and *brigadistas*; however, this has not subsequently been fully addressed because of other competing priorities.

Although the virtual control of VAD may allow for retargeting of some intervention programs (e.g., supplementation), Nicaragua cannot afford to let VAD accomplishments languish. The most critical current challenge in VAD prevention and control for the Nicaraguan Government is to secure the long-term political, institutional, and financial sustainability of VAD policies, programs, and achievements. This will require maintaining the same high level of political commitment that has existed since 1994. Central MOH authorities and international cooperation agencies will need to make a concerted effort to preserve the currently high level of political will and priority assigned to micronutrients in general and to vitamin A in particular. Contrary to diseases preventable by immunizations, nutrient deficiencies such as VAD can be virtually controlled but not permanently eradicated by public health interventions. Continued advocacy, promotion of social sustainability through increased

population awareness, social mobilization, and demand for services (NHCs, supplements, anthelmintic medications, and fortified foods), as well as continued IEC activities are needed. Equally important would be to maintain integration of VAD and other micronutrient programs.

Potential threats to program sustainability may result from constraints leading to suspension or reduction in the frequency of NHCs, pressure to remove existing trade legislation that protects the sugar industry, and/or insufficient resources assigned to health and nutrition programs in the absence of donor-based funding. Eventual financial constraints are likely to affect the continuity of NHCs, procurement of critical supplies (e.g., supplements), and staff travel related to program implementation, supervision, and monitoring. In the absence of significant additional vitamin A intake from supplements and fortified foods, VAD is likely to resume.

## LESSONS LEARNED

Nearly three decades passed without action after the initial identification of VAD as a problem of public health significance. Then several additional years elapsed following the emergence of convincing evidence on the important role of vitamin A in child survival before concrete policy and program actions were initiated in Nicaragua to address the problem. After such evidence became available and was disseminated, and international advocacy had been fostered, there was a need for an updated assessment and special consciousness-raising efforts to generate a commitment on the government's part to act. Significant impact on VAD was initially documented after six years of large-scale high-coverage supplementation and deworming (with no VAD assessments in the interim), and virtual control was achieved after three additional years of a combination of supplementation, deworming, fortification, and IEC. The case of Nicaragua exemplifies the

variety and scope of difficulties normally encountered in the long and complex road leading from science to public health programs (30) and to achieving concrete results as measured by biological indicators.

In addition to unprecedented motivation, commitment, technical skills, and clear objectives, persistence and patience are also needed by program advocates, planners, and implementers to ensure that all the contributing human and financial resources remain well meshed throughout the cumbersome and oftentimes frustrating process leading to final success in achieving public health goals in developing country contexts. A major lesson learned from Nicaragua is that sustained impact is best achieved through a conjunction of multiple interventions undertaken sequentially, rather than a single bullet approach. Several key elements appear to be associated with the performance and effectiveness of the Nicaragua VAD control programs, and a number of lessons have been learned in this regard throughout the policy development and program planning and implementation process. Many of these lessons might seem obvious, and others less so, yet they are all drawn from a decade of planned and persistent efforts, occasional failures, and continuous achievements.

**(1) Proper problem identification is critical, but not sufficient, to foster action.** Updated national or subnational information characterizing the VAD problem is critical for consciousness-raising, advocacy efforts, policy and program development, planning, and evaluation. At a minimum, data should be made available on the magnitude of the problem (clinical and/or bio-clinical indicators, vitamin A intake) and on the institutional, technical, and financial resources available, or likely to be available, to address it. Such information is best collected through national or subnational surveys covering representative samples of households, utilizing a large enough sample size to break down the results by major geographic

and/or other strata. In Nicaragua, probably because of its relatively small size, no significant differences were found by health district or even geographic area (except for the northern coastal, underpopulated Atlantic Region). Biochemical indicators are useful, particularly when clinical VAD is not obvious. Sophisticated and costly research may not be needed, but commonly available proxy indicators, such as child mortality, may not allow a proper definition of the problem for advocacy and planning purposes. When resources are limited, food supply data may be sufficient to enable the identification of potential vehicles for fortification without having to resort to costly dietary intake surveys that are not generally feasible in developing countries.

**(2) Effective consciousness-raising of decision-makers and the general population should not be bypassed.** Identification of the problem is not enough, as has been shown to be the case in Nicaragua during the 1960s. After the 1993 survey, aggressive information dissemination and consciousness-raising efforts were critical for generating awareness of vitamin A deficiency as a priority public health problem. Within this context, the availability of statistically valid information on the magnitude and distribution of the problem was of enormous value. In Nicaragua, the research community, academicians, and public health authorities had known about the existence of VAD as a significant problem since the 1960s. Yet no action was initiated until an updated assessment was made, the problem was characterized, and intensive consciousness-raising and advocacy efforts targeted to decision-makers and stakeholders generated a strong commitment to act. Since infant and child mortality rates were not very high (40–60 per 1,000 live births) compared to other developing countries and a clear ongoing downward trend had been documented, advocacy efforts placed more emphasis on the potential impact of VAD control on the severity and duration of highly frequent infectious

morbidity than on child mortality. The mortality argument is less compelling in countries with low and/or rapidly declining child mortality rates.

**(3) Strong continued political commitment is a prerequisite for program success.** Strong motivation and political commitment were secured by advancing social (health, nutrition) and economic arguments and by proposing solutions that were politically feasible and for which institutional resources were, or could be, made available. Opinion leaders, academicians, prestigious technical professionals, and the media played a critical role. Once the need for action was fully recognized by opinion leaders and the general population, decision-makers had a strong motivation to act. On the other hand, the government's political commitment was expressed in policy and budgetary decisions. In Nicaragua, as elsewhere in the world, good intentions alone clearly would not have been sufficient to respond to the problem at hand, and symbolic political commitment not reflected in actual policy and budgetary decisions would have been, indeed, irrelevant. The decision about vitamin A supplementation as an emergency measure was made by the country's highly committed Minister of Health herself, and it was accompanied by budgetary allocations for procurement of supplements and for at least partial financing of the NHCs' implementation, followed by technical guidelines for implementation that were disseminated and used for training.

**(4) Effective public-private sector partnerships with industry and NGOs pave the road toward implementation.** Public-private partnerships are needed for both fostering fortification (government, food industry) and for securing high coverage of supplementation (government, NGOs). In Nicaragua, developing a government-industry partnership for fortification required careful planning and involved a lengthy and at times frustrating process that was affected

less by technical constraints than by political, economic, and market issues. A great deal of patience was required, as well as a genuine mutual understanding of the interests and limitations of the other partners, a consensus-building and fair-play attitude, and a strong motivation to overcome any longstanding issues of mistrust. The external cooperating agencies played a valuable brokerage role which enabled them to serve as facilitators of the partnership-building process.

**(5) Integration of vitamin A control into ongoing public health and nutrition activities is highly desirable.** The Nicaragua experience clearly demonstrated that integrated programs are likely to be more attractive to health sector policymakers and more effective and sustainable over time than isolated vertical interventions. Integrated programs take advantage of common operational processes and service delivery mechanisms and channels, and encourage staff-sharing of common goals. In Nicaragua, integration was facilitated by a long tradition of community-based health care services. The VAD control effort took advantage of the unique opportunity for integration of vitamin A supplementation offered by the already-established and highly successful immunization program using a campaign approach, which was not restricted to once-a-year polio vaccines as in the case of the NIDs. Integration, or at the least, close coordination, has been maintained not only within specific VAD control interventions but also with other micronutrient programs (e.g., anemia control) and, more widely, within mainstream primary health care and nutrition services. Donor-driven supplementation programs may tend to be single and vertical, probably as a result of donor eagerness to show short-term effects; hopefully, in such a case, the scope of services may be gradually expanded by integrating other preventive services.

**(6) Training and retraining of health service personnel and community health vol-**

**unteers are essential to program viability.** Well-trained, motivated, and adequately supervised staff who have the necessary knowledge and skills are key to effective program implementation. Training has been a prominent feature in the Nicaraguan micronutrient control program. Initially, when vitamin A supplementation was integrated into the NHCs, a rapid training plan was carried out to focus on the new intervention. Later on, a substantial amount of technical and financial resources, including funding from USAID/MOST and other donors, was assigned to enable more comprehensive training; in 1999–2000 about 1,500 MOH and NGO health care personnel, in addition to community health volunteers, were trained in micronutrients. Since then, refresher training has been systematically included in supervisory activities.

**(7) Program ownership by health districts and local units provides a solid foundation for institutional sustainability.** In the initial consciousness-raising phase, participation of the health district staff in information dissemination and program planning workshops and ensuing information-sharing by district staff with local units established the foundation for ownership of the overall program and of specific activities. Program ownership is reflected through regular participation by the districts in planning and evaluation; e.g., of the NHCs, in which vitamin A supplementation is profiled as a key intervention, and in the monitoring of fortified foods. Evaluation meetings with SILAIS are scheduled twice a year for discussion of the NHCs' performance, including supplementation coverage, and once a year to discuss annual reports of fortified foods monitoring. District program ownership leads to healthy competition among the districts regarding supplementation coverage and encourages district authorities to make timely provisions to improve program performance.

**(8) Skilled program management and the timing of supply deliveries are critical, par-**



**ticularly for supplementation.** NHCs are managed by the districts with great motivation and skill, as is the monitoring of sugar fortification at production plants in the districts where these are located. Organizing the NHCs twice a year is a time-consuming process that requires skilled management and effective coordination of the different partners involved (health services, NGOs, community health volunteers, and other community groups). Planning and coordination are the responsibility of both the central- and district-level technical coordination committees. Effective social mobilization is achieved through a concerted effort led by the districts with significant communications support from the central level. The biannual campaign nature of the supplementation program makes it possible to secure supplies by submitting timely requests for vitamin A supplements to the donors well before the NHCs' implementation. However, lack of an effective supplement management logistics system has contributed to extremely low coverage through routine health services.

**(9) Building on a strong health infrastructure and community support provides a significant advantage.** Part of the success achieved in Nicaragua may be attributed to its extensive local health services infrastructure. With 28 local health centers with beds, 144 health centers without beds, and 814 health posts in 149 municipalities, Nicaragua is justifiably proud of its public health infrastructure. It also enjoys a strong tradition of community mobilization in support of health programs and a history of successful public health interventions (e.g., virtual control of iodine deficiency disorders, a relatively high coverage of prenatal care and delivery care by trained personnel, increased exclusive breast-feeding, consistently high rates of immunizations), and a roster of nearly 10,000 (one per 600 inhabitants) trained and/or trainable and motivated community volunteers (*brigadistas*). In this sense, Nicaragua offers an ideal context for local public

health interventions; unfortunately, this may not be the case in many developing countries. But it does make a compelling case for the need to build from the bottom up, both in terms of basic infrastructure and in mobilizing community advocacy, participation, and a spirit of ownership regarding the needed intervention(s).

**(10) Supervision and monitoring and evaluation systems provide timely information for decision-making.** A supervisory system was developed early on which included practical guidelines to be followed by district supervisors. Implementation of the system has been fully operational for the NHCs, but much less so for routine health services due to resource limitations; e.g., insufficient funds allocated for transportation. Similar limitations have existed for the implementation of M&E systems, particularly for the monitoring of food fortification. However, these obstacles have, for the most part, been overcome through financial support from external donors; e.g., the household monitoring of fortified foods was incorporated within the 2000 NMS through sponsorship by USAID and other donors, it was carried out in 2001 with financial support from INCAP and MI, and it was integrated in 2002 into the donor-funded SIVIN. This support has enabled M&E to proceed rather smoothly and has thus provided timely feedback to program managers; unfortunately, the decision-making process of fully utilizing M&E results is still painfully slow. On the other hand, supplementation is fully integrated into the supervisory and monitoring system for immunizations.

**(11) An effective information, education, and communications strategy is crucial.** Social communications have been given high priority and, therefore, substantial resources have been allocated for this purpose by both the Nicaraguan Government and donors. Initially, in 1994–1995, an informational campaign aimed at raising awareness and advo-

cacy to generate commitment was carried out. An IEC plan was then developed which began to be implemented in 1999 after intensive training of field personnel. Informational campaigns were carried out to coincide with the launching of fortification programs, one in 1997 along with wheat flour fortification and a second one in 2000 with sugar fortification.

**(12) Social mobilization and community participation in NHCs allows for high coverage of services.** As noted earlier in lesson nine, social mobilization and active community participation are not new phenomena in Nicaragua. This dynamism also feeds preparations for the NHCs through concerted efforts by the central and district MOH technical coordination committees. NHCs begin to be prepared several weeks in advance. In addition to securing supplies for the different preventive services offered (vaccines, vitamin A supplements, anthelmintic medications, oral rehydration salts, recording forms), coordination committees regularly launch a one-week national communication campaign with the purpose of informing the population about the importance of and dates for the forthcoming NHCs and inviting communities and relevant partners to mobilize support for and participate in the NHCs. The NHCs social mobilization efforts are regularly supported by the MOH and international donors, and partnerships have been established that leverage implementation resources beyond the health sector.

**(13) Synergistic and noncompetitive international cooperation is feasible and rewarding.** Besides being consistently strong advocates, USAID and its local field staff, INCAP, PAHO, UNICEF, MI, and, more recently, other additional donors, have been strongly committed to providing technical and financial support to the National Micronutrient Commission and the MOH for implementation and evaluation of the National Micronutrient Plan, including the

VAD control program. Unprecedented levels of interagency coordination have been established with a spirit of selfless collaboration rather than competition. In addition to USAID's direct technical and financial assistance through its VITAL, OMNI, and MOST projects, in 1999 USAID/Nicaragua developed the PROSALUD initiative, a coordinated effort to expand coverage of child survival services in three provinces through increased participation by private voluntary organizations in service delivery (CARE, Save the Children, Partners of the Americas, Project HOPE, the Adventist Development and Relief Agency International, Project Concern International), including supplementation and IEC. INCAP/PAHO has assisted with advocacy efforts and provided technical cooperation in program M&E (e.g., QA/QC and monitoring of fortified foods, SIVIN). In the late 1990s, PAHO provided key assistance to strengthen the information system for M&E of supplementation. A number of international and local NGOs are active in child survival and nutrition, and participate in micronutrient program implementation at the community level, particularly in vitamin A and iron/folate supplementation and IEC, following initial training.

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# FOLIC ACID FORTIFICATION OF WHEAT FLOUR AND THE PREVENTION OF NEURAL TUBE DEFECTS IN CHILE: A SUCCESSFUL EXPERIENCE

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## BACKGROUND

Up until the 1990s, recommended intakes of folate were based on the prevention of anemia, especially during pregnancy, a time of high vulnerability to folate deficiency. Since then, evidence has shown that low folate intake, even if sufficient to avoid anemia, is nonetheless associated with important negative effects on health. Today, low folate intakes are common around the world among individuals consuming a limited and unvaried diet. Conclusive evidence shows that when folate intake increases, there are important health benefits. Most neural tube defects (NTDs) can be prevented by the periconceptional ingestion of folic acid (1, 2). Blood folate concentrations that are adequate to prevent anemia are nonetheless associated with an increased risk of NTDs (3). Likewise, formerly acceptable red cell folate levels may be associated with an increased risk of cardiovascular disease and stroke (4). Serum and red blood cell folate levels on the lower end of the normal range also increase the risk of colorectal cancer (5). Based on this new and growing body of evidence, the current international public health focus is no longer limited to the prevention of anemia, but instead has expanded to include the prevention of birth defects such as NTDs and a re-

duction in the risk of cardio- and cerebrovascular diseases and of some cancers. The strong scientific evidence linking increases in folic acid intake with a reduction of NTDs risk has been translated into public health policies through international recommendations, which concur that all women of reproductive age should increase their intake of folate to reduce the risk of having a baby with an NTD (6, 7).

The current challenge is to implement appropriate strategies at the population level to prevent NTDs. A number of developed countries have implemented policies concerning diet, supplements use, and food fortification in order to increase folate intake among women of childbearing age. Food fortification has been shown to be effective in the prevention of NTDs, while dietary changes and prophylactic supplementation with folic acid have shown only limited impact. Therefore, in lower-resource communities, food fortification appears to be the most potentially successful intervention for increasing folate intake.

An overview of the key issues related to the role of folate in human metabolic processes is presented in the first part of this

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chapter, as well as a discussion of some of the clinical and epidemiological characteristics of NTDs and of the current strategies being utilized for the prevention of NTDs and their effectiveness. These considerations are followed by a description of the implementation of mandatory folic acid fortification of wheat flour as recently introduced in Chile, an experience that could serve as a case study for other countries in the Region of the Americas and other parts of the world.

### FOLATE IN HUMAN METABOLIC PROCESSES

Folate is a generic term for compounds that have a common vitamin activity, including compounds that are naturally present in foods as well as the synthetic form, folic acid, which is used in supplements and for food fortification. Folic acid, the fully oxidized monoglutamyl form, is more stable in foods and exhibits greater bioavailability than natural folate (8).

Food sources of folate include green leafy vegetables, citrus fruits and juices, whole grain bread, and legumes. Natural folates are very labile, resulting in a significant loss of biochemical activity during harvesting, storage, processing, and preparation, which may occur over periods of days or weeks; this is in contrast to the stability of the synthetic form of folic acid found in fortified foods, which may remain almost completely stable for even years. Natural folates from foods are all conjugated to a polyglutamyl chain containing different numbers of glutamic acids. This polyglutamyl chain is broken down to monoglutamate in the brush border of the mucosal cells by the enzyme  $\gamma$ -glutamyl hydrolyase prior to their absorption in the intestine, as only the monoglutamate forms are transported into cells (8, 9). Since folic acid contains only a single glutamate, its bioavailability is higher than natural folate. As a consequence, the low bioavailability (25%–50%)

and poor chemical stability of the natural folate determine a rather poor supply of folate from the diet in contrast with the significant amounts supplied by fortified foods. This concept has a practical application in defining the dietary folate equivalent (DFE), which is used to convert all forms of dietary folate and folic acid from fortified foods to equivalent amounts. Since folic acid in fortified products is 1.7 times more bioavailable than food folate, 100  $\mu\text{g}$  consumed as spinach would equal 100  $\mu\text{g}$  DFE, and 100  $\mu\text{g}$  consumed as folic acid in fortified bread would equal 170  $\mu\text{g}$  DFE. Therefore, the DFE of a mixed diet would be calculated as follows:  $\mu\text{g}$  food folate +  $(1.7 \times \mu\text{g}$  synthetic folic acid) (6).

Once transported into cells, folic acid and natural food folates are converted to tetrahydrofolate, thus becoming chemically identical. The primary form of folate entering human circulation is 5-methyltetrahydrofolate monoglutamate. Metabolically, natural folates and folic acid are converted to coenzyme forms required in numerous one-carbon transfer reactions involved in the synthesis, interconversion, and modification of nucleotides (purine and thymidine), amino acids (methionine from homocysteine), and other essential structural and regulatory compounds (10). Most of these reactions are sensitive to folate deficiency and can also be impaired in the absence of folate deficiency. Deficiencies of vitamin B12 (also iron and riboflavin) can appear to be folate deficiency and/or exacerbate a primary folate deficiency. At the same time, the impact of these deficiencies on folate metabolism is adversely affected by genetic background (11).

### BIOMARKERS OF WHOLE-BODY FOLATE STATUS

Biomarkers of folate status include serum folate, red blood cell folate, elevated serum homocysteine and/or S-adenosylhomocys-



teine (SAH) levels, increased uracil content in DNA, DNA hypomethylation, megaloblastic anemia, and neutrophil hypersegmentation. The most commonly used are serum, red cell folate, and serum homocysteine. Serum folate reflects very recent folic acid consumption; levels fall quickly after a reduction in intake and might be artificially high in the presence of vitamin B12 deficiency. Thus, looking at serum folate is insufficient to determine folate status. Red cell folate, however, reflects longer-term intake since folate remains in the red blood cell for its entire life span of 120 days; it has a strong correlation with liver, and therefore, tissue stores. Serum homocysteine is a sensitive indicator of folate status. It is affected not only by the deficient range of red blood cell folate, but also by normal and even above normal levels of red cell folate (12). Homocysteine can also be increased in the presence of vitamin B12 or B6 deficiencies. Any elevation in homocysteine, even at levels where overt folate deficiency is not an issue, may be undesirable because it is a risk factor for chronic disease.

Currently, there are some constraints with respect to the definition of folate deficiency at the population level, especially in developing countries. First, most of the folate status studies are based only on plasma folate determinations. Secondly, there is a recognized variability of analytical methodology to measure folate, resulting in higher folate levels when radioassays, and not microbial assays, are employed (13). Thirdly, current cutoff levels were set based on microbial assays (6), and they are usually applied to results obtained with other techniques. It seems important that cutoff levels be revised.

Impaired folate metabolism is associated with risk for developmental anomalies and diseases including neural tube defects, cardio- and cerebrovascular diseases, and cancer. Both nutrient status and genetic background are independent, but interacting, risk factors for these disorders. However, the

mechanisms that cause the pathology and the reasons why folate prevents the occurrence and recurrence of these disorders are unknown.

## NEURAL TUBE DEFECTS

Neural tube defects are a major group of birth defects that occur when the brain, spinal cord, or the covering of these organs (bones and muscles) has not developed properly. These congenital malformations include open spina bifida, anencephaly, and encephalocele, and are considered to be vitamin deficiency disorders that may be prevented through the observance of appropriate public health measures. Anencephaly and spina bifida are the most common types of NTDs. Infants born with anencephaly are stillborn or die within hours of birth. Spina bifida results from failure of the spine to close during the first month of pregnancy. Children with spina bifida can have varying degrees of paralysis of their lower limbs, be confined to a wheelchair, or have bowel and bladder problems.

After cardiac defects, NTDs are the most common birth defects worldwide. The rate of birth prevalence varies among countries, ethnic groups, and socioeconomic levels. A global average of 20 in 10,000 live births has been reported, with figures varying from 0.25 in 10,000 (Finland) to 125 in 10,000 (South Wales) (14). NTDs are of multifactorial polygenic origin, meaning that they are determined by the interaction of various genes and their alleles with multiple environmental factors, among which folate plays an important role. The metabolic alterations of folate metabolism and inadequate folate intake play a fundamental role among the associated factors that determine NTDs. In addition, gene polymorphisms that code for key enzymes and receptors for folate metabolism and transport are associated with an increased risk of NTDs (11). However, the

biochemical and developmental mechanisms which lead to the pathology, as well as those which enable folate to successfully prevent the occurrence and recurrence of these disorders, have not yet been identified.

### EVIDENCE SHOWING THE EFFICACY OF FOLIC ACID IN THE PREVENTION OF NTDs

The relationship between diet, social class, and congenital malformations was first described in the 1970s in England (15). A group of researchers noted that congenital malformations affecting the central nervous system, including NTDs, were more common in women of lower socioeconomic status who also had lower first trimester levels of red cell folate. It was suggested that low serum levels of vitamins represented poor diet and that periconceptual multivitamin supplementation might prevent some congenital anomalies, including NTDs. The Medical Research Council in England undertook a placebo-controlled study using a factorial design with four arms: multivitamins with folic acid (4 mg/day), multivitamins alone, folic acid alone (4 mg/day), and placebo. The aim was to test in women with a previous NTD pregnancy whether there was a real preventative effect, and if so, whether folic acid alone was the active ingredient or whether multivitamins intake was responsible for the positive effect. In 1991, this study showed that NTDs could be reduced by about 75%, and this was due to folic acid supplements, not multivitamins without folic acid (1). In 1992, Czeizel and Dudas published the results of a randomized trial of multivitamins (including 800 µg/day of folic acid) in women discontinuing contraception to become pregnant. The 2,104 women taking the multivitamins with folic acid had a lower rate of congenital malformations overall and no NTDs, compared to six NTDs in the 2,052 placebo-treated women, representing the expected occurrence rate (2).

### APPROACHES TO INCREASING FOLATE INTAKE

Increasing folate intake purely through dietary sources is unlikely to increase a woman's folate levels sufficiently to reduce the risk of an NTD-affected pregnancy. The bioavailability of natural folate is only half that of folic acid added through supplementation or fortification. Therefore, to meet the equivalent of 400 µg of folic acid daily, about 800 µg of dietary folate would need to be consumed per day. For example, a woman should consume 500 g daily of raw spinach or 900 g of boiled spinach or raw broccoli in order to effectively reduce the risk of an NTD-affected pregnancy.

In recent decades, it has become obvious that women with the highest risk of NTDs are unlikely to obtain adequate amounts of natural folate from foods and that they should thus be encouraged to take a periconceptual folic acid supplement or consume foods fortified with folic acid in order to increase folic acid consumption. Yet public health efforts promoting the use of supplements have not been effective in preventing NTDs. In the United States (16), United Kingdom (17), and the Netherlands (18), where around 50% of the pregnancies are planned, even with aggressive communication and educational campaigns, fewer than 40% of women consume folic acid supplements during their periconceptual period. These data indicate that folic acid awareness has not been translated into behavior change. In developing countries, the coverage can be expected to be even lower due to the availability of fewer resources for educational campaigns, difficulties in ensuring compliance, and lack of access to information about and services for periconceptual folic acid supplementation.

Meanwhile, fortification of cereals with folic acid has shown significant increases of blood folate levels (19, 20) and also significant reductions in NTD frequencies in the United States and Canada (21, 22). Following mandatory fortification of all enriched cereal

grain products since January 1998 in the United States, red cell folate levels rose from an average of 410 nmol/L to 714 nmol/L (19). The birth prevalence of NTDs fell from 37.8 per 10,000 live births before fortification to 30.5 per 10,000 live births conceived after mandatory folic acid fortification, representing a 19% decline (21). In Canada, folic acid fortification was associated with an even more dramatic decline of 48% in NTDs (22).

For these reasons, increasing folate levels through folic acid fortification of foods is an important public health strategy for reaching a large number of the target population. Currently, 19 countries in the Americas are fortifying wheat flour with folic acid, in addition to iron. The impact of this strategy on improving folate status and preventing NTDs has not been evaluated except in Costa Rica (23). Recently, a Pan American Health Organization/U.S. Centers for Disease Control and Prevention/March of Dimes technical consultation recommended guidelines to select the optimal level of folic acid fortification, taking into consideration the nutritional requirement, consumption level of the food vehicle, and costs in order to maximize the efficacy of fortification programs (24).

## FOLIC ACID FORTIFICATION OF WHEAT FLOUR IN CHILE

Congenital anomalies have become more important causes of infant morbidity and mortality as the prevalence rates of infectious diseases and nutritional problems during childhood have decreased. This is the case in Chile, where infant mortality is 8.9/1,000 (25). Congenital malformations are the second cause of infant mortality in this country, following prematurity. In Chile, the incidence corresponds to 1.7/1,000 live births, according to the ECLAMC registry (Spanish acronym for *Estudio Colaborativo Latinoamericano de Malformaciones Congénitas*, or Collaborative Latin American Study of Congenital Malformations), and rates have

not changed between 1967 and 1999 (26). According to this NTDs incidence rate, an estimated 400 babies affected with NTDs are born every year. Furthermore, in Chile, the termination of pregnancy and therapeutic abortions are not permitted by law.

Factors such as the high cost of lifelong medical attention for a patient with spina bifida and the incalculable emotional cost on the families affected by NTDs have transformed this condition into a major public health problem in the country. This situation led a group of academics and program planners from the Ministry of Health, as well as representatives from the national mill industry, to identify folic acid fortification of wheat flour as a promising strategy for increasing the population's intake of folic acid. This conclusion was reached following a number of considerations: (1) wheat flour is a staple food throughout the country; (2) milling for bread-making corresponds to 90% of the total wheat milled, and over 70% of wheat flour is used for making the types of bread typically consumed by Chileans (80 g of wheat flour/100 g of bread), known as *marruquetas and hallullas*; (3) flour mills in the country are technologically well developed, and quality assurance systems for fortification are already in place; these features have permitted, since 1951, the successful process of wheat flour fortification with iron as ferrous sulfate (30 mg/kg), thiamine (6.3 mg/kg), riboflavin (1.3 mg/kg), and niacin (13.0 mg/kg) (27); (4) the mean intake of wheat flour as bread in Chile is very high, approximately 200 g/day (28); (5) regulatory monitoring is conducted on a permanent basis by the Ministry of Health's Institute of Public Health at the premix vendor and mill levels; (6) the cost of adding folic acid to the premix is low (approximately US\$ 0.15/ton of wheat flour) so that it may be absorbed by the milling industry (29); and (7) the total cost of rehabilitation for a child affected with spina bifida in Chile has been roughly estimated as US\$ 120,000 (from birth to 18 years of age), whereas the cost of adding folic acid

has been estimated to be US\$ 175,000/year (29); hence, just one case of NTD prevented in a year would permit the recovery of nearly the entire cost of fortifying wheat flour with folic acid for a complete year.

Starting in January 2000, the Ministry of Health of Chile mandated a regulation requiring that folic acid be added at a level of 2.2 mg/kg to the premix currently used in wheat flour. This policy, based on bread consumption by the target group, was expected to result in a mean additional intake of approximately 400 mg/day in women of child-bearing age (15 to 44 years). It is important to note that folic acid-fortified foods such as breakfast cereals are not universally available, are economically out of reach for most of the population, and are not culturally accepted. At the same time, there is very little, if any, consumption of folic acid supplements. Within this context, bread fortified with folic acid was envisioned to represent the principal source of the nutrient that would benefit the entire population.

### IMPACT EVALUATION OF THE FOLIC ACID FLOUR FORTIFICATION PROGRAM

The situation described above provided an excellent opportunity to assess the effectiveness of the folic acid flour fortification program in the reduction of the risk of NTDs in a population with characteristics different from those of Canada and the United States. The impact evaluation of the Chilean intervention was undertaken by a group of researchers composed of nutritionists and geneticists from the University of Chile's Institute of Nutrition and Food Technology (INTA). It was sponsored by the Pan American Health Organization and financed by the March of Dimes, U.S. Centers for Disease Control and Prevention (CDC), and Chilean Ministry of Health, with the collaboration of the University of Florida. The assessment focused on the effectiveness of the folic flour

fortification program in increasing bread folate content and in improving folate status in women of childbearing age, as well as the program's effectiveness in reducing the frequency of NTDs at the population level, and folate intake levels of the study group were assessed both before and after the program's implementation in Chile.

### Folic Acid Content of Bread

The Institute of Public Health, which is the scientific and technical branch of Chile's Ministry of Health, monitors iron and B-complex vitamins, but not folic acid content in wheat flour, because an adequate methodology for monitoring purposes is not currently available. To measure folic acid in bread, 1 kg of bread (*marraquetas* and *hallullas*) was purchased over the counter at 50 randomly selected bakeries in the Metropolitan Area of Santiago. Samples were obtained three and six months after fortification started in these same bakeries. Folate was extracted from the samples using a modification of the tri-enzyme extraction method (30). Folate content was measured at the University of Florida using the microplate adaptation of the microbiological assay (31). The folate content for the 100 bread samples was  $202 \pm 94 \mu\text{g}/100 \text{ g}$  of bread (range 22–416  $\mu\text{g}/100 \text{ g}$ ). Only 9/100 contained  $< 37 \mu\text{g}$  folic acid per 100 g, suggesting that these were made from unfortified flour. Distribution of the values confirmed that wheat flour was fortified four months after the law mandated the addition of folic acid fortification with the expected content.

### Folic Acid Consumption from Bread and Changes in Blood Folate Concentration Levels

The National Health Service's Maternal and Child Health Program covers at least 70% of the Chilean population and operates through a series of Outpatient Primary Care Clinics that are located throughout the coun-

try. Seven hundred fifty-one women, all of whom were of childbearing age, had at least one child (but no family history of NTDs), and who were currently utilizing services at one of three outpatient clinics (Alejandro del Río, La Granja, and La Faena) in Santiago, Chile, were studied. Women were recruited and studied from October to December 1999 (before fortification), and assessed again between October and December 2000 (after fortification). Six hundred and five women (81%) completed the follow-up. Causes of dropout before follow-up were: moving out of reach (75), rejection of second venipuncture (65), death (2), and in jail (2). Subjects participating in both assessments and those lost before the follow-up were similar with respect to bread consumption and blood folates. Other characteristics of the group included the following: (1) body mass index ( $26.4 \text{ kg/m}^2 \pm 5.1$ ); (2) multiparous ( $2.2 \pm 1.2$  children); (3) 12.6% anemic ( $\text{Hgb} < 12 \text{ g/dL}$ ); (4) 75% breast-fed last child  $> 6$  months; (5) 23% used an oral contraceptive; and (6)  $\sim 60\%$  did not smoke or consume alcohol. In the follow-up group, average bread consumption was estimated based on a combination of a 24-hour recall and a food-frequency questionnaire specifically designed to assess intake of bread and other wheat flour-based foods, folic acid-fortified foods, and vitamin supplements. Estimated folic acid intake was calculated based on bread consumption derived from the mean value of data obtained from both the 24-hour recalls and food-frequency questionnaires and the mean folate content of bread. The effect of fortification on blood folate concentration was evaluated in a follow-up study. Serum and red blood cell folate and vitamin B12 concentrations were analyzed using the Bio-Rad Laboratories (Hercules, California, 1989) QuantaPhase II Folate Assay kit.

### Folic Acid Consumption

The estimated median bread intake was 245 and 239 g/day before and after fortifica-

tion, respectively. On a daily basis, 98% of the women consumed bread, and 89% ingested over 180 g/day. Ninety-seven percent of the bread analyzed, corresponding to the type of bread typically consumed in Chile, was industrially processed. None of the subjects consumed other folic acid-fortified foods, and none reported taking folic acid supplements. Mean folic acid intake was 427 (95% CI 409–445) g/day based on estimates of the daily intake of folic acid from fortified bread and reported consumption of the women studied. Almost half of them (48%) consumed  $> 400$  g of folic acid daily. Only 3% consumed  $< 100$  g/day. The intake of folic acid from bread for the rest of the group (49%) corresponded to values varying between 100 and 400 g/day (30).

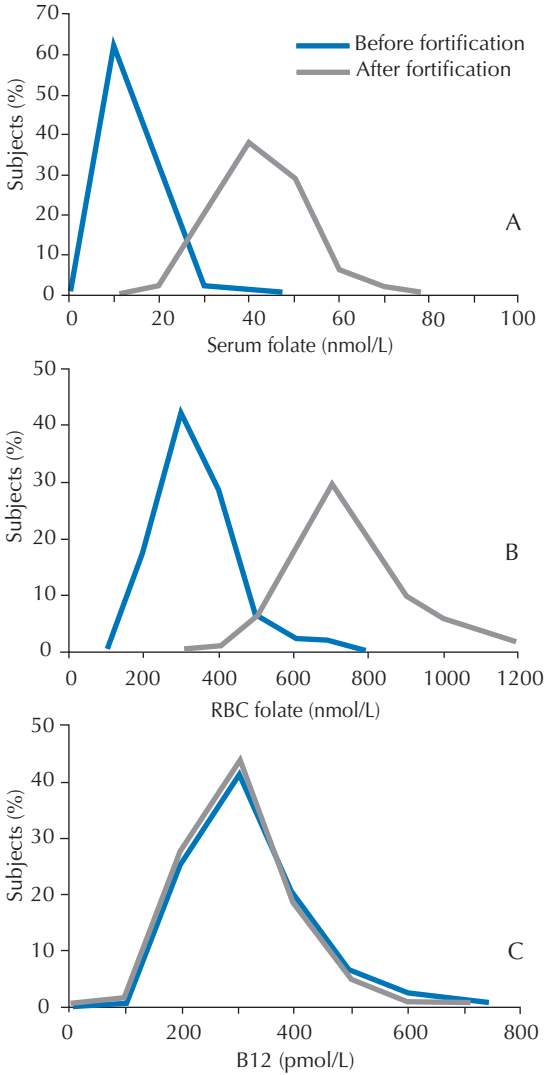
### Changes in Blood Folate Concentration Levels

The effect of habitual consumption of folic acid-fortified foods on folate levels is accepted as the best method for determining whether people are consuming more folic acid. Evaluation of folate nutritional status in the 605 women in the follow-up group confirmed the improvement in folate intake, showing a remarkable increase in serum and red blood cell folate concentrations after the program was implemented. Prior to fortification, the mean serum and red blood cell folate concentrations were  $9.7 \pm 4.3$  and  $290 \pm 102 \text{ nmol/L}$ , respectively, as compared to  $37.2 \pm 9.5$  and  $707 \pm 179 \text{ nmol/L}$  post-fortification ( $p < 0.0001$ ). As expected, vitamin B12 concentrations did not change during this time ( $266 \pm 105$  and  $268 \pm 165 \text{ pmol/L}$ ). The distribution curves for serum and red blood cell folate concentrations before and after fortification show a striking shift to the right (A and B), in contrast with the vitamin B12 distribution curves, which showed no change (C) (Figure 1).

These findings demonstrate that regular consumption of a folic acid-fortified staple food is highly effective in improving folate



**FIGURE 1. Serum folate, red cell folate, and vitamin B12 distribution curves before and after folic acid fortification of wheat flour in women of reproductive age, Santiago, Chile.**



**Source:** Hertrampf E, Cortés F, Erickson D, Cayazzo M, Freire W, Bailey LB, et al. Consumption of folic acid-fortified bread improves folate status in women of reproductive age in Chile. *J Nutr* 2003;133(10):3166–3169. Reprinted with permission.

status in women of childbearing age. Serum and red blood cell folate concentrations significantly increased after 10 months of consumption of folic acid-fortified wheat flour. This improvement in blood folate status may

be attributable to the consumption of folic acid-fortified wheat flour. The study group did not consume other folic acid-fortified foods. In addition, folic acid supplements were not taken by any of the study subjects since they have not been mandated or made available to this low-income population group by Chilean public health services. Therefore, the wheat bread fortified with folic acid was the main source of this nutrient in the population studied.

**Folate Deficiency in the Group**

Both the CDC (32) and the U.S. Institute of Medicine (6) cutoffs for serum and red blood cell folate concentrations were applied to radioassay analyses performed in this study. The prevalence of low folate levels, presenting risk for deficiency, varied widely thereby emphasizing the necessity to revise the criteria for defining folate deficiency (Table 1). It is important to highlight that although the majority of the study population presented low plasma and red blood cell folate concentrations before the fortification started, only five women presented anemia associated with these low values, and no subjects presented macrocytosis as measured according to mean corpuscular volume.<sup>2</sup> Therefore, their folate status was not sufficiently low to cause clinical signs such as anemia.

**IMPACT OF FOLIC ACID FORTIFICATION ON THE ELDERLY POPULATION**

In a group of Chilean elderly (aged 70 or over), who were being followed up by a group of researchers at INTA at the same time as the start of the folic acid fortification, significant increases in serum folate levels after six months of fortification were reported (33). Since this age group is at a

<sup>2</sup>Eva Hertrampf, unpublished observations.



**TABLE 1. Risk of folate deficiency in a group of women of reproductive age according to different reference ranges.**

|  |                             |                          |
|--|-----------------------------|--------------------------|
| Serum folate<br>(% below ref. range)     | NHANES < 3.2 nmol/L<br>1.3  | IOM < 7 nmol/L<br>25.0   |
| Red blood folate<br>(% below ref. range) | NHANES < 181 nmol/L<br>10.6 | IOM < 305 nmol/L<br>65.0 |

**Source:** adapted from Hertrampf E, Cortés F, Erickson D, Cayazzo M, Freire W, Bailey LB, et al. Consumption of folic acid-fortified bread improves folate status in women of reproductive age in Chile. *J Nutr* 2003;133(10):3166–3169.

higher risk of vitamin B12 deficiency, increased intakes of folic acid provided by fortified wheat flour could be considered as an objection to mass food fortification due to the risk of masking vitamin B12 deficiency (B12 deficiency without anemia because of additional folic acid intake). Vitamin B12 deficiency presents either with anemia, neurological symptoms, or both. High doses of folic acid may correct the anemia caused by vitamin B12 deficiency (because folic acid and vitamin B12 have a similar effect) and may lead to a delay in diagnosis of the underlying vitamin B12 deficiency, causing irreversible neurological damage. Experts worldwide accept that this is only likely to happen with folate intakes > 1 mg/day (6, 34).

Up until now, there is no evidence of harm with the folic acid levels supplied by fortified foods. Interestingly, in a recent study, a group of 1,573 elderly in the United States showed no evidence of an increase in low vitamin B12 concentrations without anemia after fortification of cereals with folic acid (35). In Chile, based on data suggesting that the elderly population (33–36) and women of fertile age (31) are at risk of vitamin B12 deficiency, a suitable approach to this problem might be to introduce B12 fortification in addition to folic acid fortification in wheat flour. It is important to note that folate deficiency is also widespread in the elderly (36); therefore, correcting hyperhomocysteinaemia through folic acid fortification might considerably reduce deaths from coronary heart disease and stroke.

## CHANGES IN NTD FREQUENCY

Blood folate levels have been shown to correlate with folate consumption and appear to correlate with NTD rates as well (37, 38). Nevertheless, blood folate levels are still an intermediate outcome. The real measure of the impact of increased folic acid consumption is the reduction of NTD rates. We decided to monitor if prevalence of NTDs declined after mandatory folic acid fortification as a means to evaluate its effectiveness.

In Chile, 99% of all deliveries occur in institutional settings, and 80% of these take place in facilities belonging to the national public health care system. About 40% of congenital malformations are diagnosed in prenatal controls; however, as earlier noted, the termination of pregnancy and therapeutic abortions are prohibited by law. A neonatal screening program for phenylketonuria and congenital hypothyroidism covers 98% of national births. NTD registry is part of routine neonatal care, and since NTDs are considered serious anomalies, only in rare cases do they escape diagnosis. Newborns with spina bifida are discharged after undergoing surgery. Stillbirths must be audited to insure proper medical care, and autopsies are mandatory in all the cases.

In 1998, in Chile the only surveillance system in place for congenital malformations was that belonging to ECLAMC (26), which registers 7% of total births in Chile, from three maternity hospitals, none of which were public hospitals located in Santiago. Birth certificates do not include information

about malformations, and given that the Chilean health system does not include a national birth defect registry, with the assistance of the CDC and ECLAMC, we established a hospital-based surveillance system in the nine Santiago-based public hospitals to register NTDs. The registry prospectively included all births (live births and stillbirths), beginning in the year 1999, with a birth weight of  $\geq 500$  g. The number of births occurring in these hospitals is approximately 60,000 per year, which represents 60% of births in Santiago and 25% throughout Chile. In the absence of a national registry, this surveillance system was seen as a potentially useful mechanism capable of providing a more accurate picture of NTDs frequency by partially correcting for sources of underestimation of NTDs, such as the termination of affected pregnancies and inadequate still-birth registry.

In each hospital one member of the staff (a neonatologist or registered nurse) was recruited and trained by the research team to review all births, and then register and describe all NTD occurrences. Types of NTDs registered were anencephaly, encephalocele, and spina bifida, regardless of whether associated or not with other malformations. In cases where two NTDs occurred concomitantly in a newborn, the defect occurring in a higher position along the spine was considered. A specially trained clinical geneticist was hired to monitor the correct registration of NTDs during the four years of the registry's duration (1999–2002). Data obtained

was reviewed monthly using the following sources: audits for deaths under 1 year old, fetal death audits, hospital discharge reports, delivery records, registry of newborns, registry of malformed newborns, registry of stillbirths, autopsy protocols, and clinical records. Validation of the collected data was periodically performed by the rest of the research team through the sources of information described above. Total prevalence rates were calculated as the total number of neural tube defects per 10,000 births.

Folic acid fortification was mandated by January 2000, and compliance was verified by April 2000 through assaying the folic acid content of bread. Data was divided in two temporally defined groups: the pre-fortification period, consisting of data collected between January 1999 and December 2000, because neural tube development of the babies born during that period was not exposed to folic acid fortification (there is evidence that fortification of wheat flour was in place since April 2000, so the babies conceived since April 2000 and born since January 2001 were benefited), and the post-fortification period, consisting of data collected between January 2001 and December 2002.

Preliminary analysis of the data shown in Table 2 reveals that the total rate of NTDs, including live and stillbirths, decreased by 40% from the pre-fortification period (1999–2000) to post-fortification (2001–June 2002), from 17.0 to 10.1 per 10,000 births (RR 0.60, 95% CI 0.46–0.77). These results indicate that wheat flour fortification with folic acid is feasible

**TABLE 2. Total NTD rates for pre-folic acid fortification<sup>a</sup> (January 1999 to December 2000) and post-fortification<sup>b</sup> (January 2001 to June 2002) in Santiago, Chile (preliminary results).**

|                           | Pre-fortification | Post-fortification | RR (95% CI)      | Decline % |
|---------------------------|-------------------|--------------------|------------------|-----------|
| NTD rates <sup>c, d</sup> | 17.0              | 10.1               | 0.60 (0.46–0.77) | 40        |

<sup>a</sup>120,636 births.

<sup>b</sup>88,538 births.

<sup>c</sup>NTD births/10,000 births.

<sup>d</sup>Live and stillbirths.

on a national scale and that this strategy holds significant potential in the effective prevention of NTDs in only a short period of time.

The evaluation of public health interventions is of major importance, since this mechanism generates information that is crucial to future planning and provides the foundation for advocacy of the intervention's effectiveness and sustainability, which, in turn, facilitates the acquisition of the necessary resources and funding for implementation. The optimal design of the impact evaluation of a program is a "probability evaluation," which entails the comparison of two randomly assigned program-exposed or non-exposed groups (39). This permits the generation of results and conclusions about program performance with the greatest confidence, making it possible to establish causality after controlling for potential confounding factors. However, its use is limited for economic, logistical, and ethical reasons. In the present study, we used a "plausibility evaluation" design (39) in which the baseline (pre-fortification) and end line (post-fortification) situations were compared. This permits us to make an argument of plausibility that reduction in the NTDs rate, which occurred over a short period of time and temporally coincided with the program, was indeed an effect of the program. Two other aspects that support this plausibility argument are the increased intake of folic acid from fortified bread and the dramatic change in folate status in a group of women of reproductive age.

### **COST-EFFECTIVENESS OF FOLIC ACID FORTIFICATION**

In a cost-effectiveness study currently in progress (40), the incremental cost of folic acid fortification was evaluated by comparing total costs for one year of fortification with those for one year without fortification. Costs included in this analysis were those as-

sumed by the milling industry (adding folic acid to the premix, quality control) and costs averted per case of prevented spina bifida (medical care, surgery, rehabilitation during 20 years). Costs not included in this analysis were those of the milling industry infrastructure (since it was preexisting), costs of additional medical complications, and indirect economic and emotional costs to family members and caretakers. Although the latter represents an enormous burden for the affected individuals, family members, and society in general, the very nature of these kinds of costs renders them difficult to translate into numbers.

Results of this analysis have shown that the cost of folic acid fortification per woman of reproductive age receiving the target intake of 400 µg/day was a mere US\$ 0.16. The cost of surgery and rehabilitation (extended to 20 years of life) per child with spina bifida was shown to be approximately US\$ 100,000. When applying this cost to the 110 cases of spina bifida prevented by the folic acid fortification program, total savings for the health care system were approximately US\$ 11 million.

### **FACTORS CONTRIBUTING TO THE SUCCESS OF THE FORTIFICATION INTERVENTION**

There are several possible factors that have played a key role in the success of this intervention. These include: (1) the existence of a group of committed academics advocating for the implementation of a national folic acid fortification program; (2) the subsequent mandate for flour fortification supported by legislators; (3) the willingness of the milling industry to accept the addition of folic acid to the premix in use and to incur additional costs related to this process; (4) the low cost of the program; and (5) the scientific collaboration and financial support received from international agencies throughout all stages of the intervention.

## AREAS NEEDING FUTURE RESEARCH

- (1) Is it possible to improve the degree of prevention already achieved in Chile with wheat flour folic acid fortification? According to efficacy studies, 70% of NTDs are preventable by controlled folic acid supplementation. However, results from effectiveness studies in Canada, Chile, and the United States have shown a 40% reduction in the NTD rate. It is unclear whether by modifying certain factors, such as removing technical and practical barriers in the fortification process, and improving vitamin B12 status in women of reproductive age, this current ceiling could be raised.
- (2) Fill a critical gap in regulatory monitoring fortification programs by adapting a simple, rapid, relatively low-cost methodology to measure the folic acid content of wheat flour and other food vehicles.
- (3) Assess other positive medium- and long-term effects of increased folic acid intake on the vascular pathologies occurring during pregnancy and adulthood, among others.
- (4) Evaluate surveillance of unknown and possibly deleterious effects caused by folic acid fortification.

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# **Integrated Strategies at the Local Level**



# IMPLEMENTATION OF BREAST-FEEDING PRACTICES IN BRAZIL: FROM INTERNATIONAL RECOMMENDATIONS TO LOCAL POLICY

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## SUMMARY

Recent breast-feeding statistics from Brazil,<sup>3</sup> indicating high rates of breast-feeding (a median duration of nearly 10 months), are both encouraging and impressive, especially when compared to 1975 national census figures showing that one out of every two Brazilian women who breast-fed had completely discontinued this practice by the second or third month after their child's birth. Similarly, the 1986 Demographic and Health Survey revealed a breast-feeding rate in this country of only around 4%—the lowest exclusive breast-feeding rate from 0 to 4 months in all of Latin America.

This chapter focuses on the evolution of Brazil's national breast-feeding program, emphasizing the role played by international policy recommendations of the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) in transforming the status of breast-feeding in a country that is not only Latin America's largest in geographical terms, but also one that is characterized by dynamic cultural, ethnic, and socioeconomic diversity. This chapter will also explore how the formulation of policies and interventions adopted in Brazil might serve as a basis for the development and/or review of new international policies and how

these, in turn, may be adapted within national and community frameworks.

In Brazil, the studies providing data on breast-feeding make it possible to divide this chapter's analysis into four periods: the 1970s, the beginnings of reactions for and against breast-feeding, which also coincided with peak use of infant formulas; the 1980s, when large-scale campaigns in promotion of breast-feeding received wide coverage in the mass media; the 1990s, when policies in defense of breast-feeding, and planning and training activities to promote it, began to take root; and, finally, the twenty-first century. The challenge for this initial phase of the new century is the need to promote ex-

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<sup>3</sup>Data on breast-feeding interventions cited for the most recent period described in this chapter, particularly the late 1990s and the 2000–2002 period, were taken partially from documents and presentations; these were modified and analyzed under the sole responsibility of the authors.

clusive breast-feeding through the sixth month of life and continued breast-feeding thereafter with appropriate complementary foods until at least 2 years of age (a WHO decision adopted in 2001, supported by Brazilian leadership at the Fifty-fourth WHO World Health Assembly), while taking into account special groups, pursuant to the WHO/UNICEF Global Strategy for Infant and Young Child Feeding. The network of human-milk banks—an area in which Brazil has demonstrated global leadership—may be the best alternative for these special groups, such as babies with HIV-positive mothers who cannot breast-feed them. The human-milk bank initiative, as well as other innovative actions, challenges, and possible solutions which draw on Brazil's experience, will also be described in this chapter.

