

ABSTRACTS AND REPORTS

PATTERNS OF BIRTHWEIGHTS: A SUMMARY

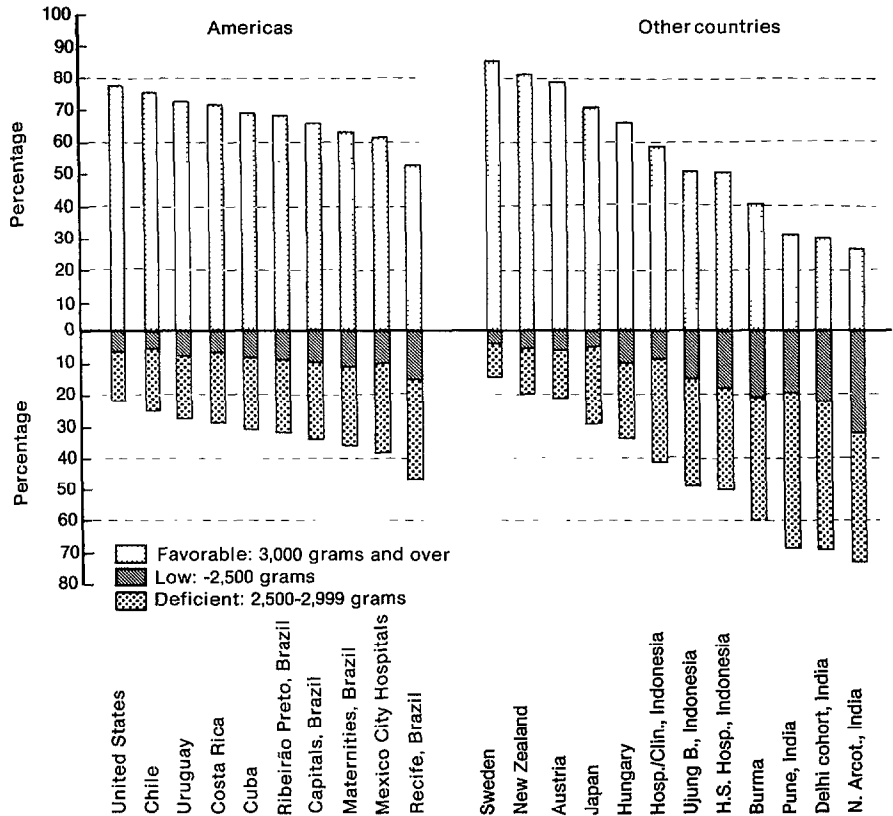
The following is a summary account of Patterns of Birthweights, a forthcoming PAHO publication by Ruth Rice Puffer and Carlos V. Serrano, that analyzes data from 22 studies of birthweight patterns in 15 countries, assesses the impact of low and deficient birthweights on infant mortality, and makes pertinent recommendations.

In 1973 the Inter-American Investigation of Mortality in Childhood (1) revealed the serious health problems caused by immaturity (low birthweight) and by nutritional deficiency in Latin America, principally as associated causes of death. Since then, major attention has been focused on the causes of low birthweights (those less than 2,500 grams) and how to prevent them (2-5). In addition, information about the distribution of live births by birthweight, by length of gestation, and by these two variables combined has improved our understanding of health problems relating to reproduction and pregnancy's outcome. The forthcoming publication *Patterns of Birthweights* by Ruth Rice Puffer and Carlos V. Serrano, which is summarized here, brings out the contrasting patterns of these distributions in 15 countries in the Americas, Europe, Asia, and Oceania; shows ways in which these patterns relate to infant mortality; and recommends actions capable of achieving future progress—actions that can be introduced into health programs as primary care is extended to all. Pertinent recommendations are also given for making greater use of birthweight data in gauging the success of maternal and child health programs.