## INTRODUCTION

The three principal challenges facing breast-feeding promotion programs in the twenty-first century may be summarized as follows:

- (1) how to ensure exclusive breast-feeding from birth through the first six months of life;
- (2) how to introduce safe and adequate complementary foods into the diet without interrupting breast-feeding from 6 months up to 2 years of age or beyond; and
- (3) how to promote adequate child nutrition for groups whose special needs are not addressed within the framework of breast-feeding recommendations targeted toward the general population, as is the case of HIV-positive mothers, women with infants without legal protection in the workplace, mothers in emergency situations (i.e., victims of natural disasters, civil war, or famine; living in refugee settings), and others whose unique circumstances warrant a

specialized application of breast-feeding recommendations.

In May 2001, ministers of health attending the Fifty-fourth WHO World Health Assembly recommended that all children receive breast milk exclusively until approximately six months after birth and that breast-feeding continue thereafter for a period of at least up to age 2 years (1). This policy decision was adopted following a careful review of the scientific literature (2) and years of debate involving commercial interests that have not always been favorable to the goals of public health. The document notes that the global recommendation is intended as a guide for infant and young child feeding practices and that in applying it, public health authorities should take into account local circumstances, including environmental, cultural, and other risk factors. On the other hand, it stresses that in order to achieve exclusive breast-feeding during the first six months of life, mothers need breast-feeding protection and support for lactation, a reality that is achieved only through clear national policies and legislation regarding maternal and child health.

In 1984, the first meta-analysis was published showing that exclusive breast-feeding from birth through 4 to 6 months of age protects children against death by infectious diseases (3). This analysis was followed by a case-control study in Porto Alegre and Pelotas, resulting in data that today are cited exhaustively in the literature. These data quantify and give meaning to such protection; i.e., the greater the degree to which children are exclusively breast-fed, the lesser the risk of their dying from diarrhea or other prevalent childhood infections, especially during the first two months of life (4).

For reasons that remain unclear, scientific validation of this type has not always been used to promote breast-feeding, however. Despite this, the knowledge accumulating over the last decade and a half on this topic has been nothing short of revolutionary: it

has clearly demonstrated that several diseases or conditions may actually become significantly worse when breast-feeding does not occur, including necrotizing enterocolitis (5), diabetes (6), allergies (7), and pneumonia (8). Breast-feeding is very important for preterm and low-birthweight babies, resulting in greater rates of intelligence (9), visual acuity (10), and lower blood pressure among 13- to 16-year-olds (11). Today we also know that breast milk, in addition to providing its adequate and vital dose of immunoglobulin at the beginning of life, continues to be an important source of proteins (some unique and irreplaceable) and calories, as well as micronutrients, such as vitamin A, during the second year of a child's life; moreover, it provides one-third of the energy necessary for child growth (12).

Infant formula was prescribed for many years, given the lack of knowledge and understanding regarding the nutritional and immunological value of breast milk, the importance of breast-feeding in terms of its physiological and emotional benefits, and its role in the reduction of infant morbidity and mortality. Women also incur the benefits of breast-feeding, as evidenced in decreased rates of ovarian (13–15) and breast (16–20) cancers and of coxofemoral subluxation due to osteoporosis (21–23), as well as in the extended postpartum infertility it provides, thereby enabling greater spacing between pregnancies (24–26).

Until the late 1970s, programs and/or activities to promote breast-feeding were designed without very much coordination, analysis, or criteria. The considerations influencing the decision to stop breast-feeding—i.e., the cultural and socioeconomic determinants, the marketing of breast-milk substitutes, and inadequate counseling and inaccurate information given by health care professionals on breast-related problems during the immediate postpartum period—continued to take their toll. Consequently, these factors, taken together with poorly designed breast-feeding programs and services, may have been responsible for the in-

creased rates of early weaning and use of artificial milk and feeding bottles during this period.

Toward the end of the 1970s and throughout the 1980s, a number of breast-feeding promotional activities elsewhere in the world, however, began to show promise in expanding the practice of breast-feeding. The most successful of these were well structured, but above all, multisectoral in their approach and well coordinated among the participating partners. In 1975, the Baguio Hospital in the Philippines was an important precursor (27). Infant mortality dropped 95% at this facility following implementation of a series of activities directly or indirectly promoting breast-feeding, such as prohibiting the use of feeding bottles, allowing "rooming-in" of infants with their mothers, using breast milk for ill or premature newborns, and providing instructional training for the health care team. In the hospitals and clinics where women were provided with prenatal and puerperium care, the children received postpartum care and the mothers adequate counseling and support for exclusive and supplemental breast-feeding, health professionals were able to increase breast-feeding rates.

This type of support should include, inter alia, information on the best time to initiate breast-feeding; how to properly position and latch the baby onto the breast; the advantages gained from breast-feeding; the need for feeding on demand; the drawbacks of using pacifiers, artificial nipples, and feeding bottles; and instruction on how to extract breast milk manually (28).

Within a more comprehensive framework, Canada provides perhaps the best example with which to illustrate the evolution of a national policy to promote breast-feeding (29). In that country between 1965 and 1971, only 25% of mothers breast-fed their children. In 1978, upon realizing the importance of securing the broad-based support of physicians before initiating any breast-feeding program, the respected *Canadian Journal of Public Health* published a position paper. This was the cat-

alyst for initiating a national policy to promote breast-feeding. In the first phase of policy development, which focused on health professionals, policy planners analyzed the factors behind the pharmaceutical industry's success in securing the endorsement and use of its products by physicians and their patients. Thus, in order to "sell" the product—in this case breast-feeding—an attractive kit was developed which included background on the scientific basis for breast-feeding, information on its clinical management, a poster which could be displayed in maternal and child health care facilities, and letters of endorsement from leading scientific professional associations and the country's minister of health. Some 62,000 kits were distributed. The impact of the kit was subsequently evaluated, utilizing a sample of 3,000 professionals, who indicated that the kit was useful for purposes of self-knowledge and that the poster was effective in stimulating greater interest in breast-feeding issues on the part of their patients.

The second phase targeted first-time mothers with a booklet entitled *How Breast-feeding Works*, published by the Canadian Academy of Pediatrics, La Leche League-Canada, and Health Canada. After distributing some 850,000 copies, the impact of the booklet was tested on a sample of 500 mothers, with a high percentage reporting that the information presented was new to them and that they considered it useful. In a third phase of the program, films on breast-feeding were shown at group workshops, reaching a combined audience of some 150,000 people. In the fourth phase, a survey was conducted to determine the number nationwide of children under age 2 being breast-fed. Accordingly, it was found that the 25% rate of breast-feeding between 1965 and 1971 had jumped to 69% by 1982. This survey also included questions about the distribution of infant formula samples in maternity wards and revealed that mothers who reported receiving these samples were nearly three times more likely to discontinue breast-

feeding during the first month postpartum than mothers who did not receive the samples. Among the mothers who received samples, 80% to 90% continued to give their babies the same brand of infant formula as the samples they had received in the hospital. The fifth phase of the policy development program was Canada's endorsement of the International Code of Marketing of Breast-milk Substitutes (ICMBMS), which will be described later on in this chapter, and hospital-wide support for a policy to promote breast-feeding.

Papua New Guinea is another country that has long recognized the need for breast-feeding promotion interventions to be supported by clear policies (30). There, a school-based breast-feeding promotion campaign was launched in response to low breast-feeding rates. Teachers were provided breast-feeding information kits that included audiovisual aids and descriptions of suggested activities. The campaign also included radio spots and articles in the print media and enjoyed support from the business community, whose members were urged to limit the sales of feeding bottles. As a result of the campaign, it became clear that enacting legislation in support of the interventions in progress could help increase breast-feeding rates in the country. Consequently, a ban on commercial advertising of breast-milk substitutes was enacted, as well as regulations on the sale of feeding bottles, pacifiers, and artificial nipples. Accordingly, feeding bottles were only sold when prescribed by a health professional. Once the law had been in effect for some time, it was observed that feeding bottles were used only when prescribed and that breast-feeding rates indeed increased.

The experiences of Canada and Papua New Guinea offer somewhat unique glimpses into the effectiveness of various strategies designed to increase breast-feeding rates, given that, for whatever reason, very few studies conducted to date have attempted to evaluate the impact of specific breast-feeding promotion actions



and/or programs. In order to do this in Brazil, one such survey was administered in the metropolitan areas of São Paulo, in the country's southeast, and Recife, in the northeast, both prior to (1981) and six years following (1986) the launching of the country's national breast-feeding program (PNIAM) (31). More studies of this type are needed, for reasons we will discuss later on in this chapter.

Reflecting on the circumstances surrounding the PNIAM, both before the program existed and after it was formed, and also having had the opportunity to experience several such moments in the history of breast-feeding both from within and outside the country, the authors of this chapter will attempt to present a historical perspective on how Brazil was able to achieve the dramatic improvements in its national breast-feeding rates as described at the beginning of this chapter. We recognize, however, that some elements might be lacking due to incomplete documentation. Consequently, the use of research that includes interviews with the actors involved in the various phases, records searches in small cities, and unpublished dissertations and/or theses would be quite useful in order to shed light on unanswered questions regarding what was done up until 1989 (32).

Following a presentation of the historical perspective, the authors will discuss the rethinking of policies and actions to promote, protect, and support breast-feeding—policies and interventions which are currently being developed at the national and international levels—beginning with whether they have or have not been implemented, and if not, we describe some of the difficulties and possible obstacles to their full implementation. The influence of Brazilian policy and experiences on the decisions taken at international conferences and, likewise, the implementation of international recommendations in Brazil, is a subject that merits further debate and study by scientists and health managers. For the purposes of this chapter, as mentioned earlier, the discussion of the

process in Brazil will be divided chronologically into the 1970s and before, the 1980s, the 1990s, and the twenty-first century.

### THE 1970s AND BEFORE: CREATING AWARENESS OF BREAST-FEEDING BENEFITS

While there are no national population studies that document breast-feeding rates in the decades prior to the 1970s, isolated studies suggest that the practice of breast-feeding in Brazil reached an all-time low during the 1970s. A review of the National Household Survey corroborates this point, indicating that in 1975 the median breast-feeding rate for Brazilian women was 2.5 months (33).

A number of forces were in play during this period which either overtly or subtly discouraged the adoption of breast-feeding practices. These included:

(1) *Pediatricians with little knowledge of lactation management* (34): In previous decades, pediatricians routinely encouraged the use of feeding bottles and individualized infant formulas, fixed breast-feeding schedules, and the administration of water and tea between feedings, and they would especially prescribe the feeding bottle if they believed a child was not gaining weight as fast as it should, diagnosing the problem as “hypogalactia.”

(2) *Commercial promotion of breast-milk substitutes*: At the time, unethical advertising of infant milk and baby products (including baby bottles and pacifiers) were regularly featured in the global mass media, and the demand for these products was in part created through the use of clever labels featuring attractive, well-fed babies in pleasant surroundings. Breast-milk substitutes (at the time advertised as “like mother’s own milk”) were also marketed, using a variety of tactics including baby beauty contests, appealing advertising photographs, and the practice of supplying free milk products to the children

of pediatricians. Moreover, there was no incentive for pediatricians to promote the practice of breast-feeding at learning institutions specializing in childhood diseases and abnormalities, inasmuch as infant formula representatives had ready access to professors and students at these schools, a situation which proved its worth over time as a highly efficient and sustainable marketing technique (35).

(3) *Free distribution of powdered milk*: This practice was almost always carried out by the Government through what were known as supplemental food programs, in which mothers were entitled to receive powdered infant formula or whole milk beginning with the birth of the child. In 1979, there were nine such programs operating in the country (36). Distribution also took the form of surplus milk donations from producer countries—this practice was particularly widespread in the country's northeastern states and had the effect of causing the poorest sectors of the population to become dependent on the use of *mingau* (a kind of gruel-like substance prepared with flour and powdered milk) to feed babies; this phenomenon is well documented in an anthropological study by Nancy Scheper-Hughes (37). The question arises whether this "*mingau* culture" that became established in the 1970s is responsible for the low indicators of exclusive breast-feeding that continue to persist today in northeastern Brazil.

(4) *Rigid routines in maternity wards*: Newborns were kept in the nurseries (or neonatal intensive care units), and mothers were taken to these facilities to breast-feed their babies at specific times of the day. Nighttime feedings were not allowed. Maternity ward routines also included the use of feeding pauses after the birth of the newborn and the introduction of pre-lacteal fluids, the use of feeding bottles in the nursery, inadequate or inaccurate instructions, an excessive concern with hygiene of the nipples, and no guidance on how to latch and hold the baby for breast-feeding (38, 39).

In 1974, concern over premature weaning and the role of products that interfere with breast-feeding led Pernambuco's Minister of Health Fernando Figueira to ban feeding bottles and free milk in the state's health units and maternity hospitals.<sup>4</sup>

The first study to document improper marketing practices of breast-milk substitutes in Brazil appeared in 1977 (35). It described advertising techniques in use in lay journals dating back to 1916, as well as those which appeared in respected scientific journals such as *Pediatria Prática* and the *Jornal de Pediatria*. This study clearly demonstrates how mothers and pediatricians were being progressively influenced by subliminal messages idealizing the use of feeding bottles as easy and convenient—a practice pediatricians could manipulate to their own advantage by creating and then prolonging dependency by mothers on the feeding bottle's use.

By the mid-1970s, international attention had focused on a controversial report by South African journalist Mike Muller entitled *The Baby Killer* (40), which denounced the unethical promotion and sale of powdered milk products for infants in the Third World, particularly in poor rural African communities where high rates of child malnutrition and mortality presented a grave public health concern. This report was translated into Portuguese and was widely circulated in Brazil. Consequently, as part of the WHO Collaborative Study on Breast-feeding, the World Health Organization evaluated 15 companies, including Abbott-Ross, American Home Products, Wyeth, Borden, Carnation, Gerber, and Nestlé (41), who were believed to be engaging in deceptive promotional practices targeting physicians, retail businesses, and mothers of newborn children. The study shows conclusively that the majority of the companies wished to sidestep altogether the allegations placed before them, denied any wrongdoing, and in

<sup>4</sup>Decree No. 99, published 12 March 1974 in the *Diário Oficial de Pernambuco*.

many cases blamed the mothers themselves for misunderstanding and/or incorrectly using their products. Many company representatives also denied an interest in competing with or encouraging the substitution of their products for the practice of breast-feeding, noting that their marketing efforts stressed the use of their products only when breast milk was insufficient, and emphasizing, in their own defense, that as a response to the WHO study, these messages were further modified to stress that "breast milk is better but . . . when breast-feeding is not possible, [product X or Y] may be used with effective results if instructions are properly followed."

The information uncovered by this study served as a wake-up call and led international organizations to revisit their decision-making processes. For example, data collected in Ethiopia, India, Nigeria, and the Philippines shed light on the enormous availability of breast-milk substitutes marketed to mothers (e.g., 54 such substitutes were sold in the Philippines alone) and the high cost of these products (15 to 30% of per capita GDP in this same country).

In 1979, the Joint Meeting of WHO and UNICEF on Infant and Young Child Feeding was held, which included presentations on breast-feeding activities by participants and discussions among the international actors in the field who were already concerned with the widespread practice of early weaning. One of the recommendations from this event called for the drafting of a code of ethical behavior to guide the marketing of products which interfere with breast-feeding and encourage early weaning. The Brazilian delegation at the Joint Meeting was headed by the president of the National Food and Nutrition Institute (INAN), which collaborated on the preparation of such a code. The authors of this chapter feel that INAN's contribution to the drafting process greatly facilitated the launching in Brazil of its own national breast-feeding program, known as the PNIAM (*Programa Nacional de Incentivo ao Aleitamento Materno*), only two years later.

The work of the INAN team in preparing background material and preliminary documents which were eventually incorporated into the International Code of Marketing of Breast-milk Substitutes (ICMBMS) also had internal consequences, in the sense that it led the team to discuss wider strategies for addressing the country's own problem of early weaning. In 1980 INAN sought assistance from the Pan American Health Organization (PAHO) and UNICEF in the development of a breast-feeding promotional video designed to raise awareness and stimulate support among key actors, including politicians, public health authorities, the mass media, community leaders, and the church. The video included witness testimonies from well-known pediatricians and a special message by the country's president, João Baptista de Oliveira Figueiredo, and placed the value of breast milk within an economic context, appealing to viewers to consider the country's vast size and population, and the economic burden placed both on mothers and the country of artificial milk products. The video was shown in locales throughout the country, including to a gathering of Brazil's state ministers of health and social security, who pledged their collective support to the decision to implement the PNIAM.

The experiences of Brazil during this period strongly indicate that the emergence of a national political conscience in favor of breast-feeding, supported by arguments put forth at the international level by participants at the 1979 WHO/UNICEF Joint Meeting, provided an essential foundation in support of local programming activities (42). In this sense, the policy decision taken by Brazilian authorities in 1981 to launch the PNIAM—administered through cooperation among several government ministries and related agencies—might be viewed as a strategy that successfully capitalized on an international climate increasingly favorable to the promotion of breast-feeding. At the same time, the policy directly addressed the public health sector's concern with the country's

high early weaning rates and offered concrete scientific and economic evidence of the need for Brazilian mothers to return to the practice of breast-feeding.

### THE 1980s: BUILDING SUPPORT FOR A NATIONAL PROGRAM

A 1981 evaluation of breast-feeding conducted in the metropolitan areas of São Paulo and Recife revealed that the median duration of breast-feeding was 2.8 months and 2.4 months, respectively, which means that 50% of women breast-fed for less than three months (31). Given the earlier-presented 1975 census data finding that the median breast-feeding rate was 2.5 months, it became clear that breast-feeding rates in Brazil had changed little or not at all in the intervening six years.

In February 1981, the Government mandated INAN, through a specially named management team and technical work group, to coordinate the PNIAM.<sup>5</sup> The most salient activities undertaken during this time were: (1) the provision of national coordination and support for state- and community-level initiatives, (2) a mobilization of all key actors working in the field of breast-feeding, and (3) ensuring well-organized media campaigns. Consequently, an evaluation of the PNIAM conducted in 1986 found that in São Paulo the duration of breast-feeding had increased from 2.8 to 4.2 months, while in Recife it went from 2.4 to 3.5 months. And in Recife, exclusive breast-feeding, which had been extremely low in duration—only 15 days—climbed to an average duration of 32 days (31) when measured against comparable populations and instruments of data collection and analysis.

The social mobilization process, which began with nationwide presentations of the

video described in the previous section, was followed up with the first media campaign, with coverage by nearly 100 television channels reaching some 15.5 million families and 600 radio stations with a listening audience of approximately 20 million households. Four print media campaigns were also launched with the objective of attracting the support of well-known personalities with the ability to influence public opinion. In addition, over a period of 45 days, the slogan “Breast-feed your child for at least the first six months of life” was featured on some 10 million sports lottery tickets; household water, electricity, and telephone bills; personal bank account statements; and other similar types of commercial documents. Seventeen radio spots, each focusing on a different aspect of the disadvantages of early weaning, were developed and disseminated, and the scripts of these were also recorded for distribution via some 9,000 public address systems in use at formal and informal community gatherings. This phase of the campaign also included the printing of some 1.5 million instructional brochures for mothers and 400,000 pamphlets for health professionals, in addition to an illustrated breast-feeding training manual targeted to this latter group.

By the end of 1981, the goal of setting up an office in each of the Brazilian states, which could in turn coordinate the work of locally based agencies and other groups involved in the program, had been achieved. This success was largely attributable to the high profile role played by the Catholic Church, the literacy movement, mothers’ groups, and professional associations such as the Brazilian Federation of Gynecology and Obstetrics and the Brazilian Society of Pediatrics, the latter of which secured a place for the issue of breast-feeding on the agendas of its scientific congresses and related events, provided free space in the Society’s journal and other publications, and utilized its professional network to distribute more than 70,000 copies of print materials to its members.

<sup>5</sup>Established by Decree 10/02/1981, published in the *Diário Oficial da União*.

The exact number of events held during the social mobilization process, as well as the number of participants involved in their organization and mothers and other family members who directly benefited from them, will perhaps never be known. What is known is that prior to the social mobilization campaigns, uniform standards and methodologies related to breast-feeding were basically nonexistent, as were reliable instructional materials. Among the very few texts existing in Portuguese (albeit not formally published until a while later) was one by Murahovski et al. (43) based on a pioneering teaching project on breast-feeding in Santos.

With support from UNICEF, two national surveys were conducted. The quantitative survey provided the PNIAM with basic data—some of which have already been cited in this chapter—on the situation of breast-feeding in Brazil (34), and the qualitative survey sought to determine the most effective ways in which awareness campaigns in the future could reach mothers and health professionals with well-designed messages to counter early weaning practices.<sup>6</sup>

Following the PNIAM's launching, the Ministry of Social Security instituted a series of changes in hospital and delivery care policies, including that of a "rooming-in" policy which would allow mothers and their newborns to stay in the same room together. As noted earlier, prior to this time, maternity wards generally observed rigid routines which included physically separating the mother and child during postpartum care, using serum dextrose as a routine prelacteal food product, imposing specific times for breast-feeding, and other similar measures indicative of inadequate clinical lactation management (34). Thus, for its time, the adoption of a mother-child rooming-in policy represented an enormous departure from traditional health care practices.

Policies designed to protect breast-feeding practices began to emerge during the 1980s,

supported and strengthened by Brazil's approval of the ICMBMS at WHO's Thirty-fourth World Health Assembly in May 1981 and the Government's adoption of the Code as official law. Of particular concern were the problems of working mothers and the tangible benefits they and their young children could reap as the result of national regulations safeguarding their health.

Even prior to the national Code's adoption, and certainly more systematically once it took effect, infant milk product companies had fallen under intense pressure from advocates of the International Baby Food Action Network (IBFAN)<sup>7</sup> to modify infant formula labels and to halt their unethical marketing practices. The membership of the initial Brazilian IBFAN chapter, which began its activities in 1983, was small and perhaps for this reason, it was difficult for the group to monitor marketing practices in any comprehensive fashion. On the other hand, in light of IBFAN's international boycott on Nestlé infant milk products and the fact that this company held a virtual monopoly on sales of infant formula in Brazil, the country reaped indirect benefits, since Nestlé formula labels and its advertising techniques were modified here as well (44). Initially, this boycott was called off following a 1984 meeting in Mexico after Nestlé agreed to abide by the Code's requirements and was monitored closely for a period of six months by the International Nestlé Boycott Committee in eight different regions around the world.

Between 1982 and 1983, a second mass media breast-feeding promotion campaign was launched in Brazil. Building on the experiences of the 1981 campaign and mindful of findings emanating from the quantitative and qualitative surveys conducted that same year, the campaign included a strategic planning

<sup>6</sup>Unpublished data.

<sup>7</sup>A network of NGOs and individuals formed in 1979 in Geneva, Switzerland, for the purpose of defending breast-feeding from abusive marketing practices by manufacturers of breast-milk substitutes.



component.<sup>8</sup> Since the quantitative survey had shown that some 85%–90% of mothers initiated breast-feeding (34), the campaign was able to design well-targeted messages which, instead of urging women to merely breast-feed their newborns (such as would have been the case, for example, in the United States, where less than 60% of mothers initiated breast-feeding), encouraged women to *support the practice* in general, and, specifically, its *continuation*, through such slogans as “Breast-feeding: Keep it up; every woman can!” At the same time, in addressing the causes of early weaning, the campaign relied on information gathered from the qualitative survey, which revealed that women who believe their milk to be “weak” were prone to anxiety and thus to introduce early complementary feeding with the feeding bottle; other women feared their breasts would sag as a consequence of breast-feeding; while still others felt that working outside the home would preclude the possibility of being able to continue breast-feeding; and finally, some women believed in following the instructions of their pediatricians, whose formal training during this period had focused more on how to prescribe infant formula than on clinical lactation management and imparting this knowledge to their patients. Special messages responding to these concerns were incorporated into five television and radio public service announcements presented by popular Brazilian personalities of the entertainment industry, all of whom donated their time and fees to the campaign.

The country’s top three television networks ran these promotional spots during commercial breaks; they were also featured prominently in conjunction with Brazil’s most-watched television soap opera. This coverage reached an approximate viewing audience of half a billion in São Paulo and

169 million in Recife,<sup>9</sup> as well as similarly large numbers in other Brazilian cities. It is worth noting that during this period, there was no advertising of infant formula; on the other hand, commercials for Nestlé baby food were frequently broadcast, as were those for a variety of feeding bottles and artificial nipples; also seen sporadically were commercials for the locally produced Ninho brand of fluid milk used in the preparation of homemade infant formula.

Campaign planning activities also included the distribution of a breast-feeding promotional background kit to print journalists, whose interest in the topic resulted in the publication of 78 articles in popular magazines between 13 February and 27 March 1983 in 25 Brazilian cities.<sup>10</sup>

In the months following the second campaign, a series of events occurred. In December 1983, weakened coordination prompted the Ministry of Health to rescind the program status of breast-feeding promotion interventions, including them instead as activities within the *Ações Integradas de Saúde* (Integrated Health Actions) structure. On the other hand, between 1984 and 1986, a number of breast-feeding promotional activities continued to be organized at the level of the individual Brazilian states. During this same period, UNICEF also began shifting its priorities toward the GOBI (Growth, Oral Rehydration, Breast-feeding, and Immunization) primary child health interventions.

In 1985, INAN and the Fernandes Figueira Institute of Rio de Janeiro worked together to found a number of human-milk banks (HMBs), which prior to this time, had existed in only a handful of the country’s hospitals.

At the international level, a milestone in the history of breast-feeding took place in 1986, when the Thirty-ninth World Health Assembly issued a resolution to clarify Article 6 of the ICMBMS. It stated that “Since the

<sup>8</sup>Erica Witte, member of the public relations team responsible for the campaign, in a videotaped speech entitled “Breast-feeding: Who Wins, Who Loses” (IBFAN, Brazil, 1989, directed by S. Afran).

<sup>9</sup>Castelo Branco Media Department, undated document.

<sup>10</sup>Jelliffe EFP, Jelliffe DB. The Brazilian National Breast-feeding Program. 1983 trip report.



large majority of infants born in maternity wards and hospitals are full term, they require no nourishment other than colostrum during their first 24–48 hours of life . . .” and that “only small quantities of breast-milk substitutes are ordinarily required to meet the needs of a minority of infants in these facilities, and they should be available in ways that do not interfere with the protection and promotion of breast-feeding for the majority.” The resolution urged WHO Member States to “ensure that the small amounts of breast-milk substitutes needed for the minority of infants who require them . . . are made available through the normal procurement channels and not through free or subsidized supplies.” Finally, in reference to formulas then being marketed for children over 6 months of age, the resolution noted: “the practice being introduced in some countries of providing infants with specially formulated milks (so-called ‘follow-up milks’) is not necessary.”

The final years of the 1980s represented a period of renewed program coordination and the final stages of activity implementation by various technical committees whose work had focused on specific breast-feeding issues since the PNIA’s inception. Accordingly, in 1987, primary emphasis was placed on the ICMBMS Committee, the Human-milk Bank Committee, the Committee on Working Women, the Education Committee, and the Community Committee. The results were decisive and in 1988 laid the foundation for at least four breast-feeding promotion policies: in December, Brazil approved its own version of the ICMBMS, known as the Marketing Regulations for Infant Feeding Products (NBCAL), and issued a comprehensive government directive establishing the operating requirements for the country’s HMBs. Another landmark achievement for the breast-feeding promotion movement was the incorporation into the new Brazilian Constitution of two new benefits in support of breast-feeding: the right of workers to four months of maternity

leave in order to facilitate exclusive breast-feeding, and the right of fathers to five days of paternity leave in order to provide support during the critical period following the mother and child’s release from the health care facility and return home.

In May 1988, the Ministry of Health issued a series of regulations regarding health standards for HMBs and providing for technical training of staff at these facilities. The regulations also transformed the first of the country’s HMBs, established at Rio de Janeiro in 1943, into a national reference center responsible for coordinating the development and surveillance of HMBs. It is also worth noting that the coordinating team, beyond merely establishing HMBs for local collection, processing, and storage of breast milk for distribution to needy newborns, also utilized these facilities as centers for breast-feeding promotional activities. Over time, many of the HMBs came to be known as Breast-feeding Promotion Centers and continue to operate under this name until today, utilizing and reinforcing the same philosophy under which they were originally created.

In 1989, WHO and UNICEF drafted a document that today plays a crucial role in all programming activities for work in the areas of prenatal care and the initiation and continuation of breast-feeding. The Joint WHO/UNICEF Statement on Protecting, Promoting, and Supporting Breast-feeding: The Special Role of Maternity Services (45) set out a series of recommendations entitled “Ten Steps to Successful Breast-feeding,” which together summarize the essential measures to be taken by health care facilities. These include the preparation of a written breast-feeding policy and training of all staff for the policy’s implementation. Following this training, health care providers would be responsible for informing all pregnant women about the benefits and management of breast-feeding; helping mothers to initiate breast-feeding within half an hour of birth; showing them how to breast-feed and how to maintain lactation even if they should

be separated from their infants; facilitating 24-hour rooming-in of mother and child; encouraging breast-feeding on demand; discouraging the use of bottles, artificial nipples, and pacifiers; and fostering the establishment of breast-feeding support groups and referral of mothers to these following their hospital or clinic discharge. Inasmuch as there were no international guidelines in place during this period for the training of personnel on breast-feeding practices and prenatal and delivery routines, the WHO/UNICEF initiative filled a very important vacuum in the community of public and private health care professionals.

### THE 1990s: GLOBAL POLICY FUELS LOCAL ACTION

The earlier-cited meta-analysis conducted by Feachem and Koblinsky in 1984 (3), as well as the Victora et al. study (4), both clearly demonstrating the significant boost to health afforded to children by mothers who had exclusively breast-fed them during the initial months of life, had been widely disseminated in Brazil by the early 1990s. By this time, the message regarding the benefits of breast-feeding was very clear: exclusive breast-feeding (i.e., feeding with breast milk exclusively and no other liquids, including water or tea) from birth through 4 to 6 months of age protected children against diarrheal diseases, respiratory infections, and other infectious diseases. This knowledge, as reflected in the literature of this period, could now be used as the fulcrum for creating new indicators, recommendations to physicians, messages to mothers and their families, and indeed for retooling the organic content of breast-feeding promotion programs themselves.

At the close of the 1980s, and armed with this new knowledge, authorities at WHO, UNICEF, and a variety of bilateral and technical organizations came together to formulate a strategy that would take stock of the various determining factors interfering in the

practice of exclusive breast-feeding and would revisit programs that had been particularly effective in promoting the practice. As a result of this effort, the Interagency Group on Action on Breast-feeding (IGAB) was created. The IGAB promoted a series of specific technical meetings with the objective of gaining better insight into how these determining factors function. Meetings were organized to focus on such topics as health services and hospitals; mothers' and community groups; training, communication, and education; the ICMBMS; and the situation of the working woman, the latter of which was held in Brazil in March 1990. This process culminated with the production and adoption of the Innocenti Declaration on the Protection, Promotion, and Support of Breast-feeding by participants at the WHO/UNICEF policymakers' meeting on "Breast-feeding in the 1990s: A Global Initiative" held in Florence, Italy, on 30 July–1 August 1990. Among those invited to share their experiences in the development of breast-feeding promotion programs were Brazil and the president of INAN.

Why is the Innocenti Declaration important? In contrast to previous international documents that had been produced by health authorities, it was the fruit of a long and highly participatory process of analysis and resulted in clearly defined goals and operational targets to be reached by the countries over the next five years. Essentially, the Declaration recommends supporting and promoting the decision of women to exclusively breast-feed during the first four to six months of the child's life and to continue breast-feeding with appropriate and adequate complementary foods for up to 2 years of age or beyond. The Declaration recommended four primary strategies to achieve these ends by the year 1995: (1) the appointment of a national breast-feeding coordinator of appropriate authority and the establishment of a multisectoral national breast-feeding committee composed of relevant government entities, NGOs, and health professional associations; (2) ensuring that every health facility providing maternity services fully practiced all

of the WHO/UNICEF-recommended “Ten Steps to Successful Breast-feeding”; (3) taking the necessary action to give effect to the principles and aim of all articles of the ICMBMS and subsequent relevant World Health Assembly resolutions in their entirety; and (4) enacting “imaginative legislation” protecting the breast-feeding rights of working women and establishing the adequate means for its enforcement.

It is important to note that at the time of the Declaration, exclusive breast-feeding was recommended for the first four to six months of life, as there had been no well-developed studies conducted to document the effects of an exclusive diet of breast milk during the entire first six months of life in terms of adequate child growth and nutrition, nor had the benefits of such breast-feeding been recognized in terms of child morbidity/mortality and the health of the mother. Or, said another way, the great majority of revolutionary research findings regarding the benefits of breast-feeding to the child (3–12) described in this chapter’s Introduction did not emerge until later on during the 1990s, and much of the information regarding the positive effect of breast-feeding on the mother’s health (13–26) is even more recent. For these reasons, the recommendation of exclusive breast-feeding for the first six months of life (i.e., versus four) came about only after a 2000–2001 literature review of over 3,000 references (2) and a WHO technical evaluation on the subject (1).

In September 1990, the World Summit for Children, attended by heads of state and government, representatives from a variety of United Nations agencies, and a large number of international NGOs, was held in New York City. In the area of nutrition, the goals established for the decade called on governments to guarantee the “empowerment of all women to breast-feed their children exclusively for four to six months and to continue breast-feeding, together with complementary food, well into the second year”; guarantee by 1995 that 50% of hospitals attending

1,000 or more childbirths per year receive Baby-friendly Hospital certification; and to end the practice of distributing breast-milk substitutes at health service facilities (46). These goals were also designed to facilitate work on reaching year-by-year targets, and this process, in turn, provided feedback on how well the PNIAM was working toward the achievement of all its goals and indicated areas requiring special efforts.

In Brazil, the 1990s were a time characterized by the ongoing implementation and consolidation of actions that had been previously underway, but more importantly, by the large-scale training of health professionals and the initiation of other supporting and awareness-raising activities, such as the Baby-friendly Hospital Initiative (BFHI), commemoration of World Breast-feeding Week, the Friendly Postman Breast-feeding project (described later on in this section), the Firefighters for Life project (described in this chapter’s section on the twenty-first century), and a series of breast-feeding surveys.

In 1991, WHO and UNICEF launched the BFHI in an effort to transform practices in maternity hospitals worldwide and to facilitate breast-feeding by ensuring that women in maternity care have full information and support to breast-feed their infants in an environment free of commercial influences. Health facilities seeking BFHI accreditation were required to follow the organizations’ “Ten Steps to Successful Breast-feeding” guidelines, the most stringent of which was that they were “under no circumstances [to] provide breast-milk substitutes . . . free of charge or at low cost.” The Initiative created the very first international evaluation referent solely for hospitals, which contributed to the humanization of maternal and child public health care (47).

In March 1992, the Ministry of Health, working through the PNIAM/INAN and the *Grupo de Defesa da Saúde da Criança*, and with technical and financial support from UNICEF and PAHO, began taking the initial steps to implement the BFHI in Brazil.

In June 1994, the Ministry of Health<sup>11</sup> standardized the public hospital accreditation process for Baby-friendly Hospital (BFH) certification. In 1996, the PNIAM added five additional requirements for BFH hospital certification to be used as indicators to measure the quality of maternal and child health care at the given facility. To the best of the knowledge of the authors of this chapter, Brazil is the only country in the world that requires a pre-evaluation phase of compliance with the “Ten Steps to Successful Breast-feeding” guidelines, the fulfillment of additional requirements as part of the Baby-friendly Hospital certification, and is also the only country, as far as the authors have been able to ascertain, that provides financial incentives to certification as a Baby-friendly Hospital (48).

The certification process is relatively straightforward, yet thorough. A hospital seeking BFH status must first fill out a self-evaluation questionnaire, the request for which must be initiated by the pertinent health authorities. Immediately thereafter, these authorities send an evaluator certified by the Ministry of Health at the state level to conduct a pre-evaluation of the hospital and then present an analysis of the findings. When the results of the hospital’s pre-evaluation are deemed to be acceptable, the evaluator will recommend that the Ministry conduct a comprehensive evaluation of the hospital, to be carried out by two independent, certified evaluators from outside the area where the hospital is located. The results of the comprehensive evaluation are then forwarded to authorities at the Ministry of Health’s breast-feeding coordination unit for final analysis and dissemination of the results. As previously noted, hospitals wishing to receive BFH certification must first comply with all of the “Ten Steps to Successful Breast-feeding” by fulfilling at least 80% of the extended global criteria established by

WHO and UNICEF for each of the 10 steps. Once a hospital has completed the certification process and has satisfactorily met all the necessary criteria, it receives a placard bearing a reproduction of Pablo Picasso’s 1963 painting *Maternité*, which is the international symbol and logo of the BFHI. In most instances, a special commemorative ceremony is organized in which the placard is awarded by the pertinent local and federal authorities to the hospital (48, 49).

In the event that the institution in question does not meet the criteria of a given stage (i.e., the pre-evaluation or comprehensive evaluation), it is provided guidelines to assist it in achieving compliance with that stage, and a new timeframe is then established for the next evaluation.

In 1999, seven years after the BFHI’s implementation in Brazil, questions arose regarding the quality, effectiveness, and sustainability of this strategy. In response to this situation, the Ministry of Health reevaluated 137 Baby-friendly Hospitals, which accounted for 90% of the total 152 BFH-certified institutions operating in the country at the time (50). Given that no suitable standardized instrument for BFH reevaluation existed at the time, the hospital pre-evaluation instrument was used instead. The study identified some compliance-related difficulties regarding the BFHI “Ten Steps,” especially Step 5 (“Show mothers how to breast-feed and how to maintain lactation even if they should be separated from their infants”), followed by Step 10 (“Foster the establishment of breast-feeding support groups and refer mothers to them on discharge from the hospital or clinic”) and Step 2 (“Train all health care staff in skills necessary to implement this policy”). The Ministry of Health’s BFHI reevaluation revealed that 92% of the 137 hospitals continued to comply with the “Ten Steps” at the desired level of quality, thus ensuring the right of children to have access to breast milk. The reevaluation process proved to be essential as a means for verifying the BFHI’s effectiveness and conti-

<sup>11</sup>Decreets # 1.113 and 155.

nunity, thus guaranteeing that the actions taken were helping to achieve the expected results and objectives and were identifying areas requiring adjustment, which, in turn, helped health services further the PNIAM's overarching objectives.

In 1992, the Mother and Child Institute of Pernambuco, located in the city of Recife, was the first hospital to receive BFH certification. Subsequently, four hospitals were certified in 1993, followed by eight more in 1994—or double the number of the previous year. In 1995, the number of BFH-certified hospitals tripled to 26. In 1996, a total of 39 hospitals were certified, whereas in 1997 there were only 16, due to a sharp drop in applications for comprehensive hospital evaluations. In 1998, another 20 hospitals received BFH certification, followed by 26 more in 1999 (48). In that same year, the results of a hospital reevaluation caused one Baby-friendly Hospital in the state of Rio Grande do Norte to lose its accreditation. Perhaps Brazil's vast size and the BFH's strict evaluation criteria can help explain the slowdown in BFHI hospital certification, which fell off in 1997 after the addition of the five new certification requirements. A 1998 study conducted in 45 noncertified maternity hospitals located in São Paulo revealed that about one-quarter of the public hospitals and one-third of the private hospitals failed to comply with any of the BFHI's "Ten Steps." Only two public hospitals had adopted at least seven of the "Ten Steps." The study concluded that practices detrimental to the initiation and establishment of breast-feeding, such as separating the mother and baby after childbirth and the widespread use of infant prelacteal products and supplements, continued to be observed frequently—and at high levels—in São Paulo area hospitals (51).

If new maternity hospitals had continued to be certified at the rate seen in 1995, Brazil would have likely had on the order of 400 BFH-certified hospitals by 2000. At 1990s' World Summit for Children, the country had committed itself to the goal of BFHI certifica-

tion of up to 50% of its hospitals with obstetric beds and more than 1,000 births per year by 1995 (48). Yet, given the enormous number of maternity hospitals in Brazil, maternal and child health advocates knew even then, at the time of the Children's Summit, that the country, in realistic terms, would most likely achieve this goal for closer to 15%, versus 50%, of the hospitals in the country. Consequently, planning in this regard had to be readjusted, as will be discussed in the next section of this chapter.

Concerned that the policies agreed upon at the beginning of the 1990s and the crucially important goals related to them might not be implemented—not only in Brazil but in other countries around the world as well—UNICEF, various NGOs (IBFAN, La Leche League, the International Lactation Consultant Association, and Wellstart International, among others), and leading breast-feeding experts and maternal and child health advocates came together to create the World Alliance for Breast-feeding Action (WABA) in February 1992. This coalition proved instrumental in mobilizing the participation of key groups and individuals during World Breast-feeding Week (WBW), celebrated each year during the first week of August, who in turn utilized the opportunity to highlight and reinforce a variety of messages regarding such issues as the BFHI, the situation of working women, education on the importance of breast-feeding, and the ICMBMS. Today in Brazil, WBW is celebrated in communities large and small throughout the country, thereby fulfilling in letter and spirit the social mobilization role for which the commemoration was originally created (52).

Prior to 1995, WABA served as the coordinator of activities commemorating World Breast-feeding Week, after which time the Ministry of Health took over the production of all campaign materials, gearing them to adhere to WABA's specific international theme chosen for each year's observation. As part of the activities of the 1996 WBW, a part-



nership known as the Friendly Postman Breast-feeding project was established with the postal service, initially in the state of Ceará. By 1999, the Ministry had implemented this project in nine states of the northeast. As part of the initiative, letter carriers receive training from health units to enable them to answer basic questions related to breast-feeding. At the beginning of WBW and continuing throughout the entire month, they wear specially designed yellow vests emblazoned with promotional messages and distribute an informational booklet to the homes of expectant mothers and those with young children along their delivery routes (53).

In the mid-1990s, WHO and UNICEF launched a set of four training courses on breast-feeding targeting different populations: an 18-hour course on "Baby-friendly" certification for hospital teams; an 80-hour training course for facilitators of breast-feeding courses; a 40-hour counseling course for those who have direct interaction with mothers and babies; and a 12-hour awareness-raising course for health care managers and supervisors. All of these materials were translated into Portuguese at the initiative of the Brazilian IBFAN network and were subsequently used by the Ministry of Health.

By the late 1990s, human resources training had become one of the most important activities of the PNIAM. Stemming from management efforts initiated in 1998, planning was based on well-defined goals and resources, which included reevaluating the effectiveness of the various components supporting the PNIAM, including WBW, BFHI-related training, and compliance with ICMBMS, among others. Outgrowths of these activities included a training course for HMB personnel and another on NBCAL, the Brazilian version of the ICMBMS, offered by IBFAN members. This high level of activity resulted in the training of more professionals between 1998 and 2002 than at any other time previously in the history of the PNIAM.

Public health authorities responsible for the surveillance of proper food labeling and

advertising, personnel working in the field of consumer protection, and staff of the attorney generals' offices at the state level were all invited to undergo NBCAL training. These training courses were held between 1999 and 2000, and included a practical compliance monitoring component, which, for the first time, provided the Ministry of Health with data that would allow it to determine levels of compliance with NBCAL by the baby foods and products industry in its advertising and marketing of baby foods, pacifiers, artificial nipples, and feeding bottles.

The 1999 National Survey on the Prevalence of Breast-feeding, carried out by the Ministry of Health in all the Brazilian state capitals and in the Federal District, analyzed a sample of 48,845 children under 1 year of age. The results of this study showed that during the first month of life, 53.1% of children in the areas studied were breast-fed exclusively, whereas rates of exclusive breast-feeding fell off sharply thereafter, down to 9.7% in the interval between 151 and 180 days. With regard to the timely use of complementary feeding (breast milk with the addition of complementary foods between 6 and 9 months of age), 48.9% of the children studied received complementary feeding at the appropriate time. In the 9- to 12-month age group, only 44.2% of children continued to be breast-fed.<sup>12</sup>

### THE TWENTY-FIRST CENTURY: RESPONDING TO THE REMAINING GAPS

Since 1999, and with support of a legal consultant from the Office of the Attorney General of the Federal District, the Ministry of Health has opened an ongoing dialogue with the baby foods and products industry and has established fines and other punitive measures to be applied to those companies found in violation of any of the articles of

<sup>12</sup>Ministry of Health, unpublished data, 1999.



NBCAL, which are considered as law. This coordination among governmental entities signified a critical juncture in and of itself, in the sense that it pointed out the need to revise the NBCAL a second time (its first revision had been in 1992). The Code was reformed between 2000 and 2001, and resulted in the publication of new, more comprehensive and detailed decrees. Following publication of the second revision of NBCAL, in 2002, the Ministry of Health, in conjunction with the IBFAN network, developed an updated course to prepare new trainers and to provide refresher training for food safety inspectors and public health professionals.

Baby-friendly Hospitals accreditation, which had fallen to its lowest point in 1997, perhaps due to the addition of the five new requirements, subsequently experienced a recovery and then an upward trend. In 2001 the Ministry of Health decided to implement a program of systematic reevaluations of Baby-friendly Hospitals<sup>13</sup> every three years, to be performed by Ministry-certified external evaluators applying a reevaluation instrument that had been developed by UNICEF for this purpose.

Planning efforts designed to speed up BFH accreditation in Brazil included development of a 42-course intensive training program on the BFHI, in which 1,819 health administrators and unit managers from 859 hospitals and maternity wards in 24 states participated between 2000 and 2002 (50). The training series culminated with the drafting by trainees of a specific plan of action for the implementation of the BFHI at the hospitals under their responsibility. Approximately one year following the training, participants would then meet with local Ministry of Health personnel and technical experts to discuss and complete a special written form based on the "Ten Steps to Successful Breast-feeding" and the country's five additional BFH requirements. By ascertaining whether each of the steps and

requirements had been achieved, partially achieved, or not achieved, participants were better able to focus on specific compliance-related difficulties, which in turn facilitated a process of mutual support and joint problem-solving (50).

In 2002, an additional 57 hospitals received BFH certification, which by December of that year brought the total number to 258 Baby-friendly Hospitals distributed among 24 Brazilian states. That year also marked the highest number of BFH certifications secured to date, an achievement most likely due, at least in part, to the positive role played by the training and follow-up meetings between hospital administrators and unit managers with the BFHI review teams. Meetings of this type were held in 18 different states and proved their ability to help accelerate the BFH certification process by providing valuable feedback and support to hospital administrators and unit managers for overcoming the remaining obstacles in their path to official certification (50).

There is no uniform geographical distribution of Baby-friendly Hospitals in Brazil, perhaps due to varying degrees of motivation among the regional teams and their level of organizational capacity. However, according to a 2003 study, the highest concentration of BFHs is found in the country's northeast, where 48% of hospitals have received certification, followed by the southeast (17%), the south (17%), central-west (13%), and north (5%). Of these hospitals, 47% are public, 34% are philanthropic, 9% are private, 8% are teaching hospitals, and 2% are military (50).

The same study revealed that only 163 of the 630 hospitals with more than 1,000 child-births per year had BFH certification, equivalent to 26% of the goal set for 1995. Of Brazil's 27 states, only seven were able to meet that goal. The other states did not achieve certification of 50% of their hospitals with more than 1,000 childbirths per year until December 2002. This study underscored the need to rethink strategies and plan new types of interventions. Neverthe-

<sup>13</sup>Ministry of Health Decree No. 29 of 22 June 2001.

less, for a number of reasons that have not yet been sufficiently analyzed, certification dropped off in 2003 and 2004: only 290 hospitals had received BFH certification by the end of 2003, and only 300 by July 2004. In other words, considering that in 2004 there were more than 3,000 hospitals with maternity beds in the country, less than 10% of the country's maternity hospitals had received BFH certification.

The growth of the network of HMBs, which currently number 160, has been remarkable in recent years, especially due to team monitoring and training in all parts of the country. Each year, there are approximately 44,500 preterm and 187,000 low-birthweight babies born in Brazil (i.e., more than 230,000 babies), in addition to those born with various other types of conditions, including children of HIV-infected mothers (the latter currently representing less than 1% in Brazil). During 1999 alone, the HMBs benefited approximately 100,000 children, while in 2000 some 60,000 registered donors gave on the order of 79,000 liters of breast milk. Despite these numbers, this network still has much work to do in order to meet ongoing demand, even though home collection of donations of surplus milk has increased significantly in states where the Firefighters for Life project has been implemented. In this project, firefighters receive training to encourage the donation of surplus breast milk, answer basic questions, and offer advice to donor mothers on problems associated with breast-feeding, such as proper hygiene for the extraction and storage of breast milk donated to HMBs. In 1997, of the 12,203 liters of breast milk collected in one Brazilian state, 8,242 liters were collected by local fire stations (50). In 2002, the Ministry of Health organized the first-ever nationwide seminar for Firefighters for Life, which included the participation of firefighting managers from every corner of the country. One objective of the gathering was to raise awareness among firefighters and encourage firehouses in every state and com-

munity to adopt and participate in the project. Just as the popularity of these community partnerships increases, there is a growing need to evaluate their impact at the local, state, and national levels.

Premature or low-birthweight babies born to HIV-infected mothers can receive pasteurized milk from the HMBs; however, due to current supply constraints, no pasteurized breast milk is available for such babies when they are of normal birthweight or born to term. Consequently, Brazil's HIV/AIDS policy on the feeding of these newborns recommends no breast-feeding and the use of infant formula distributed by the Government free of charge through the first six months of the child's life and thereafter the use of distributed whole milk.

Since 2001, efforts have been stepped up to encourage countrywide participation by local branches of the national postal service in activities held in conjunction with World Breast-feeding Week. In 2002, nearly 23,400 letter carriers received training on how to effectively communicate basic messages regarding the importance and advantages of breast-feeding to family households along their regular mail routes. As in the case of the initiatives utilizing the country's firefighters, the impact and scope of those involving the postal service remain unevaluated to date (53), even though these activities have shown promising initial results. During 2002 it was estimated that some 3.4 million expectant mothers and children under 1 year of age benefited from them.

Between 2001 and 2002, the Ministry of Health launched a new breast-feeding promotion project, entitled the *Iniciativa Unidade Básica Amiga da Amamentação* (Friends of Breast-feeding Health Units Initiative) or IUBAAM, as a means of promoting, protecting, and supporting breast-feeding through the country's basic health units, with the end-goal of each adopting the precepts of the BFHI's "Ten Steps to Successful Breast-feeding." This initiative is yet another activity that the basic health units, in conjunction

with hospitals, can undertake to consolidate breast-feeding as a universal practice, and at the same time it enables them to make their own significant contribution to the health and well-being of the mothers and babies under their care. The "Ten Steps to Successful Breast-feeding of the IUBAAM" were developed on the basis of a systematic review (54) that included experimental and quasi-experimental interventions conducted as part of prenatal care and during the monitoring of the mother and baby, and proved to be an effective tool for extending the duration of breast-feeding. While based on the BFHI "Ten Steps," the IUBAAM version substitutes Step 4's hospital version ("Help mothers initiate breast-feeding within half an hour of birth") with "Listen to the concerns, experiences, and doubts of pregnant women and mothers regarding the practice of breast-feeding, and strengthen their self-reliance," and Step 7's 24-hour rooming-in hospital practice with "Instruct nursing mothers on the lactation amenorrhea method and other contraceptive methods compatible with breast-feeding."