The distribution of birthweights of live births in an area or country has a distinct relationship to the quality of life, the growth and development of the newborn, and infant mortality. In all, *Patterns of Birthweights* analyzes 22 distributions of birthweights from countries and special studies.¹ This analysis found favorable birthweights of 3,000 grams or more to account for anywhere from 27% to 85% of the births

¹ In the Americas: Brazil (four studies—Recife, Ribeirão Preto, nine maternities, and Brazilian capitals), Chile, Costa Rica, Cuba, Mexico (from hospitals in Mexico City), Uruguay, and the United States. In other regions: Austria, Burma, Hungary, India (three studies—Pune, Delhi, and North Arcot), Indonesia (three studies—Hasan Sadikin Hospital, Ujung Berung, and hospitals and clinics), Japan, New Zealand, and Sweden.

FIGURE 1. Percentages of live births with low, deficient, and favorable birthweights in 22 studies and countries of the world.



Source: R. R. Puffer and C. V. Serrano, *Patterns of Birthweights*, Pan American Health Organization, Washington, D.C., 1987 (in press).

studied (Figure 1), the highest percentage being found in Sweden and the lowest in the North Arcot study in India. In Sweden, those with low birthweights (less than 2,500 grams) accounted for only 3.6% of all singleton live births, and those with deficient birthweights (2,500–2,999 grams) accounted for only 11.6%. At the other extreme, in Burma and India only 27% to 40% of the births studied had favorable birthweights, 38% to 49% had deficient birthweights, and 20% to 32% had low birthweights.

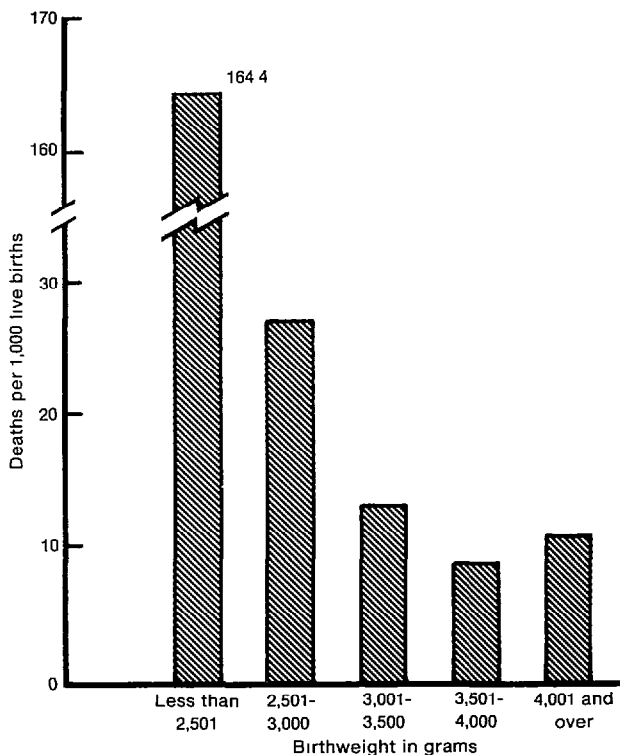
In the Americas, the United States had the highest incidence of favorable birthweights (77%) and Chile had the second-highest (74%). Of all the study areas in the hemisphere, Recife, Brazil (1974 data), was found to have the lowest incidence of favorable birthweights (52.4%). The incidence of deficient birthweights ranged from

20% to 33% in all areas and countries except the United States, where it was 16%; and the incidence of low birthweights ranged from 6.4% in Chile to 14.6% in Recife, Brazil.

Infant mortality in the 15 countries also varied widely, ranging from a low in Sweden (1983 data) of 7.2 deaths per 1,000 live births to highs in Burma, India, and Indonesia of 96 to 114. In Recife, Brazil, the infant death rate at the time of the Inter-American Investigation (1968–1970) was 91.2 deaths per 1,000 live births. It should also be noted that wide variations in infant mortality have been found within as well as between countries.