IUBAAM implementation, in addition to providing benefits for mothers and children accessing care from the basic health care network, will also strengthen Brazil's BFH-certified hospitals, inasmuch as basic health units with "Friends of Breast-feeding" certification can become references for the hospitals, in terms of complying with Steps 3 ("Inform all pregnant women about the benefits and management of breast-feeding") and 10 ("Foster the establishment of breast-feeding support groups and refer mothers to them on discharge from the hospital or clinic") of the BFHI. As earlier mentioned in this chapter, the 1999 BFH reevaluation brought to light difficulties in compliance by hospitals with several of the steps. If implemented properly as an official Government program, the Ministry of Health and breast-feeding consultants feel that the IUBAAM initiative (operating in only one Brazilian state as of the writing of this chapter) and the ongoing BFH

certification process can serve as mutually beneficial reinforcing agents in consolidating the achievements to date of Brazil's PNIAM.

## THE FUTURE OF BREAST-FEEDING

As the world approached a new millennium and the Innocenti Declaration its 10th anniversary, the international organizations community recognized the need to revisit the goals of the Declaration and, in 2002, to rethink what became known as the Global Strategy for Infant and Young Child Feeding.<sup>14</sup> The foundation of this strategy is the reaffirmation of the Declaration's basic tenets; i.e., the need to promote, protect, and support exclusive breast-feeding for six months as a global public health recommendation and to seek optimal ways in which to introduce safe and appropriate complementary feeding, without interruption of breast-feeding, until at least the second year of life or beyond. The strategy also encompasses the great challenge of the first years of this century, which is how to implement these two recommendations for groups with special needs, including HIV-infected mothers; families living in emergency situations, such as natural disasters, famine, and civil unrest; families living in refugee settings; and mothers and their children facing other types of exceptionally difficult circumstances.

Some organizations have already stepped up to this challenge: WHO and UNICEF have developed a counseling course on infant feeding for HIV-infected mothers; whereas UNAIDS, WHO, and UNICEF have prepared materials on HIV and infant feeding, how to approach breast-feeding and breast-milk substitutes in emergency situations, and practical advice and tips on complementary feeding.

In Brazil, messages and policies to promote exclusive breast-feeding for the first six

<sup>14</sup>Approved as Resolution 25 at the Fifty-fifth WHO World Health Assembly, May 2002.

months of life have been available and in force for more than 10 years. Consequently, the Brazilian Government was able to take decisive action to help ensure adoption of a WHO resolution urging countries to protect, promote, and support exclusive breast-feeding for six months as a global public health recommendation at the Fifty-fourth World Health Assembly in 2001, inasmuch as the country had proven conclusively that the prevalence of exclusive breast-feeding can be increased. National surveys confirmed an increase of nearly 10 times in the prevalence of exclusive breast-feeding from 0 to 4 months of age, which was approximately 3.8% in 1986 and had increased nearly 10 times by 1996 (55), with rates reaching 35.6% in the country's state capital cities during 1999.<sup>15</sup>

Taking into account the successes and shortcomings of the national breast-feeding program over the last few years and the need to continue to improve exclusive breast-feeding rates, the thrusts of the PNIAM in the immediate and medium-term future will include: to continue to support and strengthen the numerous breast-feeding advocacy and promotional initiatives underway at the community, state, and national levels; to transform the focus in professional health training and practice toward baby-friendly care of newborn infants and to encourage still-uncertified hospitals to strive to achieve BFH status as soon as possible; to provide support to ensure that all current BFHs maintain their certification in the future; and to improve support for breast-feeding programs at the primary care level through efforts oriented toward universal implementation by basic health units of the IUBAAM initiative. As family health teams and community health promoters, our challenge will also be to evaluate the role of the numerous interventions discussed in this chapter in achieving the dramatic tenfold improvement in exclusive breast-feeding rates over the past two decades, as well as to mea-

sure the relative impact of each on the national rates of child morbidity, mortality, and physical and mental development. The authors of this chapter believe that an evaluation of this type is long overdue and one that would, at the same time, yield a clear blueprint for future actions, validating the extensive efforts carried out by different individuals and institutions on this issue to date and providing clear answers to those who still question the crucial role of breast-feeding in protecting and improving integral maternal and child health.

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<sup>15</sup>Unpublished Ministry of Health data, 1999.



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# THE BEST BUY PROJECT IN PERU: NUTRITION RECOMMENDATIONS WITHIN THE CONTEXT OF LOCAL URBAN MARKET REALITIES

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## SUMMARY

In an attempt to address the food and nutritional insecurity of low income population groups living in peri-urban areas of Lima, Peru, a project was designed, developed, and implemented between the years 1991 and 1993. At that time, individuals belonging to this population segment were facing the devastating effects of hyperinflation on their family economies, with a progressive reduction of their purchasing capacity which, in turn, affected their accessibility to basic food sources.

The project was implemented by the Peruvian Institute of Nutritional Research (*Instituto de Investigación Nutricional*, or IIN) utilizing an extended partnership between grassroots organizations of community kitchens (known as *comedores populares*), the mass media, the private sector, and international cooperation agencies. It consisted of the identification, through a periodic surveillance of prices, of the foods that provided the most cost-effective units of energy and protein based on current food prices in local markets. These foods became known as the “best buy” foods and were used to design and develop nutritionally sound recipes through a fully participatory process with members of the *comedores populares*.

Nutrition messages were also developed to promote recipes incorporating “best buy” foods. Recipes and messages were disseminated through the mass media and in face-to-face educational activities. After five months of implementation, the project was evaluated and showed significant rates of exposure to the dissemination and education activities, recall of recipes and messages, and use of the promoted recipes.

This project demonstrated that it is possible to improve the accessibility to and proper use of foods by low income populations living in peri-urban areas through an innovative strategy that captures the values given to foods by people. The basic conceptual method of the project is also being applied by the Pan American Health Organization (PAHO) in other types of initiatives to face the overweight and obesity epidemic in the Region of the Americas.

## BACKGROUND

The dramatic growth of cities in the developing world over the past decades has brought with it the challenge of widespread

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urban poverty. The global average rate of urbanization is expected to surpass the rural one by 2005 (1). Urban rates per region are predicted to reach 83% in Latin America and the Caribbean, 53% for Asia and the Pacific, and 55% for Africa by the year 2030.

Efforts to address the unique problems associated with urban poverty have been quickly surpassed by the rate of poverty growth in urban areas. The problems of the urban poor have become increasingly more pressing, including the issues of how this population segment can secure an adequate livelihood and the ways in which sufficient family income affects key indicators of human welfare, such as food security and nutrition. Food security is the basic right of all people to have access to the food they need. Food security exists when all population groups, at all times, have physical and economic access to sufficient, safe, and nutritious foods which meet their food preferences and dietary needs for an active and healthy life. Ensuring food security and appropriate nutrition of the urban population—and in particular of the poorest households—has become a major challenge worldwide.

Following migration to urban areas, traditional food habits shift towards urban models using different, ready-to-use, and affordable foods. Food insecurity and inadequate food practices, combined with unhealthy living conditions, lead to a high prevalence of malnutrition, where under- and overnutrition, frequently accompanied by micronutrient deficiencies, increasingly coexist. This, in turn, has a negative impact on urban development by diminishing people's capacity to work and diverting resources to health care (2). However, issues of food security and nutrition associated with urban poverty have garnered either little, or misleading, attention from decision- and policymakers (3).

Food and nutrition security in urban areas is a function of availability, accessibility, and the proper use of foods. Making foods available for the growing millions of people living in cities is a tremendous logistical challenge.

It is a huge task to feed a city of several million people, or even of several hundred thousand, who require many tons of food each day. This requires much coordination among producers, transporters, market managers, and retailers who work in stores, on the street, and in open-air markets. However, nutrition experts have reported that, on average, the availability of food is adequate in Latin American countries (4).

People living in urban areas are heavily reliant upon purchasing foods in the local markets. Low resource urban dwellers usually experience difficulties in purchasing adequate amounts of food to meet their needs and preferences. Most, if not all, of the food consumed in cities must be purchased, and poor families can spend as much as 60–80% of their income on food. However, due to low family income and high market prices, many urban households are unable to meet their own needs; an important nutrition gap between socioeconomic groups is expressed by more malnourished children and increased consumption of lesser-quality foods in the lowest income brackets of households in urban Latin America (4).

Not only is proper nutrition very difficult when little money is available for food; this problem is compounded when the skills to effectively use available resources are limited. Several efforts have been made to understand how food security is affected within the context of urban poverty, how poor families behave in market economies, and what impact this behavior has on their nutrition and health. A longitudinal study conducted in poor peri-urban districts of Lima (5) from 1972–1973 and 1979–1980 found that economic changes in Peru—an increase in food prices between these time periods averaging 12.66 times and a decrease in family income—affected the daily diet composition of families. These changes are summarized in Table 1 and represented a decreased intake of animal protein, fat, calcium, and riboflavin. In spite of these dietary changes, the study reported no significant al-

**TABLE 1. Observed changes associated with economic changes in food selections by low income families, 1979–1980 vs. 1972–1973.**

| Food        | Increased intake | Same intake | Decreased intake |
|-------------|------------------|-------------|------------------|
| Meat        |                  |             | ✓                |
| Milk        |                  |             | ✓                |
| Eggs        |                  |             | ✓                |
| Fish        | ✓                |             |                  |
| Cereals     | ✓                |             |                  |
| Fried foods |                  |             | ✓                |
| Legumes     |                  | ✓           |                  |
| Vegetables  |                  | ✓           |                  |

teration of children's anthropometric indexes, suggesting that families could make appropriate nutritional adjustments even under adverse economic circumstances.

Adapting feeding behavior according to the availability and accessibility of foods in urban markets has also been reported recently in other contexts. In Maputo, Mozambique, where the urban poverty rate is around 60%, only a small portion of the urban poor have access to land to grow their own food. In 2002, shortages in maize production increased the price of this product; the Institute of Statistics reported that food made up more than 60% of the average family's total expenditure and that poor households were eating more rice than usual due to the sharply rising prices of maize (6).

The skills used to adapt poor families' diets to negative economic changes have limitations when the magnitude and speed of these changes are exceptionally high, affecting urban food security in the poorest households. From 1988 to 1990, Peru experienced an economic crisis of unprecedented proportions that caused the price indexed of goods to increase by 5,900 times (7). According to an unpublished study, poor families increased the percentage of income set apart for food purchasing from 57% to 68.8%; despite this adjustment, the percentage of poor households that did not fulfill their daily energy requirements increased. During this period, government food donation programs were also affected, reducing their coverage by 68% from 760,000 to 245,000 individuals (8).

*Comedores populares*, or community kitchens, have played an important and traditional role in diminishing the impact of economic crisis on low income families in Peru. They first arose as a survival strategy among groups of residents as marginal settlements grew around the country's major urban areas during the 1960s and 1970s. The peri-urban zones occupied by these rural migrants lacked such basic infrastructure as water, sewage, health services, and education. The precarious nature of these living conditions compelled the new inhabitants to organize themselves to secure and provide the missing services. Women formed Mother's Clubs, and some of these clubs began buying food in bulk and preparing meals as a group to feed their families.

The Peruvian Government provided foods, funds, and basic equipment to these groups. Some NGOs channeled additional food funded by international cooperation agencies, but mostly helped to develop the capacity of the *comedores populares* by providing opportunities for women to access credit and obtain training in administration, management, food preparation, and nutrition. Among the outcomes, different studies found an improved self-esteem and a sense of empowerment among the women, as well as strengthened social connections among friends and workers. Over the long term, these program elements contributed to broader community and economic development, particularly through the women's empowerment and increased confidence in their abilities. The kitchens multiplied and eventually became a major channel for distributing food to the urban poor (9).

However, the *comedores populares* were not exempt from the effects of the economic crisis of the 1980s. An assessment of the nutritional value of their meals found deficiencies in energy in half of the *comedores* studied (10), strongly suggesting that the previously observed capacity to adapt the diet of poor families to the urban market context had become greatly diminished under the severe

crisis conditions. Some interventions were designed and implemented by NGOs to help the *comedores populares* by providing information on the nutritional value of their meals, resulting in a maintenance of appropriate energy and protein content despite the high inflation rate during the intervention period (11).

## THE BEST BUY PROJECT

Taking into account this background, the Peruvian IIN designed and implemented the Best Buy Project.<sup>2</sup> The purpose of the project was to contribute to the improvement of nutrition among low income peri-urban families. The goal of the project was to improve the performance of the *comedores populares* by encouraging them to purchase foods in a more cost-effective way. The project's strategy was to provide updated information on the foods that were the most affordable sources of energy and protein based on current market prices, as well as nutrition education activities.

### Extended Partnership and Commitment

The project was financed by the Canadian Cooperation in Peru initiative (*Fondo de Contravalor Perú-Canadá*) and lasted three years. Multiple partnerships were established for the implementation process. Memorandums of understanding were signed between the IIN and 247 *comedores populares* from Lima's peri-urban districts of San Juan Miraflores, Chorrillos, Puente Piedra, and El Agustino; these documents clearly described the mutual responsibilities for the project's implementation.

The country's largest private bank, the *Banco de Crédito del Perú*, agreed to partici-

pate by financing the production of project messages and recommendations and disseminating these through the mass media and the company's branch offices throughout the country. The leading media outlets, including national television channels, radio stations, and newspapers, provided free time or space for the dissemination of the project's messages and recommendations.

### Project Methodology

The project used a participatory strategy to facilitate the construction of practical, viable, accessible, and acceptable recommendations as a result of the convergence of applied nutritional knowledge; the existing community knowledge, values, and culture; and the use of appropriate technology. This strategy was implemented in the following steps (12):

**Baseline assessment:** The purpose of this formative study was to provide critical information for the design and refinement of the project's implementation. Different qualitative research techniques were used. A survey of *comedores populares* was conducted to gather information on the most commonly used foods, knowledge and attitudes on nutrition, and media exposure; focus-group interviews of the *comedores populares'* cooks were carried out to identify the values and reasons behind specific food selections; in-depth interviews of the *comedores populares'* leaders allowed the project's staff to familiarize themselves with the logistics of the various organizations, including all the steps involved in the purchasing of food and supplies; and finally, observation of food preparation permitted the identification of cooking techniques and tips. The main results of the assessment were:

**Commonly used foods:** A list of preferred foods was developed, allowing the food database to be used by the project to be re-

<sup>2</sup>Project Directors: Hilary Creed-Kanashiro and Bruno Benavides. Key project staff: Sofía Madrid, Graciela Respicio, Dora Herrera, and Rocío Leon.

duced to a manageable size. A complementary list of the most-used local markets was also prepared and utilized for price surveillance.

*Values behind food selection:* The most valued food attributes were, in order of importance, taste, economy, volume, and easiness in cooking.

*Exposure to media:* Radio was the most prevalent form of media used by the members of the *comedores populares*. A list of the radio stations most frequently listened to was developed and used for the dissemination of messages.

*Cooking techniques:* It was observed that for half of the days, the menus were deficient in energy, while protein content was deficient in three out of four observation days. An important finding was that a similar nutritional content of the *comedores'* menus could be obtained with 70% of the money actually spent by *comedores*.<sup>3</sup> A significant observed difficulty was the ability to scale a recipe initially designed for a family into one that could be used in a *comedor*; oftentimes, the initial proportions were altered, especially in recipes involving meats and eggs.

*Continuous local prices surveillance:* Based on the list prepared of preferred foods, the corresponding prices of these were gathered periodically from the list of preferred local markets. At the beginning, the surveillance was carried out on a weekly basis. After some months, it became clear that the variation in prices was small, and the frequency was thus changed to every two weeks. The initial intention was that members of *comedores populares* would gather the price data, but the leaders of these subsequently asked to be relieved of this duty because of their numerous other responsibilities. The proj-

ect staff then assumed surveillance activities themselves, using standardized forms specially developed for this purpose. The forms included the date of surveillance, the district, name of the market, and a table in which the food names were entered in the first column, and the second and third columns included blank fields for the unit of purchase and the price per that unit, respectively. Two markets per district were collected each time, allowing an average price of the foods per unit of purchase to be obtained, and thus representing a broad picture of prices in the low income peri-urban local markets of Lima.

*Identification of the "best buy" foods:* Using the Nutrient Contents Table of Peruvian Foods developed by the IIN and the actual average price of food in local markets, a specially designed software calculated the price of each unit of energy and protein for each food. The formula used was as follows:

*First step:* calculation of the price of food gross 100 g

$$Pg = \frac{p \times 100}{u}$$

where:

Pg = price of food gross 100 g

p = price per unit of purchase

u = unit of purchase in grams

*Second step:* calculation of the price of the food's net weight (Fnw)

The price of food gross 100 g was assigned to the food net weight. For example: *jurel's* (a Peruvian type of fish) gross 100 g represents *jurel's* net 65 g, in consequence:

$$Pn = \frac{Pg \times 100}{Fnw}$$

where:

Pn = price of food net 100 g

Fnw = food net weight

<sup>3</sup>Creed H, Benavides B, Madrid S, Respicio G, Herrera D, León R. Informe Final, Proyecto "La Mejor Compra." Instituto de Investigación Nutricional. Lima: 1992.

*Third step:* calculation of the price of a nutrient’s unit

$$P_{un} = \frac{Pn}{N}$$

where:

P<sub>un</sub> = price of one nutrient’s unit

N = number of nutrient’s units contained in 100 g of food

Once the price of each unit of nutrients was calculated, foods were then sorted in ascending order, based on each’s price of energy (kcal) and protein units. The foods with the most economical price units of energy and protein were identified as the “best buy” and were selected for recipe development and testing.

The analysis of 30 months of price surveillance in local markets also provided valuable information (Table 2). A group of foods produced in the country was consistently in the top of the analytical efficiency list of foods. A second group of foods, which included imported foods or those using imported supplies in their production, never appeared in the “best buy” positions. A third group was formed by foods with moves to the “best buy” positions following a seasonal pattern. The fourth group included foods that moved up and down the tables according to subsidy policies. Other foods showed no specific pattern.

*Recipe design:* Two techniques were used for this purpose.

*Successive filters:* The project staff designed recipes using the list of “best buy” foods for energy and protein, based on a sound nutritional combination of food groups. These combinations were:

- CEREAL + BEANS,
- CEREAL + BEANS + ROOTS,
- CEREAL + BEANS + FISH, and
- CEREAL + ROOTS + FISH.

The designed recipes were tested in a first filter, which consisted of reading the recipe ingredients and cooking procedures to members of the *comedores populares*. Using only their perception of taste, price, volume, and easiness in cooking, the testers selected or rejected recipes.

The recipes that were selected were then tested in a second filter, which consisted of cooking the recipes and offering them to members of the *comedores populares* during focus-group interviews, in which the recipe’s actual appearance and taste were tested. Again, recipes were accepted or rejected.

Those accepted were finally prepared by the *comedores populares* themselves, and their members were subsequently interviewed to verify whether or not the recipes had satisfied them and their relatives at home.

**TABLE 2. Observed patterns of efficiency reported after 30 months of food price surveillance.**

| Group 1: Always “best buy”   | Group 2: Never “best buy”                    |
|--|--|
| Cereals: rice, local wheat, cornmeal   | Meats: beef, poultry, eggs, seafood, viscera |
| Legumes: soy beans, local bean varieties, peas, lima beans, soy flour        | Dairy: milk powder, evaporated milk, cheeses |
| Fish: <i>jurel</i> , <i>lorna</i> , <i>merluza</i> (local varieties of fish) | Roots: yellow potato                         |
| Sweets and oils: sugar, shortening, mixed oils                               | Legumes: chickpea                            |
|  | Fruits and vegetables                        |
| Group 3: Seasonally “best buy”   | Group 4: “best buy” when subsidized          |
| Roots: white potato, yellow sweet potato, cassava                            | Cereals: wheat flour, wheat noodles          |
| Meats: giant squid   |  |



*Recipe fairs:* The list of “best buy” foods were also shared with cooks in the *comedores populares*, who were invited to provide suggestions as to how to prepare recipes with these foods, based on the above-mentioned combinations of foods, and then were allowed to improvise and apply their own experience and skills. Each *comedor* suggested a number of recipes in each food combination. Then the cooks short-listed these by combination using the criteria of taste, price, volume, and easiness of cooking, and finally each *comedor* selected one that would represent them in a recipe fair. During the fair, the participating *comedores* prepared their selected recipe in an exhibition and offered samples to the other participants; they also shared the recipes’ ingredients and cooking techniques.

*Recipe dissemination:* The designed, tested, and approved recipes were then disseminated. The dissemination included the ingredients and their amounts, the cooking techniques employed, and the nutritional values of each recipe. Indications of the recipe for special needs were highlighted; for example, those with important quantities of iron were promoted as useful in the prevention and treatment of anemia.

Four elements were kept in mind during the dissemination process: the recipes should be attractive and acceptable, the cooking techniques should be easily understood, the target population should feel that the recipe is useful in addressing their specific needs, and they should be strongly encouraged to try the recipes.

The recipes were disseminated using the following media:

*Face-to-face education activities in the comedores populares:* Project staff visited each participating *comedor* on a regular basis to provide the newly developed recipes and loan support to nutrition education activities. The project designed a poster and a special recipe book which

highlighted the best recipes designed by the *comedores populares*, according to the above-mentioned four elements. On average, each participating *comedor* received 5.2 visits during the project’s three-year duration.

*Recipe fairs:* This activity was also used for recipe development, as mentioned above. Selected *comedores* prepared recipes using their own newly created recipes and shared these with other *comedores*. Cooking techniques and nutritional information were important components of this exchange.

*Mass media:* Recipes, lists of “best buy” foods, and nutritional recommendations were disseminated using a special weekly 30-minute program broadcast during prime time on the country’s largest television channel; a total of 163 programs were produced and aired. Two additional television stations disseminated the recipes and messages as part of each’s highest-rated daily news program. The two most important radio stations in the country also disseminated the recipes and messages on a daily basis; 1,220 radio programs were produced and disseminated. Finally, four newspapers sharing a significant readership also participated by disseminating a daily space dedicated to promotion of the recipes and messages, totaling 557 articles.

## Project Results

A survey in probabilistic samples of households, participating *comedores*, and nonparticipating *comedores* was conducted five months after the launching of the dissemination of the project’s recipes and nutritional recommendations. The survey was carried out between 10 a.m and 2 p.m. In the case of households, the person in charge of cooking during the survey day was interviewed. In the case of *comedores*, one cook was randomly selected among the cooking team on the survey’s day.

Four variables were studied: exposure to the mass media campaign; recall of the project's recipes following media exposure; reported use of the project's recipes, i.e., when the interviewee reported the preparation of at least one recipe, at least one time, as promoted by the project; and the observed use of the project's recipes, i.e., interviewers requested to see the recipe that was being used or that had already been prepared at the moment the survey was carried out. This last variable was only explored in both types of *comedores*.

The following were the reported findings of the survey,<sup>4</sup> which are also presented in Figure 1:

**Exposure:** Sixty percent of the interviewed households, 70% of the participating *comedores*, and 57% of the nonparticipating *comedores* reported that they had seen, listened to, or read about the Best Buy Project and/or its messages. The high exposure was attributed in part to widespread television coverage. These differences were not statistically significant.

**Recall:** Among those who reported positive exposure to the mass media campaign, 58% of the households, 87% of the participating *comedores*, and 77% of the nonparticipating *comedores* recalled at least one project recipe. The recall was significantly higher in both types of *comedores* when compared to households.

**Reported use:** Participating *comedores* reported a significantly higher use of at least one project recipe (76%) than nonparticipating *comedores* (11%) and households (40%).

**Observed use:** Twenty-two percent of the participating *comedores* were preparing a project recipe during the day they were surveyed, in comparison with 7% of nonparticipating *comedores*. This difference was statistically significant.

## Discussion

The evaluation showed that the project achieved its goal of improving the selection of foods by *comedores populares* and hence contributed to the improved accessibility by low resource families participating in these grassroots organizations to adequate foods. The basic concept of the "best buy"—to obtain better nutrition at the lowest possible market price—has enabled scientific knowledge to become better attuned with the needs and expectations of low income urban families and create a feasible, relevant, and low-cost appropriate technology solution to address the accessibility to and proper use of foods in urban contexts.

The results also showed the important contribution of the mass media in communicating the nutritional messages of the project and in facilitating the promotion of its goals. The use of the project's recipes was, however, much higher when face-to-face activities were also in place, highlighting the latter's contribution to the achievement and sustainability of effective behavioral change.

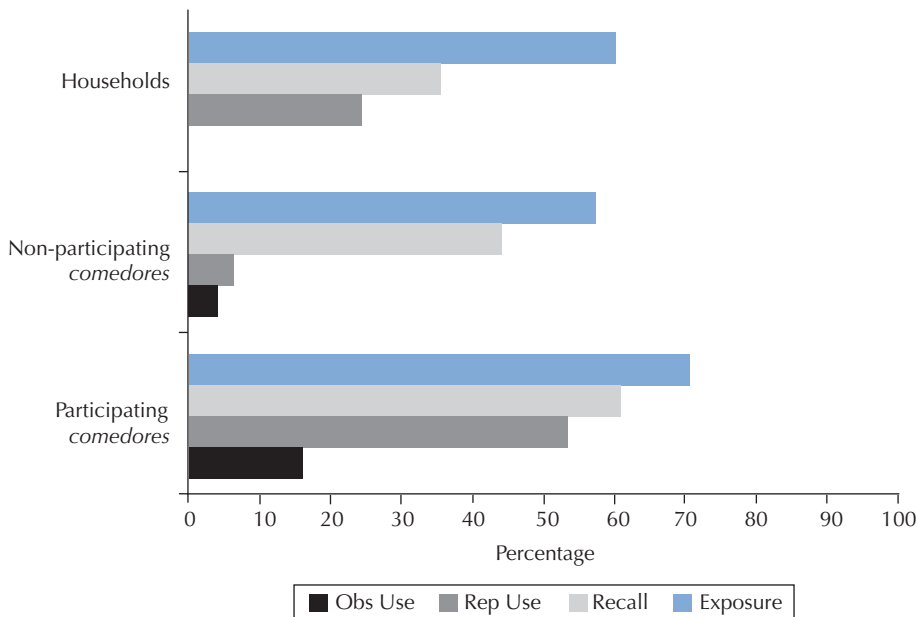
The results of the surveillance analysis are important because they provide policymakers with valuable information regarding the potential impact of specific policies on the availability and accessibility of foods in urban contexts. It should be noted that the Best Buy Project was focused on improving the accessibility to energy and protein sources, which explains why fruits and vegetables were never an efficient purchase option. Thus, the analysis did not include other micronutrients.

## Other Applications of the "Best Buy" Concept: the Planut<sup>®</sup> Nutritional Planner

Poverty in urban settings, even in affluent societies without problems of accessibility and availability, is associated with low intakes of fruits, vegetables, and dairy products, resulting in deficient levels of vitamins, minerals, trace elements, and fiber (13). Not

<sup>4</sup>Benavides B, Creed H, Jacoby E, Madrid S. Reporte de Evaluación de "La Mejor Compra." Instituto de Investigación Nutricional. Lima: 1991.

FIGURE 1. Results of the Best Buy Project.



all socioeconomic conditions that facilitate weight gain faced by poor families are under their control (14). Consequently, poor families are affected by the paradoxical combination of undernutrition and obesity.

Children from poor families are more likely to suffer from obesity than the general population (15–17). In addition, over the past two decades, obesity has increased among children (18), especially those from poor families (15, 17). Other studies have also documented that food insecurity has a paradoxical association with overweight status among women, resulting in a potentially increased incidence of obesity-related chronic diseases (19).

The software Planut® Nutritional Planner has been designed, developed, and disseminated through the Region of the Americas, and it is being used by a variety of professionals and institutions, facilitating the implementation of PAHO's recommendations for weight gain prevention and obesity control (20).

An important conceptual upgrade of Planut® is that the focus of attention has been

shifted from nutrients composition to the dietary balance of food groups. Planut® is based on a series of dietary guidelines prepared by the Countrywide Integrated Non-communicable Diseases Intervention Program of the Regional Office for Europe of the World Health Organization (21), which are consistent with recommendations already included in most of the national guidelines prepared by PAHO Member Governments in the Region of the Americas.

One of the strengths of Planut® is the use of existing food composition tables from 14 countries of the Region, facilitating its wider use by professionals throughout the Americas. However, the use of these tables may impose limitations on actual application, since most of the tables contain insufficient information on some important nutrients, such as fat composition breakdown including cholesterol and other micronutrients. In view of this reality, it would seem imperative that national efforts to update the nutrition information included in their country composition tables receive increased priority and support, since in many cases these tables

were developed at a previous point in time when there existed a different paradigm of the given population's nutritional needs.

During the development of the tool, another important pitfall of the information available for consumers was identified. While the current nutritional guidelines are oriented to the promotion of a balanced combination of different food groups, the nutrition information included in product labeling only includes data on nutrient composition with no information on the proportion of different food groups in the processed food. As a result of this deficiency, all processed foods were removed from the nutrition composition tables to ensure that users of Planut® will receive only reliable and accurate information. New improvements in providing nutrition information to consumers will necessitate changes in food labeling requirements that include detailed information on food group composition.

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# AGITA SÃO PAULO: ENCOURAGING PHYSICAL ACTIVITY AS A WAY OF LIFE IN BRAZIL

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## BACKGROUND

The lack of regular physical activity, also known as a sedentary lifestyle, has been considered one of the most prevalent and worrisome public health problems in recent years. It is a risk factor associated with the development of the principal noncommunicable diseases. Various epidemiological studies have demonstrated very clearly that the risk physical inactivity poses to health is greater than that of known factors, such as tobacco use, high cholesterol levels, high blood pressure, and overweight (1, 2). In the United States, data on sedentary lifestyles disseminated in 2003 by the Centers for Disease Control and Prevention (CDC) (3) showed that the prevalence of physical inactivity between 2000 and 2001 in this country was 27%; in that period, the percentage of those who met physical activity and health recommendations increased from 26.2% to 45.4%.

In the Region of the Americas, the prevalence of this risk factor has not been clearly established because, until recently, there existed no single and universally accepted instrument for evaluating physical activity levels that would have made it possible to obtain regional figures of reference. However, data from different countries in the Americas show that more than 50% of the

population is irregularly active; in other words, this group does not engage in physical activity at the minimum recommended frequency of five days a week, 30 minutes per day (4). In some countries in the Region, the prevalence of sedentary lifestyles is nearly 60%. In Chile (5), according to the First National Survey on Quality of Life and Health of 2000, the percentage that engages in fewer than 30 minutes of physical activity three times per week (regarded as sedentary by this criterion) was a noteworthy 91% of the population.

Some of the studies analyzed by Jacoby, Bull, and Neiman (6) in Brazil, Chile, and Peru clearly show that more than two-thirds of the population of these countries do not meet the recommendations for the frequency of physical activity needed to obtain health benefits. Results from studies conducted in Bogotá, Colombia, place the rate of physical inactivity at 79% of the population, and only 5.25% of individuals regularly engage in physical activity (7). These studies also indicate that women practice physical activities less frequently than men and that physical

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activity decreases as chronological age increases (8). Another significant result is the fact that physical inactivity differs according to socioeconomic level. People at the lowest socioeconomic levels present the greatest risk of being physically inactive (9). Therefore, older adults, women, and individuals at lower socioeconomic and education levels are at greater risk of being physically inactive and, by extension, of developing noncommunicable diseases.

However, it should be pointed out that the problem of sedentary lifestyles is not exclusive to developing countries. Indeed, a recent study conducted by Vaz de Almeida (10) found that the risk for physical inactivity was greater in countries such as Portugal (9.15), Belgium (4.6), Italy (4.25), and Greece (4.21), and that the countries with the most physically active populations in Europe were Austria, Finland, and Sweden. According to this same study, the proportion of adults who engage in three hours or less of recreational physical activity is 57% in the United States and 83% in Portugal.

Scientific information from the last few decades clearly demonstrates the beneficial relationship between physical activity and health. Epidemiological data show that physical activity plays an important role in the prevention, control, treatment, and rehabilitation of the principal noncommunicable diseases, such as obesity in adults (11, 12) and in children and adolescents (13), hypertension (14), diabetes (15), stroke (16), cardiovascular disease (17, 18), myocardial infarction (19), osteoporosis and hip fracture (20), and cancer (21), in addition to the reduction of inflammatory markers for noncommunicable diseases (22) and of mortality from any cause (23, 24). The positive effects derived from regular physical activity may be categorized as follows:

- (1) Physiological/biological: weight and body fat control and loss, preservation of lean muscle mass, blood pressure control, improvement of blood lipid

profiles, blood glucose control, increase in cardiovascular and respiratory capacity, and either maintenance of or decreased loss of bone mass (1).

- (2) Psychosocial: increase in self-esteem and self-image; reduction of depression, stress, and insomnia; reduction in consumption of medicines; and greater socialization (25).
- (3) Cognitive: better results on attention, memory, and reaction time tests and overall cognitive performance (26); and decreased risk of Parkinson's disease (27), dementia (28), senile dementia, and Alzheimer's disease (29).
- (4) Industry and employment: reduction in labor turnover; improvement of institutional image; and reduction of medical care costs, job absenteeism, and work-associated stress (30).
- (5) School: improvement in academic performance and in relationships with parents and teachers; reduction in absenteeism and of behavioral disorder risks; prevention of juvenile delinquency, alcoholism, and substance abuse; and increase in sense of responsibility (31, 32).

In Brazil, the first data on physical inactivity in the municipality of São Paulo showed a prevalence of sedentary lifestyles of some 60% in men and 80% in women (33). Data following the national census of 1996 and 1997, as analyzed by Monteiro and colleagues (9), showed that barely 13% of the population engaged in at least 30 minutes of physical activity in their leisure time on one or more days weekly, and that only 3.3% carried out the minimum daily recommended amount of at least 30 minutes five times per week.

Another important point with regard to physical activity and its impact on public health is the cost of sedentary lifestyles to health plans. Garrett and colleagues (34) estimated that nearly 12% of total medical expenditures related to depression and anxiety,



and 31% of expenditures related to colon cancer, osteoporosis, coronary disease, and stroke, are attributable to physical inactivity. The costs these diseases represented to one U.S. medical insurance company of over 1.5 million members were US\$ 35.3 million for cardiovascular diseases (the most costly), with the overall estimated cost of physical inactivity totaling US\$ 83.6 million; that is, US\$ 56 per member.

The Center for Physical Fitness Laboratory Studies (CELAFISCS), which receives advisory services from the CDC, calculated in 2002 the direct cost of physical inactivity to the public health care system of the state of São Paulo. The initial data indicated that the cost associated with physical inactivity between 2001 and 2002 was approximately US\$ 37 million. In light of this finding, as well as others regarding the high prevalence of noncommunicable diseases—with cardiovascular diseases being the leading cause of morbidity and mortality—the Ministry of Health sought to create an incentive program for the regular practice of physical activity as a way of maintaining, improving, recovering, and achieving the highest possible level of health for the residents of São Paulo.

The purpose of this chapter is to describe the experience of a pioneering program to promote physical activity in Latin America, Agita São Paulo, considered by some experts in this field (6) to be one of the most exemplary initiatives developed to date for the promotion of active lifestyles in the Region of the Americas.

First, this chapter details the emergence of the program, its structure and objectives, and the messages it has utilized, and then describes the new and innovative strategy proposed to combat sedentary lifestyles through the adoption of the so-called mobile ecological model (35), which takes into account individual and environmental factors in the promotion of physical activity. This chapter describes the educational materials developed by the program as well as a series of mega-events used to mobilize the population

and raise collective awareness regarding the importance to overall health and well-being of engaging in regular physical activity. It also includes a summary (Table 3) of the best practices selected by governmental entities, civil society, and private enterprises to promote physical activity. As will be seen, the inherent flexibility that characterizes the majority of the components of Agita São Paulo ensures their adaptability to a number of other communities throughout the Region and around the world. Finally, the chapter concludes with the presentation of a series of indicators regarding the impact of Agita São Paulo on the population's physical activity levels and on its knowledge of the health benefits accrued from observing a more active lifestyle. It also describes the formation of international networks to promote physical activity, such as the Physical Activity Network of the Americas (PANA) and Agita Mundo, which seek to spread the momentum and spirit of Agita São Paulo and other programs like it beyond state, national, and continental borders.

## CREATION AND STRUCTURE OF THE AGITA SÃO PAULO PROGRAM

In 1995, the leadership of CELAFISCS, an institution widely recognized within and outside Brazil for more than two decades of contributions in the field of sports and physical fitness, set out to discover new ways to promote physical activity. Taking into account the most recent paradigms of health promotion and a large body of scientific evidence indicating a strong link between the observance of physically active lifestyles and a reduction in the risk of morbidity and mortality from noncommunicable diseases—particularly cardiovascular diseases—CELAFISCS seized upon the idea of promoting physical activity as a cornerstone in the achievement, improvement or recovery, and maintenance of optimal levels of overall health and well-being among the population.

Existing data on the high prevalence (70%–80%) of physical inactivity in the state of São Paulo—and particularly among the lower income sectors—called attention to the need to implement interventions for individual behavior change and to reduce the prevalence of sedentary lifestyles. In this context, the minister of health of the state of São Paulo at the time asked CELAFISCS to develop a statewide program to promote physical activity.

An initiative of this scope faced two important challenges. First, only limited information was available on the promotion of physical activity in developed countries, and, second, the target population was enormous. The state of São Paulo has 34,752,225 inhabitants spread across 645 municipalities covering an area of 248,808 km<sup>2</sup>. The capital city, São Paulo, has more than 10 million inhabitants (with 16,446,000 inhabitants living in the metropolitan area) and constitutes one of the world's largest urban concentrations.

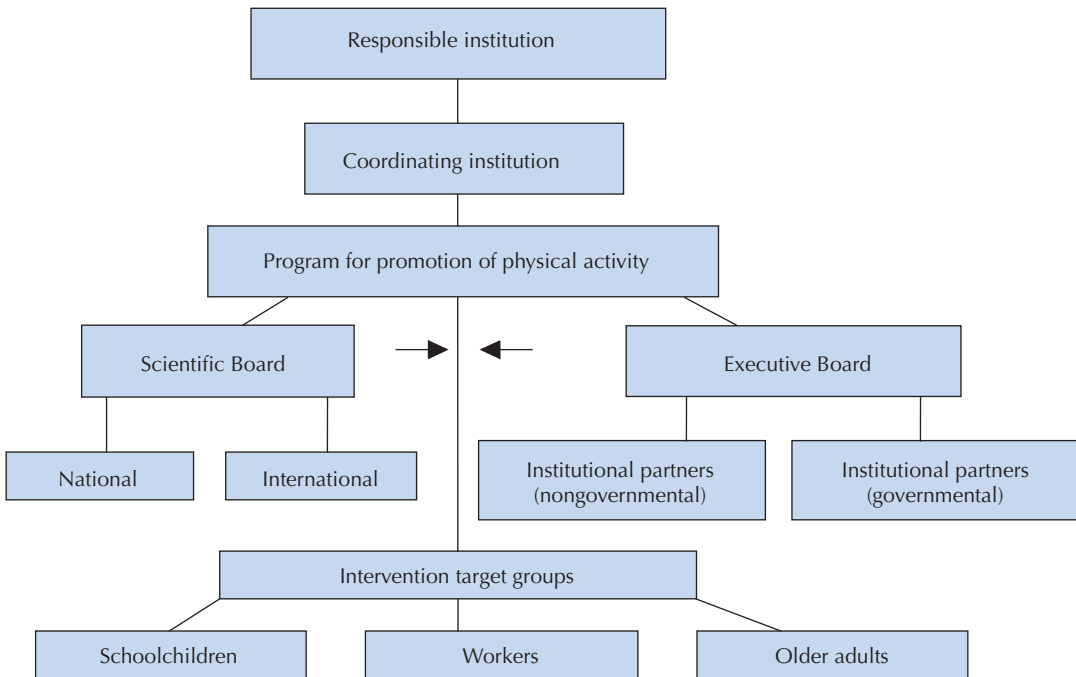
The program planning process lasted two years and included consultations with the Pan American Health Organization (PAHO), the CDC, the Department of Health Education of the United Kingdom, the Cooper Institute and Cooper Aerobics Center (Dallas, Texas), and a variety of other programs to promote physical activity from Australia, England, and Finland. CELAFISCS prepared the program's logical matrix, which outlined the scientific basis for the need to promote physical activity among the population, as well as the program's objectives, beneficiaries, overall strategy, actions, expected results, and means of evaluation. Following the preparatory phase, *Agita São Paulo* was launched in December 1996. The initiative had the support of various state governments, nongovernmental organizations, and the private sector, and was officially established by the state's governor in February 1997.

The name of the program was selected after two years of consideration and with the assistance of marketing consultants. *Agita* is a Portuguese word that means more than just

to move the body; it also suggests energizing the mind and seeking energy, movement, and motion during one's leisure time. Indeed, the program calls on its target audience to develop a mindset prioritizing the pursuit of active lifestyles to improve their overall health and sense of well-being. The program's logo consists of a clock in which the placement of its hands serves as a reminder of the need to undertake 30 minutes daily of moderately intense physical activity. The clock is called the *Meia-Horito* (Little Half Hour) and was incorporated into all the program's promotional and educational materials. Later on a female version—the *Meia-Horinha*—was introduced, as well as other family members—two children and a pet puppy.

From the beginning, *Agita São Paulo* sought to establish a unique identity distinguishing it from other efforts to encourage the practice of sports and physical activity in the country. It saw in the formula of partnership formation the possibility of consolidating its own identity and ensuring the program's sustainability and success over time. Figure 1 presents a diagram of *Agita São Paulo*'s functional organization. CELAFISCS, the program's central coordinating body, receives partial financial support from the Ministry of Health of the state of São Paulo, under which there are two committees or boards. The Executive Board consists of partnered governmental and nongovernmental institutions from civil society, while the Scientific Board is comprised of renowned national and international experts whose knowledge helps to ensure the theoretical soundness of the strategies and evaluation techniques adopted by the program.

Forging intellectual partnerships with other national and international initiatives was a key strategy in the program's development. This dynamic was further strengthened by close linkages with governmental, nongovernmental, and private sector agencies, who could then all work together on a single program with a common objective. In addition, a select group of Brazilian and non-

**FIGURE 1. Organizational structure of scientific and executive-level partnerships.**

Brazilian professionals with extensive expertise in the field of physical activity and its promotion were invited to meet with the organizers of Agita São Paulo and to become members of an international scientific board.

The Executive Board, overseeing the work of more than 300 partnered institutions, was given responsibility for analyzing the organization, execution, planning, and performance of the gamut of initiatives underway to disseminate Agita São Paulo's message. Various social sectors are represented on this Board, including education, health, sports, industry, trade, and services (36). Program actions are geared principally toward the three population groups at greatest risk of physical inactivity: schoolchildren (children and adolescents), workers (young economically active men and women), and older adults (those over 60 years of age).

Regular meetings of the Executive Board guarantee the continuity of program activities and are held on the first Tuesday of every

month (except in January), always at the same time (from 2:00 p.m. to 4:00 p.m.), and always in the same place (the Ministry of Health). Since 1997, between 45 and 60 representatives from the partner institutions have taken part in these meetings. During the meetings, actions and strategies to promote physical activity are presented and discussed, and activity schedules are exchanged to encourage the participation of and strengthen opportunities for linkages among the program partners. The Executive Board is also responsible for publishing *Agita News*, a monthly newsletter highlighting the activities of all the Board's partners carried out in the state capital of São Paulo and in other municipalities of São Paulo, as well as at the national and international levels (represented by the Physical Activity Network of the Americas [PANA] and *Agita Mundo*, to be discussed at the end of this chapter). *Agita News* is delivered in person to the representatives participating in the monthly meeting and is

sent by e-mail to the program’s partner institutions and to the national scientific advisers. It is also available to all interested parties on the program’s Web site ([www.agitasp.org.br](http://www.agitasp.org.br)).

With regard to program structure, it should be noted that the intersectoral balance between the Executive and Scientific Boards, and the intrasectoral balance, in particular, have yielded very positive results. For example, when backing was obtained from the Industrial Federation, it was clear that support should also be solicited from the Chamber of Commerce, and when support from the Lions Club was garnered, backing from the Rotary Club was also obtained. The same strategy was used in academic circles and consisted of encouraging federal, state, and private universities to become involved in the initiative.

Another innovative strategy was to strengthen existing programs by providing each community with sufficient autonomy to develop initiatives within the framework of its own unique social and cultural environment. In this way, all of Agita São Paulo’s numerous entities shared a common objective and developed a solid sense of purpose, despite the diversity of actions in which each was involved. Table 1 summarizes the factors that were key to the successful promotion of physical activity, based on a qualitative analysis carried out by the program partners with special advisory support from PAHO.

The organizers of Agita São Paulo realized early on that the participation and collaboration of medical professionals would also be crucial to the program’s success. A specially established Medical Committee concluded that physicians were not sufficiently aware of the benefits of physical activity and therefore did not “prescribe” it to their patients. Bearing in mind that traditional medical culture is heavily inclined to prescribe medication for nearly all types of health conditions, the idea of launching “Agitol, the formula for active living,” was conceived. This mock prescription medication comes in a box whose appearance resembles other pharma-

**TABLE 1. Key ingredients contributing to the success of Agita São Paulo.**

- 
- ⇨ Promotion of the inclusion principle among the governmental and private sectors and civil society
  - ⇨ Establishment of intellectual and institutional partnerships
  - ⇨ Intersectoral and intrasectoral balance
  - ⇨ Mutual reinforcement and strengthening of agendas among partner institutions
  - ⇨ One single objective lending itself to a diversity of actions
  - ⇨ Collaboration with and high visibility in the mass media
  - ⇨ Clear messages that are easy to understand and remember promoting strategies that are practical and feasible to achieve optimum levels of physical activity
  - ⇨ Flexibility in adaptation of interventions to local sociocultural realities
  - ⇨ Promotion of the concept of behavior change as a process involving the progression through a series of stages and culminating in the achievement of a more active and healthier lifestyle
  - ⇨ Opportunities for social interaction, enjoyment, and mutual support among population segments at highest risk
- 

ceutical products but whose contents actually consist of educational material on the importance of physical activity to overall health and well-being that is geared specifically toward the medical community. By providing suggested dosages for physical activity—a single dose of 30 minutes, two of 15 minutes, or three of 10 minutes—the product’s creators were able to inject a sense of humor into Agita São Paulo’s messages and increase their popularity among health professionals while at the same time raising this group’s awareness concerning the dangers of a sedentary lifestyle. All in all, Agitol provided a classical health promotion approach utilizing the strategy of disease prevention through behavior change.

**OBJECTIVES AND MESSAGES ON THE PROMOTION OF PHYSICAL ACTIVITY**

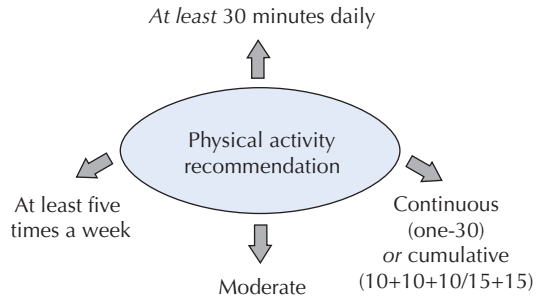
Essentially one objective, consisting of two parts, was established at the beginning of the Agita São Paulo Program: (1) to increase the population’s knowledge about the

biological, psychological, and social benefits to health of physical activity and (2) to raise the population's level of moderate physical activity. The program's goal was to (1) increase the degree of knowledge about the benefits of physical activity by 50% and to increase physical activity by close to 20% within a period of 10 years (2% annually).

Various behavior change models were used as the basis for designing the program's intervention strategies. The first of these, the Transtheoretical Model (37), conceives behavior change as a process that involves a progression through a series of stages, beginning with pre-contemplation and moving through the contemplation, preparation, action, and maintenance stages. Adoption of this theoretical construct allowed the Agita São Paulo Program to develop carefully crafted messages targeted to individuals and groups at each of these stages and to provide the necessary incentive and support to help them to move forward to the next stage. The program stipulated that the proposed changes in attitude and behavior should take into account the different stages along the developmental continuum and aim to promote an increase in physical activity to at least the next-higher level (37). In other words, the objective of the gamut of interventions designed was to have sedentary individuals become at least irregularly active, those who were irregularly active to become at least regularly active, those who were regularly active to become even more active, and to ensure that the segment of the population which was already highly active maintained this optimum level without the risk of incurring injuries.

The quintessential message adopted by Agita São Paulo—that adults undertake at least 30 minutes of moderate intensity physical activity on most, if not all, days of the week—was first developed in 1995 by the CDC and American College of Sports Medicine (ACSM) and was based on numerous physiological, epidemiological, and clinical studies confirming the health benefits ac-

**FIGURE 2. Agita São Paulo physical activity recommendation.**



rued from this duration and intensity level of physical activity (38) (Figure 2).

This body of evidence has furthermore demonstrated that the physical activity recommendation may be completed in one continuous session lasting at least 30 minutes or achieved cumulatively through multiple sessions of at least 10 to 15 minutes each. Daily activities where activity can be accumulated include recreational hobbies (playing soccer, football, baseball, basketball, racquetball, etc.; running; walking; bicycling; dancing; swimming), domestic chores in the home (pushing a baby stroller, walking the dog, washing the car, vacuuming, cleaning windows, cutting the grass), and activities that may be incorporated into the working day (walking or bicycling to and from the workplace, getting off at an earlier bus or subway stop, climbing stairs instead of using the elevator, going to the gym during lunchtime).

Various high-profile scientific organizations back this 30-minute recommendation, including—in addition to the CDC and ACSM—the World Health Organization (WHO) and the American Heart Association (39). The recommendation has been adopted by various large-scale health promotion programs in countries outside the Region of the Americas, including Australia and Great Britain. In the intervening decade since the recommendation was first developed, it has been reevaluated and its validity upheld in a cumulative body of scientific studies, the



more recent of which emphasize that the activity frequency should be at least five days a week (40).

The concept of *moderate* physical activity is particularly relevant for the cultural context of São Paulo. Indeed, the modern, fast urban pace that characterizes life in the metropolitan area has led many residents to report that a lack of time is a major barrier to developing an active lifestyle (41, 42). Thus, the idea of engaging in moderate physical activity in brief sessions is probably a more appealing alternative than single 30-minute periods of intense physical activity. Another factor perhaps influencing this tendency is the warm and tropical climate that is found in many parts of Brazil.

### THE “MOBILE” ECOLOGICAL INTERVENTION MODEL

One of the most innovative components of Agita São Paulo, which has garnered the program well-deserved national and international recognition, is the promotion of behavioral change to increase the population’s physical activity level. The “mobile” ecological intervention model utilizes as its basis a series of interacting determinants of physical activity, as proposed in the ecological model of Sallis and Owen in 1997. According to this proposal (43, 44), the intrapersonal and social and physical environmental factors form a three-dimensional, dynamic model, similar to that of a mobile. Intrapersonal factors include biological, affective, and demographic aspects (gender and age), knowledge, and behavior, which interact simultaneously with those of the social environment (cultural and social milieu, availability of supportive behaviors, public policies governing resources and incentives) and the physical environment (natural environment, including climate and geography; constructed environment, including the architecture of homes and work sites; public transportation infrastructure, availability of recreational

sources), thereby positing that behaviors are influenced by multiple levels of factors in constant interaction (Figure 3). This model makes it possible to develop behavioral change interventions, based on an identification of the specific variables involved and on an understanding of their relationship to one another and to the target population.

### DEVELOPMENT OF PROMOTIONAL PRINT MATERIALS AND PRODUCTS

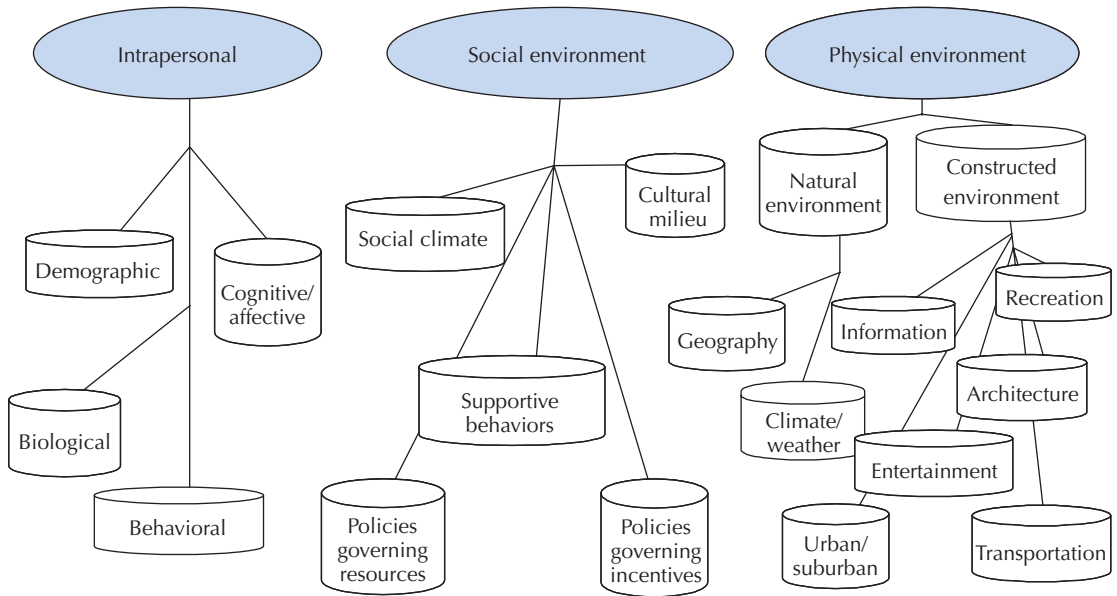
The health benefits derived from an active lifestyle have been highlighted in all of the orientation manuals and guidelines prepared in relation to the Agita São Paulo Program (39, 45), but since these are long-term benefits which are accrued, in some cases, only gradually, they are not always immediately perceived by the population. Thus, both the physical and mental health benefits are emphasized in the program’s promotional materials (Table 2), taking into account that emphasis on the latter seems to be more effective when seeking behavioral change because people’s perception of increased mental well-being sometimes occurs more spontaneously. This strategy has been particularly effective in promoting the importance of physical activity in schools and the work environment, where the benefits may be demonstrated both on an individual and collective level.

The program employs a variety of materials (Figure 4) to encourage increased physical activity. These include:

- Pamphlets, posters, and flyers aimed at the general public and at specific population groups (schoolchildren, workers, and older adults)
- Posters promoting mega-events (e.g., Agita Galera, Agita Mundo, Agita Older Adult)
- Posters for specific campaigns (e.g., dengue prevention and control) or related to special commemorative events, anniversaries, and other celebrations



**FIGURE 3. Mobile ecological model to promote physical activity developed by the Agita São Paulo Program showing multiple dimensions of influence on behavior.**



**Source:** Matsudo VKR, Andrade DR, Matsudo SMM, Araújo TL, Andrade E, Oliveira LC, et al. “Construindo” saúde por meio da atividade física em escolas. *Revista Brasileira de Ciência e Movimento* 2003;11(4):111–118.

- Orientation manuals for general program implementation and activities development for public schools
- Physical activity and nutrition pyramids
- “Manufacturing” and promotion of Agitol, “the formula for active living”
- Promotional material tied to special occasions (e.g., Carnival, the summer vacation period)
- General information books highlighting Agita São Paulo activities and best practices and describing the program’s impact and the role of partner institutions
- Promotional give-away products (e.g., key rings, t-shirts, baseball caps, fans, stickers, mouse pads, bookmarks, compact disc cases).

Much of the material just described is produced with financial support from the Min-

**TABLE 2. The benefits of physical activity.**

| Physiological                | Psychological                                    |
|------------------------------|--|
| Lowers blood pressure        | Increases self-esteem                            |
| Helps control body weight    | Reduces depression                               |
| Improves joint mobility      | Helps maintain independence and self-sufficiency |
| Improves blood lipid profile | Reduces social isolation                         |
| Improves physical resistance | Increases well-being                             |
| Increases bone density       | Improves self-image                              |
| Increases muscular strength  | Reduces stress                                   |
| Improves insulin resistance  |  |

istry of Health in as-needed quantities for specific program activities and also to provide information about events sponsored in conjunction with the Ministry. The governmental institutions and private entities that participate in the program have been granted permission to freely reproduce this material, incorporating their own logos and otherwise personalizing it as deemed necessary, as long as the basic message remains unchanged.

**FIGURE 4. Educational and promotional materials: Agita São Paulo.**



### MOBILIZATION OF MEGA-EVENTS

In order to increase public awareness of the benefits of regular physical activity, the overall program strategy includes the organization of mega-events designed to attract high visibility in the mass media and among the general population. Large-scale promotion and coverage is presented in all the major media, including television, radio, newspapers, and magazines. Three mega-events are organized per year, one for every targeted population group: Agita Galera (Get Moving Everyone) or Active Community Day, which is geared toward schools; Active Worker Day; and Active Older Adult Day.

#### **Agita Galera: Active Community Day**

Beginning in 1997, Agita Galera has been held on the last Friday of August of each year. Organization of this event requires major logistical preparation involving the training and support of tens of thousands of

health and education professionals in the 640 cities of the state of São Paulo. The participants include more than 6,000 public and private schools, 250,000 teachers, and 6 million students who come together to discuss the positive effects of a more active lifestyle and how to create permanent mechanisms that promote health and physical activity in the school environment. To facilitate this process, a manual has been developed and distributed at the primary and secondary school levels to teachers, health service providers, and the mass media. Each year, a teleconference is broadcast via cable whose overriding message is that creating a culture based on regular physical activity is not solely the responsibility of physical education teachers, but also of their colleagues in all academic disciplines—including the life sciences, mathematics, history, and languages—to highlight as part of the course material the relationship of physical activity to their particular field of knowledge. Collective and individual activities of 15 to 20 minutes, including dances, and art,

photography, and writing contests, are also incorporated into the regular class period in order to reinforce basic messages concerning the benefits of an active lifestyle. Community participation in Agita Galera is encouraged through outdoor activities organized in the streets and plazas of large and small cities throughout the state. Often these events include the participation of the state minister of health and general program coordinator, who are transported by helicopter from site to site. A 15-minute informational video produced in English, Portuguese, and Spanish is available at the Agita São Paulo Web site which illustrates the principal promotional strategies employed by Agita Galera organizers, a list of events, and an evaluation form enabling organizers to measure the process and impact of events on schools and communities.

### **Active Worker Day**

Educational material and activities have been developed to encourage increased physical activity in both the public and private workplace. These activities include holding conferences on health and physical activity during accident prevention weeks and raising awareness among company directors, as well as training human resources staff, on how to work effectively with new concepts of physical activity and health promotion.

In addition to the general suggestions contained in the educational materials, the different missions and perspectives of the various institutions have been taken into account, and special efforts have been made to respond to the specific needs of different worker groups. At the same time, the Agita São Paulo Program participates in events held to celebrate International Workers' Day on each 1 May and has encouraged its partner institutions and others to include the topic of physical activity in celebrations of all types held throughout the year.

### **Active Older Adult Day**

Agita São Paulo has designed materials, including a pamphlet and poster, with content specifically geared to the needs and goals of the older population. Observing recommended levels of physical activity is, in this case, promoted as a strategy for maintaining functional independence. Every year, usually to coincide with the 1 October observance by the United Nations of International Day for Older Persons, a mega-event is organized that includes a walk, dances, and games with multigenerational appeal calling on all citizens to celebrate life. The walk usually lasts no longer than 30 minutes and takes participants through urban green areas. On this day, baseball caps and sun visors, a commemorative bag with informational material, oversized cardboard hands, and candy are distributed as souvenirs.

### **World Physical Activity Day: Agita Mundo**

By the year 2002, the success of the Agita São Paulo Program was becoming well known around the world. The program's philosophy and ripple effects influenced a WHO resolution adopted at the Fifty-fifth World Health Assembly that made physical activity the central focus of World Health Day 2002. That same year, the governor of the state of São Paulo issued decree 46.664/2002, establishing 6 April as Physical Activity Day, which continues to be commemorated throughout Brazil and in various other countries inside and outside the Region of the Americas under the slogan "Agita Mundo." The occasion is marked by the dissemination of materials, such as posters, fans, and stickers, in three languages (English, Portuguese, and Spanish) and the organization of group walks and of different celebrations to promote physical activities for men and women of all socioeconomic levels, ages, and ethnic groups. With the adoption of resolution

WHA 55.23 in May 2002, the international Move for Health initiative was born and is held every year on 10 May, reinforcing the spirit and energy of Agita Mundo and World Physical Activity Day.

### **BEST PRACTICES FOR PROMOTING PHYSICAL ACTIVITY**

One of the key ingredients behind the success of the Agita São Paulo Program has been its strategy of dissemination through both the public sector (principally through the Ministries of Health and Education) and a broad spectrum of the private sector, including civil society at large. As a means of disseminating the most effective of the strategies emanating from this wide range of institutions, as part of the celebration of World Physical Activity Day in 2003 and 2004, the program organized the First and Second Encounters on Best Practices in the Promotion of Physical Activity, which yielded material for two publications. Eighty-four examples are summarized in the first publication and 147 in the second of experiences in promoting physical activity. A selection of these is presented in Table 3.

### **A PHYSICAL ACTIVITY PROGRAM FOR A MEGACITY: AGITA SAMPA**

During its first seven years of activities, one of Agita São Paulo's most outstanding achievements has been the launching by the mayor of metropolitan São Paulo of the Agita Sampa program (decree 45.724/2005) to encourage the regular practice of physical activity. As part of this program's implementation, a multisectoral effort was initiated among all of the municipal ministries (e.g., Health, Sports, Education, Transportation, Culture) with the goal of creating a permanent and universal strategy to promote physical activity in a variety of contexts and environments, including parks, plazas, streets, and neighborhoods.

### **IMPACT OF AGITA SÃO PAULO ON LEVELS OF PHYSICAL ACTIVITY AND PROGRAM KNOWLEDGE: THE EVALUATION COMPONENT**

Periodic evaluations are conducted of the program's impact utilizing a series of indicators and the collection of data from the target population. The elements taken into consideration include the following:

- (1) Number of program partners
- (2) Number of activities and events organized annually by the program and by its partners
- (3) Frequency with which the program has participated in national and international scientific events
- (4) Quantity of educational material produced and disseminated
- (5) Determination of target population's degree of general knowledge about physical activity and health
- (6) Identification of barriers and motivations to engaging in physical activity
- (7) Determination of the general population's level of physical activity and that of the three specific groups targeted by the program
- (8) Determination of the economic cost of specific diseases and conditions associated with sedentary lifestyles
- (9) Assessment of the economic impact of physical activity interventions
- (10) Assessment of the impact of physical activity interventions on community-wide morbidity and mortality rates

Evaluations of Agita São Paulo have been carried out on a regular basis since 1999. The evaluations, depending on the component being studied, are carried out either semiannually or annually in localities of metropolitan São Paulo as well as in the interior, central, and coastal municipalities of the state. Household interviews are conducted with residents over 15 years of age to determine that population's level of physical activity

**TABLE 3. Agita São Paulo activities summary, selected partner institutions, 1997–2004.**

| Specific Actions  | Permanent Measures  |
|---|---|
| <b>MINISTRY OF EDUCATION</b>  |   |
| <ul style="list-style-type: none"> <li>• Mobilization of 6,000 schools in the state's public network to celebrate Agita Galera</li> <li>• Physical Activity Day commemorated on 6 April in the public school network by decree no. 46.664/2002</li> <li>• Implementation of the Agita Familia program, in which children and their families participate in joint educational and sociocultural weekend activities, such as 30-minute physical activity sessions at the beginning or end of the day. Currently more than 400,000 people and 5,306 public schools are involved in the program.</li> </ul> | <ul style="list-style-type: none"> <li>• Organization of physical activities at schools; among them, Agita Night for students and teachers of night classes</li> <li>• Physical activity sessions (stretching and relaxation) at the beginning of the day and at the beginning of some classes</li> <li>• School rumbas adopted by some schools, incorporating a variety of Latin rhythms to accompany physical activities</li> <li>• Diploma awarded to teacher whose class has the most "movement"</li> </ul>   |
| <b>MINISTRY OF SOCIAL WELFARE AND DEVELOPMENT</b>   |   |
| <ul style="list-style-type: none"> <li>• Integration of older adults into physical activity programs administered by Ministry staff</li> </ul>  | <ul style="list-style-type: none"> <li>• Inclusion of promotion of physical activity in social intervention programs</li> <li>• Inclusion of physical activity promotion in the technical training manuals for health workers providing basic care to older adults</li> <li>• Inclusion of information on Agita São Paulo on the Ministry's Web site</li> </ul>   |
| <b>MINISTRY OF THE ENVIRONMENT</b>  |   |
| <ul style="list-style-type: none"> <li>• Adaptation of Agita São Paulo logo and clock for use in Ministry materials</li> <li>• Construction of an indoor walking trail at Ministry headquarters</li> <li>• Implementation of gym program for Ministry staff</li> <li>• Inclusion of the verb "agitar" in names of conferences and other institutional events</li> </ul>   | <ul style="list-style-type: none"> <li>• Preparation and distribution of Agita informational materials and promotional items, such as t-shirts, key rings, and stickers</li> <li>• Inclusion of links to Agita São Paulo activities and to institutional publications on the Ministry's Web site</li> <li>• Annual celebration of the Agita Verão summer event on state beaches and of the Agitando la Sierra event in winter</li> </ul>  |
| <b>MINISTRY OF JUSTICE</b>  |   |
| <ul style="list-style-type: none"> <li>• Health fair in the city of São Paulo to commemorate World Physical Activity Day</li> </ul>   |   |
| <b>REGIONAL HEALTH DIRECTORATES AND CENTERS</b>   |   |
| <ul style="list-style-type: none"> <li>• Organization of activities related to Agita events: <ul style="list-style-type: none"> <li>– Agita Galera: health professionals take part in school activities</li> <li>– Celebration of World Physical Activity Day</li> <li>– Agita Older Adult: organization of dance and walking groups and seminars and talks for health professionals on the importance of physical activity</li> </ul> </li> </ul>  | <ul style="list-style-type: none"> <li>• Periodic meetings with local health units in which Agita São Paulo's message and activities are disseminated</li> <li>• Inclusion of physical activity component in a program specifically targeting the health and well-being of health workers</li> <li>• Implementation of physical activity programs in health units</li> <li>• Organization of walks for health and conferences promoting the importance of physical activity</li> <li>• Periodic situational review of levels of sedentary lifestyles among health worker staff and at-large local population</li> <li>• Dissemination of Agita program information via local electronic networks</li> <li>• Creation of regional networks for the promotion of physical activity</li> <li>• Inclusion of physical activity component in family health programs and community groups for the treatment of hypertension and diabetes</li> </ul> |
| <b>MUNICIPALITIES AND CITIES</b>  |   |
| <ul style="list-style-type: none"> <li>• Organization of events to celebrate Agita Galera, including Agita in the Plaza, Agita in the Parks, and Agita in the Neighborhoods</li> </ul>  | <ul style="list-style-type: none"> <li>• Formation of walking and tai chi chuan groups and organization of activities for older adults</li> </ul>   |

(Continued)



**Table 3. Agita São Paulo activities summary, selected partner institutions, 1997–2004. (Continued)**

| Specific Actions  | Permanent Measures  |
|---|---|
| <b>MUNICIPALITIES AND CITIES</b> (Continued)  |   |
| <ul style="list-style-type: none"> <li>• Participation in World Physical Activity Day</li> <li>• Organization of physical activities in conjunction with the Agita Carnaval event and World Health Day</li> <li>• Construction of bicycle paths and sponsoring of biking trips</li> <li>• Inclusion of the concept of physical activity in community events and exhibits, including health fairs and specific disease prevention and control activities, among them dengue fever</li> <li>• Talks on the importance of physical activity targeting health professionals, community health promoters, students of all ages, and older adults</li> <li>• Preparation of signs and posters promoting the importance of an active lifestyle and healthy diet</li> <li>• Printing and distribution of Agita São Paulo educational material in shopping malls, other commercial establishments, churches, government centers</li> <li>• Placement of signs about physical activity in all basic health units</li> <li>• Incorporation of a 30-minutes-of-physical-activity-daily message on the respective letterheads and in all official documents of the Ministries of Sports and Health</li> <li>• Formation of Internet discussion groups on physical activity</li> <li>• Inclusion of a physical activity message in the salary receipts of civil servants and printed on all municipal electricity bills</li> <li>• Organization of special events, such as “24 hours of walking” in São Paulo municipalities</li> </ul> | <ul style="list-style-type: none"> <li>• Physical activity work-outs to begin the school and work day in public and private schools and Agita participating institutions</li> <li>• Continuing health education activities, incorporating the concept of physical activity to combat specific diseases (e.g., gymnastics against dengue, basketball against tuberculosis)</li> <li>• Formation of walking groups among family health teams and others in basic health units</li> <li>• Joint intersectoral activities developed by the Ministries of Health, Education, and Sports to promote physical activity</li> <li>• Placement of informational material on physical activity on all mobile health caravans</li> <li>• Organization of dance groups for people with hypertension</li> <li>• Implementation of technical protocols for behavioral change with regard to physical activity</li> <li>• Implementation of guided physical activity programs</li> <li>• Designation of streets specially set aside for the enjoyment of recreational activities</li> <li>• Creation of community walking trails</li> <li>• Creation of the “Walking Truck”: a truck with sound equipment that travels through neighborhoods and encourages people to participate in walking activities</li> <li>• Monthly outdoor day devoted to physical activity with participation by various community groups</li> </ul> |
| <b>ASSOCIATIONS</b>   |   |
| <ul style="list-style-type: none"> <li>• Organization of activities in conjunction with the Agita Galera, Agita Mundo, Agita Verão, and Agita Older Adult mega-events</li> </ul>  | <ul style="list-style-type: none"> <li>• Observance of Quality of Life and Health Days</li> <li>• Placement of articles promoting physical activity and the importance of active lifestyles in association journals</li> <li>• Participation in Agita in the Plaza events</li> <li>• Formation within juvenile diabetes associations of physical activity groups</li> </ul>   |
| <b>UNIVERSITIES</b>   |   |
| <ul style="list-style-type: none"> <li>• Organization of activities in conjunction with the Agita Galera, Agita Mundo, Agita Verão, and Agita Older Adult mega-events</li> <li>• Convocation of scientific events related to the study of physical activity</li> <li>• Inclusion of physical activity promotion in the mission of public and private academic foundations devoted to improving conditions of institutionalized minors and delinquent adolescents</li> </ul>   | <ul style="list-style-type: none"> <li>• Dissemination of information on physical activity on the institutions’ Web sites</li> <li>• Placement of posters and distribution of information for students and professors</li> <li>• Dissemination of information on a variety of physical activity topics in internal publications and on weekly schedule of institutional activities</li> <li>• Development of physical activity programs targeted to university staff members</li> <li>• Publication and presentation of scientific research on physical activity</li> </ul>   |
| <b>PRIVATE BUSINESS SECTOR</b>  |   |
| <ul style="list-style-type: none"> <li>• Organization of walk-in-the-park programs and other types of walks for staff members and families tied into special commemorative occasions</li> <li>• Promotion of and participation in World Physical Activity Day, World Health Day, Agita Galera, and other Agita mega-events</li> </ul>   | <ul style="list-style-type: none"> <li>• Dissemination of Agita São Paulo message in corporate communications media</li> <li>• Placement of Agita program information in strategic locations throughout the company (e.g., health unit, restrooms, employees’ cafeteria, staff lounges, waiting rooms, central lobby)</li> </ul>  |

(Continued)



**Table 3. Agita São Paulo activities summary, selected partner institutions, 1997–2004. (Continued)**

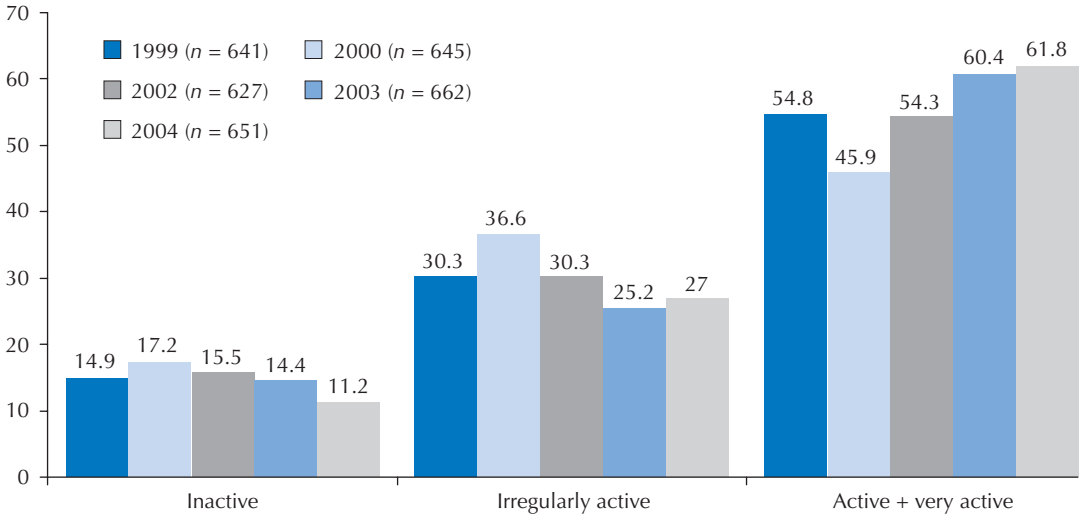
| Specific Actions  | Permanent Measures  |
|---|---|
| <b>PRIVATE BUSINESS SECTOR (Continued)</b>  |   |
| <ul style="list-style-type: none"> <li>• Inclusion of topics related to physical activity in the observance of Accident Prevention Week</li> <li>• Opportunities for participation in sports activities for staff members</li> <li>• Staff conferences on physical activity and administration of questionnaires to determine levels of physical activity</li> <li>• Launching of personalized “corporate” versions of Agitol (e.g., “Exercil Plus”)</li> <li>• “Adopt a Sedentary Person” health promotion campaign</li> </ul>   | <ul style="list-style-type: none"> <li>• Periodic distribution of informational material to staff members and family members</li> <li>• Access to on-site gymnasium and/or recreational facilities</li> <li>• Incentive-based campaigns to discourage sedentary lifestyles among staff (e.g., the accumulation of “miles” and points that can be exchanged for gifts at the end of a given period, other forms of special recognition for staff members accumulating the most physical activity)</li> <li>• Organization of walking and running teams</li> </ul>  |
| <b>HOSPITALS, CLINICS, AND HEALTH INSURANCE COMPANIES</b>   |   |
| <ul style="list-style-type: none"> <li>• Participation in the program’s mega-events (Agita Galera, Agita Mundo, and Agita Older Adult); World Health Day, World No-Tobacco Day, and Mental Health Week; as well as commemorative events related to weight and obesity control and prevention and control of hypertension</li> <li>• Institutionally sponsored walking, stretching, and relaxation programs</li> <li>• Development of on-site physical activity facilities for use by health professionals</li> <li>• Development of research studies on the effects of physical activity in patients with asthma and lower back pain, and on the knowledge of health professionals concerning the benefits of physical activity</li> <li>• Creation of multidisciplinary groups to promote benefits of physical activity to the community at large</li> </ul> | <ul style="list-style-type: none"> <li>• Inclusion of physical activity in group therapy sessions for patients with mental health problems</li> <li>• Placement of information on Agita São Paulo in physicians’ offices</li> <li>• “Prescription” by doctors of Agitol to encourage increased physical activity among patients</li> <li>• Provision of orientation sessions on physical activity in waiting rooms and other public areas of health facilities</li> <li>• Conferences and discussion groups on physical activity for patients</li> <li>• Provision of telephone advice on physical activity for patients via a proactive call center</li> <li>• Walking programs for groups of patients accompanied by health professionals</li> <li>• Presentation of educational videos on physical activity</li> <li>• Physical education and tai chi chuan classes for patients</li> <li>• Availability of physical trainers to work with patients</li> <li>• Teaching activities for physicians and medical students to encourage them to promote the benefits of physical activity during interactions with their patients</li> <li>• Availability of specialized courses for family health professionals on topics related to physical activity</li> <li>• Monthly field day featuring walks, games, and sports</li> </ul> |

and knowledge about the program and its message. An internationally tested and nationally adapted questionnaire is used to assess physical activity levels (46). This questionnaire, known as the International Physical Activity Questionnaire, or IPAQ, when used in its short version, determines the frequency and duration of vigorous and moderate forms of physical activity and of walking. In 2000, data were obtained from semiannual visits to some 645 people selected at random, the analysis of which showed higher levels of physical activity among those who were familiar with the program’s objectives (43.0%) than among those who were not (35.3%).

Data on physical activity levels analyzed between 1999 and 2004 on more than 3,000 individuals (Figure 5) clearly show positive progress in the metropolitan area of São Paulo, where the rate of sedentary lifestyles decreased from 15% to 11%. The percentage of people classified as irregularly active went from 30% to 27% and that of active and very active people increased from 55% to 62%.

Data corresponding to the state of São Paulo, grouped according to sex and age and socioeconomic and educational levels, and with regard to the impact of the Agita São Paulo Program, showed that 55.7% had some knowledge of the program, more than 60% of those with higher educational levels knew

**FIGURE 5. Level of physical activity of population (percentages of inactive, irregularly active, active, and very active) in metropolitan São Paulo, 1999, 2000, 2002, 2003, and 2004.**



about the program, and 37% were familiar with the program’s objective. In analyzing the impact of the program on the metropolitan area, positive progress could be seen in the increase from 53% to 61% in the percentage of people who said they knew the program’s name. Of that group, in 1999, 19% were familiar with the program’s message, while in 2004 that figure rose to 23%.

**INTERNATIONAL NETWORKS TO PROMOTE PANA AND AGITA MUNDO**

**PANA**

As a result of the positive impact of the Agita São Paulo Program in the state of São Paulo and throughout the country (44), since 1998, similar initiatives in other countries have begun to emerge and subsequently have been consolidated into an international network to promote physical activity, which has become the coordinating nexus for the participating national networks. The Physical Activity Network of the Americas (PANA) is a good example of the joint effort

by associations, partnerships, and established strategic coalitions working to combat sedentary lifestyles in the Region. PANA has been consolidated into a network of networks and seeks to encourage the practice of physical activity in the Americas with a minimum of bureaucratic structure while at the same time fostering action, inclusion, simplicity, and flexibility. PANA’s guiding principles are:

- to be an inclusive network that incorporates both national and international public and private institutions;
- to focus on research and public health programs to benefit communities and whole populations;
- to promote the sharing of experiences and knowledge; and
- to promote an environment that improves human resources development among health professionals working in the area of physical activity and the prevention of sedentary lifestyles.

Numerous national and local programs have been promoted within the PANA frame-

**FIGURE 6. Educational and promotional materials: The Physical Activity Network of the Americas.**



work. In Argentina, these include A Moverse Argentina, Argentina en Movimiento, and Salí a Moverte; in Bolivia, Muévete Bolivia; and in Colombia—which launched the Colombian Physical Activity Network—Muévase Pues, Muévete Bogotá, Risaralda Activa, Actívate Pereira, Buga en Movimiento, Guajira Activa, Madrúgale a la Salud (Cartegena), Palpita/Vibra Quindío, Cauca Activa, Cundinamarca Activa y Positiva, Boyacá Activa, Colombia Activa y Saludable, Cali en Movimiento, A Moverse, and Huila Activa y Saludable. In Costa Rica, the programs include Movámonos Costa Rica; in Ecuador, A Moverse Ecuador; in Mexico, the Nacional Physical Activity Program; in Peru, Muévate Perú; and in Venezuela, Venezuela en Movimiento. A sampling of these educational and promotional materials is presented in Figure 6. Based on the nature and scope of activities developed by each program, the national networks in the different countries have also begun to form partnerships and develop joint work strategies in much the same

way as the Agita São Paulo Program has done since its inception.

### **Agita Mundo**

The goal of the Agita Mundo Network, as noted earlier in this chapter, is to create an international momentum for a more active lifestyle as a crucial element in the promotion of overall mental and physical health and well-being for all individuals, communities, and nations. Since its inception in 2002, the Agita Mundo network has promoted research and the dissemination of information on the benefits of physical activity and on strategies to increase it, has advocated for physical activity and health, and has supported the creation of programs and local and national networks to promote physical activity. At the last meeting of the Agita Mundo network, held in São Paulo in October 2004, the decision was made to create the Agita Mundo map, which includes a comprehensive list of intervention programs,

Web sites on physical activity, major publications, the institutions associated with the network, physical activity reference centers, and data on the prevalence of sedentary lifestyles throughout the world.

The principal documents produced by the network, the São Paulo Manifest and the Declaration of São Paulo on the Promotion of Physical Activity, as well as the results obtained through the mobilization of the PANA and Agita Mundo international networks, are available in English, Portuguese, and Spanish at [www.rafapana.org](http://www.rafapana.org) and are coordinated in São Paulo by CELAFISCS. In addition, the networks receive ongoing support from a variety of institutions, including the International Union of Health Promotion and Education, PAHO, and the CDC.

## CONCLUSIONS

The Agita São Paulo Program has proven to be a successful model of intervention for the promotion of physical activity, especially in developing countries, and an effective strategy in different levels and sectors, because it simultaneously encompasses the actions of institutions and interest groups from the public and private sectors and from civil society, with a common objective: combating sedentary lifestyles. The program's positive impact on the community derives from its firmly rooted principle of inclusion, which nurtures cultural and regional diversity, as well as the promotion of intellectual and institutional partnerships; the balance and dynamism that characterizes its intersectoral and intrasectoral partnerships; the opportunities for mutual strengthening and reinforcement of the respective missions of the individual partner institutions; the presentation of one clear and simple message that is easy to understand and remember (i.e., 30 minutes of physical activity, preferably every day); the sound scientific basis for the program's messages, intervention strategies, and evaluation component; the support of

the communications media in the dissemination of messages and information to broad and diverse audiences; and Agita São Paulo's universality and adaptability to a variety of social and environmental settings.

## ACKNOWLEDGMENTS

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# PROMOTING ACTIVE LIFESTYLES AND HEALTHY URBAN SPACES: THE CULTURAL AND SPATIAL TRANSFORMATION OF BOGOTÁ, COLOMBIA

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## INTRODUCTION

This chapter describes the recent transformation in the lives of the citizens of Bogotá, Colombia, and in the urban environment they share. Statistics point to substantial qualitative and quantitative improvements in this large, bustling, cosmopolitan world capital. There are promising signs of increased physical activity, a situation that could provide useful input for the planning of a wide variety of public and private efforts aimed at counteracting the increase in sedentary lifestyles, obesity, and chronic diseases in this city. Indeed, scientific evidence shows that these health conditions can be prevented<sup>2</sup> by combating risk factors<sup>3</sup> through physical activity. Regular physical activity, combined with a proper diet and restricted tobacco and alcohol use, diminishes the likelihood of dying from chronic disorders related to overweight and obesity, such as cardiovascular disease (3), type 2 diabetes mellitus, and some types of cancer (of the colon, prostate, ovary, and endometrium) (4).

Despite important cultural and urban planning changes in Colombia, the general urban situation with regard to physical activity is very similar to that of other large Latin America cities: half the population, including all age groups over age 5, is overweight,

giving rise to an ever-increasing incidence of chronic disease, even among the very young. The incidence of these modern ills is growing in Colombia at an annual average rate of 10%; in some seven years, this could translate into more than 75% of Colombians being overweight. In Bogotá, most overall mortality is related to chronic illnesses (21.7% of deaths from ischemic heart disease, 14.1% from cerebrovascular problems, and 7.2% from diabetes mellitus).<sup>4</sup> Nevertheless, in the last six years, bicycling and walking have doubled—not counting recreational and sports purposes; if this trend continues, a moderate reduction in chronic disease in the future can be expected.

Although there is still scant scientific evidence of a correlation between improved urban milieus and increased physical activity, the study on the transformation of Bogotá described in this chapter should enrich

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<sup>1</sup>Director, Fundación Ciudad Humana, Bogotá, Colombia.

<sup>2</sup>"It is now clear that regular physical activity reduces the risk for coronary heart disease, diabetes, colon cancer, and several other major chronic diseases and conditions" (1).

<sup>3</sup>"Eighty percent of obese adults suffer from diabetes, high cholesterol levels, high blood pressure, [and] coronary heart disease" (2).

<sup>4</sup>Secretaría Distrital de Salud. Death certificates, 2001. Preliminary data.

the international discussion on the topic. Hence, more than providing definitive results and evidence for the entire country, this chapter presents the case of Bogotá, which interdisciplinary teams from the Public Health Institute of Colombia's National University and the Fundación Ciudad Humana have begun to study from a comprehensive perspective.<sup>5</sup> This interplay between diverse theoretical and practical approaches should contribute to additional reflection on the promotion of physical activity in other locales in the Region of the Americas.

Structural and functional changes in cities and in modern urban life—such as the increased use of motor vehicles and of automated technology—translate into habits that are conducive to a sedentary lifestyle, which, in turn, is one of the leading factors of higher levels of overweight and obesity among urban dwellers. Thus, the participation in Latin America of urban planners in efforts to prevent and fight against chronic disease, while a very recent phenomenon, is nonetheless timely. In the past 20 years, many researchers, especially in the United States, have paid special attention to the role of the urban environment or milieu in the maintenance and promotion of public health. This is because individual and collective well-being is closely associated with a series of physical, social, cultural, and economic conditions that influence the effectiveness of efforts to lower the incidence of disease among the population (5).

Factors related to urban layout and design, including topography and land distribution and zoning (public vs. private), directly and indirectly influence many forms of behavior that are determinants of physical

activity or inactivity. According to Schmid, Pratt, and Howze (6), changes in environment are more likely to encourage increased physical activity than are policies that attempt to influence individual behavior. Urban structure can influence physical activity and buttress public health efforts, or it can impede the success of health policies aimed at discouraging a sedentary lifestyle, especially in activities related to mobility and recreation. Indeed, the qualitative and quantitative characteristics of public traffic, as well as public spaces for pedestrians (parks, sidewalks, jogging paths, etc.) and cyclists (bicycle paths or routes), are some of the principal factors that determine physical activity or inactivity. However, the correlation between these topics (city living, urban design, physical activity, obesity, sedentary lifestyle, and public health) has barely been addressed by researchers of urban and public health issues in Latin America, and even less so by municipal policymakers and technical experts. And notwithstanding findings showing a correlation between physical activity and urban milieu discussed in this study, government officials and technical experts in Bogotá have not coordinated their efforts vis-à-vis urban and public health issues.

As will be elucidated further in the Conclusions section of this chapter, Bogotá's cultural and spatial transformation was the result of an overall process that was unplanned and, to a certain extent, unintended, in the sense that the various constituent parts were not necessarily coordinated, although they complemented each other. Citizen education campaigns, the recovery of public space, and the construction of walkways and bikeways—among other major achievements—contributed to persuading people to change their daily behavior related to physical activity. In the long run, these new habits may increase life expectancy and improve the quality of life in the city. In addition to the campaigns and efforts between 1995 and 2003, the urban transformation of the 1990s made it possible for these actions to have a

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<sup>5</sup>These two entities have begun a nationwide study funded by the Social Protection Ministry. The purpose of the study is to evaluate sedentary lifestyles and physical activity, and the (positive or negative) correlation between the characteristics of city life and physical activity. A subsequent study will attempt to introduce a model for urban transportation to demonstrate the possibilities for change in levels of physical activity in three of the country's departments, including Cundimarca, of which Bogotá is the capital.

very positive influence on physical activity. Some of these transformations are related to:

- population density, which rose to an average of 200 inhabitants per hectare;
- a reduction in average trip distances to approximately 8 km;
- the increased use of mass transportation, with buses in an informal private network accounting for more than 70% of the daily trips taken in motorized vehicles; and
- limited ownership and use of automobiles: only 13% of the population owns a private automobile, and merely 19% of trips are made in automobiles.

This chapter examines the above factors and is divided into four sections. The first outlines the changes carried out in the city and breaks these changes down into different categories. Hence, it analyzes the period in question from several vantage points—physical and functional, social, economic, and political—to present a point of reference for discussing the two major redefinitions undergone by the city in the next two sections. The first redefinition, that of citizen education, analyzes the transformations that have taken place, focusing especially on the term of Mayor Antanas Mockus Sivickas and the citizen education campaigns carried out during his administration. The second redefinition, that of esthetics, space, and function, examines the principal changes occurring during the term of Mayor Enrique Peñalosa: public space, mass transit, individual transportation, and nonmotorized transportation. The fourth section presents this chapter's conclusions, stressing the complementarity between the two types of redefinitions and their probable role in increasing physical activity.

## THE GENERAL TRANSFORMATION OF BOGOTÁ

Although Bogotá's transformation is especially noticeable in its spatial dimension, and

particularly in its transportation infrastructure and the characteristics of its public spaces, it has affected every facet of the city. Accordingly, before turning to the central issue examined in this chapter—Bogotá's cultural and spatial transformation—a brief overview of changes in the physical and functional, social, economic, and political dimensions is presented in separate subsections. This crosscutting examination of events in the Colombian capital is the principal starting point for understanding the origin and scope of changes of a general nature as well as those related to physical mobility, public transportation, and the behavior of the residents of Bogotá themselves between 1995 and 2003, in which the latter changes had to do more clearly with physical activity. To allow for a better understanding of the magnitude of the changes in the Colombian capital, the evolution of the principal indicators over a decade is presented, and an overview of the general characteristics of public transportation before these transformations occurred is given.

### Physical and Functional Aspects

Despite the profound crisis in the private construction sector,<sup>6</sup> Bogotá has seen a considerable change in physical and functional issues, due to the recovery of public spaces for pedestrians (promenades and tree-lined alamedas, among others), the construction of roads and related infrastructure, the building of bicycle paths (a total of 300 km, at a cost of more than US\$ 46 million), the recovery of parks and medians, and, especially, the implementation of the TransMilenio system.<sup>7</sup> This is a new

<sup>6</sup>Between about mid-1998 and 2003, Bogotá's construction industry experienced an acute crisis, closely linked to the national economic situation, disequilibrium in the financial system, and the elimination of UPAC (Unit of Constant Purchasing Power), a price index. Housing construction had come to a complete standstill by the end of this period.

<sup>7</sup>The name TransMilenio refers to the various components of Bogotá's new mass transit system. The company responsible for the system is referred to as TransMilenio S.A.

urban transportation system with lanes for the exclusive use of buses, fixed bus routes and stops, accordion (stretch) buses, and feeder (suburban to downtown) buses. TransMilenio operates like a subway-type mass transit system, sharply reducing travel time for some 13% of public transportation passengers.

In general, urban mobility has improved, especially during peak hours, reducing congestion and travel time (7). Indeed, whereas in the mid-1990s traffic moved at a speed of well below 10 kph during rush hour, by mid-2003 it had increased to 18 kph. The most significant functional change in transportation is the reduction by more than one-third in the number of private vehicles driven during rush hour and the rise in the number of trips on foot and by bicycle, from 7% to 11% and 2% to 4%, respectively, between 1998 and 2003 (Figure 1) (8). This has been made possible to a large extent by the citizen education programs and the improvement of public spaces, the building of bicycle paths, and the more rational use of automobiles during rush hour, among other factors. Automobile use was reduced through the program known as “Pico y Placa,” which takes 40% of private vehicles off public streets from Monday through Friday between 6 a.m. and 9 a.m. and 4 p.m. and 7 p.m.<sup>8</sup> This change has translated into significant progress both in relative and in absolute terms, because it has been achieved within the context of a constant increase in the total number of vehicles in the city and in the total number of daily trips taken in motor vehicles.

Despite higher rush-hour driving speeds,<sup>9</sup> one of the most important indicators of, and one of the most important achievements from, improved urban mobility is the consid-

erable reduction in traffic accidents—from 1,387 in 1995 to 585 in 2003, a decline of more than 50% (Figure 2) (9). This improvement stems from citizen education campaigns, successful efforts to discourage people from driving while under the influence of alcohol, and the transfer of responsibility for traffic control from the local to the national police. The decline in traffic accidents underscores one of the most outstanding features of the formal and functional improvement in the city: it can be said that today travel in Bogotá has become twice as safe, which has had a positive impact on economic, social, environmental, and, especially, public health issues.

## Social Aspects

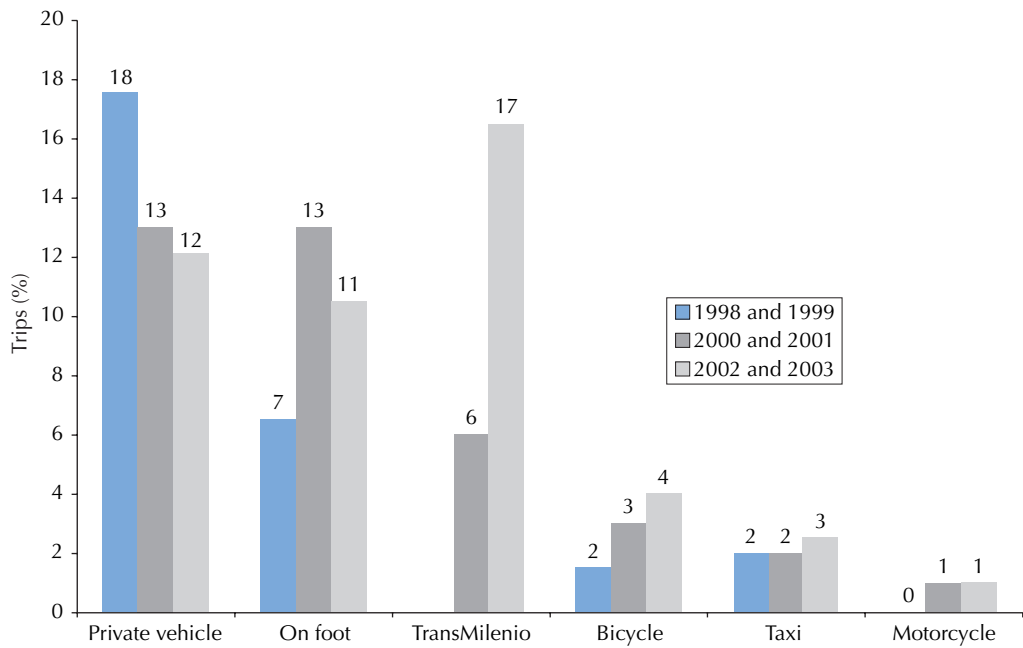
There have also been significant social changes, both in form and in substance. First, all public utility services now reach more households. Between 1998 and 2003, households with access to clean drinking water rose from 93% to 100%; those with access to adequate sewage disposal, from 84% to 95%; and those with access to gas energy sources from 50% to more than 80%. Most of these beneficiaries live in lower income neighborhoods. The process of providing these services and improving living conditions in these neighborhoods was called *desmarginalización* (poverty alleviation). During the mayoral term of Enrique Peñalosa (1998–2000) alone, 316 neighborhoods were incorporated into urban improvement plans, ensuring them drinking water and electricity and bringing them street-paving projects. Furthermore, more than US\$ 400 million was invested to benefit 650,000 low income residents (10). In the late 1990s, outlays for public education were doubled, and enrollment increased to 140,000 (11), thereby indicating that 98% of school-age children were being schooled by the end of 2003.

The social transformation of Bogotá has gone beyond investment in household public utility services and the provision of infrastructure. The mentality of its citizenry has

<sup>8</sup>Starting in August 2001, the “Pico y Placa” program was extended to public transportation vehicles, 20% of which have been taken off the streets from Monday through Saturday.

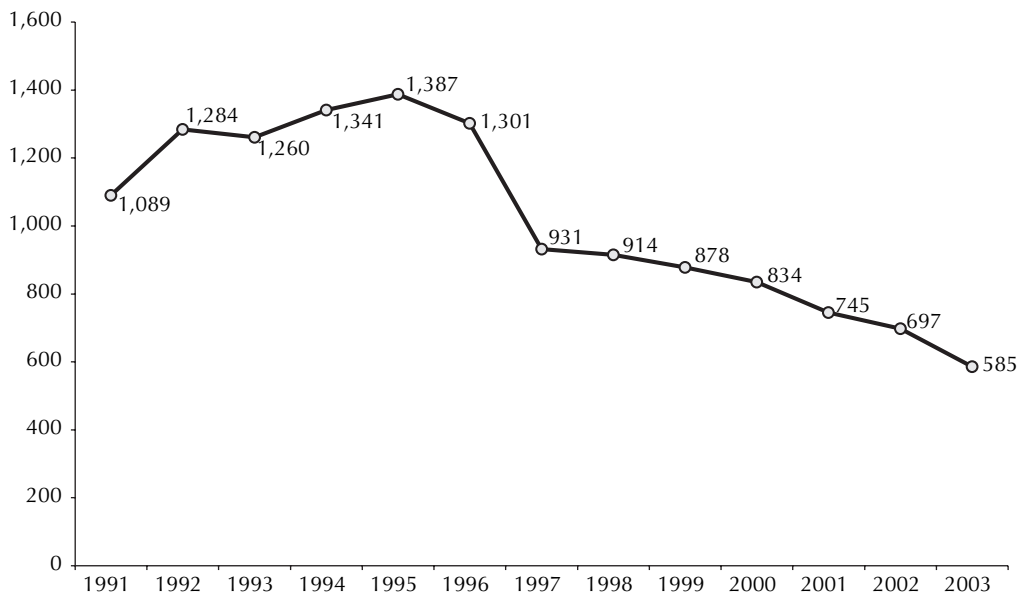
<sup>9</sup>According to a 1995 study by the Japan International Cooperation Agency, the average rush-hour driving speed was only 5 km/hour, whereas in 2003, the Bogotá Transit Authority determined that it had risen to 16 km/hour.

**FIGURE 1. Evolution of functional changes in transportation modes during rush hour in Bogotá, 1998–2003.**



Source: Encuesta Anual de Percepción Ciudadana del Proyecto “Bogotá, Cómo Vamos”, 2004.

**FIGURE 2. Reduction in deaths due to traffic accidents in Bogotá, 1991–2003.**



also changed, and though this is hard to demonstrate with statistics, the acceptance of many education and awareness-raising programs points to this change. In 2001 and 2003, surveys were conducted to gauge these programs' impact (Table 1). Although the results suggest that there have been considerable changes in this regard, the changes between 1995 and 2001 were, presumably, even more significant, because from 1995 to 1997 priority was given to programs to educate the population and encourage behavioral changes.

Some of the most significant achievements in the city are related to personal security, as seen in the decline in the violent death rate by 46.6% between 1994 and 2003 (Figure 3). This is one aspect in which the city has changed and improved the most. Nevertheless, most of the population is not yet completely aware of the improvements stemming from the declining violent death and crime rates. There is a large difference between statistics on and perceptions regarding or anecdotal evidence of insecurity. Furthermore, Bogotá's mass media did not actively support policies to improve security, unlike in other countries, for example, the "Zero Tolerance" campaign in New York, through which the number of police and law enforcement agents increased. In Bogotá, the foundations for this progress were education, gun control, reconciliation between antagonistic groups, peaceful conflict resolution, and citizen education, among other efforts.

## Economic Aspects

Changes have also been seen in the economic sphere, both in increased tax collection and in higher public investment. Between 1990 and 2003, tax receipts in Bogotá tripled, and the credit rating on domestic debt improved considerably, reaching a level twice as high as the rating given in preceding years. In the same period, tax revenues jumped from some US\$ 200 million to more

than US\$ 750 million. The revenue increase came from a higher surcharge on gasoline, the implementation of a plan to fight tax evasion, the updating of the real estate register, a simplification of tax laws, the assessment of a property tax for public works (known as *valorización de beneficio local*), the raising of public utility rates, and national funding for the TransMilenio system (12)—for 15 years, 52% of the total budget for this system will come from the federal government. The rise from 14% to 20%, and then to 25%,<sup>10</sup> in the gasoline surcharge was one of the greatest sources of revenue for the investment in transportation (a street grid known as *malla vial* and mass transit). In addition, there were two anti-tax-evasion plans,<sup>11</sup> and the district (capital) land registry was updated,<sup>12</sup> with which significant supplementary resources were obtained. In addition to these increases in general revenues, additional resources were created with the selling of part of Empresa de Energía de Bogotá to private investors, which yielded US\$ 485 million.

One of the greatest achievements in the management of the capital's finances has been the reduction in operational costs and the allocation of the resources saved to investment. Until 1994, more than 45% of the annual budget went to operational costs, compared with 52% in 1992. Since 1995, expenditure on this item has continued to decline and accounted for just 20% in 1999. Furthermore, investment rose from 30% of the budget in 1992 to 75% in 1999 (Figure 4). Sounder public finances increased residents' confidence in the city's managerial capacities, allowing additional voluntary taxes to be collected between 2001 and 2003. As the city council did not accept a proposal from the mayor to increase taxes, the mayor chose to ask citizens to voluntarily increase their

<sup>10</sup>Agreement 24 of 1997.

<sup>11</sup>The first anti-evasion plan allowed US\$ 30 million to be collected in 1999 and US\$ 35 million in 2000. The second plan allowed a 40% increase in the taxpayer roster.

<sup>12</sup>Agreement 24 of 1997.