Patterns of infant mortality by birthweight appear similar in many studies, with the lowest death rates occurring among newborn with birthweights of 3,500–3,999 grams. Mortality is generally excessive among those with birthweights of less than 2,500 grams. For those weighing 2,500–2,999 grams (deficient weights) the infant death rate is usually two to three times the rate for those in the most favorable (3,500–3,999 grams) weight group. Data from 1982 in Chile that exemplify this pattern are shown in Figure 2. Thus, low and deficient birthweights

FIGURE 2. Infant mortality in five birthweight groups, Chile, 1982.



Source: R. R. Puffer and C. V. Serrano, *Patterns of Birthweights*, Pan American Health Organization, Washington, D.C., 1987 (in press).

clearly need to be considered in striving to reduce infant mortality. Within this context, newborn with deficient birthweights share some characteristics and disadvantages of newborn with low birthweights. Although the perils they confront tend to be less serious, the deficient birthweight group is often several times larger than the low birthweight group, and so the former also stands in need of identification and preventive actions.

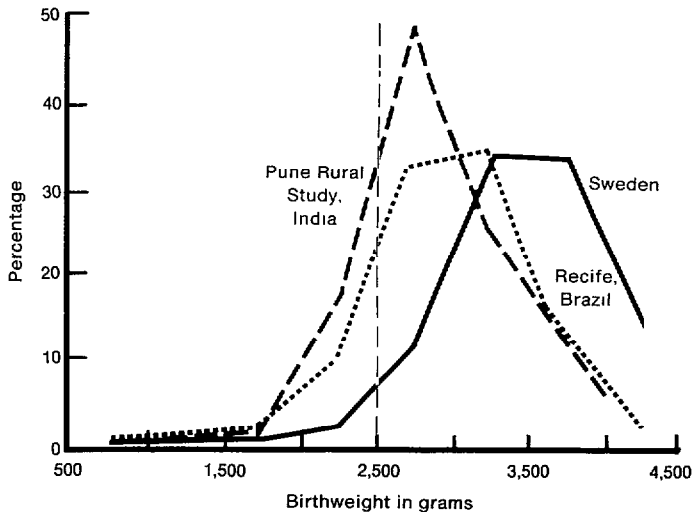
In general, all newborn weighing 3,000 grams (6.6 pounds) and over are considered to have favorable birthweights. Although the infant death rate is relatively high in the group with birthweights of 4,500 grams and over, the numbers of births (and infant deaths) in that group, especially in developing countries, are very small.

Three examples illustrating the very different types of birthweight patterns found in the 22 distributions are shown in Figure 3. In Sweden, which had the highest incidence of favorable birthweights, 34% of the newborn weighed 3,500–3,999 grams and 34% weighed 3,000–3,499 grams. The pattern was shifted to lower birthweights in Recife, Brazil, where 35% weighed 3,001–3,500 grams and 33% weighed 2,501–3,000 grams. However, a different pattern was evident in the three India studies, with the largest incidence of deficient weights (2,501–3,000 grams) being found in the Pune study, results of which are shown in Figure 3. These findings show that specific information about the distribution of birthweights in a particular country or area to be served is needed in order to plan health measures that will improve the chances for survival, growth, and development of the newborn.

The data presented in *Patterns of Birthweights*, especially those from unusual experiences in several Latin American countries, show that marked reductions of infant mortality are feasible. In both Chile and Costa Rica, for example, recent marked increases in the incidence of favorable birthweights have been accompanied by dramatic declines in infant mortality.