**TABLE 1. Evolution of citizens' behavior and respect for laws in Bogotá, 2001 and 2003, by percentage.**

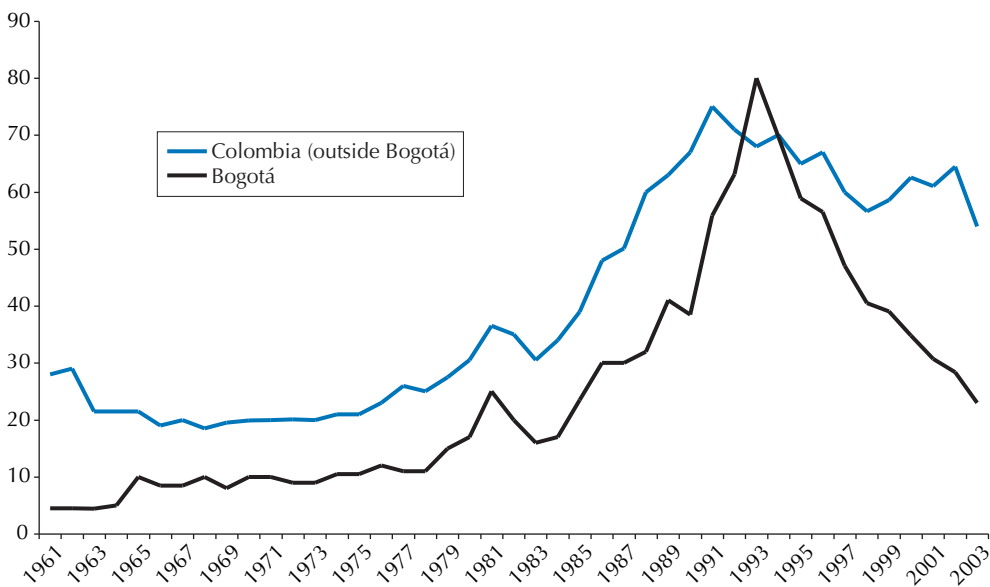
| Indicator   | 2001  | 2003  |
|---|-------|-------|
| Those who are familiar with and abide by safety belt laws                                   | 13.30 | 25.70 |
| Those who do not justify breaking laws regarding parking in no-parking zones                | 62.00 | 84.70 |
| Those who generally respect local laws  | 43.00 | 48.80 |
| Those who justify breaking the law when doing so is the only way to attain their objectives | 24.10 | 17.30 |
| Those who justify disobeying laws that are customarily ignored                              | 8.90  | 6.60  |
| Those who justify breaking the law when it is economically advantageous to do so            | 11.80 | 7.50  |
| Those who think that it is preferable to have a weapon for personal protection              | 24.80 | 10.40 |

*Source:* Observatorio de Cultura Urbana (Observatory of Urban Culture).

annual tax payments by 10%. Some 70,000 taxpayers accepted to do so and contributed more than required of them. This shows the degree of popular recognition and acceptance both of the mayor and of his management of the city. To a large extent, the residents who paid more did so as a way to express their appreciation for the city's great transformation and the improvements in public management. Hence, an additional achievement was the municipal government's renewed credibility in the eyes of the general population.

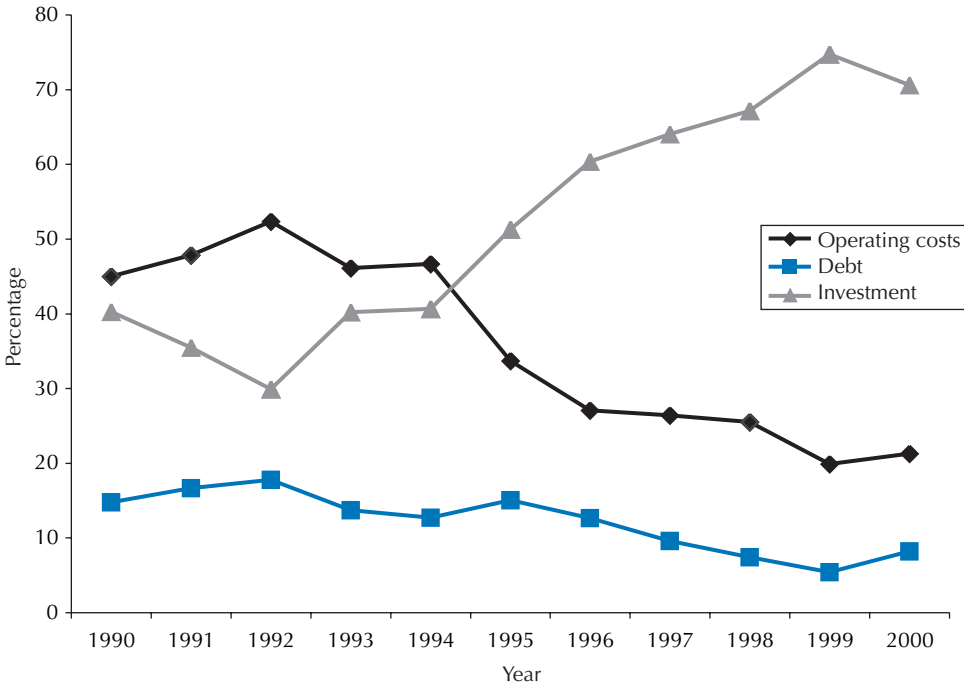
### Political Aspects

There have also been considerable changes in the political realm, both among elected officials and among their constituency. Elected officials have taken important, innovative actions in favor of the redefinition of community participation and the use of public space. And voters, through the mayoral elections, have expressed their disagreement with the traditional political class and bipartisan system by casting what is called an "opinion vote," which is a new

**FIGURE 3. Homicide rates per 100,000 inhabitants in Bogotá and outside of Bogotá over the last four decades.**

*Source:* Instituto Nacional de Medicina Legal y Ciencias Forenses.

**FIGURE 4. Percentage in evolution of investment costs, debt servicing, and operational expenses, 1990–2000.**



form of public expression that has opted to eschew traditional clientelistic voting patterns. Interestingly enough, this alternative vote has manifested a different expression in each election. On the one hand, persons not linked to the traditional political machinery have been elected—such as professor Antanas Mockus (1995–1997), Bogotá’s first mayor of “civic or alternative” origin;<sup>13</sup> on the other hand, voters have rejected populism—as personified by the candidate Carlos Moreno de Caro—when, in the following elections, they chose to embrace a politician, consultant, and university professor named

Enrique Peñalosa (1998–2000). Both Mockus and Peñalosa operated in a context that strongly favored major policy transformations, allowing, among other things, an increase in the efficiency of civil servants and a reduction in corruption, through an improved public sector procurement system.

**An Overview of the Factors Leading to Change**

As regards the transformation of Bogotá, this subsection looks at the factors that explain the general changes, and, in particular, those related to transportation. The initial assumption is that the transformation of Bogotá was the result of a sea change in the political sphere,<sup>14</sup> which translated into a

<sup>13</sup>In Colombia, a mayor of “civic or alternative” origin is one who is elected by popular vote and whose political roots do not lie in either of the two large centrist parties, the Conservative Party and the Liberal Party. In addition, such candidates come from different sectors of the public administration; generally they are academics or representatives of lay or religious civic movements (e.g., leaders of unions or associations, demobilized guerrilla movements, ethnic minorities).

<sup>14</sup>“The political dimension is not limited to a group of men, but rather to all groups and to all men, without exception . . . and the political dimension is related to the joint action of citizens for the attainment of common good” (13).

redefinition of the roles of actors both at the at-large and the individual levels.

As we saw in the previous subsection, in the political sense, this redefinition has included both voters and elected officials, with the voting populace expressing their collective will through use of the “opinion” vote, and with the officials elected in two successive mayoral terms spearheading a redefinition of citizenry participation and the use of public spaces. Moreover, these officials have striven to defend public interests over private interests and the general good over partisan priorities. This political stance represents an aberration in traditional Colombian politics, which in earlier years had produced a series of governments characterized by a distinct lack of will in defending the public’s best interests and safeguarding the rights of their citizens.

The unfavorable political climate for traditional politicians and the sociocultural transformations characteristic of the 1990s led voters to opt for alternative proposals, such as the election of Antanas Mockus in 1994. This shift in voter preference in Bogotá had been presaged in other cities of the country and was even replicated in national and local elections in many other countries and cities of Latin America. It has brought into power a diversity of new players that includes civic leaders (both lay and religious), representatives of unions and not-for-profit and business associations, and ethnic and political minorities—such as members of indigenous groups, black communities, left-wing parties, and former guerrillas—as well as nationalists, intellectuals, populists, and entertainers (singers, actors, comedians, and sports commentators, among others).

Factors encouraging changes in transportation and physical mobility are closely tied to political issues. Hence, in Bogotá, change took place within the framework of determining the role of the principal stakeholders: city hall, transportation companies, and the general public. City hall promoted changes in the way people conceived of

transportation and how it should function; transportation companies accepted and followed through on making internal changes in the sector’s organization; and citizens changed their thinking by accepting new laws, standards, and programs related to the creation of infrastructure projects. To better explain the magnitude of these changes, the next subsection examines the characteristics of urban mass transit in the late 1990s.

### **Urban Transit Prior to the Transformation**

Starting in the early 1980s, when the urban area was burgeoning and there were limited new alternatives for managing existing urban transportation infrastructure, the quality of daily transportation in the city progressively deteriorated. Then, in the early 1990s, urban transportation further worsened due to the massive introduction of vehicles, spurred by a macroeconomic policy that opened the borders and cut import tariffs.

Bogotá, as well as nearly every other major population center in the Region of the Americas, found itself a victim of what became known as “the transportation problem,” a dangerous dichotomy marked by widespread automobile gridlock and a woefully inadequate system of public thoroughfares to accommodate the swelling number of vehicles in circulation. In Bogotá, this situation led to considerable changes in the city’s socioeconomic and spatial structure until the physical boundaries could no longer continue to expand. Hence, there was a series of positive and negative occurrences, among which the most important were:

- a higher population and housing density;
- displacement of the downtown business district toward the north of the city;
- consolidation of several “subcenters” within the city and of one metropolitan “hypercenter”;

- radical changes in the criteria used by residents in choosing a place to live; and
- consolidation of a once-unreliable mass transit system.

The last item in this list requires closer examination, in view of the fact that the transformation of Bogotá's once-unreliable transportation system has significantly contributed to increasing the amount of time residents spend walking. Indeed, the current TransMilenio system, with its fixed bus stops and the long distances that need to be walked to reach these stops, stands in sharp contrast to the traditional system, in which buses allowed passengers to disembark wherever the latter requested. Prior to the construction of TransMilenio, passengers of the traditional system accounted for more than 80% of daily trips in the city. The population's unruliness was reinforced by a semi-informal organization of the traditional transportation system that forced drivers to seek out passengers in order to guarantee their income. Hence, drivers had turned the city into a type of battlefield in what became known as the "centavo war." Nevertheless, in practice, the unreliability of collective transportation was due in part to the particular way the system was operated. The poor service—with the lack of set bus schedules, disregard for stops, irregular routes, and generalized overall lack of discipline—was not the result of the "centavo war," the lack of civility, or the drivers' socioeconomic and cultural characteristics, as is frequently suggested. Rather, the "centavo war" was built into the structure of this type of transportation system, requiring buses to be filled to capacity despite the low profit margins this ridership produced.

These problems were not exclusive to Bogotá in the 1990s: precarious organization and management of collective transportation are characteristics common to a number of Latin American cities. To a large extent, this situation is the result of a lack of political will on the part of local governments as well as

their inability to organize, control, and/or manage municipal transportation systems, on the one hand, and, on the other, the serious obstacles small, informally organized transportation enterprises often face in evolving into more stable entities. Over time, these latter types of companies have become consolidated into a de facto transportation management system. As noted by Coing and Henry (1989), "an exhaustive assessment makes the organization of transportation [in developing countries] a true 'system,' even if this system has nothing to do with our standards [those of industrialized countries]. . . . Very strong social and functional regulations hide behind apparent disarray. . . . [Within this apparent disarray] there can be regulation mechanisms, almost always based on stakeholders' roles" (14).

## THE CULTURAL REDEFINITION OF BOGOTÁ

On 30 October 1994, Antanas Mockus was elected *Alcalde Mayor* (i.e., mayor of the entire metropolitan area) of Bogotá. In garnering a large majority of the votes—64%—he scored an impressive victory over Enrique Peñalosa, the candidate for the Colombian Liberal Party, who received 30%.<sup>15</sup> His rise to power followed a novel and unusual electoral campaign, known as *Ciudadano en Formación*, one of whose fundamental tenets was named the "No P;" as in No Publicity, No Politics, No Money (*plata*), and No Parties. This campaign was decidedly the most eccentric and least expensive<sup>16</sup> in the history of the city and the country.

In the District (capital) Development Plan for 1995–1997, called "Forming a City," the Mockus administration gave priority to six

<sup>15</sup>Registraduría del Estado Civil (vital records and electoral oversight office), information from 1994 national elections.

<sup>16</sup>The approximate cost of the campaign was 8 million Colombian pesos, or US\$ 8,000 at the 1994 exchange rate.

topics, in the following order: citizen education, public space, the environment, social progress, urban productivity, and institutional legitimacy (15).

## Citizen Education

Education of Bogotá's citizenry became the linchpin of Mockus's efforts, which focused mainly on facilitating or strengthening behavior changes—changes in the way the city's inhabitants relate to one another and gain control of the places where they carry out their daily activities. Citizen education was defined as "the set of shared attitudes, customs, actions, and minimum rules that generate a sense of belonging, facilitate urban coexistence, and lead citizens to respect common heritage and recognize their rights and duties" (16). Furthermore, it "consists of facilitating, from a position of political authority, a greater convergence of law, morality, and culture, through the promotion of self-regulating and mutually regulating processes. A familiarity with and internalization of cultural norms that are considered desirable and that set limits on social action in highly heterogeneous social and cultural milieus should promote socially acceptable behavior without the threat of legal punishment, which is the last resort of state control. In sum, the result should be education for a new expression of *social obligations*, a new citizen morality constituted by new patterns of coexistence" (10).

The promotion of citizen education played a leading, strategic role in the administration's actions. It was both a project and a strategy, encompassing several topics initially proposed as strategies of the government's plan. For the first time in the history of Colombia, and perhaps in all of Latin America, an administration focused its efforts on educating citizens and devoted a significant portion of its resources to that end, which had been part of candidate Mockus's *Ciudadano en Formación* and "Forming a City" electoral platform. Under this plan, more

than US\$ 100 million was allocated to the Citizen Education Program for a period of four years, starting in 1995. The program was carried out by the District Institute of Culture and Tourism (IDCT).

The three basic strategies on which citizen education was based were: citizen self-regulation, modification of contexts, and institutional incentives. These strategies were aimed at bringing about harmonious relations among citizens through conflict resolution and the overcoming of racial and social prejudices.

The implementation of the citizen education concept was carried out through programs designed to teach Bogotá's residents by entertaining them and leading them to reflect on the importance of improving their everyday behavior within the context of the city's physical and social environment. The programs developed were numerous and highly varied in their approach. The actions—promotional signage and other types of street representations and events—were symbolic, ingenious, and thought-provoking. However, very unpopular measures were also adopted, in an effort to reduce violence, lower the rate of alcohol-related accidents, and reduce the number of gunshot wound victims. One special focus was the restriction of arms possession among civilians carried out through anti-gun campaigns. A "semi-dry" law known as the "carrot law" or "carrot hour" was created, forcing nighttime establishments to close at 1:00 a.m., and the production, sale, and use of gunpowder for recreational purposes were prohibited. Despite their initial unpopularity, these measures later came to be widely respected. According to surveys conducted after their enactment, the anti-violence efforts were approved by 92% of the population; the steps to curb alcohol consumption, by 81%; and the restrictions on gunpowder, by 77%.<sup>17</sup>

<sup>17</sup>Bogotá, Centro Nacional de Consultoría. *Conocimiento y evaluación del programa "Cultura Ciudadana."* Unpublished report, 1998, p. 108.

One important component of the actions was based on entertainment and communication: the idea was to teach people by encouraging them to have fun during the learning process. The main focus of the efforts was interpersonal communication through entertaining street activities. Games were created, such as one using a *perinola* (a small top) and another with white and red “citizen cards”: the game with the top was meant to symbolize participation, with anyone being able to win or lose, and the card game was intended to signal citizen approval or rejection, similar to the cards used by soccer referees. To encourage the population to reflect, a series of “urban theater” skits were staged using street mimes and actors. In March 1995, the first of these skits sought to teach citizens to respect pedestrian crosswalks (called “zebras”), to wear safety belts, and to refrain from honking horns. The actors, disguised as cloistered monks, were to encourage citizens to reflect on the importance of lowering noise levels in the city. These and other types of skits were designed to “bring about a sense of belonging in a city [traditionally] characterized by inhospitality and a weak citizen-oriented culture.”<sup>18</sup> After a series of activities utilizing an interpersonal strategy had concluded, much more broad-based efforts were introduced, characterized by programs and actions known as “Bogotá’s Charm,” “the Capital Card,” “the Rules of the Game,” “Bogotá Is to Be Won or Lost,” and “We All Chip In,” among others.

One of the actions that received the most attention nationally and internationally was the utilization, starting in March 1995, of street mimes to raise the population’s awareness of the need to use crosswalks. These skits were widely covered by the media, which greatly helped to publicize the efforts

and their objectives. Hence, with the tacit support of the media—an unexpected ally that contributed free airtime—the actions to raise the population’s awareness through skits and symbolic representations achieved a large part of their objectives.

Thus, over time Bogotá residents came to recognize the significance of a government administration’s efforts to raise awareness about the need to improve urban life. Although statistics are not very accurate indicators of the scope of the change in thinking generated during Mockus’s first term, in the “mind of the imaginary Bogotá dweller,” there is the idea that citizen education has been one of the most profound changes in the capital’s recent history. The work carried out in Mockus’s first period will be vividly remembered for a long time. However, unlike other administrations, it will not be remembered for its landmark public infrastructure projects—as has been the custom in Bogotá’s history—but for the transformation in its citizenry resulting from large-scale education initiatives.

Residents’ overall assessment of the citizens’ education program was extremely positive. It scored 7 on a scale of 10; 61% considered it the most important and concrete action carried out by the Mockus administration, and 96% felt that the program should continue. When asked to choose from a list of proposed phrases in the same survey, 44% of the respondents associated the program with the idea of “educating people to be more civilized,” and 23% with the idea of “improving the work of the police and the authorities to reduce feelings of insecurity in the city.”<sup>19</sup>

The citizen education program was complemented by the founding of the Observatory of Urban Culture in September 1996 as a vehicle to facilitate the study and monitoring of the city and its changes by “constructing a multidisciplinary structure for the observa-

<sup>18</sup>Taken from a 1995 presentation given at the Observatory of Urban Culture by the Center of Social Studies. “Memoria y evaluación del Instituto de Cultura y Turismo, Programa de Cultura Ciudadana.” Bogotá, National University of Colombia, School of Human Sciences, IDCT. Unpublished report, 1998, pp. 102–104.

<sup>19</sup>Bogotá, Centro Nacional de Consultoría. *Conocimiento y evaluación del programa “Cultura Ciudadana.”* Unpublished report, 1998, p. 108.



tion, research, collection, and rigorous and periodic systematization of information on the culture of Bogotá; and by promoting a confluence of interests by researchers and by city government in order to analyze and evaluate urban processes and the results of the actions of the various city government agencies in the capital.”

### THE REDEFINITION OF ESTHETICS, SPACE, AND FUNCTION

In 1997, in a more hotly contested election than the preceding one, Enrique Peñalosa, running as an independent candidate, captured 48% of the votes, defeating the “populist” candidate, Carlos Moreno de Caro, who received 31%. The District Development Plan for 1998–2000, called “For the Bogotá We Want,” stressed the following topics and projects: poverty eradication, social integration, a city on a human scale, transportation, urban planning and services, security and coexistence, and institutional efficiency. In addition, the following “megaprojects” were drafted: an integrated mass transportation system, street construction and maintenance, the creation of a land bank, a district park system, and a district library system.

The definition of these megaprojects clearly set the priorities for the actions to be undertaken. Hence, the most notable achievements of the Peñalosa administration were directly related to these projects. Furthermore, the particular statute for the megaprojects allowed teams outside the government to be formed, even with young managers almost completely unfamiliar with urban issues or with the specific field of work involved, but who were responsible for concrete tasks and strategic projects—known as macroprojects.<sup>20</sup> The administration’s dis-

course and actions from 1998 to 2000 were punctuated by an overarching invitation to the inhabitants of Bogotá to envision a new city, to move “discussion on the city beyond the subject of potholes and security, so that we will become aware that we can build anything we imagine” (17). The first 24 months were very taxing for the mayor, however, in the sense that he experienced difficulties in conveying to his constituency what he was thinking, proposing, and carrying out for Bogotá—the creation of “a city that today seems utopian; [a city that is] reforested, that has bicycle paths, beautiful promenades, is full of parks; [a city] with nearly navigable, clean rivers; with lakes [and] libraries; [a city] that is clean and egalitarian” (17).

Although improving the city’s appearance was not one of the priorities of the development plan, it was one of the mayor’s principal concerns. Despite the large amount spent on advertising for actions to improve the city’s image, such as the well-known campaign called “Bogotá, 2,600 Meters Closer to the Stars,” launched in August 1998,<sup>21</sup> the mayor encountered challenges in getting across his message of encouraging people to imagine a new city. Indeed, Peñalosa’s proposal was only fully understood after the projects had been completed. The reasons for this were, on the one hand, the relatively felicitous effort to convey ideas and provide information on projects in progress, and, on the other, the fact that most of Bogotá’s residents had only limited points of comparison, which effectively prevented them from imagining a different city.

In the search for an “egalitarian” city with “beautiful promenades,” public space and physical mobility became the central elements. Proposals and actions of the Peñalosa administra-

<sup>20</sup>Very few project managers were highly specialized in fields related to the projects being conducted. One exception was the head of the Metro project, Dr. Darío Hidalgo G., a transportation expert.

<sup>21</sup>“The campaign seeks to convey the notion that Bogotá is a humane city, owned by all its residents, and that its dwellers are proud of it. It wants to instill in residents a sense of belonging and appropriation. . . . This is the legitimization of a characteristic conceived as part of the city’s heritage, a recognizable emblem of its identity vis-à-vis the country and the world” (18).

tion were designed to create a friendlier and more humane city, with public spaces allowing people to come together (promenades, plazas, parks, tree-lined avenues—mistakenly called “alamedas”<sup>22</sup>), and where these spaces could be used by all citizens regardless of social class.

Enrique Peñalosa’s management has been recognized both nationally and internationally for the important innovations it introduced in urban transportation. This recognition has been expressed in many ways. According to a December 2000 survey conducted by the Colombian daily *El Espectador*, more than 40% of the population described his administration as “excellent.”

### **Mobility and Transportation: The Redistribution of Public Space**

Between 1998 and 2000, there was an authentic transformation in the approaches used to respond to the issues of physical mobility, transportation, and public space. The nature of these approaches can be regarded as a radical break from the way these urban issues traditionally had been addressed. Indeed, there is now widespread consensus among the city’s dwellers that the effect of the Peñalosa administration’s policies regarding mobility transcended physical projects such as TransMilenio, the creation of bicycle paths, the recovery of green space, or programs such as “Pico y Placa” and “Without My Car in Bogotá.” From a practical standpoint, these efforts offered Bogotá’s populace the opportunity to get from one point to another in the city in a new way, but on another plane, they enabled the citizens of Bogotá to reclaim their city and take back its public spaces for their own enjoyment and benefit.

Peñalosa’s administration made TransMilenio a high priority and the centerpiece for the transformation of mass transport in

the city between 1998 and 2000. Within the framework of the Bogotá Development Plan, nearly US\$ 300 million was allocated in 1998 to the bus system as the backbone of the mass transit service. Most of this amount was used for investment in roads and related technical infrastructure required for the implementation of an efficient transportation system, and it brought about a new physical and functional structure for the organization and operation of mass transport. The service’s planning, organization, infrastructure construction, coordination, and control were placed under the responsibility of a “district” (municipal) company named TransMilenio S.A. (10). Yet private transportation companies were made responsible for the system’s actual operation; that is, for providing the buses and hiring the drivers.

The type of physical infrastructure chosen followed the lead mainly of experiences in the cities of Curitiba, Brazil, and Quito, Ecuador. The structure is an integrated system made up of a high-capacity arterial network and feeder networks. Along the bus routes, there are fixed stations where passengers can pre-pay before boarding. These are divided into simple, intermediate, and head stations. There are also stations along the feeder routes.

In addition to developing TransMilenio as a new concept of mass transport, the Peñalosa administration also promoted alternative forms of transportation through such programs as “Pico y Placa” and “One Day without a Car,” both intended to counter the predominance of private automobile use and to encourage the construction and improvement of promenades and bicycle paths, so as to stimulate an increase in nonmotorized transportation activities such as walking and bicycling.

Public discourse and actions discouraging the use of individualized transportation were, in general, innovative, coherent, and on-target. Discourse on the impact of automobiles on the urban environment was also relevant, stressing the tenuousness of de-

<sup>22</sup>In Spanish, *alamedas* should be used only in reference to poplar groves.

pending on this form of transportation in the medium and long term. In this regard, it was frequently pointed out that “if we do not succeed in getting people who own automobiles to utilize public mass transportation, the functioning of our city will become unviable, for both economic and environmental reasons, not to mention the collective despair [this will cause] our citizenry.”<sup>23</sup> The Peñalosa administration steadfastly pointed out that personal vehicles “are the most serious threat the city will have in the future . . . private automobiles are the worst threat to quality of life in this city” (20).

As mentioned above, people were encouraged to use their automobiles rationally through peak-hour controls known as “Pico y Placa.” This consisted of a non-coercive restriction designed to reduce rush-hour traffic so that automobile owners would not feel so dependent solely upon this form of transportation and to discourage the purchase of additional family vehicles. This measure succeeded in taking more than one-third of private vehicles off the street each day.

Mayor Peñalosa’s anti-automobile and pro-sustainable-city discourse made it possible to conduct a trial run of what the city would be like without cars. On 29 February 2000, Bogotá held its first “Without My Car in Bogotá” day; as with similar experiences in many cities of Europe, the city functioned for one working day without automobiles being driven. The objective of the event was to encourage reflection that would allow citizens to imagine a new, more humane, and sustainable city. Despite the many missteps characteristic of such a large-scale trial, residents generally supported the event and voted in a referendum for it to be carried out annually.

The importance given to public space was one of the most important contributions of the 1998–2000 administration. Public space, which once “belonged to no one and was not

given serious attention by city government, [and which] anyone could take for his or her exclusive use, without any consideration for [other] human beings . . . came to be the pre-eminent space in the city” (21). Although much remained to be done in terms of theoretical studies, in practice considerable strides were made: an Office to Defend Public Space (*Defensoría de Espacio Público*) was created<sup>24</sup> and given the responsibility of recovering land illegally occupied or seized. Furthermore, large public spaces were set aside for pedestrians through the establishment of formal and technical standards governing the placement of promenades, park benches and fences, picnic tables, bus stops, public phones, and other fixtures; tree planting and landscaping; signposts; and lighting.<sup>25</sup> All told, 836,143 m<sup>2</sup> of public space was created (22); 1,034 park areas were taken back, improved, and maintained—approximately 54% of the city’s total of protected green areas. Almost 70,000 trees and 183,651 garden plants were planted; and 202 km of thoroughfares and 280 ha of parks were protected. All of this was done at an approximate cost of US\$ 100 million.

The actions to recover, improve, and maintain public space also led to progress in the construction of a network set aside for nonmotorized vehicles. The Bicycle Path Master Plan proposed the construction of 450 km of paths exclusively for bicycles (called *ciclorrutas*): 300 km (two-thirds of the total distance) have been completed to date, making the network in Colombia’s capital the largest in Latin America and one of the largest in the developing world. The sizeable investment (US\$ 46 million through 2001)

<sup>24</sup>Agreement 18, 26 August 1999.

<sup>25</sup>Many executive orders were issued on the design and construction of promenades, through the following documents: Executive Order 682, 4 August 1998; Executive Order 758, 4 September 1998; Executive Order 170, 17 March 1999; Agreement 38, 13 December 1999; Executive Order 198, 21 March 2000; Executive Order 822, 28 September 2000; Executive Order 1003, 14 November 2000.

<sup>23</sup>Agreement 4 of 1999.

has resulted in a number of impressive technical and construction achievements, including the fact that the largest expanse of the bicycle path network was completed in less than three years, a very short time for such an ambitious undertaking.

### **CONCLUSIONS: THE COMPLEMENTARITY BETWEEN ISOLATED ACTIONS AND INDEPENDENT ACTIONS**

The conclusions of the author of this chapter regarding both the increase in physical activity among Bogotá's residents, as discussed in earlier parts of the chapter, and the city's physical and spatial transformation, described in subsequent sections, are very similar, not only because of conceptual similarities but also because of the interdependence of these topics. Indeed, both changes stem to a large extent from a complementary process of isolated political actions that were independent from one other in terms of the issues at hand as well as in terms of when and where they were carried out. Although today Bogotá city dwellers walk and use bicycles more than ever before, this achievement is due to effective urban transportation policies and not, in all fairness, to successful public health efforts or the promotion of increased physical activity per se. This occurrence serves to illustrate that if a public policy is channeled in the right direction, its positive effects may extend well beyond the sphere or issue that was originally targeted. This unintended interconnectedness between different disciplines and aspects within the same geographical framework nonetheless provides a strong and convincing argument for the value-added nature of comprehensive and well-coordinated efforts. The experience in Bogotá demonstrates the positive efforts to be derived from the formation of teams to address both challenges related to urban transportation as well as those related to improving public health status,

particularly as regards sedentary lifestyles and physical activity. The question arises that if the world-class capital city of Colombia has unintentionally attained unprecedented coordination and results in the transformation of its human and physical characteristics, what would occur in other cities if urban planning and the design of transportation structure were to adopt from the outset as the criterion for socioeconomic evaluation the benefits that this type of infrastructure would bring to the health and well-being of the population? Based on the experience in Bogotá, many fields of research and reflection open up for future exploration of the concrete strengths to be offered by conscious coordination between teams of urban development and public health specialists. Consequently, this chapter's conclusions have been divided into two parts, which detail, on the one hand, the factors leading to cultural and spatial change, and, on the other, the elements that may contribute to an increase in physical activity through changes in the way populations mobilize themselves from one area of the city to another.

### **The Recent Transformation of Bogotá**

Bogotá's recent transformation is the result of a long process that lasted approximately a decade, the most significant aspect of which was the complementarity and continuity between actions that redefined the roles of citizens and those that redefined public esthetics, space, and function. However, it should be noted that no "macro" or overarching plan for the transformation was followed by the two government administrations, nor was there continuity in terms of policies or parties between the first and the second mayor—indeed, Antanas Mockus and Enrique Peñalosa were political opponents in the 1994 election. Still, the achievements in transportation underscore the complementarity between the goal of improving transportation and changing the population's behavior. Although the projects involving concrete and asphalt have

strongly impacted the way people move about in the city, this achievement is also related to a change in thinking regarding the city in general and mobility in particular. In recent years, there has also been a structural change in the way transportation is thought of and provided, entailing both municipal authorities and the citizens they serve. First, there were citizen education campaigns; then, for the first time in the city's history, mass transit was made a top priority, based on the rational use of automobiles, the implementation of the TransMilenio project, the taking back of public space, and the creation of options for getting around not requiring motor vehicles. Hence, the intention was to strike a new balance in the use of public space. In this regard, Mayor Peñalosa took a very bold public stance by declaring that private automobiles were not a viable, long-term alternative for daily transportation in a city that wished to be efficient, equitable, and humane.

A high degree of reflection regarding mobility has been attained, and significant actions have been taken. Furthermore, a high level of coherence has been achieved between theory and practice, which, in and of itself, is an extremely rare phenomenon in today's society. Indeed, although many large metropolitan areas have elected officials who claim to prioritize collective and nonmotorized transportation, in practice they do not question the indiscriminate use of automobiles, perhaps due to the high political cost of doing so. If the majority of elected officials fail to carry out programs that encourage the rational use of private vehicles or that propose to take back public space, it is most likely because such actions could directly affect their image or their possibilities of being reelected.

The transformation of Bogotá over the past decade has been a complex process requiring an inordinate reserve of political will, coherence between plans and actions, an important investment in collective and nonmotorized transportation, and especially,

the participation and education of citizens and the creation of an ongoing dialogue with them. For example, although the taking back of promenades has benefited most residents, the measure was apparently rejected at first, due to what has been called a "lack of points of comparison." It has been demonstrated that residents' lack of comparison with other urban realities—either within the city or outside of it—prevented them from clearly perceiving the magnitude of the problems in the infrastructure they used every day. The case of the promenades has parallels with collective transportation. Despite its previous inadequacies, public transportation has traditionally been evaluated positively and has scored relatively high in surveys in recent years, despite the worsening of driving conditions. In the case of the recovery of public promenades, the beneficiaries—the vast majority of Bogotá's citizens—did not have a true point of comparison to assess what it meant to see uncongested thoroughfares and clearly marked and respected pedestrian crosswalks, since these phenomena had never formed part of their shared history.

Changing the way people think was one of the most important challenges taken up by the two administrations, since it entailed bringing about a radical transformation in the type of city and citizens that had existed until then. Indeed, the emerging metropolis of Bogotá had been structured much more around the automobile than around mass transportation. Private automobiles had enjoyed privileged status during successive governments (both national and local) even though historically only a minority of residents had owned one. Models of urban development centering around the indispensability of automobile use reflected the distinct influence of the United States, the traditional source of emulation by Colombian society's middle and upper classes.

Yet since the late nineteenth century, the considerable influence of the United States, particularly in the socioeconomic and politi-



cal spheres, when not clearly detrimental, has produced decidedly mixed results. For example, some urban sectors of Bogotá increasingly resemble cities in the United States; nevertheless, a closer look reveals that this similarity harbors many of the limitations characteristic of a Third World city: Bogotá's northern sector has seen a considerable expansion of infrastructure to accommodate automobile use, while the center has become increasingly overlooked from this standpoint. The appearance of much of the city, and in particular the north, is closely linked to the predominance of the automobile, as seen in the proliferation of streets and in the formal characteristics of private residences and of consumption patterns and in the choice of leisure-time activities. The preference for the automobile is most obvious in the structure of the city, since the most important infrastructural elements to facilitate driving benefit the north, at the expense of the rest of the city—particularly the south—thereby aggravating the city's traditional socioeconomic and spatial segregation. This segregation, in turn, has led to an important imbalance that is currently spreading throughout the metropolitan area.

In this sense, by vigorously limiting the use of private automobiles and instead promoting collective and alternative forms of urban transportation, Bogotá is setting a precedent for many other cities in Latin America. Hence, the achievements in physical activity described in this chapter and their possible future impact on preventing sedentary lifestyles and chronic disease are important additional arguments, albeit in a different discipline, that enhance the analysis of Bogotá's transformational experience.

### **Public Health and Physical Activity**

The budding achievements in public health and physical activity strongly resemble other changes in the city, which stem more from the convergence of isolated, complementary factors that originated indepen-

dently from one another rather than from purposefully planned efforts coordinated among various public entities. Indeed, there was no overall or sectoral plan regarding urban issues, transportation, or public health to mobilize the people of Bogotá on a large scale. Although there have been sectoral efforts focusing on physical activity, these likewise have been partial and somewhat marginal for a city of this size. And while programs have been created that focus on physical activity, they have targeted relatively small groups of individuals, such as the employees of specific private or public enterprises. Still, the "Sunday Bicycle Path," a program that every Sunday makes more than 100 km of streets available for nearly one million people to walk, skate, or ride bicycles, is more than 25 years old and has become part of the city's recreational heritage.

The changes in Bogotá can be defined as a succession of well-focused and well-thought-out public actions that have complemented one other in different ways. Although these policies have not been coordinated, due to the issues they address and due to time and space constraints, they have favored increased physical activity. Indeed, two mayors and three city governments between 1995 and 2003 consolidated highly diverse actions that on the whole led to a substantial increase in physical activity. The unifying factor in all these actions appears to be the complementarity between campaigns focusing on changing citizens' behavior (citizen education) and the construction of public spaces and infrastructure for mass transport and alternative forms of mobility. Nevertheless, it must be recalled and emphasized that, in addition, there have been improvements on other fronts, such as the considerable reduction in crime and traffic accident rates, increased citizen participation, and higher housing density, among others. Although almost two-thirds of the half-hour of universally recommended daily physical activity is met through the time it



takes for most commuters to walk to the nearest station of the TransMilenio system, the elimination of parking on public streets has also forced drivers to engage in additional physical activity, since the distances from their parked automobiles to their offices or other downtown destinations have likewise increased.

However, and despite the progress seen with regard to physical activity, ongoing research<sup>26</sup> points to an important discrepancy between what the residents of Bogotá perceive with respect to their physical activity or inactivity and the amount of activity in which they actually engage. Indeed, two-thirds (66%) of the respondents consider themselves to be physically active, which, technically, refers to a maintenance level of exercise. If this perception were accurate, it would have very positive implications for the population's health and well-being, because it would mean that the vast majority engage in physical activities at periodic moments throughout their daily lives. Nevertheless, an analysis of the levels of activity at different times throughout the day shows that the citizens of Bogotá are sedentary during at least 75% of their spare time, 90% of their work hours, and 79% of the time they spend commuting.

Another particularly worrisome finding produced by this research is that the barriers or impediments to undertaking physical activity are related more to individual than to societal reasons or causes. Indeed, it would appear that people are sedentary more out of a lack of willpower (30%) or energy or time (20%) than because of general, socioeconomic, and spatial issues in cities. The possible lack of space or of safety are very rarely mentioned as barriers to physical activity. Another important contradiction, especially

since walking, running, and climbing stairs cost nothing, is that 25% of the respondents point to a lack of money as the principal impediment to doing physical exercise.

Both the study of chronic disease and efforts to prevent it lead to an attempt to bring about behavior changes, which can only occur through a minimum, gradual adaptation to individuals' internal or external conditions. The internal factors are related to educational and cultural level, socioeconomic class, sex, age, physical activity or inactivity, and daily work routine, among others. The external factors are related to physical and environmental, as well as sociocultural, conditions. Physical and environmental conditions encompass the availability of recreational, sports, and urban infrastructure; geographical and climatic characteristics; and the conditions in which mobility takes place in a city, among others. Sociocultural conditions include collective awareness and behavior and citizen culture; personal safety; notions or frames of reference regarding urban transportation; physical activity; and the city itself or information available within the city. In this sense, the experience in Bogotá makes it possible to presume that, on the one hand, the recovery of public space and the construction of infrastructure for nonmotorized transportation, and, on the other hand, citizen education campaigns, the reduction of the number of violent deaths, and increased respect for rules, can contribute, within an urban context, to behavior change, by discouraging sedentary lifestyles and encouraging physical activity, thus helping to improve citizens' quality of life and increase their life expectancy.

## ACKNOWLEDGMENTS

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<sup>26</sup>See footnote 5 in this chapter for a description of the comprehensive study being carried out by the Public Health Institute of Colombia's National University and the Fundación Ciudad Humana with funding from the Colombian Social Protection Ministry.

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# **Integrated Strategies at the National Level**



# IMPROVING NUTRITION IN MEXICO: THE USE OF RESEARCH FOR DECISION-MAKING IN NUTRITION POLICIES AND PROGRAMS

*Juan A. Rivera*<sup>1</sup>

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## INTRODUCTION

The purpose of scientific research is to generate knowledge. The primary tool of research, in the various areas of knowledge, is scientific method, whose application enables the duplication of experiments or studies and the comparison of results in order to formulate plausible or likely statements regarding the relationships between the variables. Scientific method can be applied to the study of an assortment of issues, and its application may be motivated by human curiosity, without the findings of the research necessarily having an immediate practical application, or the purpose may be problem-solving or immediate practical application.

The National Institute of Public Health (INSP) of Mexico, an institution devoted to public health research and nutrition, has clearly defined its inclination towards generating knowledge in order to apply it to the improvement of the population's health. This type of research, termed "mission-based research" by Frenk (1), has been defined as "the development of a research effort that modifies some aspect of reality by producing knowledge and technology." The "mission" is precisely that modification of reality.

Mission-based research in public health therefore centers its efforts on improving the

health conditions of the population by applying scientific method to the study of different objects and levels of analysis. The objects of analysis are the health conditions of the population and the organized social response (policies, programs, and actions) for the prevention and control of such conditions. The levels of analysis include subcellular particles (molecular biology), individuals (clinical research), populations (epidemiological research), and health systems (systems research), using a multidisciplinary approach to generate knowledge that makes it possible to resolve public health challenges. An important area of mission-based research is the use of scientific data for decision-making in public health, including the design and evaluation of health and nutrition policies.

An erroneous conclusion that is frequently drawn upon addressing the concept of mission-based research for the first time is that it deals with applied research, whose only purpose is problem-solving. A distinction is frequently drawn between applied research (often confused with mission-based research) and basic research, which generates universal knowledge. A key feature of the type of research that the INSP aspires to

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conduct is the attempt to generate fundamental knowledge; that is, research that has an effect on the conceptual structure or the perspective of a specific field of knowledge, and, at the same time, endeavors to be useful. This type of research, called "strategic" research, has been described by Stokes (2), who proposes that the traditional concept that standardizes research as a continuum in a single dimension, with pure research and applied research on either end, is inadequate. He also proposes that research should be conceived on a bidimensional plane, with one of its pillars represented by the search for the generation of fundamental knowledge and the other represented by the search for research usefulness. Strategic research is located in the quadrant that represents both the search for fundamental knowledge and its usefulness. A historical example of this type of research is the sort conducted by Pasteur, who combined both interests.

The Center for Research in Nutrition and Health (CINyS) of the INSP, in keeping with the philosophy of strategic mission-based research, seeks to develop a research agenda that aims to prevent and control poor nutrition in Mexico, through the generation of knowledge and technology intended to improve the effectiveness of the organized social response to the problems of poor nutrition. This chapter presents pieces of evidence on the use of scientific research findings in Mexico to generate actions aimed at preventing and controlling the population's poor nutrition and to design nutrition programs with a high potential for bringing about positive effects; data on the use of evaluations to fuel decision-making in existing programs and policies are also presented.

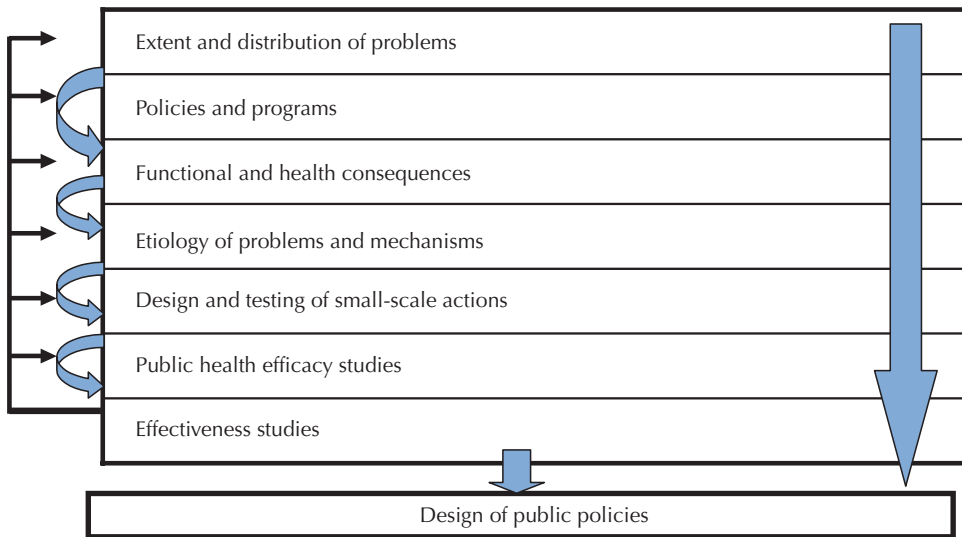
The CINyS, inspired by the philosophy of mission-based strategic research, has set up a format that serves as a guide for defining the Center's research agenda. Stages of mission-based research have been identified for each of the various problems related to poor nutrition or to the challenge faced by health systems in promoting adequate nutrition or preventing

or controlling poor nutrition. These stages usually occur sequentially, but can also function iteratively; that is, upon reaching a higher stage it is sometimes necessary to return to a previous stage in order to answer the new research questions that have emerged.

The research sequence around the problems of poor nutrition (Figure 1) starts with (1) a study of the conditions (extent and distribution of the population's poor nutrition problems and their determinants) and responses (food, nutrition, and health policies and programs with a potential impact on poor nutrition), and continues with (2) studies on the functional consequences or on the health of the population suffering from poor nutrition, in order to determine the importance of the problems, followed by (3) studies on the etiology of the problems and on the biological or social mechanisms that explain them. The next stages consist of (4) the design and testing of small-scale actions or interventions, (5) controlled clinical trials for studying the efficacy of the interventions or actions, and (6) effectiveness studies or the evaluation of actions or programs, including process and cost-effectiveness evaluations. Figure 1 concludes with the design of policies and programs and their evaluation in order to provide feedback for the decision-making process. The results of the evaluation are useful for identifying operational or design problems, which leads to new research questions that, when answered, fuel the cycle of mission-based research at some point in the Figure. In this final process, there will be close interaction between the respective researchers and the civil servants who will be in charge of designing and managing nutrition and public health policies.

Reviewing the literature during the different stages is essential in order to identify the existing knowledge and the principal voids, as well as to determine the research needs; these are contrasted with the capabilities and comparative advantages of the CINyS in order to therefore define the lines of research and research projects to which the Center can



**FIGURE 1. Stages of the mission-based research process.**

contribute effectively. This process is useful for both determining CINyS' staff training and recruitment needs, and for forging strategic partnerships with other research groups in order to generate an effective critical mass that makes it possible to respond to the challenges of mission-based research.

The following is a chronicle of the way in which, through the application of this format, research findings have been used for designing policies and programs geared to the prevention of poor nutrition in Mexico. Several of the results that are useful in tackling malnutrition have also contributed to the fundamental knowledge in this field and have been published in Mexican and foreign peer review journals.

### **STUDIES ON THE EXTENT AND DISTRIBUTION OF NUTRITION PROBLEMS IN MEXICO (A STUDY OF THE CONDITIONS)**

An important task undertaken by the CINyS has been conducting and analyzing

probabilistic national surveys that show data on the nutritional status of the Mexican population and its determinants. In 1993, when the research group that would later become the CINyS was set up in the INSP, the data from the 1988 National Nutrition Survey (NNN), conducted by the Secretariat of Health (SSA) (3), were analyzed, disseminated, and published. Ten years later, the INSP sought financial support to carry out a second NNN. Support provided by the SSA and other organizations enabled the second NNN to be carried out between 1988 and 1999 (referred to in subsequent references as NNN-99). The surveys led to an understanding of the extent and distribution of the problems surrounding poor nutrition and the determining factors, and those data were disseminated both to the scientific community and authorities responsible for the formulation of food, nutrition, and health policies. As will be described in more detail further on, through the dissemination of publications and presentations targeted to key actors involved in the design and management of policies and programs, the results of the

NNN-99 set in motion various public actions, policies, and programs for preventing malnutrition.

The following is a brief summary of the NNN-99 findings, which constituted the basis for designing the resulting nutrition policies and programs, and represented significant input for defining the CINyS research agenda.

The leading problems resulting from poor nutrition in Mexico, according to the NNN-99, were linear growth retardation (short stature), anemia and deficiencies of several micronutrients, and overweight and obesity.

### Linear Growth Retardation

In Mexico, short stature continues to be a significant public health problem among children under 5 years of age, while emaciation no longer constitutes a major problem at national and regional levels. Nationally, nearly one out of five children under 5 (17.7%) recorded low height in 1999, while only 2% showed emaciation. The analysis conducted on the prevalence of low height for this age group revealed that this phenomenon occurs predominantly during the first two years of life. Thus, while prevalence is 8% during the first year of life, it jumps to 22% during the second year, an increase of almost three times, and it remains at 20% up to age 4. There is not a subsequent recovery from short stature, as one can see upon studying the height of school-age children and women of childbearing age (4).

One of the most troubling findings of the NNN-99 was the inequity in terms of the distribution of malnutrition. Short stature is distributed heterogeneously among the population subgroups. Figure 2 shows the prevalence of short stature for each of the four regions studied,<sup>2</sup> by urban and rural areas and in indigenous children. Prevalence in rural

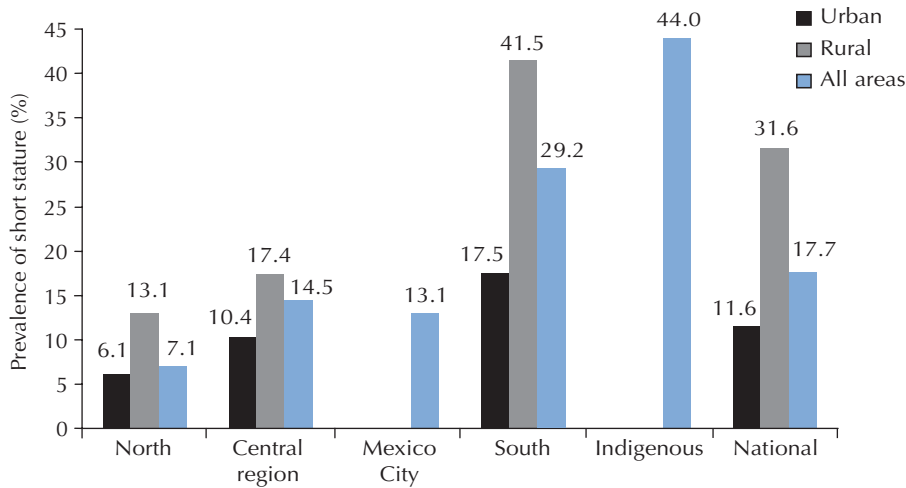
areas (31.6%) is nearly three times higher than that of urban areas (11.6%), and in the north (the most prosperous region) it is much lower than in the south (the poorest region). A comparison between regions and urban and rural areas gives rise to greater differences. For example, while the prevalence in urban areas in the north is close to 6%, in the rural south it is more than 40%, almost seven times higher (5).

One of the groups with the poorest living conditions in Mexico is the indigenous population. Nearly two-thirds of the families with indigenous children under age 5 are located in the two lowest deciles for living conditions compared to less than 15% of the families with nonindigenous children. The prevalence of short stature is approximately three times greater in indigenous children (44.3%) compared to nonindigenous children (14.5%), and the differences are reduced to around half when adjusted for socioeconomic level, yet they continue to be significantly higher in indigenous children ( $p < 0.05$ ) (6).

There is a strong tendency for the prevalence of short stature by decile of socioeconomic level to increase the lower the socioeconomic level is. The difference between the prevalence of short stature among the highest (4.6%) and lowest deciles (47.6%) was almost 10 times (5).

In 1988, the prevalence of short stature, low weight, and emaciation was 22.8%, 14.2%, and 6.0%, respectively. The changes recorded between surveys were 5.1 percentage points for short stature (22.4% with regard to the baseline), 6.6 percentage points for low weight (46.5% with regard to the baseline), and 4 percentage points for emaciation (66.6% with regard to the baseline). That is, there was a satisfactory reduction in the prevalence of emaciation, but the progress regarding short stature was less satisfactory, especially when compared to the decline recorded in South America as a whole during a similar period (5). The prevalence of short stature in South America dropped from 17.2% in 1990 to 9.3% in 2000;

<sup>2</sup>The NNN-99 was representative of four regions: the north, which mainly includes the bordering states of the United States; the south, which includes the poorest states; Mexico City, including the metropolitan area; and the central states.

**FIGURE 2. Inequity in the distribution of poor nutrition (short stature) in Mexico.**

**Source:** Rivera J, Sepúlveda-Amor J. Conclusions from the Mexican National Nutrition Survey 1999: translating results into nutrition policy. *Salud Pública Mex* 2003;45(Suppl 4):S565–S575.

that is, a decrease of 7.9 percentage points or 45.9% with regard to baseline prevalence (7). It has therefore been concluded that the decrease in prevalence of short stature recorded in Mexico from 1988 to 1999 is much lower than the one expected, particularly when taking into account significant government spending on food assistance programs during that period, which will be discussed in detail further on.

### Anemia and Micronutrient Deficiencies

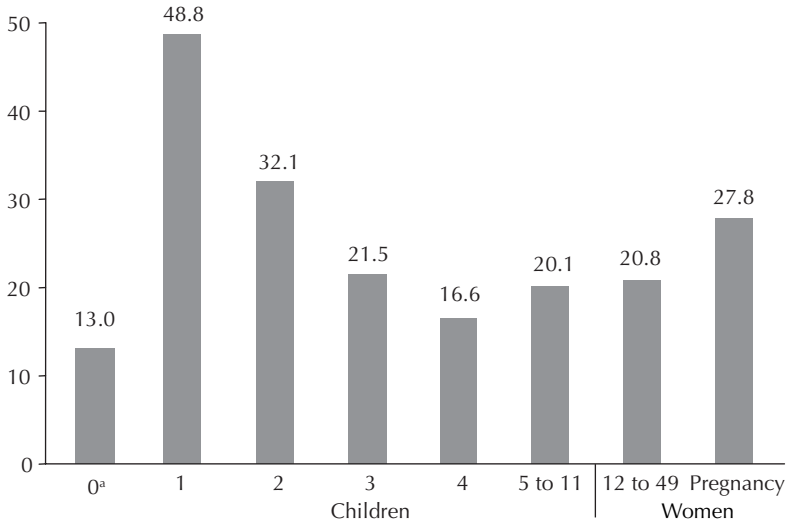
More than one out of four children under age 5 (27.2%) were anemic, and 25% to 50% of the children had deficiencies of one or more micronutrients (Figures 3 and 4). The prevalence of iron, zinc, and vitamin A deficiencies was 52%, 33%, and 27%, respectively. Furthermore, more than 25% of the children presented serum concentrations of ascorbic acid, which indicates a low daily intake of vitamin C from food (Figure 4).

Anemia and some micronutrient deficiencies appear predominantly at an early age. The prevalence of anemia reaches a peak in

the second year of life, when it affects almost half of the children, and declines to nearly 17% at 4 years of age (Figure 3). Iron deficiency affects nearly two-thirds of all children ages 1 to 2 and less than 50% of children ages 3 to 4 (Figure 4). In contrast to short stature, the differences in the prevalence of anemia and between urban and rural areas, but are higher in indigenous children (35.8%) vis-à-vis nonindigenous children (26.1%) (5, 6).

The prevalence of anemia in children ages 5 to 11 was 20.1% (Figure 3), and the most prevalent micronutrient deficiencies in this age group were iron (36%), vitamin C (30%), vitamin A and zinc (around 20%), and folic acid (nearly 10%) (Figure 4) (8–10). The national prevalence of anemia was 20.8% in non-pregnant women and 27.8% in pregnant women (Figure 3) (11), and the micronutrients with the highest prevalence of deficiency in non-pregnant women were iron (40.5%) and vitamin C (39.3%), followed by zinc (25.3%), while deficiencies in vitamin A and folic acid were around 5% (Figure 4) (9, 10).

**FIGURE 3. Prevalence (%) of anemia in children and women, Mexico, 1999.**



<sup>a</sup>6 to 11 months.

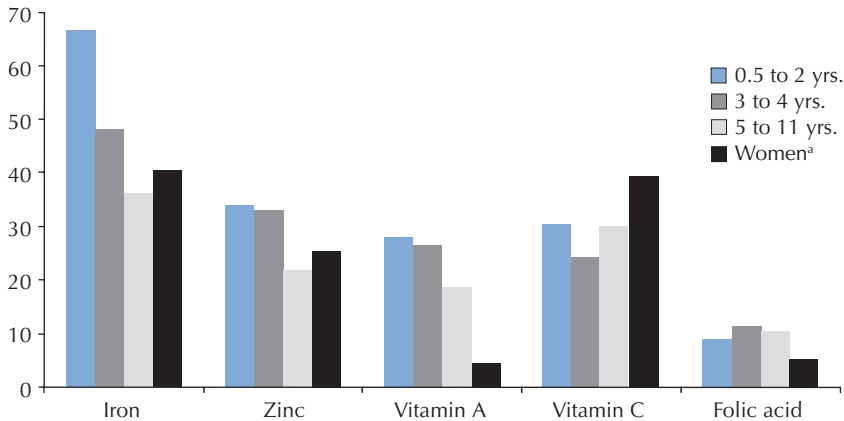
**Source:** Rivera J, Sepúlveda-Amor J. Conclusions from the Mexican National Nutrition Survey 1999: translating results into nutrition policy. *Salud Pública Mex* 2003;45(Suppl 4):S565–S575.

### Overweight and Obesity

Overweight and obesity have become a national epidemic in Mexico, particularly in adults, and already represent a concern in children. The national prevalence of overweight (z-score of weight-for-height > +2) in

children under 5 is 5.3% (Figure 5) with greater percentages in the north (7.2%), compared with the other regions (4% and 5%), and in urban areas (5.9%) vis-à-vis rural ones (4.6%). The prevalence in 1988 was 4.2% (Figure 5); as a result, the increase over 11 years was 1.1 percentage points (4).

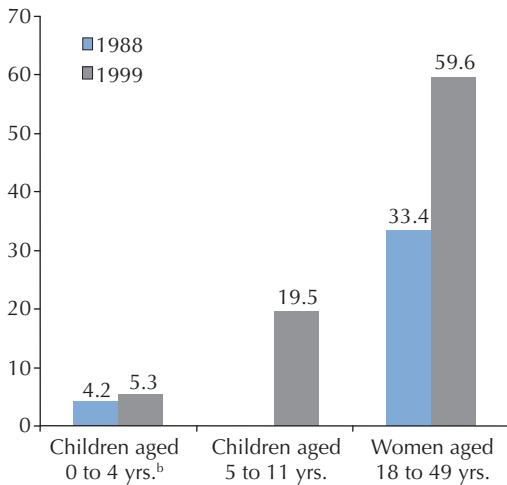
**FIGURE 4. Prevalence (%) of deficiency of selected micronutrients, Mexico, 1999.**



<sup>a</sup>Not pregnant.

**Source:** Rivera J, Sepúlveda-Amor J. Conclusions from the Mexican National Nutrition Survey 1999: translating results into nutrition policy. *Salud Pública Mex* 2003;45(Suppl 4):S565–S575.

**FIGURE 5. Prevalence (%) of overweight and obesity in children<sup>a</sup> and women in Mexico, according to results of 1988 and 1999 surveys.**



<sup>a</sup>In 1988, children aged 5 to 11 years were not studied.

<sup>b</sup>z-score of weight-for-height > +2.

**Source:** Rivera J, Sepúlveda-Amor J. Conclusions from the Mexican National Nutrition Survey 1999: translating results into nutrition policy. *Salud Pública Mex* 2003;45(Suppl 4):S565–S575.

The combination prevalence of overweight and obesity (12) in children ages 5 to 11 is 19.5% (13) (Figure 5). The regions with the highest prevalence were Mexico City (26.6%) and the north (25.6%), followed by the central region (18.0%) and the south (14.3%). The prevalence was much higher in urban areas (22.9%) than in rural areas (11.7%). The combination prevalence of overweight and obesity in women aged 18 to 49 (Figure 5) was 59.6% nationally (35.2% overweight and 24.4% obesity), with the highest prevalence in the north (65.3%), followed by Mexico City (59.1%), the central region (58.6%), and the south (55.3%).

The prevalence of overweight and obesity in women underwent an unusually significant increase over the 11 years between surveys. In 1988, the national prevalence of overweight and obesity was 24.0% and 9.4%, respectively (Figure 5), with an increase of 11.2 percentage points for overweight (an increase of 46.7% with respect to the baseline) and 15 percentage points for obesity (an in-

crease of 160% with regard to the baseline) (14). The examples shown for using research for policy and program design and decision-making refer to problems pertaining to malnutrition and not to overweight and obesity.

## STUDIES ON THE ORGANIZED SOCIAL RESPONSE: NUTRITION POLICIES AND PROGRAMS IN MEXICO

Mexico has a long history of carrying out policies and programs aimed at improving the nutrition of vulnerable groups. Despite this, malnutrition continues to be one of the country's most important public health challenges. Several CINyS publications analyze, from a historical perspective, the main strategies, programs, and policies that have been implemented in Mexico, by examining their design and implementation, as well as some of the results obtained (15, 16). Through these analyses, it becomes evident that the country has made considerable investments in food assistance programs. For example, in 1993 the Mexican Government spent more than US\$ 2 million a day on food assistance programs, including consumption subsidy programs. This figure is greater than the minimum food assistance expenditure recommended by various organizations in order to improve the population's nutrition. However, as shown in the previous section, the prevalence of malnutrition, anemia, and micronutrient deficiencies is elevated, and the speed of reducing the prevalence of short stature, an indicator of chronic malnutrition, turned out to be slower than expected during the 1990s, despite sizeable investments in food assistance programs.

These observations led to an examination of various aspects of the food assistance provided by the Government in 1988, in accordance with data from the survey conducted that year, including the extent and distribution of this assistance, in comparison with the nutritional needs of the population. That research produced very valuable findings

that were used by the CINyS to influence the design of nutrition policies during the 1990s.

It was concluded that among the reasons explaining the low effectiveness of nutrition programs in Mexico was the fact that they were not targeted to the population groups that needed them the most. Figure 6 illustrates the distribution of short stature children in 1988 and the percentage of beneficiary families of the various food assistance programs by region. Of the almost 2 million children with short stature, nearly 45% were in the southern region of the country, the poorest one, while less than 9% of the children with chronic malnutrition were located in Mexico City. Yet 51% of the families with children under age 5 benefiting from food assistance resided in Mexico City, and only 15% lived in the south, the region with the highest rates of prevalence (Figure 6).

It was also found that the probability of receiving food assistance (Figure 7) was 0.47 for families in rural areas vis-à-vis those in urban areas (using as a reference a probability of 1 for the latter), 0.24 for indigenous families vis-à-vis nonindigenous families, 0.42 for the tercile with low living conditions vis-à-vis the tercile with high living condi-

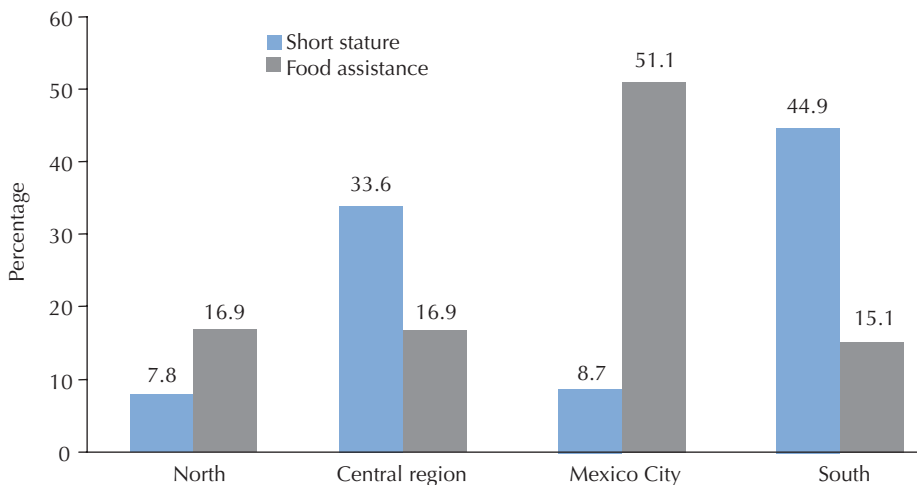
tions, 0.87 for families with children under age 2 vis-à-vis families with children ages 2 to 4, and 0.65 for families with short stature children vis-à-vis families without short stature children (Figure 7) (17).

Apart from the emphasis placed on urban areas and the lack of targeting regions with the highest prevalence of malnutrition, it was found that among poor families, indigenous groups, and children under age 2, distributed or subsidized food was not adequate for feeding children ages 6 to 24 months; there was no coordination between the programs, which led to the duplication of efforts and benefits; and the educational component was weak. These results were very useful in modifying the bases of the nutrition policies and programs at the end of the 1990s, as will be seen further on.

### STUDIES ON THE FUNCTIONAL CONSEQUENCES OF THE PROBLEMS OF POOR NUTRITION ON THE POPULATION'S HEALTH

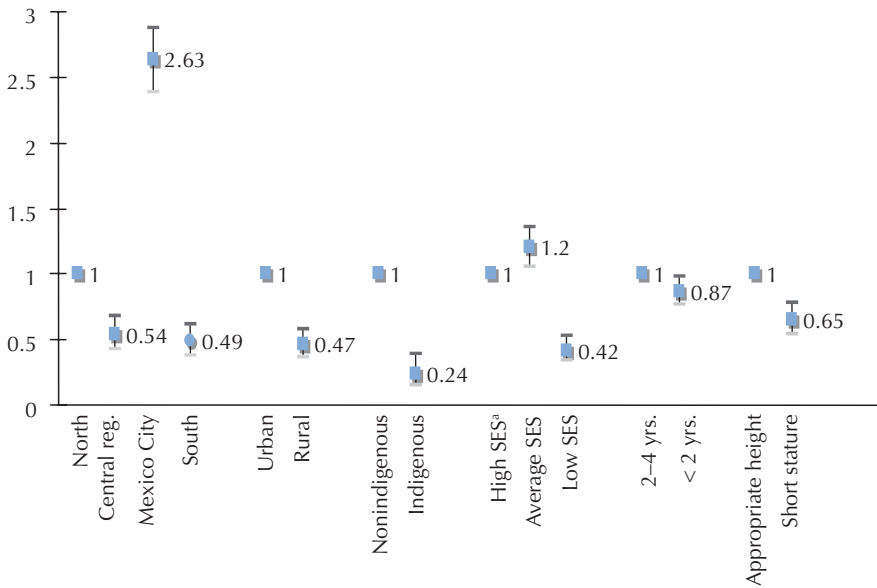
The CINyS has collaborated closely with the Institute of Nutrition of Central America

**FIGURE 6. Distribution of children with short stature and from beneficiary populations of food assistance programs, by region, 1988.**





**FIGURE 7. Rate of probability (95% CI) of participation in food assistance programs of households with children under 5.**



<sup>a</sup>Socioeconomic status.

and Panama (INCAP) and with Dr. Reynaldo Martorell and his group of researchers, currently at Emory University. Within the framework of this collaboration, CINyS researchers have participated in various analyses on the functional effects of malnutrition during gestation and the first years of life (the formative period), which have shown that the presence of malnutrition during that formative period produces adverse effects not only during childhood but indeed throughout the individual's lifetime.

Studies conducted in collaboration with INCAP point out that malnutrition during gestation and the first two or three years of life is associated with growth retardation and psychomotor development (18, 19) and has adverse effects in the longer run. For example, during adolescence and the adult years, it is associated with a reduction of: (1) body size (20), (2) the capacity for physical work (21), and (3) intellectual and school performance (22). These factors clearly can also have an impact on the individual's ability to generate income (23).

The studies furthermore demonstrate that malnutrition during the first years of life has effects on reproductive variables. For example, women with a history of moderate malnutrition during childhood have children with lower birthweights than women who were better nourished during that period of life (24). Low birthweight increases the risk of morbidity and mortality, which means that the nutrition of girls during their early developmental years can affect the health and survival of the following generation.

In short, collaborative research with the Emory University group and INCAP illustrates that malnutrition in the early stages of life not only depletes one's health and decreases chances for survival during childhood, but also leads to adverse effects on the development of human capital and on health during the adult years, and additionally has an impact on the health of the following generation. These data, by showing the functional consequences of the problems related to malnutrition, were very useful in providing a context for the problems prevalent

in Mexico and thus in convincing decision-making authorities of the need for applying actions geared toward preventing malnutrition.

### **STUDIES ON THE ETIOLOGY OF THE PROBLEMS AND THE BIOLOGICAL OR SOCIAL MECHANISMS THAT EXPLAIN THEM**

Once the main problems of malnutrition in the population and their importance have been determined, as well as the problems the CINyS has the capacity and comparative advantages to address, it is possible to identify the priority problems for research purposes. Then it becomes necessary to garner information on the etiology and the biological and social mechanisms that explain the epidemiology of the problem in order to undertake preventive or corrective actions. It is critical to review the literature at this stage for the purpose of identifying any possible gaps in the knowledge that need to be addressed through research, taking into account capacities and comparative advantages.

Following is a brief description of some of the contributions made by the CINyS during this stage of knowledge generation that have been useful for decision-making in public health.

Studies conducted in collaboration with INCAP have shown that zinc supplementation in children with zinc-deficient diets has positive effects on growth (25), on reducing bouts of diarrhea (26), and on increasing physical activity (27). This finding illustrated the need for including zinc in interventions in order to prevent stunting.

CINyS researchers have also conducted studies on the bioavailability of different chemical forms of iron and zinc in various fortified foods, with a view to designing or modifying strategies for preventing both iron and zinc deficiencies, both of which constitute major public nutrition concerns in Mexico.

One of the studies showed that reduced iron, added to a food supplement designed to lessen anemia and iron deficiency, had very low bioavailability, while two more forms of ferrous iron—sulfate and fumarate—had high bioavailability (28). These results have been used by the CINyS to recommend substituting the type of iron added to supplements.

Another study indicated that the absorption of zinc oxide—a chemical form of low-cost zinc that is currently being used in several fortified foods distributed by various programs—is similar to the more expensive zinc sulfate, when added to a corn flour-based food supplement. This led to corroborating the fact that the type of zinc used in food fortification programs in Mexico is adequate (29).

Recent research quantified the amount of iron absorbed by adding two forms of “marked” iron (Fe57 and Fe58) to milk. The absorption of iron contained in milk corresponded to 10% of the total quantity of iron added. This absorption value makes it possible to calculate the quantity of iron assimilated with regard to milk consumed. Thus, a child who consumes the 400 mL of fortified milk recommended by the program will be absorbing, with the milk, 50% to 150% of the amount required to meet his/her needs for iron, depending on the child’s age.

Another relevant finding was obtained from an analysis of a Guatemala study conducted by INCAP (30), which demonstrated that the effects of food supplementation on the growth of children at risk of malnutrition are elevated during the first two years of life and following that are almost null. For example, the size gain from 100 kcal of food supplement is almost 1 cm during the first year of life, approximately 0.5 mm during the second year, and 0.4 mm during the third year, while the figure ranges from 0 to 1.5 mm per year for children ages 3 to 7. This finding has been used to argue in favor of strengthening the recommendation to give priority to interventions targeted at the early stages of life.

## DESIGNING AND TESTING SMALL-SCALE ACTIONS OR INTERVENTIONS

The CINyS has designed actions or strategies aimed at improving the population's nutrition and has tested them on a small scale in order to evaluate their feasibility and effects. Two examples will be briefly described here.

As a part of designing fortified food supplements, the CINyS has conducted several studies of acceptance and consumption at the community level (31). Furthermore, small-scaled strategies of educational communication have been developed and evaluated in order to improve the consumption of a nourishing supplement distributed as part of a national program (32).

Before providing examples of efficacy and effectiveness studies, some examples of the use of scientific research findings to influence decision-making for nutrition policies and programs are presented in the following section.

## USE OF RESEARCH FINDINGS TO MOTIVATE PUBLIC NUTRITION ACTIONS

The CINyS has used research findings to promote among decision-makers the design and application of policies and actions geared toward improving the nutrition of the population. This section will describe some of the policies and programs whose initial motivation was the dissemination of research results directed at those responsible for health and nutrition policies, or whose design fed off of that information.

In the mid-1990s, the Mexican Government began planning an ambitious program for investing in human development in which the Secretariats of Finance, Education, Health, and Social Development participated. This program, initially called the Program for Education, Health, and Food (Progres) and currently called Oportunidades, is

a federal poverty-fighting initiative that targets low income families and their children's health, food, and educational needs and dispenses monetary transfers as incentive for encouraging the development of human capital. The participating families only receive the money if they regularly visit their local health facilities, receive health education, and enroll their children in school and ensure their regular attendance. Oportunidades began in 1997 as a national program developed to cover the immediate needs of Mexico's lowest income families and to break the intergenerational transmission of poverty. At present, it serves approximately 5 million families in rural and urban areas, selected on the basis of their low socioeconomic level.

The group in charge of designing the program consulted the INSP concerning the potential effect of the project—as originally proposed—on the nutritional status of children. The parties involved presented and extensively discussed the various pieces of evidence suggesting that gestation and the first years of life constitute a fundamental formative period and offer a unique window of opportunity to apply effective actions aimed at improving nutrition. Also shown were results of studies that underscore the importance of including micronutrients, especially iron and zinc, in assistance programs to combat malnutrition. Proof was also provided that the majority of the problems associated with malnutrition (short stature, anemia, and deficiencies of some micronutrients) show higher prevalence rates in the poorer population: in the southern region, among rural populations and indigenous families, and among those who belong to the lowest rungs on the socioeconomic ladder (3). This finding supported one of the pillars of the program; i.e., focusing actions on low income families. In addition, data were provided on the inadequate design and orientation of food assistance programs in Mexico, as described earlier in this chapter.

CINyS researchers, when consulted by those responsible for designing the Progreso program, expressed their concerns regarding a basic assumption by the program designers that ensuring monetary transfers to low income families would be sufficient to improve the population's nutrition. The researchers particularly expressed reservations about whether the monetary transfers would substantially improve the food and nutrition status of mothers and children during the vulnerable period of gestation up until the third year of life. CINyS staff submitted evidence obtained from the Mexican population on the inadequate practices of child feeding during the critical period of the first two years of life, during which time foods rich in several nutrients had been excluded, and they showed that these types of practices are considerably influenced by cultural and social factors, in addition to economic factors, and that of these, only the latter (economic) factors would be affected by the receipt of money transfers. Furthermore, the CINyS recommended adding a component that included the distribution of highly nutritional supplements in order to support nutrition during the formative stage, in conjunction with effective nutrition education activities that ensure adequate use of the supplements and utilization of the additional income for purchasing highly nutritional foods.

The CINyS researchers also proposed creating an Expert Committee on Nutrition (CEN) comprised of various institutions devoted to research in this field. CINyS recommendations were approved, and the CEN received a mandate from the Mexican Secretariat of Health to develop the nutrition component of the program, which included the distribution of micronutrient-fortified foods to children ages 4–23 months, to low-weight children ages 2 to 4, and to lactating and pregnant women. The CEN was responsible for designing the fortified foods based on existing knowledge of the nutritional status of the population (3, 33, 34). The supplements

were therefore specifically designed for young children and women. The ingredients used in their preparation were powdered whole milk, sugar, maltodextrins, vitamins, minerals, and flavorings, and contained the nutrients that are most deficient in Mexican children's diets (Table 1) (35). Children under age 2 and lactating and pregnant women from low income families made up the target group of these nutrition actions. The program also included an evaluation component as an essential part of its design (31).

In addition to Oportunidades, other nutrition programs have also been designed or adapted as a result of having disseminated the research findings to those responsible for shaping public policies. One of them is a large-scale program of pharmacological supplementation with multiple micronutrients, whose purpose is to prevent anemia and micronutrient deficiencies in infants in predominantly indigenous communities that have the highest prevalence of malnutrition nationwide (6). Inputs for program design were the results of the NNN-99 and a study on the efficacy of micronutrient supplementation, to be discussed in this chapter's following section.

Another example is a subsidized milk distribution program in operation over the last 30 years (16) and recently modified on the basis of NNN-99 findings. The program cur-

**TABLE 1. Content of calories and key nutrients in fortified foods distributed to children by the Oportunidades program.**

| Nutrient    | DRI <sup>a</sup> (%) |
|-------------|----------------------|
| Calories    | 15                   |
| Protein     | 36                   |
| Iron        | 100                  |
| Zinc        | 100                  |
| Vitamin A   | 100                  |
| Vitamin E   | 100                  |
| Vitamin C   | 100                  |
| Folic acid  | 100                  |
| Vitamin B12 | 100                  |

<sup>a</sup>Daily recommended intake (DRI) for children aged 1 to 3 years.

rently focuses on the importance of addressing iron and zinc deficiencies by fortifying milk with iron, zinc, vitamin C, and other micronutrients lacking in Mexican children's diets. This milk is currently distributed to some 5 million children ages 1 to 12. Evaluation of the efficacy and effectiveness of the milk fortification program is now underway.

The ultimate purpose of the NNN-99 was the application of its results to improving the nutritional and health status of the Mexican population. Accordingly, the INSP devoted considerable efforts to the dissemination of the survey's results, which were published at the end of 2001 (4). Following this, there was an intensive period of more than 100 presentations given to key individuals in charge of designing and implementing food, nutrition, and health policies and programs; to the academic community interested in the topic (including students); to the private sector; to lawmakers; and to the media, which concluded with the publication of a series of articles targeted to the scientific community (5, 6, 8–11, 13, 36–39). One of the first presentations of NNN-99 results was given in January 2002 to the Secretary of Health and his principal advisors. As a result of that presentation and subsequent follow-up meetings, various initiatives were born that have had a direct impact on the decisions pertaining to the nutrition policies and programs put into practice by the health sector.

In the discussion following the presentation, the Secretary of Health remarked on the importance of the survey results would represent for the Secretariat of Social Development (SEDESOL), in view of the fact that this ministerial entity is in charge of overseeing the country's poverty reduction programs, several of which include food distribution components. He pledged to arrange a meeting with SEDESOL, which was subsequently held in February 2002. At that meeting, SEDESOL learned of the survey results, showed great interest in contributing to efforts to reduce the prevalence of malnutri-

tion, and signaled its desire to initiate actions in the short term. Among the concrete actions recommended by INSP researchers so that SEDESOL might effectively contribute to reducing malnutrition were changes to the Community Milk Supply Program (*Programa de abasto social de leche*) entrusted to the Liconsa company. The program had extremely high coverage (around 4.6 million children at the time of the SSA-SEDESOL meeting), distributed an excellent quality of milk, enjoyed a large degree of acceptance by the population, and could serve as a vehicle for Mexican children to receive various nutrients lacking in their diet if these nutrients could be added without affecting the milk's overall quality or its acceptance by the beneficiaries. Iron, zinc, and several vitamins were highlighted as possible nutrients that could be added to the milk.

The Secretary of SEDESOL showed a great deal of enthusiasm regarding these ideas and instructed Liconsa's director-general to meet as soon as possible with CINyS researchers in order to evaluate the feasibility of adding micronutrients to the company's milk supply and of setting up a team to design a milk fortification project. The work carried out by the team involved researchers from the INSP and other national and foreign institutions, as well as Liconsa technical and administrative personnel. The team's efforts led to the development of a micronutrient-fortified milk distribution program that was officially launched in August 2002, just six months after the initial meeting with SEDESOL.

The INSP recommended evaluating the program's impact on the nutritional status of the beneficiary children and proposed that SEDESOL focus both on its efficacy; i.e., the effects of the program under controlled conditions that would ensure consumption, as well as its effectiveness; i.e., the effect of the program in its day-to-day operations.

The following section describes the preliminary results of the evaluation of the efficacy of the fortified milk distribution program.



### CONTROLLED CLINICAL TRIALS FOR THE STUDY ON THE EFFICACY OF THE INTERVENTIONS OR ACTIONS

Before implementing large-scale programs, it is advantageous to have scientific data on the efficacy of the programs or actions; that is to say, on the effects of the intervention when it is carried out under ideal conditions.

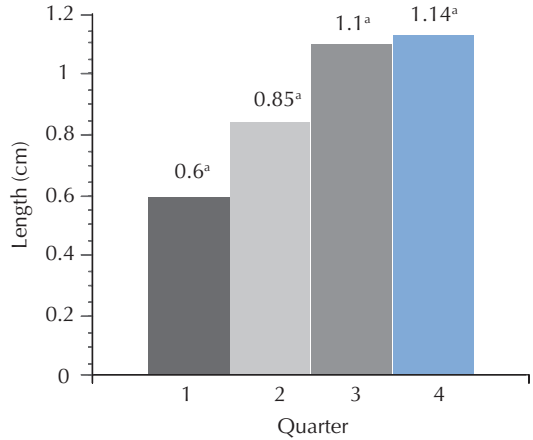
Two examples of efficacy studies are presented. The first refers to a test on the effects of supplementation with multiple micronutrients on linear growth that served as the basis for the design of a micronutrient supplementation program geared toward the country’s indigenous population, which has the highest prevalence of malnutrition. The second is a study on the efficacy of fortified milk on the prevalence of anemia and the status of iron and zinc in children under age 2.

The study on the effects of supplementation with multiple micronutrients, a randomized, double-blinded clinical trial (40), showed that one of the causes of growth retardation in Mexican children is micronutrient deficiency. Moreover, it showed that the effect of supplementation with multiple micronutrients was restricted to children less than 12 months old. Children less than 12 months old who received the micronutrient supplement grew an average of 1.14 cm more than the children who did not receive the supplement during the first year of life (Figure 8).

The objective of the study on the efficacy of fortified milk was to determine the effect of this product, under ideal conditions, on the prevalence of anemia, and iron and other micronutrient deficiencies (41). Preliminary results are presented exclusively as to the effect on anemia.

One hundred eighty children 12 to 30 months old upon beginning the study were selected. One group of children received two glasses of fortified milk daily and the other group received unfortified milk for 12

**FIGURE 8. Effects of micronutrient supplementation on growth of children under 12 months, during the initial stage, by quarter of supplementation.**



<sup>a</sup>*p* < 0.05.

Note: Generalized Estimation Equation (GEE) adjusted on the basis of initial size, initial age, sex, breast-feeding, and socioeconomic conditions.

Source: Rivera JA, González-Cossío T, Flores M, Romero M, Rivera M, Téllez-Rojo MM et al. Multiple micronutrient supplementation increases the growth of Mexican infants. *Am J Clin Nutr* 2001;74(5):657–663.

months. The milk was delivered to the homes of the study subjects, and research personnel confirmed that the children consumed the quantity of assigned milk. Before beginning the supplementation, and six and 12 months later, height, weight, and blood samples were taken. Blood samples were measured to determine the concentration of hemoglobin that makes it possible to quantify the prevalence of anemia, while weight and height data were used to assess growth.

Preliminary results indicated that among the children who were 12 to 23 months old at the beginning of the study, at six months the prevalence of anemia among those who consumed fortified milk decreased by almost twice as much (26.3 percentage points) as it did in the children who consumed unfortified milk (13.7 percentage points); as for the children 24 to 30 months old, the reduction for those who consumed fortified milk was



around 50% greater (14.5 percentage points) than it was for those who consumed unfortified milk (9.5 percentage points). The results indicate that fortified milk is highly effective in reducing the prevalence of anemia.

The study on the effectiveness of fortified milk on the nutritional status of the beneficiaries has only more recently been concluded, and the results will be analyzed and published shortly.

### EVALUATION OF STUDIES ON THE EFFECTIVENESS OF ACTIONS AND PROGRAMS

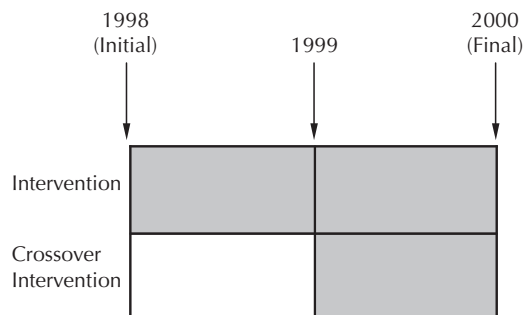
Since the end of the 1990s, Mexico has undergone a fundamental change that has led to a culture of public policy and program evaluations. The change began with the Oportunidades program, whose first director insisted on including an evaluation component in the program design. This culture of evaluation has continued, and today the majority of the policies and programs of the Secretariat of Health and of SEDESOL are subject to evaluation.

The information presented here relates to the evaluation of the effectiveness of the Oportunidades program on the nutritional status of the beneficiary children (42), taking into account the nature of the program and the benefits it provides to the target population, as were described earlier in this chapter. Those benefits include the distribution of a micronutrient-fortified food supplement that is designed specifically to correct the nutritional deficiencies of children aged 4 to 23 months old and low-weight children ages 2 to 4 years of the families included in the program.

The program initially included some 300,000 households. Since it was not possible to provide immediate coverage to its target population (around 4.5 million families), the evaluation study was originally planned with a randomized design in which a group of localities was assigned at random to one of

two groups: the first group would receive the program benefits for two years, while the second group would receive the benefits only after the two years of the study were complete. In practice, the design of the study remained intact during the first year (1998–1999); that is, while one group received the benefits of the study, the second group was kept as a control and did not receive any benefits. However, during the 1999–2000 period, both groups received the program benefits. This explains why the group that received the program benefits for two years was called the intervention group, and the group that received the benefits only during the second year was called the crossover intervention group, since it began as a control but “crossed over” to become an intervention group during the second year. Although it would have been desirable to preserve the original design, it was not possible. Nonetheless, with this design it was still possible to evaluate the effect of the program, since the intervention group received the program benefits for two years, while the crossover intervention group received them for only half of this period. Furthermore, the intervention group received the program benefits during the critical period of the first two years of life, while the crossover intervention group did not receive them for much of that period (Figure 9). The greatest impact was to be expected in the children less than 6 months old in 1998, since those who be-

**FIGURE 9. Design of effectiveness evaluation of the Oportunidades program.**



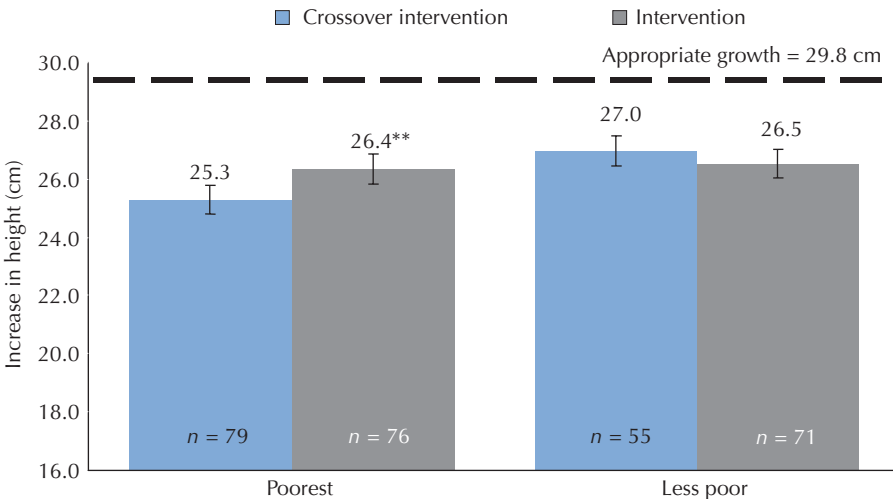
longed to the intervention group received the program benefits during the critical period of the first two years of life, while the crossover intervention group received the program benefits for only one year, starting at 12 to 18 months; i.e., they did not receive the program benefits for a significant part of the critical period (Figure 9). It was also hoped that the program would have the greatest impact on children from lower income families who showed the highest prevalence of malnutrition. For these reasons, all comparisons were made on the basis of age (< 6 months and 6–12 months at the beginning) and socioeconomic level (< middle or higher).

The less-than-12-month-old group covered from the beginning of the program was studied for the two years of the program. It consisted of 595 children (336 in the intervention group and 259 in the crossover intervention group) from 347 rural localities (205 Oportunidades and 142 control). The increase in height of each group was studied between

the baseline (1998) and the year 2000, stratified by age and socioeconomic level, through a linear regression model with random coefficients adjusted in relation to the possible effect of conglomerates. It was found that in the baseline year the children of both groups were very similar in almost all their anthropometrical characteristics, as well as with regard to age, socioeconomic level, and sex. The effect of the program (Figure 10) was significantly greater in the intervention group vis-à-vis the crossover intervention group, but exclusively in the children less than 6 months old in 1998 and with the lowest socioeconomic level ( $p < 0.046$ ). The effect on this group was on average 1 cm ( $p < 0.05$ ), which is considered biologically important. There was no effect found on the group of children in the highest socioeconomic level nor among the oldest children.

With regard to anemia, in view of the fact that its effects appear within a shorter period of time, it was possible to evaluate the effect of the program in 1999, a period in which the

**FIGURE 10. Adjusted increase<sup>a</sup> of size from 1999 to 2000 in infants aged 6 months during baseline measurement of the intervention and crossover intervention groups.**



<sup>a</sup>Adjusted on the basis of age and length in 1988, using a linear model with random intercept.

\*\* $p < 0.05$ .

**Source:** Rivera JA, Sotres-Álvarez D, Habicht JP, Shamah T, Villalpando S. Impact of the Mexican program for education, health and nutrition (Progresá) on rates of growth and anemia in infants and young children: a randomized effectiveness study. *JAMA* 2004; 291(21):2563–2570.

intervention group had received the program benefits for a year, while the crossover intervention group had not received them. In other words, in terms of anemia, it was possible to conduct the analyses in keeping with the study's original design. It was found that the prevalence of anemia, adjusted in relation to age, was significantly higher in the crossover intervention group (which was a true control during the first year) than in the intervention group (Figure 11). The effect was of 10.6 percentage points, almost a 20% impact with regard to the crossover intervention group.

In studying the consumption of the supplement by the beneficiary children, it was found that some 50% to 60% of the children in the intervention group regularly consumed the supplement, in keeping with the 1999 evaluation. It was also discovered that around 10% of the crossover intervention

group regularly received the supplement, even though this group was not expected to consume the supplement during that period (Figure 12). As is customary in programs with broad coverage, there is a certain degree of diversion of the benefits to families not included in the program. This was possible since the supplements were distributed at health centers where families from communities that were not program beneficiaries came from time to time. In any event, since the crossover intervention group received the benefits for a year, and a small percentage of them even received them during the first year, the effects discovered under the study are clearly an underestimation of those that would have been found had there been a true control group.

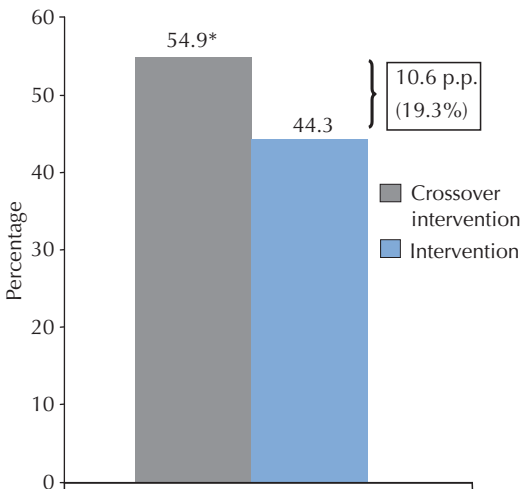
The effectiveness study concluded that the program had an important impact on the linear growth of the group of children with the greatest nutritional vulnerability (< 6 months old and low socioeconomic level) and who were exposed to the program for two years, and that it was also able to decrease the prevalence of anemia in the children exposed to the program for a year.

The results of this effectiveness study on a program currently covering roughly 5 million households were of great importance in reaffirming the program's success and in presenting evidence in support of its continuity. Other results of the evaluation have been useful in providing feedback for the program and proposing changes to its design. Following are two examples of how the evaluation results have been applied to modify the program design.

### HOW THE RESULTS OF THE OPORTUNIDADES EFFECTIVENESS EVALUATION HAVE BEEN APPLIED TO MODIFY THE PROGRAM DESIGN

One of the findings of the evaluation of the Oportunidades program's effectiveness (42) was that a significant percentage (40%–

**FIGURE 11. Prevalence of anemia<sup>a</sup> in 1999 in the intervention and crossover intervention groups.**

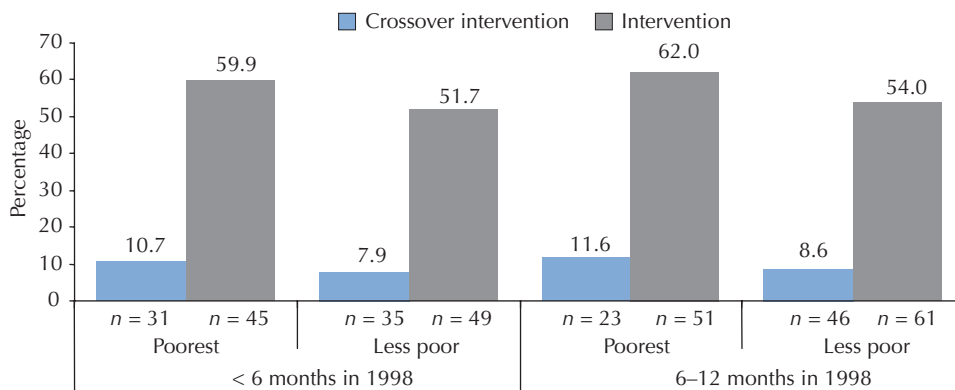


<sup>a</sup>Adjusted on the basis of age, using a GEE model.

\* $p < 0.05$ .

**Source:** Rivera JA, Sotres-Álvarez D, Habicht JP, Shamah T, Villalpando S. Impact of the Mexican program for education, health and nutrition (Progresa) on rates of growth and anemia in infants and young children: a randomized effectiveness study. *JAMA* 2004;291(21):2563–2570.

**FIGURE 12. Proportion of children whose mothers reported regular consumption (4 days a week) of baby food distributed by the Oportunidades program to the intervention and crossover intervention groups in 1999.<sup>a</sup>**



<sup>a</sup>Adjusted on the basis of age.

**Source:** Rivera JA, Sotres-Álvarez D, Habicht JP, Shamah T, Villalpando S. Impact of the Mexican program for education, health and nutrition (Progresa) on rates of growth and anemia in infants and young children: a randomized effectiveness study. *JAMA* 2004; 291(21):2563-2570.

50%) of the children for whom the fortified supplement was designed did not regularly consume the supplement (Figure 12). Upon studying the reasons for this low consumption, it was found that while the program was well accepted, low consumption might be attributed to the lack of timely availability of the supplement at the health centers as well as inadequate promotion of the supplement's consumption: only one out of 35 sessions was devoted to disseminating information on how to prepare the supplement and promote its consumption. Also, a very traditional educational approach was used under inadequate conditions: the talks were frequently held outside of the health centers where the women were standing and caring for their children under the hot sun. In summary, despite the many health and nutrition achievements of Oportunidades, its educational component remained weak and unsatisfactory.

A project was therefore developed, using a cutting-edge methodology for applying an educational communication component, including formative research and social marketing (43, 44). The project was carried out in

rural areas in two states: Veracruz and Chiapas, in both indigenous and nonindigenous communities. A communications strategy that included both mass and interpersonal media was designed and applied for four months.

A study of the preliminary results of this project indicates that it has had positive effects on various indicators of regular supplement consumption (32). This experience is currently being conveyed to the Secretariat of Health, which is implementing an educational communications strategy in four states, to be followed by a national strategy.

Another result of the evaluation of Oportunidades' effectiveness that led to modifying its program design was that it had had less of an impact on reducing anemia than expected and that it had not been successful in altering the status of iron in the children who had consumed the supplements (42). CInyS was informed that the type of iron added to the supplements was reduced iron, which is absorbed substantially less than other forms of iron (45). As a result, several studies were conducted on the bioavailability and acceptance of supplements fortified with two other forms of iron (ferrous sulfate

and ferrous fumerate) that showed adequate levels of bioavailability and acceptance (28, 46). This information has been provided to the Secretariat of Health with a recommendation to replace the reduced iron with one of the other two fortifiers.

The results of the effectiveness evaluation therefore provided valuable feedback for the program's coordinators and indicated needed changes in the design, thereby providing an example of the iterative, cyclical nature of mission-based research.

## CONCLUSION

Strategic mission-based research (1) aspires to generate fundamental knowledge, with an effect on universal scientific tradition, which at the same time may be used to solve the population's health problems.

This chapter is an account of how the principles of strategic mission-based research, as applied to the design of CINyS' research agenda, have generated useful knowledge that has had an impact on the definition of public nutrition policies and programs and on changes to current policies and programs. The chapter also presents key scientific data that have provided the necessary input for designing these new policies and programs and for properly fine-tuning existing policies and programs.

In addition, as the list of references at the end of this chapter demonstrates, the research findings and their interpretation have generated fundamental knowledge that has been published in scientific peer review journals, in addition to being useful for public health in Mexico in general.

As stated at the beginning of this chapter, mission-based research addresses various objects of analysis, including health conditions and organized social response. The research examples shown encompass both of these objects of analysis. Thus, the results of the national nutrition survey reflect the extent and distribution of poor nutrition in Mexico (the study of

the conditions), while the effectiveness evaluations presented refer to the analysis of policies (the organized social response). Furthermore, mission-based research addresses various levels of analysis, from subcellular particles up to health systems. CINyS conducts both clinical (studies on the bioavailability of micronutrients) and epidemiological or population research (the national nutrition survey or controlled tests) as well as research on health systems (evaluations of the program's coverage and effectiveness).

On the other hand, this chapter did not include examples of subcellular particle research (molecular biology) simply because, to date, CINyS has not addressed this level of analysis; nonetheless, subcellular particle analysis can be of great importance for the population's nutrition. For example, it can facilitate an understanding of the biological mechanisms involved in the etiology of poor nutrition and its consequences for health and intellectual performance, and an identification of biomarkers useful for diagnosing poor nutrition and for selecting the populations susceptible to specific deficiencies or to problems of obesity and their effects on health. At the same time, it could also be useful for developing resolution technology, for example, for food with nutritional or functional attributes aimed at reducing malnutrition. In short, addressing various levels of analysis, from subcellular particles up to health systems, is extremely useful for meeting the objectives of mission-based research.

Throughout the chapter, research experiences have been described that have successfully influenced the design of and changes to public policies. Highlighting success stories, however, does not mean that there have not been setbacks and failures along the way. The chapter does not describe several fruitless efforts made with a view to influencing public policies; attempts that resulted in frustration and skepticism among the Center's staff. The chapter likewise avoids a discussion of the difficulties in overcoming obstacles and moments of disillusionment

occasionally brought on by the same processes that eventually had an impact on public policies. It was simply determined that instead of addressing the hardships and discomforts common to any human activity that endeavors to reach noble ends, it was important to focus on outcomes that were successful and to outline the processes through which the objectives were met.

An especially important issue that remains for future endeavors is the possible reproduction of similar successful mission-based research experiences in other areas. In this regard, INSP successfully provided technical assistance to the health sector and to other governmental sectors in charge of health and nutrition policies from 1993 to 2005 (the author of this chapter can testify to this since the time period coincides with his association with the institution); to be precise, at least one of the important factors is institutional in nature and is based on current norms and standards.

Other factors are less related to institutionality and more related to people and interpersonal relations. The majority of the successes described in this chapter were made possible, to a large degree, through the participation of staff members who had vision and were convinced of the merits of informed decision-making that is founded on high-quality scientific research. These staff members were responsible for the decision-making with regard to food and nutrition policies. Without their dedication and resolve, it likely would have been much more difficult to influence public policy, even with institutional provisions and standards in place.

It was also essential to have the strong collaboration of INSP authorities who utilized their institutional investiture and broad personal relations to support the development of relevant research aimed at fueling decision-making and the dissemination of the research findings among staff members at a very high decision-making level.

Furthermore, as noted at the beginning of this chapter, the CInyS working group took

active responsibility for disseminating the research results. In addition to disseminating study findings in scientific publications and academic presentations, the results were presented at a variety of forums to diverse audiences, including civil servants, non-governmental organizations, the media, the legislative branch, and business groups. The dynamism and diligence that accompanied the dissemination process surely influenced the success of the Center's work.

Finally, it is worth noting that the Center's researchers have taken great efforts to maintain a high level of quality in their research and to bring about permanent dialogue with political authorities interested in utilizing research for decision-making, which in turn has forged an environment of mutual respect and understanding.

In synthesis, over the past decade, CInyS has been able to conduct effective strategic mission-based research, thanks to the combination of an institutional framework that confers the INSP the standing of research adviser to Mexico's social, health, and development sectors; an environment characterized by civil servants with vision and dedication to producing research to be used for decision-making in public policy and institutional authorities committed to this type of research; and the dynamism, diligence, and high-quality criteria of a group of researchers who have achieved credibility and respect in the eyes of those responsible for public nutrition policies.

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# THE PUBLIC POLICY RESPONSE TO EPIDEMIOLOGICAL AND NUTRITIONAL TRANSITION: THE CASE OF CHILE

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## DEMOGRAPHIC, SOCIOECONOMIC, AND EPIDEMIOLOGICAL CHANGES IN CHILE

Significant demographic and epidemiological changes have occurred in Chile in recent decades. In demographic terms, the population under age 15 declined from 39.2% of the total population in 1970 to 25.7% in 2002; in the same period, the population over age 65 increased from 5% of the total to 7.2%. The total fertility rate and the birth rate both declined significantly, causing a fall in the annual rate of population growth from 1.8% to 1.1%. The infant mortality rate also dropped spectacularly, going from 82.2 per 1,000 live births in 1970 to 7.8 per 1,000 live births in 2002, while life expectancy increased from 60.5 years for men and 66.8 years for women in 1970 to 73.2 and 79.5 in 2002, respectively (1).

During the same period, Chile became more and more urbanized: at the beginning of the 1970s, 75% of the population lived in urban areas, and by 2000 this figure had increased to 86.7%. The process of urbanization has produced positive effects reflected in several indicators, such as access to safe drinking water and sewerage services for more than 95% of the population, increased literacy rates, and greater access to housing

and health services. But these changes have also meant an increase in risk factors for non-communicable chronic diseases (NCCDs), such as the adoption of diets rich in fats, sugar, and salt; sedentary habits; greater access to tobacco, alcohol, and drugs; and greater exposure to environmental and psychosocial problems (2, 3).

These demographic changes and the increase in risk factors for chronic diseases have produced important transformations in the epidemiological profile of the population, beginning in the 1970s with changes in the proportions of death from broad groups of causes (Table 1). Cardiovascular diseases and tumors increased from 34.3% of all deaths in 1970 to 52.1% in 2000, while infectious and perinatal diseases decreased from 15.9% to 3.8% over that same period. Deaths from accidents and from respiratory infections also decreased as proportions of total causes of deaths (1).