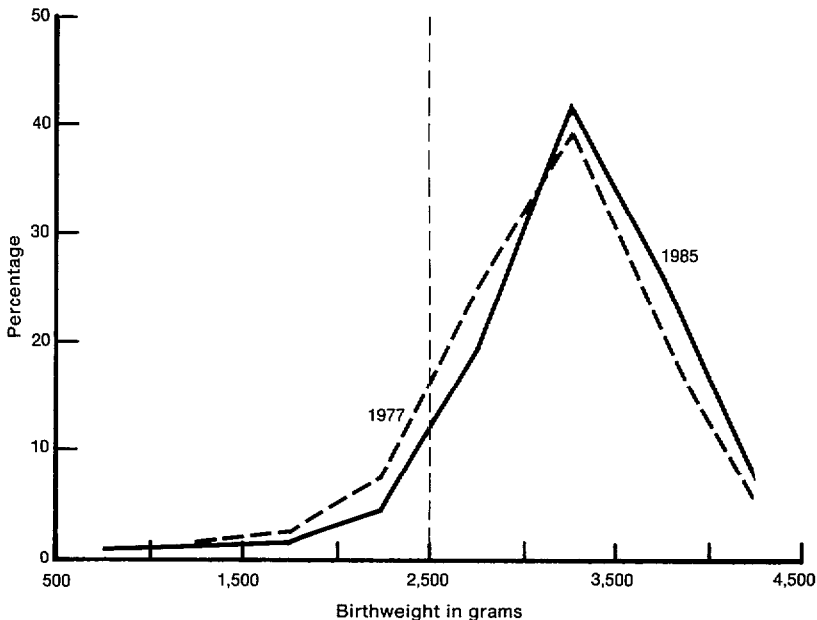
In Chile, as Figure 4 shows, 65% of the live births had favorable birthweights in 1977 as compared with 74% in 1985; in this same period the incidence of deficient birthweights declined from 24.9% to 19.5%, while the incidence of low birthweights fell from 10.4% to 6.4% (Figure 4). This shift in the distribution of birthweights was accompanied by a dramatic decline in the infant death rate—from 47.5 deaths per 1,000 live births in 1977 to 20.6 in 1984. Factors contributing to these changes in low and deficient birthweights and infant mortality included satisfactory organization and quality of health services, food supplementation, access to adequate fertility regulation, prenatal care coverage,

FIGURE 3. Distributions of singleton live births in Pune Rural Study, India, and in Sweden; and of live births in Recife, Brazil, by birthweight.



Source: R. R. Puffer and C. V. Serrano, *Patterns of Birthweights*, Pan American Health Organization, Washington, D.C., 1987 (in press).

FIGURE 4. Distributions of birthweights of live births in Chile, 1977 and 1985.



Source: R. R. Puffer and C. V. Serrano, *Patterns of Birthweights*, Pan American Health Organization, Washington, D.C., 1987 (in press).

provision of milk to pregnant women, an increase in the educational level of mothers, and the availability of professional midwives (6).

Likewise, the incidence of favorable birthweights rose from 63% to 71% in Costa Rica during the same period (1970 to 1983), when infant mortality fell from 68.0 deaths per 1,000 live births to 18.6. Some three-quarters of this drastic change in infant mortality has been attributed to public health programs (7), and extension of primary health care alone has been given credit for about two-fifths of the reduction.

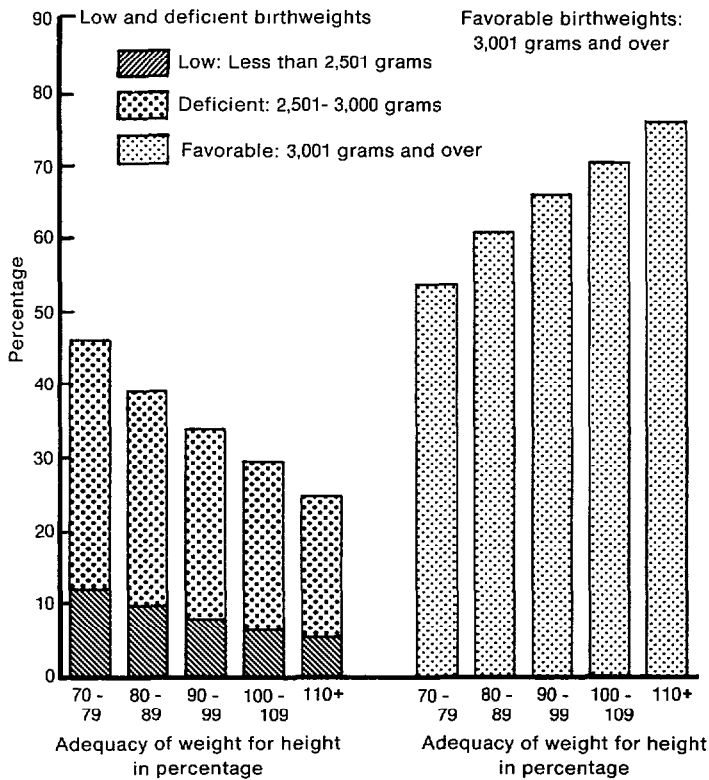
Cuba and Uruguay have also experienced improved distributions of birthweights and declines in infant mortality in recent times (8). These changes appear to have arisen from multiple actions including nutrition interventions and extension of primary health care.