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**TABLE 1. Proportion of causes of death among total causes of death, 1970–2000, by percentage.**

| Broad groups of causes   | 1970 <sup>a</sup> | 1982 <sup>b</sup> | 1992 <sup>b</sup> | 2000  |
|--|-------------------|-------------------|-------------------|-------|
| Cardiovascular<br>(A80–88) <sup>a</sup> (390–459) <sup>b</sup> (I00–99) <sup>c</sup>               | 22.3              | 27.6              | 29.0              | 27.9  |
| Malignant neoplasms<br>(A45–59) <sup>a</sup> (140–208) <sup>b</sup> (C00–D48) <sup>c</sup>         | 12.0              | 16.8              | 20.0              | 24.2  |
| Accidents<br>(AN138–150 + AE138–149) <sup>a</sup><br>(800–999) <sup>b</sup> (V00–Y98) <sup>c</sup> | 19.0              | 12.1              | 12.0              | 9.8   |
| Respiratory<br>(A89–96) <sup>a</sup> (460–519) <sup>b</sup> (J00–99) <sup>c</sup>                  | 17.4              | 8.5               | 11.1              | 10.5  |
| Digestive<br>(A97–104) <sup>a</sup> (520–579) <sup>b</sup> (K00–93) <sup>c</sup>                   | 6.9               | 8.6               | 6.3               | 7.2   |
| Ill-defined<br>(A137) <sup>a</sup> (780–799) <sup>b</sup> (R00–99) <sup>c</sup>                    | 4.5               | 8.8               | 5.6               | 3.9   |
| Infectious and parasitic<br>(A1–44) <sup>a</sup> (1–139) <sup>b</sup> (A00–B99) <sup>c</sup>       | 10.9              | 3.8               | 2.9               | 2.6   |
| Perinatal<br>(A131–135) <sup>a</sup> (760–779) <sup>b</sup> (P00–96) <sup>c</sup>                  | 5.0               | 3.5               | 1.9               | 1.2   |
| All others   | 2.0               | 10.3              | 11.2              | 12.7  |
| Total  | 100.0             | 100.0             | 100.0             | 100.0 |

<sup>a</sup>ICD-8.<sup>b</sup>ICD-9.<sup>c</sup>ICD-10.**Source:** Instituto Nacional de Estadísticas. Informes Demográficos Anuales 1970, 1982, 1992, and 2000.

## EXPLOSIVE INCREASE IN RISK FACTORS FOR CHRONIC DISEASES RELATED TO NUTRITION

With the process of urbanization at the end of the 1980s and beginning of the 1990s, the national diet changed spectacularly. Between 1982 and 1986, Chile experienced a serious economic crisis that resulted in gross domestic product falling from 14% in 1982 to 2% in 1986, in increased unemployment and poverty (4), and in a higher prevalence of malnutrition. But at the end of the 1980s, the economy revived and consumption patterns changed, with increasing consumption of fat and decreasing consumption of grains, vegetables, and fruits (Table 2) (5). In tandem with the high intake of food rich in energy and poor in specific nutrients, there were other changes in lifestyle related to growing urbanization, such as increases in sedentary

habits, stress, consumption of alcohol, and use of tobacco, all of which reached very high levels. It can be said that in the 1990s NCCDs increased explosively, with alarming prevalence figures indicated in a National Health Survey carried out in 2003 (6) (Table 3).

## CHANGES IN THE NUTRITIONAL SITUATION

The combination of changes in eating habits described above and a sedentary lifestyle provide an effective trigger for an increase in body adiposity. The steady increase in prevalence of overweight and obesity was greater in low income groups that improved their incomes and increased their consumption of energy-rich food with high contents of fats and carbohydrates. In these groups,

**TABLE 2. Availability of total calories, fat, grains, fruits, and vegetables in Chile, 1980, 1990, and 2000.<sup>a</sup>**

|   | 1980  | 1990  | 2000  | % change |
|---|-------|-------|-------|----------|
| Kcal/day per capita                         | 2,664 | 2,519 | 2,870 | + 7.8    |
| % of fat per capita                         | 20.4  | 22.0  | 26.6  | + 30.4   |
| G/day of vegetable fat per capita           | 30.9  | 27.5  | 39.4  | + 27.8   |
| G/day of animal fat per capita              | 29.6  | 33.9  | 45.4  | + 53.6   |
| Kg/year of grains per capita                | 159.1 | 143.4 | 142.6 | - 10.4   |
| Kg/year of fruits and vegetables per capita | 170.5 | 144.6 | 168.4 | - 1.2    |

<sup>a</sup>Averages for 1979–1980, 1989–1990, and 1999–2000.

**Source:** Food and Agriculture Organization, Hojas de Balance de Alimentos 1979, 1980, 1989, 1990, 1999, and 2000. Available at: [www.fao.org/documents/show\\_cdr.asp?url\\_file=/DOCREP/006/Y5065MY5065M00.HTM](http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/006/Y5065MY5065M00.HTM), accessed in January 2003.

there was also an increase in the purchasing of television sets and other electrical appliances, resulting in an average of two to three hours a day being spent watching television during the week and three to four hours spent in this activity on weekends. The increase in numbers of hours spent watching television, as data from Santiago shows, increases inactivity and passivity, and exposes children to television commercials promoting the consumption of fast foods and snacks at home and the purchase of similar types of foods in the school environment (7).

These factors, together with the steady decrease in undernutrition, have increased the prevalence of obesity measured for children under age 6 and pregnant women (Figures 1 and 2) (8), as well as for adult men and women (9) and older adults (10). The most recent data on prevalence of overweight and obesity appears in the National Survey of

Health of 2003 (6) (Figure 3). Its results are conclusive: 61.3% of people over age 15 suffer from overweight or obesity, with 1.3% suffering from morbid obesity. These findings demonstrate that overweight and obesity are the most important nutritional problem in Chile and one of the country's most important public health challenges. Unfortunately, this situation is similar to that seen in other countries of Latin America (11, 12).

## POLICIES AND PROGRAMS TO ADDRESS FOOD AND NUTRITIONAL PROBLEMS

### Programs Designed to Reduce the Importance of Malnutrition as a Public Health Problem

In the past, Chile was successful in reducing malnutrition in a relatively short period of time through implementation of sound policies based on primary prevention through the National Complementary Food Program (PNAC). This program encompassed nearly all the vulnerable population; that is, all pregnant and nursing women and all children under the age of 6 participating in public health programs, and achieved a high level of coverage by reaching more than 1.2 million pregnant women and children. The PNAC was complemented with a special program of secondary prevention for pregnant and nursing mothers with undernutrition and for

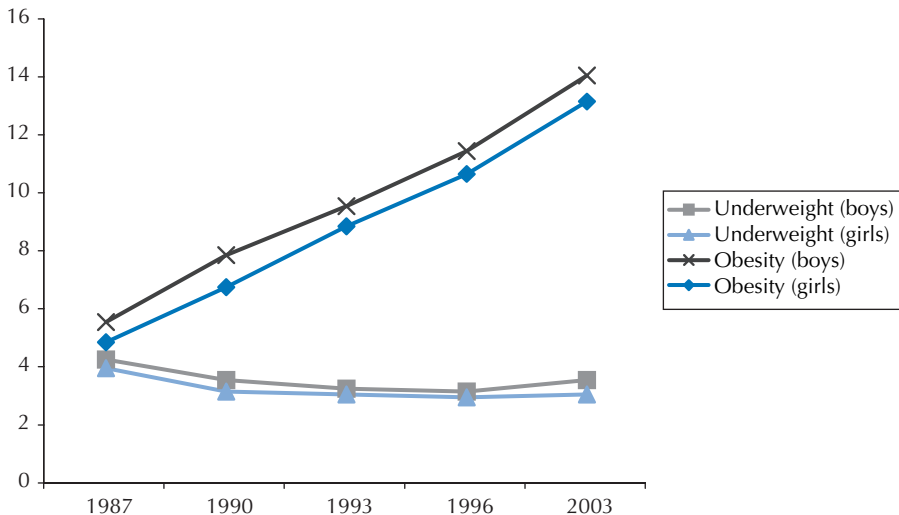
**TABLE 3. Risk factors in Chile, National Health Survey 2003.<sup>a</sup>**

|                      | Men (%) | Women (%) | Total (%) |
|----------------------|---------|-----------|-----------|
| Obesity              | 19.0    | 25.0      | 22.0      |
| Overweight           | 43.0    | 33.0      | 38.0      |
| Hypercholesterolemia | 35.1    | 35.6      | 35.6      |
| Sedentary lifestyle  | 88.4    | 91.4      | 89.8      |
| Smoking              | 48.0    | 37.0      | 42.0      |
| Cardiovascular risk  | 64.2    | 46.2      | 54.9      |

<sup>a</sup>Representative sample at the national level of population over age 16.

**Source:** Chile, Ministerio de Salud. *Encuesta Nacional de Salud 2003*. Santiago: Ministerio de Salud; 2004.

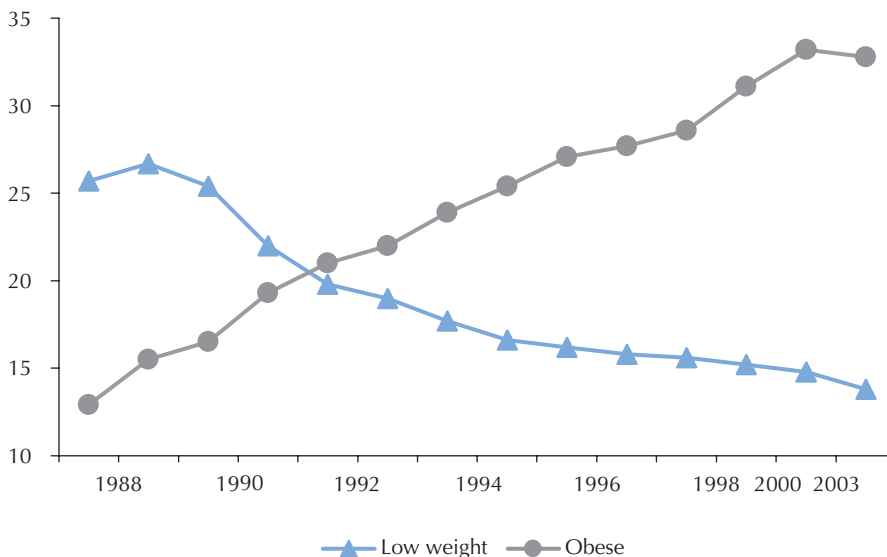
**FIGURE 1. Percentage of evolution in nutritional status of Chilean schoolchildren 6 years of age, by sex, 1987–2003.**



Underweight: BMI < 5th percentile on NCHS/CDC 2000 reference.  
 Obesity: BMI > 95th percentile on NCHS/CDC 2000 reference.

Source: Junta Nacional de Auxilio Escolar y Becas, Institute of Nutrition and Food Technology, 2004.

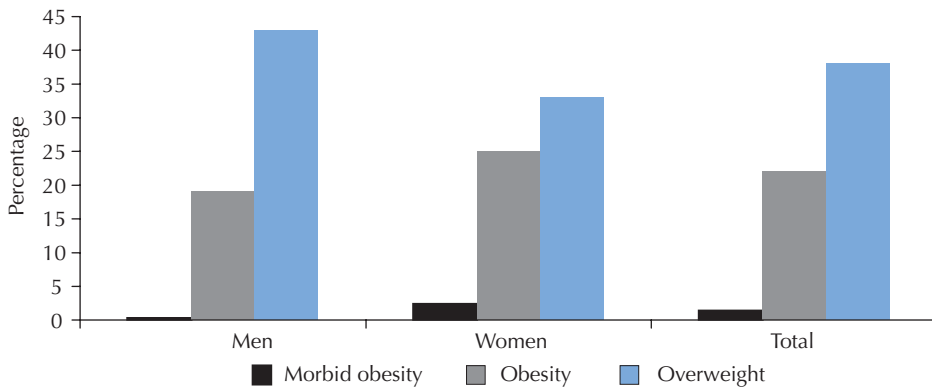
**FIGURE 2. Prevalence (%) of obesity and low weight in pregnant women, Chile, 1988–2003.**



Sources: Rosso P, Masdones SF. *Curva patrón de incrementos ponderales para las embarazadas chilenas*. Santiago: UNICEF, Ministerio de Salud; 1996, and Ministerio de Salud de Chile Web site. Available at: [www.minsal.cl/ev/en/dic04/embarazadas/totales/consulta\\_servicio.asp](http://www.minsal.cl/ev/en/dic04/embarazadas/totales/consulta_servicio.asp), accessed in September 2004.



**FIGURE 3. Nutritional status. Chilean population age 15 and over, by sex, National Survey of Health 2003.**



**Source:** Chile, Ministerio de Salud. *Encuesta Nacional de Salud 2003*. Santiago: Ministerio de Salud; 2004.

children at social risk or suffering from mild malnutrition. An intense program of tertiary prevention, or rehabilitation, was also launched for children with severe or moderate malnutrition who were hospitalized in special centers until they were fully recovered. Food programs in the education sector also were strengthened to complement the PNAC. This included a program sponsored by the National Kindergarten Board, covering approximately 62,000 children, and the School Food Program (PAE), which covered some 600,000 children between the ages of 6 and 14. These programs represented an annual cost of US\$ 200 million for the country (13).

The group of initiatives just described were characterized by high coverage (more than 80% of the respective target groups) and by the scaled character of the interventions, which ran the gamut from universal prevention measures to the fastest recovery possible for the seriously malnourished in order to prevent additional consequences. Thus, by covering the full range of problems, the results were synergistic and greater than if each component had been implemented separately.

In the case of children, malnutrition, using the weight-for-age indicator with Sempé reference values, and the maximum cutoff point

of one standard deviation, stood at 15.5% in 1975. It was reduced to 8.2% in 1989 (14) and to 5% in 1993. Low weight for pregnant women, according to 1987 Ministry of Health reference values (15), was reduced from 26% in 1987 to 7% in 2003 (Figure 2).

This effort was supported by a technical consensus that overcame political barriers and whose stability was maintained through the terms of various government administrations. There was an ongoing exchange of information and cooperative work between academic specialists at the universities and professional and technical personnel at the Ministry of Health who oversaw the programs. For example, during the height of the economic crisis in 1982 the PNAC was reduced by 30%. An increase in malnutrition, as measured through the existing nutritional surveillance system, was immediately observed. In light of this situation, academic groups reported the situation to the technical personnel at the Ministry of Health and to the country. The policy was immediately reversed, and malnutrition again declined. Another example was the 1985 proposal to substitute rice for the milk provided to preschoolers, a step that was not implemented due to opposition by several groups of professionals and academic specialists (14).

It should be noted at this juncture that these interventions were made possible through decades of groundwork that had established a national public health system characterized by a services network of incremental complexity (rural posts, primary care centers, and hospitals) which facilitated the implementation of nutritional programs at the local level. Public health activities also took place within a legal framework providing for continuity, since programs cannot be modified arbitrarily to reflect political trends, even if this can also be an obstacle when programs need to be adapted to a new epidemiological and nutritional situation in the country.

### **Review and Modification of Policies and Programs to Prevent Micronutrient Deficiencies and to Promote Healthy Eating Habits**

By the end of the 1980s, malnutrition had practically disappeared as a public health problem in Chile. As a result, nutrition was not among the priority issues on the national political agenda of the early 1990s. Despite this, nutritional problems had not been resolved, and certain disorders due to micronutrient deficiencies persisted, such as iron deficiency anemia in infants and pregnant women and low height-for-age among the poor. Furthermore, as earlier noted, during this same period, an explosive increase in obesity was observed. In response to this situation, academic groups, together with professional and technical personnel working in nutritional programs, convoked a Food and Nutrition Forum in 1994, with the goal of updating the national agenda regarding food and nutrition concerns. The Forum succeeded in gaining the attention of the government and making it more aware of the problems that persisted in this area despite the virtual eradication of poor nutrition in terms of calorie and protein intake. The objective of ensuring adequate food and nutrition for all Chileans was proposed. It was emphasized that

Chile was a country with problems of poor nutrition due both to undernutrition and to an excess and imbalance of micronutrients, which manifested themselves through growing rates of chronic diseases, obesity, and inactivity, and with these conditions, in turn, taking on greater significance in terms of morbidity and mortality on a national scale. The poor began to experience micronutrient deficiencies and higher risks for chronic diseases of nutritional origin. A document was prepared and approved by all the technical groups active in the field of public nutrition (16). The following subsections describe the priorities and orientations proposed in the document in order to bring food and nutrition policies into greater harmony with the country's current realities.

#### *Food Programs*

It was recommended that existing programs for supplementary feeding be evaluated with regard to: (1) their impact on growth and development in the different stages of the life cycle; (2) the coverage achieved and their effect on the coverage of other programs (for example, in the case of the PNAC, on the coverage of primary health care actions; and in education, on the coverage of basic education); (3) food distributed (quality, acceptability, and equitable distribution within the family); (4) their degree of orientation toward the poor and other high-risk population segments; (5) the transfer of income toward those sectors; and (6) the cost-effectiveness relationship for each program. A review of the existing standards for each program was also recommended, to include criteria for eligibility, the duration of program benefits for each recipient, and criteria for entry into and exit from the programs.

#### *Poverty and Food Safety*

The Food and Nutrition Forum document proposed the establishment of mechanisms for detecting social and nutritional risk in

families in extreme poverty in order to prevent malnutrition in mothers and children through early detection of social and nutritional problems. Once the problems were detected, it was recommended that integrated mechanisms for intervention in high-risk families be developed that also addressed any related economic, social, and nutritional aspects. Intervention options in this area were considered limited by the prevailing economic system. It was proposed that as long as high levels of poverty continued to exist, it would be necessary to maintain supplementary feeding programs. Their continuation was justified not only because of the nutritional benefit they brought to their target audience but also because they served as an effective means to encourage vulnerable groups to seek preventive health check-ups and to attend preschool and school education. Furthermore, by being directed to the poor, supplementary feeding programs were viewed as an efficient mechanism for income transfer and for the provision of necessary micronutrients.

#### *Micronutrients*

In this area, the Forum proposed the following actions: (1) the establishment, as soon as possible, of mechanisms for supplementation with iron, zinc, and copper for groups with a high prevalence of deficiencies in these micronutrients (pregnant women and children under 2 years of age); (2) the establishment of programs focusing on the detection and treatment of goiter in areas where the prevalence of this disease remained high; (3) the launching of programs for fluoridation of water and fortification of food with fluorine in areas of the country deficient in this substance; and (4) an evaluation of the calcium content in the national diet, by means of studies of prevalence of osteoporosis in the female population, and calcium supplementation programs for the groups most affected by deficiency of this micronutrient.

#### *Food and Nutrition Interventions for the Prevention of NCCDs*

It was proposed that a survey be conducted on the prevalence of obesity, unhealthy eating habits, dyslipidemia, smoking, alcohol consumption, and physical activity, by sex and age groups, to be representative of the general national population, which would then serve as a baseline for preventive nutritional interventions against NCCDs. At the same time, an analysis was proposed of all existing information available from social programs in the public sector regarding overweight and obesity in infants, preschoolers, schoolchildren, and pregnant women. It was planned to design an educational strategy incorporating content on the prevention of NCCDs in (1) formal education, starting with preschool education and continuing throughout the entire primary, secondary, and university education spectrum; and in (2) nonformal education, including health programs or other related programs carried out through municipalities, nongovernmental or grassroots organizations, and other similar institutions. There was also a proposal to carry out nutritional programs in primary health care for the prevention of NCCDs, actively incorporating the municipalities in programs for control of obesity, alcoholism, and diabetes, as well as smoking and drug addiction, which are also risk factors for NCCDs related to nutritional factors.

With respect to the mass media, the 1994 Food and Nutrition Forum participants suggested that well-designed social communication techniques be adopted and targeted to the general population, as a way to counteract the pervasive influence of campaigns carried out by the food, alcohol, and tobacco industries. It was agreed that technical groups should provide content for the social communication campaigns, but that the campaigns themselves should be the responsibility of those with specialized media commu-

nications skills. Intersectoral coordination, clear messages, and continuity over time were deemed as key ingredients in maximizing the impact of the campaigns. Furthermore, it was agreed that this impact should be measured on a continuous basis, and quantitative goals for the reduction of risk factors (obesity, smoking, alcohol consumption, diet, physical inactivity) should be established, in accordance with the findings of the representative baseline survey.

There was a consensus that local governments should be the parties directly responsible for issues related to personal development and well-being and that they should take responsibility for planning appropriate sports and recreational activities, as well as for promoting physical activity among the general population, as a way to encourage the adoption of healthier lifestyles that help prevent NCCDs. Furthermore, these programs should seek to increase community interest and participation in the broadest scope possible of health-related issues.

Given the high involvement of the private sector in food production, distribution, marketing, and consumption, the Food and Nutrition Forum document proposed that food industry representatives participate in the preparation and implementation of nutritional policies aimed at preventing NCCDs, thereby seeking to create greater private sector incentive for the production and commercialization of foods high in nutrition and a decreased focus on those with high caloric value (i.e., a high content of fats and refined sugars), but without nutritional value.

#### *Upgrading of Human Resources Education*

At undergraduate and graduate schools specializing in food and nutrition issues, it was proposed that the curricula be updated to reflect the country's new epidemiological reality by incorporating, by the year 2000, course materials on healthy nutrition for the prevention of NCCDs, food quality and safety, and other similar issues. It was further

suggested that refresher courses be organized for personnel currently working in food and nutrition programs.

#### *Control of Food Quality and Safety*

The Food and Nutrition Forum recommended promoting the establishment of mechanisms for systematic, ongoing coordination among all the institutions whose work involved issues related to food quality and food safety control—the Ministries of Health, Economy, Agriculture, and Housing, and their affiliated agencies, as well as universities and scientific societies—so as to encourage the joint evaluation and resolution of existing shortcomings in food protection. In addition, special emphasis was placed on the importance of supporting a revision of current legislation and regulations, and the changes necessary for updating these were defined.

The Forum document—visionary for its time—also served as the basis upon which the Institute of Nutrition and Food Technology (INTA) of the University of Chile redefined its internal policies to make them more responsive to the country's new demographic and epidemiological realities. Three new programs—Chronic Diseases, Secondary Malnutrition, and Food Quality and Safety—were created as a result of this organizational review, and the importance of conducting research in the specific areas of micronutrients (iron, copper, zinc, and fluoride), growth size deficits, obesity, lipids, osteoporosis, and NCCDs was stressed.

In response to the Forum's actions and proposals, in January 1995 the Chilean Government created the National Commission for Food and Nutrition, which in turn established working groups on food safety for the poor, designed food programs, promoted food protection regulations and the adoption of healthy habits and lifestyles, organized activities for the prevention of NCCDs based on nutrition, and prepared nutritional guidelines for the population (17).

It is interesting to note that a little more than a decade later, nearly all of the proposals and recommendations of the Food and Nutrition Forum of 1994 have been successfully implemented. These will be discussed in the following section.

## Results of the Policy and Program Changes: The Current Situation

### *Food Programs*

The working group on food programs has sought to optimize the PNAC's effectiveness, and in 1998 fortification with iron, zinc, and other micronutrients was included for milk (fortified pure milk) delivered to 80% of Chilean children under age 2, with the goal of preventing iron deficiency anemia in infants. This program enabled a reduction in anemia among Chilean infants from 30% in 1998 to 8% by the year 2000 (18). The program's impressive success spurred Argentina and Mexico to subsequently adopt this strategy. In addition, from the year 2000, a special milk was introduced for phenylketonuria and for children with low birthweight. Also, as an obesity prevention measure, the proportion of fat in milk has been progressively reduced.

In 2000, after an intense technical and political discussion that included the participation of a research commission of the Chilean Congress, the bidding conditions for the PAE were changed, and the need to actively promote healthy nutrition in all governmental food programs was established. Thus foods with less saturated fats and sugars, and increased quantities of fruits and vegetables, dairy products, and legumes, were included in the diet for 1.5 million preschoolers and schoolchildren. These changes in school menus represented an increase in the consumption of fresh fruits and salads from four to 18 times a month; the elimination of foods with high fat and caloric content, such as sausages, and of the so-called "milk drinks"

(which, in fact, contained no milk) and their replacement with reduced-fat milk, in order to increase the intake of calcium; an increase in consumption of fish and vegetables to twice a week; and a reduced intake of sugar and refined carbohydrates. Thus nutritional quality in the school diet was improved, and the fat and caloric content was reduced.

### *Poverty and Food Safety*

The Ministry of Planning launched a poverty eradication program called "Chile Solidario," incorporating all the elements highlighted in the 1994 Forum document. Chile Solidario targets high-risk families and utilizes interventions that integrate economic, social, and nutritional issues and facilitate access to a gamut of State resources and subsidies. However, the program's structure, instead of merely providing passive assistance to the designated recipients, encourages beneficiaries to become proactive in the improvement of their particular circumstances and to move beyond their current state of poverty. Access to the nutritional programs overseen by the Ministries of Health (PNAC) and Education (PAE) is assured for these families, as well as educational activities designed to raise awareness concerning healthy food and nutrition habits.

### *Micronutrients*

In addition to the changes concerning inclusion of iron, zinc, and copper in the PNAC, in 2000 the Ministry of Health established a legislative framework providing for the compulsory fortification of wheat flour with folic acid, in order to prevent neural tube defects, the congenital malformation that leads to results that can include the death of the newborn or neurological effects that require rehabilitation throughout life. The assessment of the impact of this intervention on the population showed that after only two years of this measure being in effect, malformations were reduced by 42% (19). In addition, a national law that man-



dates salt iodization for all salt used for human consumption has permitted the eradication of endemic goiter in the population (20). The policy of water fluoridation in the country was continued, and for rural sectors a special program for milk fluoridation was created. A pilot study over three years (1994–1997) showed a 40%–60% reduction in caries among children between the ages of 3 to 6 (21). This program is currently being expanded to other rural areas of the country through the PNAC in the Ministry of Health and the PAE in the Ministry of Education. With respect to calcium, nationwide studies were conducted among schoolchildren (22), pre- and postmenopausal women, and older adults, to determine the level of calcium deficiencies in the population. This led to a national policy to encourage consumption of products rich in calcium (23).

#### *Prevention of NCCDs through Food and Nutrition*

In order to respond to the epidemiological and nutritional changes that took place in Chile (24, 25), it was necessary to characterize the burden of disease on the population. For this purpose, a study was conducted in 1995, based on 1993 data, that showed that 75% of the burden of disease came from NCCDs (26). This led the Ministry of Health to shift from its traditional approach centering on maternal and child problems to one that gave priority to emerging problems and responded to the increase in risk factors related to cardiovascular diseases, cancer, accidents, and mental health problems. Among the principal determinants of these problems are deficiencies in food and nutrition, insufficient physical activity, smoking, and other psychosocial and environmental factors.

A strategic plan to address these problems was established and goals set for the period 2000–2010. The plan, based on the National Council for Health Promotion (Vida Chile), an intersectoral entity made up of 28 govern-

mental organizations, was devised utilizing a decentralized structure in 12 regions and 308 of the country's 341 municipalities. Strategies for each determinant were implemented at the local level targeted to preschoolers and schoolchildren, as well as in workplaces and municipality offices (27). The principal achievements of this initiative have been the establishment of a model of decentralized management for health promotion, with projects and programs being carried out in a majority of the country's municipalities, and a baseline that was defined using a survey conducted in November–December 2000 (28) to set objectives for the year 2010 (29) (Table 4).

#### *Upgrading of Human Resources Education*

Since 1998, training courses have been provided throughout the country on health promotion and prevention of NCCDs, first for managers in the health sector, then for municipality leaders in 1999–2000 (covering more than 120 municipalities) (30), and then for community leaders in 2000–2001 (31). In

**TABLE 4. Intersectoral goals for the year 2010, by percentage.**

| Indicator  | 2000<br>% | 2010<br>% |
|--|-----------|-----------|
| Obesity in preschool children (W/H > +2 sd NCHS reference)                   | 10        | 7         |
| Obesity in first grade (W/H > +2 sd NCHS reference)                          | 16        | 12        |
| Obesity in pregnant women (Ministry of Health reference)                     | 32        | 28        |
| Sedentary lifestyle in persons over age 15                                   | 91        | 84        |
| Smoking in eighth grade  | 27        | 20        |
| Smoking in women of childbearing age (ages 15–44)                            | 45        | 40        |
| Population in organizations  | 4         | 10        |
| Vida Chile Plazas (one to be placed in each of the country's municipalities) | 0         | 100       |

**Source:** Chile, Ministerio de Salud. Objetivos sanitarios para la década 2000–2010. *Boletín de Vigilancia en Salud Pública de Chile El Vigía* 2002;5(15):1–15.



the universities, distance degree courses for health professionals have been offered, with more than 600 students participating in 2002–2003. There are two master's degree programs in health promotion, in addition to these issues being included in undergraduate curricula in health, nutrition, the social sciences, and other related fields.

### *Control of Food Quality and Safety*

In 1997 new food health regulations were promulgated which, although still containing significant shortcomings, nonetheless represented progress with respect to previous regulations. Since then several commissions continue to work on this issue, and considerable advances have occurred in the area of food labeling. However, there is still no coordinating entity for food quality and safety regulation and for the body of related actions being carried out in the country by the three ministries—Health, Agriculture, and Economy—having responsibilities in this area. Despite Chile being a food exporter, the country has no modern institutional structure to support food production, consumption, and exports (32). During 2003, there were weekly meetings of all the governmental, private, and academic institutions involved with the issue, and a diagnosis of the situation was carried out. But there was no success in establishing a proposal for a centralized authority to coordinate, regulate, and modernize the sector.

## **RELEVANT POLICY AND PROGRAM ACHIEVEMENTS**

### **Changes in the Standard for Measuring Nutritional Status**

One of the most important achievements was the 1992 change in the standard for measuring nutritional status, to include systematic consideration of height among in-

fant and in the school population, which had previously prevented evaluating the problem of children with low height and weight for their age, but with weight sufficient for their height. Such children were classified as malnourished according to weight-for-age, but using weight-for-height as an indicator, they could be considered obese. In addition, using the earlier criteria, children who gained little weight in a given month were considered at risk, an indicator that was extremely sensitive but not very specific and that led to exaggerated estimates of the number of children at risk. It was necessary to show that, given the fact that monthly weight gain fluctuates greatly, it is preferable to evaluate this criterion on a quarterly basis. Although the criterion for weight gain was still reasonable for selecting children for the special program for risk of malnutrition, it was decided that children who maintained a normal weight-for-height should not remain in the program for longer than six months.

### **Preparation of Nutritional Guidelines for the Chilean Population**

A broad consultative process was established, culminating in the preparation of a series of national nutritional guidelines, along with the reorganization of food and nutrition programs (PNAC in the Ministry of Health and PAE in the Ministry of Education) and the updating of food health regulations in order to encourage the food industry to produce healthier foods (13). The preparation of these guidelines was enormously useful, since it generated a broad debate on the need for a healthy diet to prevent nutrition-related chronic diseases. The guidelines facilitated a broader consideration of food safety issues beyond specific concerns related to chemical and microbiological safety and a closer examination of the impact of diet and food choices on health and chronic diseases.

## Education on Food and Nutrition for Preschoolers, Schoolchildren, and Consumers

The major advances in food and nutrition education to date have been at the preschool and primary school levels. In 2001 and 2002, an initiative supported by the Food and Agriculture Organization of the United Nations called “Food and Nutrition Education in Primary Schools” carried out a pilot project at 10 primary schools in four regions of the country and worked out the methodology and materials for incorporating content related to food and nutrition into the primary curriculum (33, 34). This project was successful and has currently moved into the phase of nationwide training of schoolteachers to use the project methodology and materials in all of the country’s 11,000 primary schools. The project is complemented by another one combining education in food and nutrition with physical activity, for both preschoolers and schoolchildren (35). Finally, a program of consumer education was designed, using distribution of educational materials in supermarkets and individual training at the place of purchase by students in nutrition to promote healthier food consumption (36). These new educational forms break the traditional mold of knowledge dissemination, make use of interesting graphic material, and are available in Spanish in CD form and at the INTA Web site ([www.inta.cl/consumidor](http://www.inta.cl/consumidor)).

## Preparation of Active Life Guidelines for the Chilean Population

In order to combat the high prevalence of sedentary lifestyles, physical activity guidelines were prepared in 2001–2002, with six messages directed to the general public (37). A specific policy was also adopted to increase the number of hours and intensity of physical activity in preschool centers and primary schools throughout the country, as well as to introduce physical activity into the primary health care structure through an

agreement between the Ministry of Health and Chile-Deportes. In May 2003 the World Health Organization (WHO) published the document “Diet, Nutrition, and the Prevention of Chronic Diseases” (38), providing scientific data on the importance of adequate diet and physical activity. A later year, on 22 May 2004, the Fifty-seventh WHO World Health Assembly approved a document for a “Global Strategy on Diet, Physical Activity, and Health” (39), which definitively endorses the public policies on food and physical activity that are currently being implemented in Chile.

## LESSONS LEARNED

**(1) Policies may be sound and still insufficient.** Chile has carried out sound policies for confronting malnutrition. Moreover, when the country was faced with a new demographic, epidemiological, and nutritional reality, it was able to respond with innovative policies. However, these policies have come into existence too late and have not been sufficiently vigorous to respond to the magnitude of the challenge: an explosive increase in risk factors in general, and, in particular, in those relating to diet, such as the case of obesity. This has been clearly demonstrated in successive surveys on risk factors that have been carried out in the country. The 2003 National Health Survey (6), concluded based on a representative national sample of 3,600 people, that obesity affects 23.2% of the population over age 16. Overweight affects 38% (43.2% of men and 32.7% of women), hypercholesterolemia 35.4%, hypertension 33.7%, and smoking 42%. As a result, 55% of the respondents are at high or very high cardiovascular risk. In this sense, Chile’s situation is very similar to that found in developed countries, where likewise, there has been no definitive response at the society level. Even more significantly, neither government authorities nor the public at large seems to be fully aware of the size of the problem nor of the seriousness of its consequences.

**(2) To succeed, appropriate methodologies for changing the population's habits must be applied.** Changing the behavior of the population as regards diet, physical activity, the use of tobacco, stress, and other environmental aspects requires an integrated effort by the public health sector and other areas of the national government. In general, the Chilean public now has sufficient information about the need for and benefits of having a healthy diet, engaging in physical activity, not smoking, and controlling the most important risk factors. However, that knowledge has not been accompanied by behavioral change. This change becomes perhaps more difficult in an environment that places high emphasis on consumption and is characterized by the unscrupulous marketing of products encouraging consumers to increase their intake of fast foods and sugary beverages, their use of tobacco, and their dependence upon automobiles and electrical appliances, thereby reducing the opportunities for physical activity.

**(3) The gap in human resources training and education must be addressed.** Significant change is required in the training and continuing education of professional and technical human resources in order to equip this workforce to adequately respond to the country's rapidly changing demographic, epidemiological, and nutritional profile. Unfortunately, the response capacity of academic and other public institutions responsible for implementing policies and programs has been weak and extremely slow. This explains why for many years in Chile high caloric foods continued to be provided through nutritional programs, when the problem of malnutrition was already in full retreat and there was an explosive increase of obesity, especially among the poor.

**(4) The lack of adequate regulations for supporting healthy diets and active lifestyles is a weakness requiring corrective action.** The case of Chile shows that it is possible to work

on educating and raising awareness of the general public even without achieving parallel reinforcement from standards, regulations, and programs to support collective behavioral change. For example, in Chile there are no regulations regarding the advertising of unhealthy foods during the hours that children are most frequently watching television, nor are there laws restricting the advertising of cigarettes and alcohol. Likewise, there is no legislation to promote or facilitate physical activity in the educational and workplace settings. Regulations on healthy food production are practically nonexistent, and the few which exist concentrate on ensuring the microbiological safety of the end product, ignoring the role of excess saturated fats, sugars, and salt as determinants of NCCDs. New regulations should include nutritional concepts which favor the production of foods that are not only safe but beneficial for health, while at the same time establishing limits on consumption of saturated fats and trans-fatty acids, free sugars, and salt; favoring foods that contain unsaturated fats and other healthy ingredients; and encouraging the increased consumption of fruits and vegetables, as well as of legumes, whole grains, and dried fruits.

## CONCLUSION

Demographic, epidemiological, and nutritional changes have occurred so rapidly in Chile that successful maternal and child policies were not modified in a timely way, changing only at the end of the 1990s. It was not until 1998 that a policy of health promotion was implemented to combat the growing incidence of obesity in the Chilean population, the high levels of sedentary lifestyles, and the explosive increase in risk factors for NCCDs. Although this policy was properly formulated, intersectoral in nature, financed by the State, decentralized to the municipal level around the country, and in harmony with WHO proposals—in particular, those

expressed in the 2004 document on the “Global Strategy on Diet, Physical Activity, and Health”—in practice it remains insufficient, given the magnitude of the problem and the rapidity of change. In order to meet the current challenge, more intense social action will be required, bolstered by political support, skilled and conscientious human resources, and regulations that are supportive and facilitate the establishment of the strategy as a priority State policy to take effect throughout the country. The goal is to make the healthy option, within the context of proper diet and adequate levels of physical activity, also the easiest option to take. This requires not only strengthening knowledge and motivation among the general population, but also making changes at the social and environmental levels that allow the healthy option to become the preferred option.

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# TRANSPORTATION, URBAN DEVELOPMENT, AND PUBLIC SAFETY IN LATIN AMERICA: THEIR IMPORTANCE TO PUBLIC HEALTH AND AN ACTIVE LIFESTYLE

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## INTRODUCTION

The headline read: “88% do not feel safe on the streets of Lima.” With that eye-catching opening, in November 2003, Peru’s *El Comercio* newspaper reported the results of a public opinion poll, together with another no less alarming finding: “53% do not even feel safe in their own home” (1). “The streets belong to us,” declared an editorial appearing in Puerto Rico’s *El Nuevo Día* one year later, which called for a national civic crusade “to make sure that people feel safe on the streets and to take back our cities” (2).

In November 2004, Chico Buarque, a well-known Brazilian singer, referred to life in Rio de Janeiro with these words: “The social differences of old were not what they are today. When I was little, I played soccer with the kids from the slums. Today’s social isolation, with people more and more afraid of violence and withdrawing into their own bullet-proof world, makes that type of contact almost impossible now” (3).

For the majority of Latin Americans, this kind of story is very familiar, and Buarque hits the nail on the head by reminding us—especially those of us who are now going gray—of what we’ve left behind: those times when we enjoyed a sense of community, when we had freedom of movement and the

streets belonged to all of us (or almost all of us). Will this be our unavoidable destiny? Probably not. As the saying goes, “Nothing lasts forever.” And then there’s the case of the city of Bogotá, which seems to confirm that.

The tale of Samuel Sotomayor is illustrative. When Samuel returned to the streets of Bogotá in 2001 after 17 years in prison, he felt “wonderment: on the one hand, Bogotá had changed tremendously; it was more orderly, parks and green areas had sprung up in the neighborhoods, the transportation system had been modernized, and everywhere people were coming and going, to school or to work, riding along on bicycle paths . . . a city that was no longer a crazy, irresponsible teenager, but now a keen young person searching anxiously for his or her own destiny.”

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Samuel, a fictional character from the novel *Cobro de Sangre*, by Mario Mendoza (4), tells a story with which anyone who had been away from this city during the 1990s could identify. Indeed, in that period Bogotá emerged from the chaos of the streets and rampant violence to collectively embrace a life-affirming perspective and a respect for one's neighbor that, among other things, turned public places back over to pedestrians and cyclists, set up parks, and created a good public transportation system. In the eight years since this experiment began, the rate of deaths from violence had fallen 42%.<sup>6</sup>

From a public health perspective, the situation in a majority of cities throughout the Region of the Americas presents a series of common problems, including a lack of security, violence, stress, social disintegration, and physical inactivity, all of which are recognized health risk factors leading to epidemics in cardiovascular diseases, mental health problems, and obesity, which together cause almost 60% of the deaths in the Region today (5). Yet from the perspective of both urban planners and elected political authorities, the diagnosis is commonly that of a *sick city*, characterized by symptoms of rampant delinquency, unsafe streets, social segregation, chaotic transportation, a shrinking of public spaces, and environmental pollution. Unlike the public health approach, which focuses on the individual, the urban planning mindset seeks to address existing ills from a collective perspective, setting as priorities the improvement of urban quality of life, securing a healthy environment, and providing efficient public infrastructure, such as transportation and appropriate urban land use, among others.

Yet even if public health authorities and urban planners take disparate and unarticulated approaches, it is nonetheless worthwhile to question whether these viewpoints are necessarily irreconcilable, and more

specifically, if there might not be some link between the environmental quality of the city, the availability of options for public transportation, and the status of health and physical activity of the city's inhabitants. These considerations are the central questions that this chapter will address, and the reader will discover numerous responses within the two main sections of this chapter. First, the history of sedentary lifestyles in developed countries is addressed, followed by a description of the current situation in Latin America, which now confronts the dilemma of whether or not to take the same road as the nations of the Northern Hemisphere. The final section and the conclusions identify urban and transportation policies that could become part of public health efforts to promote the importance of adopting an active lifestyle. This broader scope in the field of urban planning policies could prove to be vital, especially now that the World Health Organization (WHO) has placed among its highest priorities the adoption of a population-wide, prevention-based strategy to combat the global epidemic of non-communicable diseases (6).

### **The City and Public Health: A Historical Relationship**

Despite their common historical roots, urban planning and public health have followed separate pathways for more than half a century. The influential report of Edwin Chadwick on the health and living conditions of the working classes in the British Isles during the mid-nineteenth century laid the foundation for the public health focus by pointing out that substandard and overcrowded housing and labor conditions, as well as the unhygienic state of the streets, were associated with the large-scale cholera and typhus epidemics then ravaging the population. Influenced by civil engineering, his report's proposals for health sector reform consisted of adopting strict measures for the disposal of solid wastes and excreta, as well as for rodent

<sup>6</sup>A detailed description of Bogotá's transformation is found in the Ricardo Montezuma chapter in this book.

control. Widespread propagation of these measures curbed the epidemics then rampant, years before the microorganisms that caused them were identified.

Curiously, scientific progress and the theory of germs shifted the public health focus from the city to the microscope. Hence, attention passed from the population's health to the health of the host—the affected individual—and the functions of the physician became more prominent. The major change in public health in the twentieth century was the emphasis on individual health risks versus social or environmental considerations, and the predominant strategy was aimed at identifying individual risk factors and modifying them by changing personal behavior.

Nevertheless, the relationship between the city and public health has once again gained importance. In the last century, the promotion of collective health in urban metropolises—a relatively new specialty—helped to reconfirm the close relationship between the quality of urban life and human health and well-being (7). Also, within the urban context, theories such as “new urban planning” and “a return to the traditional city” have emerged, which contend that the quality of city life can be improved through transportation policies that promote commuting on foot or by bicycle and discourage and/or restrict the use of personal vehicles (8). A growing body of empirical findings, descriptive observations, and social critiques has fueled the notion that the current rate of uncontrolled growth in large cities and the constant increase in motor vehicle traffic are two of the principal culprits in the deteriorating quality of life and health of urban populations.

Indeed, traffic accidents, poor air quality, stress, the loss of social cohesion, and physical inactivity are found in almost all twenty-first century large metropolises. Echoing these observations, in 1999 WHO published the report *Healthy Cities and the City Planning Process* (9); later, in 2001, along these same lines, the U.S. Institute of Medicine pub-

lished its report on *Rebuilding the Unity of Health and the Environment: A New Vision of Environmental Health for the 21st Century* (10). Despite the fact that the recommendations included in these reports have merited special attention at the community and municipal levels in countries throughout the Region of the Americas, they have received only a lukewarm reception on sectoral and national political agendas (11).

## THE PARADIGM OF CHANGING INDIVIDUAL BEHAVIOR

After having been applied for nearly a quarter century, the prescription of behavioral change at the individual level does not seem to have led, in and of itself, to significant results in terms of controlling the epidemics of obesity and diabetes, nor in controlling cardiovascular diseases and certain cancers. This can be seen in the United States and in other high income countries and may also be the case in certain developing countries. In the United States, for example, not only is it currently recognized that the health objectives for the year 2000 were not met, but it is entirely likely that the new and ambitious objectives set for 2010 will similarly not be achieved (12). Among them are eliminating exposure to environmental pollution, increasing by 100% the number of adults who participate in moderate physical activity (from 15% to 30%), and reducing the adult obesity rate from 23% to 15% (13). To date, the greatest progress made with respect to these indicators has occurred principally among those groups with the highest income and educational levels. In Latin America, where a coherent plan to combat chronic diseases has yet to be implemented, those individuals who follow proper guidelines for eating and undertake some degree of physical activity belong to the most comfortable social groups (14–16). This finding and the limitations it suggests are most likely due to poor practical implementation of the scien-

tific knowledge generated experimentally—both in the clinical and population contexts.<sup>7</sup> In other words, under controlled conditions many research projects have documented that changes in behavior may produce positive health effects, but when put into practice—if this occurs—whether within the health services setting or at the population level itself, the results nonetheless have left a great deal to be desired (17, 18).

After carrying out an extensive and detailed review of social marketing campaigns aimed at encouraging proper eating habits and increased physical activity, Alcalay and Bell (19) indicate that, in controlled clinical and personalized trials, positive effects from controlling health hazards can be achieved in 10% to 20% of the cases, but it is unlikely that these effects can be achieved with population-based interventions, even when the project's economic resources are not a limiting factor. The authors conclude that it is necessary to rethink intervention strategies based on mere information dissemination and to place more emphasis on the role of environmental factors and social norms. Nevertheless, it should be recognized that in addition to this particular challenge, and especially in Latin America, the general public has limited direct access to scientific information, as well as difficulty in putting that information into practice.

The only modest results obtained in terms of behavioral change may also be explained by the fact that epidemics such as obesity and diabetes are not deemed to be a critical situation that demands significant social changes (20). Along this same line, Alfred Sommer, Dean of the Johns Hopkins University School of Public Health, recently pointed out that “it is a lot easier to avoid risky behavior when everyone else does as well, and

when the environment doesn't support it” (21). Christopher Caldwell, a writer with *The New Yorker*, observed that the lower rates of smoking achieved in the United States in the last 40 years are attributable more to “social self-binding”—the social commitment (and political will) to combat the habit or put an end to it—rather than to access to new information (22).

Public health recommendations to change lifestyle habits have focused on the individual's cognitive and behavioral processes, dissociating them in the majority of cases from their social and cultural determinants. This perspective was based on such theories as reasoned action and planned behavior and the Transtheoretical Model (23), which share a common postulate: that people learn to surmount risks and overcome obstacles for the benefit of their health, but without any fundamental modification of those risks and obstacles. The logical sequence would be: *informed individual* → *change of attitude* → *behavior change*.

These considerations should not lead us to conclude that educational activities, information provision, and social marketing are totally ineffectual. On the contrary, they are essential starting points for reaching consensus and developing new health paradigms, as well as for recruiting the first wave of innovative individuals willing to attempt behavior change. However, these actions are insufficient in and of themselves if we consider the vast majority of the population. Anti-smoking campaigns exemplify how information was vital for that first group to initiate changes, but it was not until after instituting public standards (regarding advertising and the sale of tobacco to minors), restrictive measures (such as smoke-free public places), and economic deterrents (higher taxes) that a substantial drop in the number of smokers was noted in the population, at least in those societies where such types of actions were implemented. The use of safety belts in automobiles is another example of how the combination of information, incen-

<sup>7</sup>This type of research refers to controlled clinical trials in which the researcher randomly assigns individuals to one of two groups: one that receives the intervention (or treatment) and another that receives a placebo and serves as an observer.

tives, and coercion succeeded in securing widespread compliance, especially in developing countries.

With regard to promoting physical activity, the interventions that have been studied to date indicate three possible results: only short-term effects, little effect, or no effect at all (24). This has led some experts to conclude that the principles of individual behavioral change alone are an inadequate response to the epidemic dimension of sedentary lifestyles and that more attention needs to be focused on the complexity of this behavior, as well as on the possibility of responding to the epidemic with interdisciplinary actions (25).

## A SEDENTARY LIFESTYLE IN THE NORTHERN HEMISPHERE

### The Paradox of Little Demand for the “Best Buy”

In the last quarter century, countless studies have shown the usefulness of physical activity for both physical and mental health. Among the principal public health benefits are a reduction in mortality and prevention and control of obesity, hypertension, diabetes, and cardiovascular diseases. It has also been established that physical activity decreases stress and facilitates positive social interaction (26, 27). It is not an exaggeration, then, to claim that this abundance of benefits qualifies as “today’s best buy in public health” (28).

The quantity and intensity of physical activity needed to obtain these benefits has been well documented. The recommendations, furthermore, have gone from more to less: from practicing aerobics and other types of systematic exercise, as was advised in the 1970s and 1980s, to today spending a mere 30 minutes daily in moderate forms of physical activity, such as walking, bicycling, dancing, or going up and down stairs. These 30 minutes a day help to ensure a healthy outcome

with a minimum investment in physical effort, time, and money and also hold the potential for increased social interaction among large and diverse groups of people who have incorporated a gamut of physical activities into their daily routine (29).

In the United States and other developed countries, however, the scientifically proven benefits derived from following recommendations on physical activity did not translate into higher active lifestyle rates or into a reduction of obesity rates. The Centers for Disease Control and Prevention’s statistics indicate that physical inactivity rates remained almost constant (at approximately 55%) during the 1990s (30). At least with respect to the U.S. population, this finding cannot be attributed to a lack of available information, especially in light of the fact that there is almost universal recognition of the benefits of an active lifestyle. The reason for this incongruity, then, must lie beyond the existence of information and awareness.

### U.S. Suburbia, Personal Vehicles, and Technological Innovation

Those who have studied physical activity, particularly in the United States, pay close attention to the possible influences exerted on human behavior by the urban environment and the available means of transportation in large cities, particularly as these relate to physical exercise. This relatively new interest stems in part from discoveries made by transportation experts and urban planners over the past 30 years through their studies of “human mobility,” which indicate that certain characteristics of the organization and layout of cities influence people’s daily commuting practices—with or without motor vehicles—as well as the degree to which they lead a sedentary life (31).

During the second half of the twentieth century, U.S. economic growth and continuous improvement of the middle class’s standard of living led to a progressive abandonment of collective dwellings in traditional



urban centers and to migration to individual dwellings located on the periphery of those centers, thus creating low density suburbs. One of the reasons for this migration was the expectation of recovering that lost sense of peace and harmony to be found only in the countryside without having to sacrifice the benefits and conveniences of city life. Urban growth's new direction was fueled by the large-scale construction of expressways and turnpikes and a parallel and growing dependency on private automobiles.

The suburban model in the United States consists of an extensive spread of single-family homes with a scattering of commercial centers and other activity and services centers, each at some distance from the others. This segregation and parceling of the land—unlike the traditional European model consisting of a diverse, compact city—results in a situation in which the majority of the inhabitants' typical destinations are far from one another and poorly interconnected, so that some type of motorized transportation is needed to get from one place to another in a reasonable amount of time. Some believe that this suburban model discourages walking, reduces available public spaces, decreases human contact, and creates a dependency upon automobiles. At the center of some of the theories advanced in several North American urban doctrines, such as the New Urbanism (8, 32), is the need to reverse this trend and to improve people's quality of life, an idea which has attracted the attention of public health experts interested in turning the tide against the growing tendency toward physical inactivity.

The influences of mass versus individual transportation have contributed to the formation of two opposite systems of urban structure and space utilization. For example, in the majority of European cities, the space allocated for mobility represents around 20% of the urbanized land surface; on the contrary, in some U.S. cities this percentage is above 70% (33). In Paris, space allocated for

traffic circulation represents only 23%, while in Los Angeles it is more than 70%. The differences in these two urban mobility models not only have to do with space utilization, but are also manifested in well-defined and dissimilar social characteristics, which most likely preceded the present urban realities. In the case of Paris, mass transportation has contributed to the development of what is public, what is community, and what is social, while in the case of Los Angeles, where mobility in one's own automobile is both a priority and a majority value, the principles are much more related to what is private and individual.

In developed countries where urban planning has favored mass transportation, concentric, dense cities have been fused—the European cities.<sup>8</sup> “The Stockholm subway is a good illustration of the densifying effect induced by urban rail transportation: the 1954 transportation plan, which proposed the subway, was conceived around the same time as the 1952 urbanization plan; and the subway stations opened at the same time—or even before—completion of construction of the new neighborhoods surrounding the stations” (34). In developing cities, there is only the case of Curitiba, Brazil, in which urban planning has been based on a system of mass transportation. On the other hand, in places where urban planning has given priority to individual transportation, the presence of highways and automobiles has given

<sup>8</sup>The majority of European cities, “enormous urban concentrations, dense and well covered by mass transit, seem to discourage motorization or at least the use of automobiles.” Dupuy G, *L'auto et la ville*, Flammarion, Paris, Collection Dominos, 1995, p. 21. There exist other cases in the world where mass transit has played an even more central role in urban life, but this appears to be related to such characteristics as space availability or the particular type of city planning. For example, in Asian cities such as Tokyo and Hong Kong, the active role of mass transit has been influenced by the lack of space, and the new cities of the former Soviet Union have been deliberately designed on the basis of mass transit.



way to dispersed, low density agglomerations similar to the residential suburbs so typically found in the United States.

There are also other factors that help to explain the contemporary tendency toward a sedentary lifestyle and its pervasiveness. Among these, the most obvious factor involves the evolving nature of the working world that accompanies rapid urbanization. Here we see growth in the services sector, automation in the manufacturing sector, and an economy increasingly dominated by computers and computer technology. Domestic life, as well, has been “liberated” from physical labor, and the growing mechanization of household tasks is ubiquitous. Promoting increased physical activity appears to be not only impractical within this context, but anachronistic, since the idea would be at cross-purposes with the sign of our times: productivity and the ability to do more things in less time. Even our entertainment preferences and how we spend our free time have changed: a predilection for walking, versus electronic games and television, has been relegated to the category of “a thing of the past,” in much the same way as has the idea of children going to play in the “great out-of-doors” from morning to dusk. According to economist Darius Lakdawalla, rapid assimilation of technological innovations in the marketplace and in domestic life is alone responsible for some 60% of the increase in obesity in the United States (35).

### **How Does the Urban Physical Environment Influence Physical Activity Levels?**

The previous section’s discussion is not only logically persuasive and supported by significant econometric estimates, but is further bolstered by important empirical corroboration indicating just how certain physical, functional, and cultural characteristics of a city and its transportation system (in other words, the urban physical environment) im-

pact on human health through their influence on physical activity, air quality, and personal and traffic safety. For example, an ecological study conducted by Ewing and colleagues (36) has linked suburban life in the United States with hypertension and obesity. With even more refined study methods, these same authors have shown, in the city of Atlanta, that in neighborhoods where land use is more diversified (i.e., includes a mix of residences, commercial businesses, entertainment and recreational centers, and public parks, for example), the obesity rates recorded are lower than those in the type of suburban neighborhoods described earlier in this chapter. The authors found, furthermore, that the city-obesity relationship was affected by the frequency with which people walked (37).

In a study conducted in eight provinces in China, where a group of adults was monitored between 1989 and 1997, the results at the end of that period showed that automobile ownership was correlated with developing obesity. Among the male subjects who had acquired a car (14%) during the eight years that the study lasted, an average weight increase of 1.8 kg was observed, along with an increased risk of obesity, in comparison with those who had not acquired an automobile during that same period (38).

At a more detailed level, studies carried out by experts in urban affairs and road safety—mainly in Europe and the United States—show how specific characteristics of urban space design and transportation systems influence the population’s level of physical activity. The most studied factor has been urban density and non-motorized transportation; i.e., walking and bicycling. It is currently recognized that higher population and urban building densities promote the habit of walking. This effect can be increased even more with a highly diversified land use plan that includes residences, businesses, entertainment sites, and schools all located within a relatively close distance

to one another (39). In a study by Frank, Andresen, and Schmid, it was found that obesity risk decreased 12.2% in each successive quartile of mixed land use and declined by 4.8% for each additional kilometer walked. They also observed that every additional hour of using an automobile increased the obesity risk by 6% (37).

The second-most-studied aspect dealt with transportation systems and street networks. The traditional urban grid layout represented by the typical city block provides high “connectivity,” in contrast with the characteristic curvilinear layout of U.S. residential suburbs. In the traditional layout, there are any number of viable options for interconnecting two given geographical points (high connectivity), while in the suburban layout, the “streets” are not intended to connect pedestrian destinations, but rather, follow the logical flow of motor vehicle traffic.

Furthermore, low connectivity and long distances between daily destinations, while increasing the functionality of the automobile for a U.S.-type lifestyle, at the same time hinder the appeal and profitability of public transportation because of the long distances that must be traveled as a result of the distinctly segregated use of public space. In the United States, 90% of the total number of daily trips are made in an automobile, and in more dispersed urban suburbs, such as those of Atlanta, for example, every resident travels an average of 55 kilometers a day, while in Philadelphia and San Francisco, cities with higher population densities, the averages are 27 and 34 kilometers, respectively.

The third element that characterizes a city’s physical environment and has been extensively studied is urban space design. Factors such as degree of street cleanliness, pavement condition, the presence of natural greenery, and personal and traffic safety all influence a person’s decision to walk, although it has been noted that these elements have only a modest impact, basically on recreational walking rather than walking to and from the workplace (29).

## From Scientific Evidence to Public Policies

The issue of urban design and its relationship with physical activity, as just presented in a brief overview here, has generated two responses in the United States. On the one hand, there are those who maintain that the influence of transportation policies on health is conclusive, especially with regard to traffic accidents, environmental pollution, and physical inactivity (40, 41); consequently, the proponents of this response propose that attention be focused not on highway construction, but rather on promoting investments in various forms of commuting, whether by public transportation, on foot, or by bicycle. This investment—according to this group—could have a multiplier effect if it were to be accompanied by parallel changes in city designs, thereby making metropolitan areas more varied, dense, compact, and stimulating to pedestrians (42, 43).

On the other hand, a group of experts recently brought together by the U.S. Institute of Medicine and the Transportation Research Board, after having evaluated the scientific evidence available to date, concluded that most of the existing information has come from cross-sectional studies,<sup>9</sup> which makes the establishment of a cause-and-effect link more difficult, even though the group did, at the same time, recognize the possibility of an *associative* link between a city’s physical environment and its people’s health, including physical activity. In light of these findings, the experts maintained that it would be premature to adopt public policy decisions based on this accumulated data and instead recommended conducting new studies with better conceptual preparation and more rigorous designs (44).

<sup>9</sup>This refers to studies conducted at a particular point in time (surveys, for example) in which the final result—physical activity or obesity—is evaluated at the same time as explanatory variables, such as the physical environment and the socio-demographic characteristics of the participants.

## PHYSICAL ACTIVITY, WALKING HABITS, AND MASS TRANSIT USE IN LATIN AMERICA

### Walking for Utilitarian and Recreational Purposes

Until a few years ago, public health experts depended on surveys related to the practice of sports in order to determine the level of sedentary lifestyle among a given population. In Latin America, those surveys—usually administered by sports authorities—showed that only some 15% to 20% of adults engaged in sports activities, usually men and individuals at a high socioeconomic level, and that this activity tended to decline with age (45, 46). In the absence of a more refined means of study, around 80% of the population was classified as “inactive.”

The recent development of standardized methods for measuring physical activity, such as the International Physical Activity Questionnaire (IPAQ) (47), has improved those measurements. This new instrument now makes it possible to analyze all domains of physical activity (i.e., domestic chores, work-related, recreational, and transportation), as well as their duration and intensity. Unfortunately, the IPAQ, in its short format, does not make a distinction between the different activity domains.

Figure 1 shows the results of surveys conducted in a selection of Latin American cities that used the short version of the IPAQ questionnaire (48–52). In general, the participants (men and women combined) were classified as “active” if they had undertaken at least 30 minutes of moderate physical activity in five out of the last seven days prior to the survey, or if they performed vigorous physical activities<sup>10</sup> 20 minutes a day at least three times

per week. However, the different city surveys presented variations in their definition of what constituted an “active” person.<sup>11</sup> Despite these variations, which may need to be adjusted to make the survey results fully comparable, it may be observed that between 37% and 75% of the survey participants were classified as active. These rates are two to four times greater than the results reported from the earlier-described sports surveys. How can this difference be explained? Is it due to the inclusion of physical work carried out around the home and walking? And as regards walking, how much is attributable to walking for recreational purposes versus walking for utilitarian purposes (e.g., domestic chores, transportation on foot as part of the regular workday)? The answers to these questions are relevant to the extent that they might help define and further refine intervention options.

The authors of the physical activity study conducted in Pelotas, Brazil, in 2002 (Figure 1) point out that even though recreational physical inactivity was reported as being inversely proportionate to socioeconomic levels, there is a direct correlation between socioeconomic level and overall inactivity level. In other words, overall physical activity among individuals in the lower socioeconomic strata was greater than that of groups at higher socioeconomic levels. The same authors postulate that “the results reflect the probability that occupational activities are a more important component than physical recreational activity in developing countries.”

10Vigorous physical activity is activity that accelerates respiration (and heart rate) and causes the individual to sweat more than with moderate physical activity. In metabolic terms, the first represents a minimum expenditure of 6 MET (metabolic equivalents) while the second represents from 3 to 6 MET. More information is available regarding these concepts at <http://www.cdc.gov/nccdphp/dnpa/physical/measuring/met.htm>.

11In the case of the Brazilian cities of Manaus, Belén, Rio de Janeiro, and São Paulo, the definition of “active” mentioned in the text adds a further option: the combination of moderate, vigorous, or walking activities performed at least five days a week for at least 150 minutes weekly. In the case of the city of Pelotas, the authors of the study used a broader definition of “active”: people who performed 150 minutes of moderate or vigorous physical activity, without considering the weekly frequency.

<sup>10</sup>Vigorous physical activity is activity that accelerates respiration (and heart rate) and causes the individual to sweat more than with moderate physical activity. In metabolic terms, the first represents a minimum expenditure of 6 MET (metabolic equivalents) while the second represents from 3 to 6 MET. More information is available regarding these concepts at <http://www.cdc.gov/nccdphp/dnpa/physical/measuring/met.htm>.

Given the importance of walking as a utilitarian and recreational activity, in 2003 Halal and colleagues conducted a second survey in Pelotas (53)—this time for the purpose of studying the pattern of recreational walking in order to be able to compare these results with the previous study, in which they examined all the walking domains: occupation, transportation, and leisure. According to this study, 73% of the respondents (71.8% of the men and 74.3% of the women) had walked to some extent during the previous week. Among those adults who followed the recommendation to walk  $\geq 150$  minutes per week in all the walking domains (regardless of weekly frequency), the participants belonging to the lower socioeconomic strata walked more than those in the higher socioeconomic groups (50.8% versus 38.4%). And among those who met the same requirement to walk  $\geq 150$  minutes, but this time taking into account only recreational walks, the higher socioeconomic groups reported higher rates than the poor (25.5% versus 11.6%). Thus, walking for utilitarian reasons by the poor seems to be almost four times more important than for groups belonging to higher socioeconomic classes (Figure 2).

According to a survey conducted by the FES Foundation in Colombia with the IPAQ questionnaire (48), the case of Pelotas is similar to that of Bogotá: of the 36.8% of the latter city's residents—both men and women—who met the minimum requirements of physical activity, 60% reported that they walk, 20% participated in regular recreational activities, 11% utilized a bicycle as a means of transportation, and 9% performed much of their physical activity as part of household tasks and/or physically demanding occupational tasks.

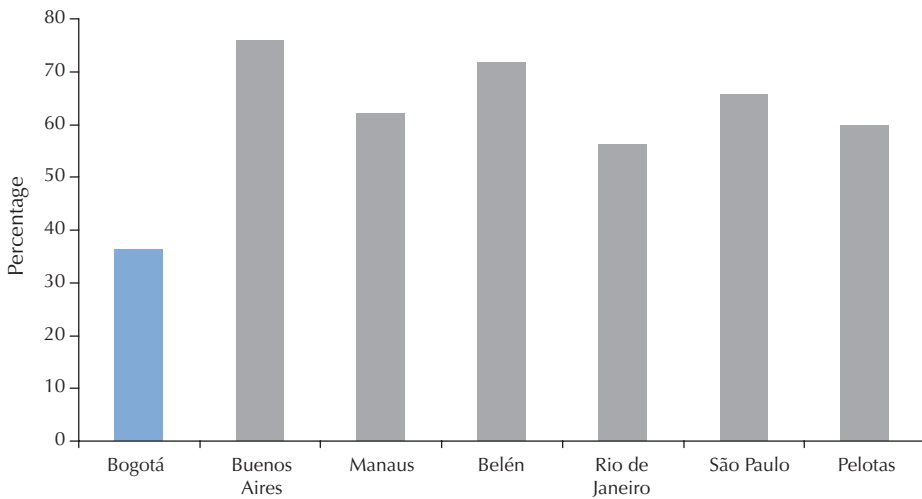
The physical activity profiles for Pelotas and Bogotá may very well resemble those of many other Latin American cities, in the sense that the local economies typically are based largely on manufacturing concerns and there is widespread use of mass transportation. Use of a private automobile con-

tinues to be the exclusive domain of a select minority. But this dynamic is changing, and utilitarian physical activity will tend to decline as economic development increasingly incorporates automated and computerized production systems that are less dependent on physical work and the demand for private automobiles and mechanization in the home increases.

Walking is both a form of transportation and a widespread leisure-time activity throughout the Region of the Americas whose practice should be encouraged and facilitated within the context of physical activity's contribution to optimum health and well-being (54). This relationship draws attention to the nature of transportation systems and mobility itself: according to experts, on average, two-thirds of the urban population in developing countries move about by means of walking or riding a bicycle; i.e., for utilitarian reasons (55). Given this situation, the reinforcement and ensured sustainability of these forms of mobilization seems advisable, before motorcycles and private automobiles become the transportation option of choice. Indeed, in many large cities in developing countries, the motorcycle has already become the stepping stone to complete motorization for the populace; it has succeeded in replacing taxis and buses in terms of personal preference, with a corresponding impact on accident rates and noise and air pollution levels.

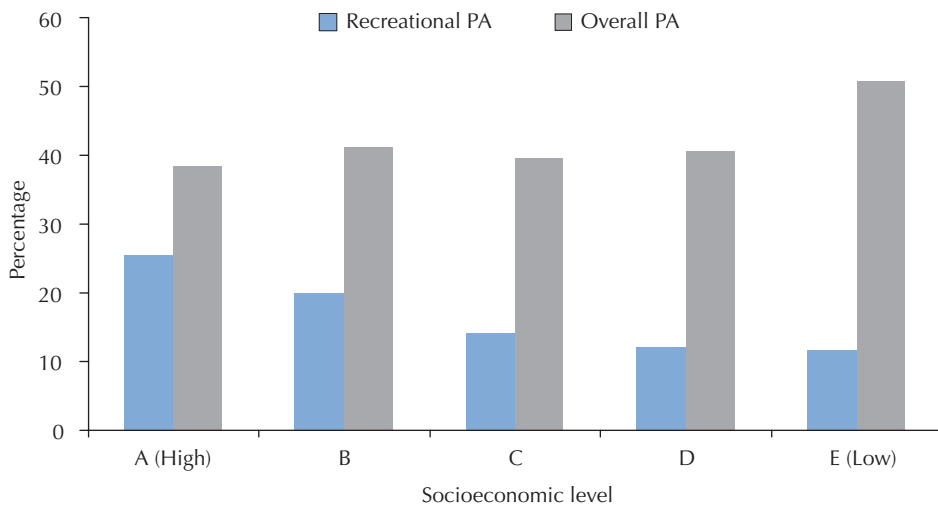
In developed countries where the dependence upon private automobiles is very high, interventions aimed at promoting physical activity by discouraging frequent vehicular use have yielded merely modest results, and mainly only among highly motivated individuals (56). Experience indicates that an efficient mass transit system and widespread bicycle use are achieved only in the presence of proactive government policies favoring public transportation and energy conservation, as is the case in Germany, Japan, the Netherlands, and the Scandinavian countries. In these societies, travel by foot or

**FIGURE 1. Minimally active population rates (men and women) measured with the short version of the IPAQ questionnaire.**



**Sources:** **Bogotá:** Gómez LF, Duperly J, Lucumi D, Venegas AS, Gamez R. Niveles de actividad física global en la población adulta de Bogotá. Prevalencia y factores asociados. *Gaceta Sanitaria* (in press). **Buenos Aires:** Bazán NE, Díaz G, Kunik H, O'Connor C, Gavini K. *IPAS Tango: la aplicación del cuestionario internacional de actividad física en la Ciudad de Buenos Aires, Argentina*. Buenos Aires: Gobierno de la Ciudad de Buenos Aires, Secretaría de Educación, Instituto Superior de Deportes; 2003. **Manaus, Belén, Rio de Janeiro:** Brasil, Ministério da Saúde, Instituto Nacional do Câncer. Reporte, 2003. **São Paulo:** Matsudo SM, Matsudo VR, Araújo T, Andrade D, Andrade E, Oliveira L, et al. Nível de atividade física da população do Estado de São Paulo: análise de acordo com o gênero, idade, nível socioeconômico, distribuição geográfica e de conhecimento. *Revista Brasileira Ciência e Movimento* 2002;10(4):41–50. **Pelotas:** Hallal PC, Victora CG, Wells JCK, Lima RC. Physical inactivity: prevalence and associated variables in Brazilian adults. *Med Sci Sports Exerc* 2003; 35(11):1894–1900.

**FIGURE 2. Recreational physical activity (PA) and overall physical activity rates (including recreation, transportation, work, and miscellaneous) among those who walk ≥ 150 minutes per week, by socioeconomic level, in Pelotas, Brazil.**



**Source:** Hallal PC, Victora CG, Wells JCK, Lima RC. Physical inactivity: prevalence and associated variables in Brazilian adults. *Med Sci Sports Exerc* 2003;35(11):1894–1900.

bicycle is feasible and convenient not only because travel by these means within certain areas takes the same amount or less time than the same trip would take by automobile, but also because automobile use implies additional costs (e.g., fuel, parking, licensing, taxes). In other words, walking and bicycling from one point to another in the city, instead of being viewed by residents as a stigma, are viewed positively as a viable, efficacious, and economical means of urban mobility.

### Mass Transit Systems

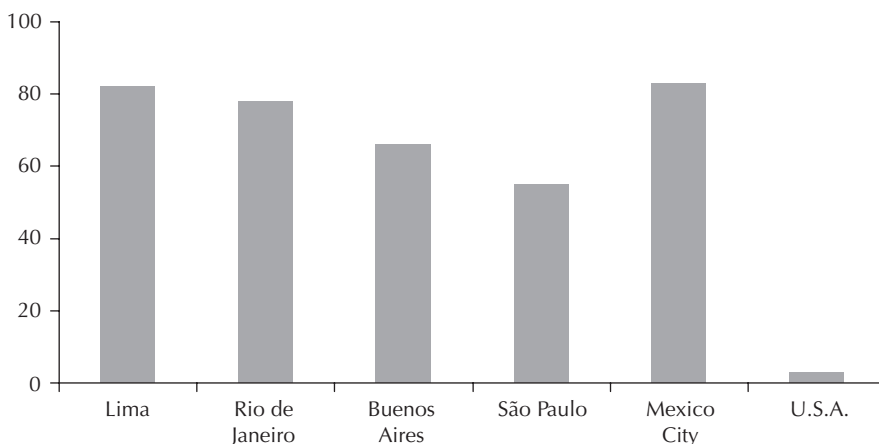
In Latin America, a minority of the population—yet a rapidly growing one—uses the private automobile as a means of daily transportation. The average number of vehicles per family in this region was 0.15 during the 1990s (41), compared to 1.8 in the United States in 1995 (57).

Transportation studies in five Latin American metropolitan centers have shown that between 55% (São Paulo) and 83% (Mexico City) of the total number of daily trips are made using public transportation, with inter-

mediate levels being 66% in Buenos Aires, 78% in Rio, and 82% in Lima (58). Throughout the developing world, the average number of trips on public transportation represents between 70% and 85% of the total number of daily trips (55). In comparison, the Nationwide Personal Transportation System survey in the United States indicated that 86% of the total amount of commuting by urban dwellers is via private automobile, contrasted with only 3% via mass transit systems (Figure 3) (29).

The impact of public transportation use on walking habits can be explained by the fact that passengers are usually required to walk to and from the bus (or train) station, and to and from their final destinations; thus, each trip has two components: one “motorized” and one “non-motorized.” In Bogotá, a series of surveys conducted by the organization *Bogotá, Cómo Vamos* (Bogotá: How Are We Doing?) (2002) show that mass transit passengers walk for 18.5 minutes a day, on average, which represents almost two-thirds of the recommended 30 minutes a day of moderate physical activity for health pur-

**FIGURE 3. Percentage of total daily trips made using mass transportation systems in Latin America and the United States.**



**Sources:** **Latin America, end of the 1980s data:** Figueroa O. A hundred million journeys a day: the management of transport in Latin America's mega-cities [Internet site]. Available at: <http://www.unu.edu/unupress/unupbooks/uu23me/uu23me0f.htm>. Accessed in November 2004. **United States, 1990 data:** Frank LD, Engelke PO, Schmid TL. *Health and Community Design: The Impact of the Physical Environment on Physical Activity*. Washington, DC: Island Press; 2003.



poses. In other words, daily use of mass transportation for commuting purposes could serve as an effective, wide-reaching public health intervention.

The bus systems in Bogotá and Curitiba are examples of how public transportation and pedestrian walkways (or bike paths for cyclists) can function synergistically, especially when access to public transportation stations is directly connected to pedestrian or bicycle path networks, as may be seen particularly in cities with high-density buildings (59). This is precisely the idea behind the concept of “transportation-oriented development,” which seeks to stimulate the growth of urban density and diversity alongside mass transportation corridors. The synergy between public transportation and walking habits can be made even greater if transportation systems are fast and efficient, and directly accessed by pedestrian walkways and bicycle paths. In other words, if conceived and managed with these strategic concepts in mind, public transportation systems have the capacity to become catalysts for the development of a city’s physical environment and can help to create a more favorable urban infrastructure for moving around on foot or by bicycle (60, 61).

On the other hand, the situation that prevails in many Latin American cities today involves a series of unregulated, decentralized options driven by demand. In Lima and Mexico City, for example, where the means of public transportation are controlled by thousands of private enterprise providers, the ubiquitous private automobile has invaded major thoroughfares, connecting side streets, and even public spaces, thereby creating inefficiencies and stimulating further demand for individual forms of motorized transportation.

The precarious organization and management of public transportation today in Latin America stem from the inability of city governments to effectively oversee and control transportation distributional patterns and volume, at the same time that transportation

providers from the more or less informal sector have scant capacity or incentives to improve their own services. This latter group has created—whether out of financial need or convenience—a series of cooperatives, unions, committees, enterprises, and other types of similar arrangements in order to ensure their continued operation and sustainability. In fact, the collective number and size of these ventures have in many cases transformed them into the only (albeit *de facto*) urban transportation service provider, following the disappearance or weakened state of their public sector counterparts. Despite this, the day-to-day basic operations of these improvised arrangements lack the structural solidity and rational, broad-based scope and vision that might characterize for-profit, centralized enterprises of the formal sector. In Mexico City, for example, taxis represent 74.7% of the overall vehicle fleet allocated to public transportation, yet they make up only 6% of the total daily trips, while the corresponding rates for buses and minibuses are 22.2% and 73%, and the subway rates are 2% and 18% (62).

It is a fact of life that higher income levels and enhanced purchasing power increase the desirability of personal automobile and/or motorcycle ownership for the relative independence and convenience they offer as compared with other forms of transportation, in addition to their serving as symbols of economic well-being and prestige (63). The goal of securing access to individualized means of transportation stems not only from a function of lifestyle, but is also driven by public policies that fail to take into account the negative and costly effects of automobile transportation—in terms of energy consumption, environmental damage, risk of collision and injury, and increased tendency toward physical inactivity and developing obesity—resulting in an ironic situation that, in effect, only further reinforces the appeal and legitimacy of personal vehicle ownership. Examples of this *de facto* subsidizing of automobile use include the creation of new

residential communities increasingly distant from large metropolitan centers, public policies that favor investments in new highway construction over those aimed at improving mass transportation infrastructure, the development of incentives to boost automobile imports, and the establishment of only moderate gasoline taxes. In these cases, the rationale of a transportation policy becomes one that is centered on moving the largest number of vehicles possible in the shortest amount of time with a minimum of traffic congestion (64). In low and middle income economies, this situation often translates into a cross-subsidization by the poor for the benefit of the most economically well-off, a phenomenon which has attracted the scrutiny of diverse experts questioning the long-term sustainability of today's status quo (65).

One of the greatest problems facing the Region of the Americas, from the perspectives of both transportation and public health experts, is the increasing number of private vehicles in circulation and the deterioration (deregulation, decentralization, privatization, and equipment aging and disrepair) of mass transportation, a situation which has wrought significant social, environmental, energy, and health consequences (66, 67). The increasing number of trips made in private automobiles is still limited in Latin America in comparison with the United States, but that trend is changing. For example, in Chile, which has experienced significant economic growth over the past 15 years, there is a growing predilection toward use of private automobiles and living away from the city in distant suburbs that increasingly resemble the U.S. model. Between 1991 and 2001, the number of trips made on public buses in Santiago decreased from nearly 60% to 42%, while the number of trips made in automobiles increased from 18.5% to 38% (Figure 4). The effects of this trend on environmental pollution and health have already become clear, and some measures—including restricting the volume of vehicles in simultaneous circulation and improving fuel

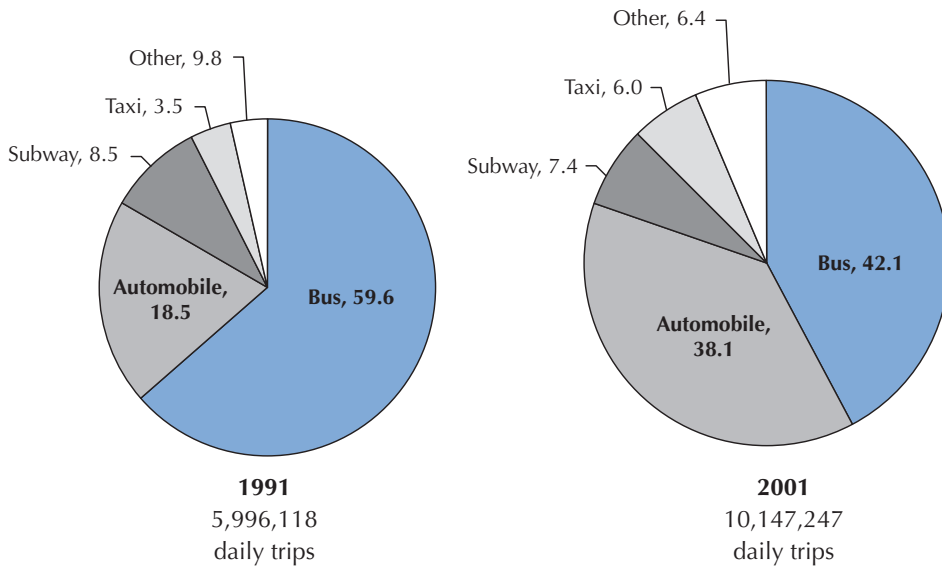
and quality—have already been adopted.<sup>12</sup> Although these measures have not solved the problem, there is at least some consensus between political authorities and public opinion polls recognizing the relationship between automobiles, transportation systems, and health. Hopefully in the future, this recognition will extend to other health problems, such as sedentary lifestyle, stress, and quality of life of the population, creating a favorable synergy for public health actions in this area.

### **Policies for Sustainable Urban Transportation**

There is no doubt that transportation fulfills an important function in economic development by promoting efficiencies in the labor market, providing access to goods and services, and fostering urban growth, both nationally as well as internationally. Hence, some 16% of the World Bank's total annual loans go to this sector (66). This same institution, however, points out important challenges threatening the sustainability of transportation systems, especially in the developing world. Among these are increasing motorization, emerging transportation needs related to world trade, vehicular congestion, environmental pollution, limited access by the poor to means of transportation, and users' expectations that road systems should be safer and of better quality (68). To cope with these challenges, a sustainable transportation policy has been taking shape in recent years, a key element of which is the notion that a higher demand for transportation services might very well not reflect legitimate demands from passengers, but could be strongly influenced instead by factors such as physical distances created by urban dispersion, deficient public transportation systems, and a false sense of the real costs of driving (41).

<sup>12</sup>Recently, Chile's transportation authority launched a new surface public transportation system known as Transantiago with the goal of discouraging private automobile use and similarly helping to reverse the other trends noted.

**FIGURE 4. Distribution of daily trips, in percentages, per type of transportation used, 1991 and 2001, Santiago, Chile.**



**Source:** Etcheberry Celhay J. Transantiago. Work presented at the Seminario Transantiago en Marcha. Santiago, Chile, 11 November 2004. Available at: <http://www.transantiago.cl/seminario/315>, 3, slide 3. Accessed in January 2005.

Sustainable transportation, from the World Bank’s perspective, consists of three central elements: economic sustainability, to allow for efficient use of physical resources and their maintenance; social sustainability, so that the benefits of transportation may be available to all groups within society; and environmental sustainability, which should be taken into account in order to avoid the external effects of both public and private transportation in terms of health and the environment, when making decisions aimed at improving overall socioeconomic development. Aside from the financing and management strategies that are an intrinsic part of this proposal, the policy of sustainable transportation points to three specific actions that have a synergistic effect from the sustainability standpoint: addressing environmental problems, ensuring road safety, and promoting alternative transportation, which includes better pedestrian infrastructure and promoting bicycle transportation.

The foregoing discussion constitutes an excellent opportunity to establish linkages

between public health and transportation interventions. Many of the public health concerns that have been raised in response to growing urban motorization have now been reinforced. The fact that the current trend in road policies is to emphasize people mobility, and not vehicle mobility, has placed the human dimension at the very center of the debate, along with the issue of health (particularly the importance of physical activity); as a result, the well-being of the population—both city and suburban dwellers—might very well come to the forefront and occupy a preferential place on the public agenda. The social impact of public transportation is no less important, inasmuch as it facilitates increased social contact and interaction. In contrast to the isolation inherent in private automobile use, mass transportation breaks down social barriers by bringing together passengers of all socioeconomic strata who take the train, bus, or ferry on a daily basis. This exchange can create more social confidence and stimulate the implementation of other types of social policies seeking to im-

prove living conditions across a broad spectrum of society.

## ROAD SAFETY

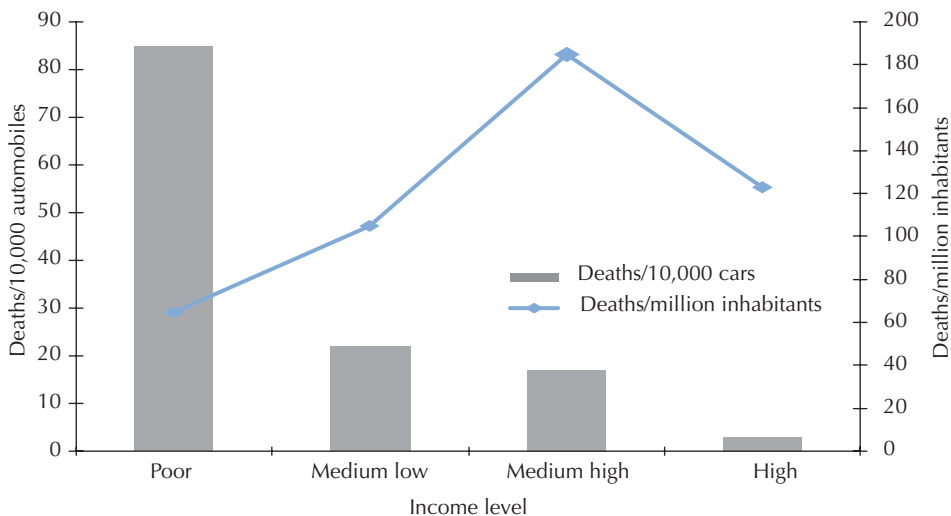
### The Impact on Health

Traffic accidents were one of the first problems related to transportation issues to capture the attention of political leaders around the world. As early as 1974, WHO World Health Assembly resolution 27.59 declared that traffic accidents constituted a major public health problem. Today it is estimated that every year 1.2 million people lose their lives and nearly 50 million are wounded in traffic accidents (69). According to WHO, in 1990, transportation-related injuries ranked ninth place among factors contributing to the world disease burden, and it is estimated that if the current trend continues, by 2020 traffic accidents will have risen to third place. In Latin America and the Caribbean, the number of deaths attributable to traffic accidents will increase by 48%; in Asia, by 144%; while in high income countries, it will

diminish by 26%. The problem’s dynamic indicates that deaths on public thoroughfares tend to rise as the income level of the affected countries increases; when the latter is high, the trend goes down. On the other hand, when one considers the ratio of the number of deaths to the number of motor vehicles (deaths per 10,000 vehicles), as a country’s income level increases, there is a steady decline in these rates. The latter is explained mainly by the progressive application of measures at several levels: automobile design and transit management systems, traffic safety education, the establishment of speed limits, the use of safety belts, and the prohibition against driving under the influence of alcohol (Figure 5). In the majority of poor countries, on the other hand, implementation of these life-saving measures poses an enormous challenge in and of itself.

Lack of safety on the roadways involves other health problems as well. Nearly two-thirds of all traffic accident victims are pedestrians, and of that group, one-third are children. In Latin America and the Caribbean, the majority of victims are between 15 and 30 years of age, and three-quarters of the victims are men,

**FIGURE 5. Public roadway deaths per traffic volume and population for various income levels.**



**Source:** International Road Federation 1993. World Road Statistics 1988–1992. In: *Sustainable Transport: Priorities for Policy Reform*, World Bank, 1999. Available at: [http://www.worldbank.org/transport/pol\\_econ-docs/276,21](http://www.worldbank.org/transport/pol_econ-docs/276,21), Slide 21. Accessed in January 2005.

which is consistent with greater exposure by this group. Pedestrians and cyclists are the most vulnerable users of public thoroughfares; of the total number of deaths, pedestrians represent 25% in Trinidad and Tobago, 40% in Mexico, and 62% in El Salvador; and cyclists represent 3% in Saint Lucia and 10% in Jamaica (70). On the other hand, in Canada and the United States, pedestrians represent 16% and 11%, respectively, of traffic accident victims; nearly 90% of the victims are either drivers or passengers in vehicles.

The danger that streets and highways entail for pedestrians and cyclists also has a negative impact on people's mobility and physical activity (71). It is estimated that this problem could be more acute for the elderly, who, aware of their fragility, tend to avoid the streets (72).

The economic costs of the lack of road safety represent approximately 1% of the gross national product in low income countries and 1.5% in middle income countries. In low income countries, those costs translate into US\$ 65,000 million annually, which is a higher figure than what those countries receive in development assistance during the same period (68).

### **New Prospects for Road Safety**

In the 1970s, the introduction of the Haddon matrix—still widely in use today—represented the first systematic approach to the problem of traffic-related injuries. This model suggested that accidents have three time phases: before, during, and after the injury incident. Each one of these phases, in turn, can be examined within the context of three principal factors: the injury victim, the vehicle and its equipment, and the physical, social, and/or cultural environment (73). This perspective offered public health authorities and specialized personnel—particularly epidemiologists—the opportunity to apply basic public health principles to traffic safety and injury prevention policies and programs. Specifically, Haddon's compelling

framework facilitated a new focus on mechanical energy exchange and the human body's injury threshold to this force and contributed to the subsequent adoption of such measures as vehicle speed controls and the prohibition against driving while under the influence of alcohol. Thus, the traditional thinking that placed blame for collisions on driver behavior (e.g., failure to perceive and/or react to danger in a timely manner) has, over time, given way to a more etiological, systemic perspective in which all forces at play on public thoroughfares—including the structural design of the vehicles and roads themselves—are considered as potential causal factors and responsibilities are more equally shared between transportation system providers and users (73).

More recently, a report by the WHO's Regional Office for Europe has attempted to go beyond the Haddon matrix by developing a road safety concept that incorporates the macro-scale aspects which affect vehicle traffic risk exposure, such as land use, urban design, and transportation policies. In other words, it proposes that road safety plans take into account the specific preferences and policies of transportation and urban development, since these policies determine to a large extent the scope and magnitude of road safety problems. Thus, an urban development policy that favors mass transit and non-motorized means of commuting facilitates the implementation of safety measures on all public thoroughfares (i.e., not just on highways) and helps ensure the efficiency of these measures, in contrast to a scenario in which the dominant preference is transportation by private automobile (74). Without a doubt, this option increases the synergy between road safety and urban design policies, strengthening their public health component.

## **CONCLUSIONS**

This chapter seeks to call attention to the influence exerted by urban development de-

sign and public transportation structure and options on public health and the level of physical activity of city dwellers. Table 1 offers a brief summary of the positive effects that various urban interventions could produce on physical activity.

The rapid urbanization of Latin America, as we have seen in this chapter, has, in many cases, produced a negative impact on the quality of life of inhabitants of large metropolitan areas, and has favored the adoption of individualized modes of motorization (motorcycle or private automobile) and the use of urban public space in a manner resembling the U.S. suburban model, thereby compromising opportunities for fulfilling the current recommended levels of physical activity, especially walking. There is an emerging need to restrain and discourage these trends now and in the future, not only because of their negative impact on human health, but also because of their negative economic, environmental, and social effects, and the need to improve public transportation efficiency and to responsibly address the citizenry's quality of life concerns. New and creative approaches to urban zoning codes, including densification and mixed-use communities, coupled with measures to improve road and personal safety and mass transit systems, can provide the crucial underpinning for adequately responding to all of the above challenges and at the same time help to dispel the notion that socioeconomic development and prosperity are inextricably related to and/or dependent upon the availability and ownership of individualized forms of motorized mobility.

Public policies currently enjoy a prominent place on the international agenda, with particular focus on those related to sustainable transportation systems and road safety, as well as on such public health issues as combating a sedentary lifestyle, injury prevention, clean air, and quality of life of the population. The convergence of these public health and urban planning priorities indicates that at least some municipal govern-

ments in the Region of the Americas are showing increased sensitivity to the problems of urban quality of life and suggests that the groundwork for implementing the proposals set forth in this chapter is now being laid.

The health and physical activity data on urban life in Latin America presented earlier in this chapter lead to the following conclusions and preliminary recommendations:

- Information gathered from applications of the IPAQ questionnaire indicates that walking is an important part of everyday life for those individuals whose physical activity levels are sufficiently adequate to enable them to derive health benefits. Furthermore, walking for utilitarian purposes is more common than recreational walking, particularly among low income groups.
- Data from transportation studies are consistent with the above finding. In the majority of the Region's large cities where there is widespread use of public transportation and fewer private vehicles on the streets, there are indications that a large part of people's daily commutes is undertaken on foot or by bicycle, and not via privately owned automobiles, as in the United States and other areas that have adopted the U.S. residential/suburban model.
- This suggests that public health policies and strategies should promote the importance of walking and bicycle-riding, in addition to advocating for better infrastructure and safety for individuals who participate in these activities. Due to the potential scope of the target population, this approach should be accorded preferential attention and be complemented by similar strategies aimed at increasing participation in a variety of other recreational activities requiring physical exertion.
- Research findings need to be consolidated concerning the impact of inter-



**TABLE 1. Impact of transportation, road safety, crime control, and public space on physical activity of urban inhabitants.**

| Area of Intervention   | Physical Activity Impact  |
|--|---|
| <b>Transportation</b>  |   |
| Public transportation  | Accounts for a large portion of non-motorized mobility (walking or bicycling) to reach mass transportation means in areas not covered by motorized means of feeder/connecting transportation  |
| Alternative transportation   | Riding a bicycle and walking are the most widespread alternative means of mobility and provide users with the opportunity to incorporate physical activity as part of their daily routine.  |
| Clean air  | Can be a persuasive factor in encouraging people to spend more time out-of-doors and on the street and engage in sports and other types of recreational physical activity   |
| <b>Road Safety</b>   |   |
|  | Promotes greater use of public thoroughfares for walking, biking, and traveling via automobile to sports, exercise, and recreational centers  |
| <b>Crime Control</b>   |   |
|  | Promotes use of public thoroughfares for recreational or utilitarian purposes   |
| <b>Public Space</b>  |   |
| Structures designated specially for pedestrian use (sidewalks, crosswalks, etc.) | Ensure personal protection and safety. While important for all population age groups, these structures are particularly important for older adults.   |
| Parks/recreational facilities  | Open-air parks encourage walking and bicycling, while recreational facilities (indoor or outdoor) stimulate physical exertion and social interaction in sports such as baseball, basketball, football, tennis, and swimming.              |
| Preservation/conservation of historical, architectural, and cultural centers     | The presence of these centers in areas with restrictions on vehicular traffic and parking promotes physical activity.   |
| Closing streets for recreational purposes  | Events such as bike rides, street festivals, block parties, special sports and dance competitions, etc., solidify community sense of identity and stimulate collective interest in participating in recreational and physical activities. |

ventions in the areas of urban development, mass transit, and citizen education, similar to those adopted in the cities of Bogotá, Curitiba, Quito, and others, on physical activity levels, personal health status, and optimum cost/benefit.

- Studies are needed on the costs to personal health and the environment—as yet unknown—of transportation programs that directly or indirectly promote individualized forms of motorized mobility versus those whose design favors a combination of physical activity and mass transit.

In the programmatic and public policy areas, public health in Latin America is facing important challenges, which can be summarized as follows:

- the need to forge closer ties and synergy between the public health sector and those responsible for urban transportation systems, road safety, environmental protection and municipal land management, preservation of public spaces, providing incentives for non-motorized forms of transportation, and designating physical structures primarily for pedestrian and cyclist use (Table 2

**TABLE 2. Effect of various urban development interventions on health.**

|  | Physical activity | Prevention of trauma/deaths | Respiratory diseases | Social interaction |
|--|-------------------|-----------------------------|----------------------|--------------------|
| <b>Transportation</b>  |                   |                             |                      |                    |
| Mass transit   | + + <sup>a</sup>  |                             |                      | + <sup>b</sup>     |
| Alternative transportation (bicycling)                                       | ++                |                             |                      | ++                 |
| Clean air  | +                 |                             | ++                   |                    |
| <b>Safety on the streets</b>   | +                 | ++                          |                      | ++                 |
| <b>Crime control</b>   | +                 |                             |                      | ++                 |
| <b>Public space</b>  |                   |                             |                      |                    |
| Facilities and structures designated for pedestrian use                      | ++                | +                           |                      | ++                 |
| Parks/recreational centers   | ++                |                             |                      | ++                 |
| Preservation/conservation of historical, architectural, and cultural centers | +                 |                             |                      | ++                 |
| Closing streets  | +                 |                             |                      | ++                 |
| <b>Urban design</b>  |                   |                             |                      |                    |
| Density of population and buildings  | +                 |                             |                      | +                  |
| Diversity of urban land use and attractive urban design                      | +                 |                             |                      | +                  |

<sup>a</sup>Important effect.<sup>b</sup>Moderate effect.

shows the impact on health and the synergy potential of various public policies);<sup>13</sup> and

- supporting the efforts and sustaining the achievements made to date in all of the aforementioned areas.

The community of public health professionals can play an important leadership role in promoting priority actions in all of the identified areas by showing the magnitude and health consequences of a sedentary lifestyle and its relationship to urban development choices, advocating public policies that favor physical activity and the highest possible quality of life for all sectors of urban residents, and monitoring population changes with regard to physical activity level and overall health status.

## ACKNOWLEDGMENTS

The authors express their gratitude to Ruth Long, a masters in public health degree

<sup>13</sup>This idea is also found in WHO's Global Strategy on Diet, Physical Activity, and Health, endorsed by WHO member countries in 2004 in World Health Assembly resolution WHA 57.17.

candidate from The George Washington University, Washington, D.C., for her work in conducting an electronic literature search on transportation issues for use as background material in this chapter.

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## CONCLUSIONS

Despite the successes of recent decades in the majority of countries in the Region of the Americas, large segments of the population, especially those living in poverty and marginalization, continue to suffer from nutritional problems. In these sectors, children under 3 are the most vulnerable group, and therefore, at greatest risk for the immediate, medium-, and long-term consequences of inadequate nutrition.

At the same time, the rise in prevalence of overweight and obesity in many parts of the Region reminds us of the need to address issues related to excessive caloric intake and sedentary lifestyles.

This book assembles the contributions of noted Latin American authors to scientific knowledge about the magnitude and nature of nutritional problems and their lifelong consequences for individuals and also provides a strong scientific basis for the importance of promoting physical activity and the adoption of active lifestyles. The various chapters describe a series of successful experiences from the Region in both rural and urban settings and at the local and national levels that may serve as viable models for adaptation in other geographical and cultural contexts within or outside the Americas.

The articles included in this compendium were selected to encourage policymakers and health and nutrition program planners, as well as future public health and nutrition professionals, to seriously reflect on the critical need to avoid passive acceptance of persistent nutritional problems and to recognize the emerging threats to health posed by sedentary behaviors in the Region. On the basis of a full awareness and understanding of these issues, the public health and research community will be able to effectively promote science-based action that can yield positive, measurable results in the health of populations.

A review of the scientific evidence on the consequences of inadequate nutrition and its impact on the physical growth and mental development of individuals and populations, of the capacity of that evidence to optimize potential, and of the results emanating from successful programs in several countries, leads to the following conclusions:

(1) There is sufficient scientific evidence on the impact of malnutrition on the health of individuals and populations to confirm the urgent need for effective, low-cost programs to reduce its high prevalence. It should also be noted that the Region of the Americas already possesses a critical mass of knowledge and experience that may make it unnecessary to import programs from other parts of the world.

(2) The successful experiences described in this book are flexible enough in their design to enable them to be adaptable in a variety of circumstances in locales and countries nearly everywhere. In this sense, the Region has a battery of models, methodologies, instruments, and processes at its disposal that have proven their effectiveness in combating malnutrition and hold great potential for successful adoption in other parts of the world.

(3) These experiences also show that to achieve the expected results, the technical expertise and support of diverse disciplines are required, among them public health, med-

icine, nutrition, epidemiology, economics and planning, communications, and the applied social sciences. Focused on a common objective, these contributions will facilitate the development and execution of responses that are both practical and sustainable.

(4) The experiences described in this book show us that regardless of the approach adopted by the program proposals, all of these have required the collaboration of a broad segment of interests—the government; local, national, and international organizations; the business community; and civil society—in the design and implementation of activities.

(5) One of the elements essential to the success of any initiative is the full empowerment of all the institutions involved and civil society in terms of program objectives and their active (versus merely passive) participation.

(6) Successful completion of each stage of the programs (identification of needs and problems, planning, execution, monitoring, and evaluation) requires skilled, experienced professionals familiar with the appropriate tools, methodologies, and instruments called for in each instance, as emphasized in the chapters by Rea and Araújo, and Dary and Mora and their respective colleagues, among others.

(7) To demonstrate their achievements, programs should conduct process and impact assessments that prove the effectiveness of the interventions at the individual and population levels, identifying from the outset the particular results they seek to obtain.

(8) The key to the feasibility of the proposed interventions is the commitment of governments and the international community, translated into the allocation of sufficient and appropriate financial and human resources.

The above conclusions, particularly as they relate to the need for an integrated, multidisciplinary approach and a solid scientific foundation, are equally applicable to the other focus of this book—the promotion of increased physical activity and the observance of active lifestyles at all socioeconomic levels of the population. Several additional points with respect to this still-emerging public health issue need to be made:

(1) Sedentary lifestyles are a major risk factor contributing to the global burden of noncommunicable diseases. In 2004, the World Health Organization, through its endorsement of a Global Strategy on Diet, Physical Activity, and Health, signaled its resolve to prioritize among its Member States the adoption of a population-wide, prevention-based response to this epidemic.

(2) In light of mass urbanization trends over recent decades, researchers—aware that the ability to secure health and well-being is closely associated with a series of physical, social, cultural, and economic variables—have sharpened their focus on the role of the urban environment in determining individual and collective health status.

(3) The evidence emanating from these studies suggests that it is unrealistic to expect healthier behaviors to be achieved and maintained at the individual level if these efforts are not facilitated and strengthened by supportive policies and plans fueled by sustained political commitment.

(4) As the chapters by Matsudo and Matsudo, Montezuma, and Jacoby and colleagues point out, concrete examples—including the large metropolises of São Paulo, Brazil, and Bogotá, Colombia—are already yielding promising results to support the idea that major behavioral and environmental risk factors are indeed amenable to modification through the implementation of essential and concerted action between the various sectors we have cited throughout this book.

The authors and I bring this book to our readers with the desire that each of its contributions will become the object of an in-depth analysis that examines both the programs and their scientific underpinnings, and that these motivate decision-makers in the international community to bring to fruition the necessary interventions to address nutritional inequities and risk factors associated with noncommunicable diseases.

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*Nutrition and an Active Life: From Knowledge to Action* is an anthology by leading public health experts from the Pan American Health Organization and the international development community. The book's selections focus on how research in nutrition and the promotion of active lifestyles can provide vital input for the creation of public policy and planning and for the design, implementation, monitoring, and evaluation of programs.

You and I, in one way or another, stand to directly benefit from this science and its effective application. The knowledge gained from the research presented here has the power to transform the lives of mothers and children, the economically active population, older adults, and all age groups whose sedentary lifestyle places them at greater risk of developing life-threatening chronic diseases.

*Nutrition and an Active Life: From Knowledge to Action* is an important contribution that should be of particular interest to practitioners, researchers, and decision-makers in the fields of health promotion, community education, nutrition, maternal and child health, physical activity, policy development in public health and urban planning, social communications, and other related areas.