In the United States it has been found that, aside from length of gestation, a mother's prepregnancy weight and her weight gain during pregnancy are the most important determinants of her newborn's birthweight, according to outstanding research by the National Institute of Neurological Diseases and Stroke (9) and the National Center for Health Statistics (10). Regarding weight gains during pregnancy, the infant death rate was found to be nearly three times as high for infants born to women gaining less than 21 pounds (9.5 kg), as compared with those gaining 21 pounds or more (11). (The recommended weight gain is 22 to 27 pounds, or 10 to 12 kg.)

The mother's prepregnancy weight is also an important determinant of birthweight. The study of 56,500 live births in Brazilian capitals (12) examined the adequacy of the mother's prepregnancy weight relative to the outcome of pregnancy. When the maternal weight was only 70-79% of the adequate weight for height, 11.8% of the newborn had low birthweights and 34.3% deficient birthweights. Only slightly more than half, 53.8%, had favorable birthweights. On the other hand, among the newborn of mothers with 110% or more of the adequate weight for height, the percentages of low and deficient birthweights were 5.3 and 18.8, respectively, and three-fourths of the newborn had favorable birthweights. Moreover, as Figure 5 shows, the birthweight results improved steadily as the adequacy of maternal weight for height increased within this range.

These and other findings have shown that the outcome of pregnancy depends in part on satisfactory weight gain and adequate prepregnancy weight. Therefore, one goal for maternal health programs is to promote and maintain the health of women during the reproductive period, to promote measures that help women have satisfactory weights before pregnancy, and to encourage them to gain an optimal amount of weight during pregnancy.

FIGURE 5. Distributions of birthweights of live births according to adequacy of maternal weight for height in Brazilian capitals, 1978-1979.



Source: R. R. Puffer and C. V. Serrano, *Patterns of Birthweights*, Pan American Health Organization, Washington, D.C., 1987 (in press).

Analyses of combinations of birthweights and lengths of gestation have revealed the need for considering both measurements in investigating causation and prevention. When births of low weight (less than 2,500 grams) are divided into preterm deliveries (at less than 37 weeks) and term deliveries (at 37 weeks and over), the latter group is said to have intrauterine growth retardation. The incidences of intrauterine growth retardation were high in the studies in Burma and India, three times higher than those of preterm low birthweights. Term births of low birthweight are apt to be associated with factors such as deficient prepregnancy weight and the mother's nutritional state, small weight gains in pregnancy, urinary tract infections, and the synergistic action of infection, maternal nutritional deficiency, and preeclampsia.

In several countries of the Americas, birthweight is being added to the official birth certificates and tabulations prepared routinely for all live births. Birthweight serves as a measure of the

success of prenatal care and health programs. Also, birthweight is the first record available for use in monitoring a child's growth and development. A recommended goal for local health services is to obtain records of all live births, including birthweights, for use in their health programs. Ideally, birthweight should be included on the birth certificate in all countries. Tabulation and analyses of the birthweights of all live births at the local, state, and national levels are advised for evaluating programs and obtaining current knowledge about progress made in increasing birthweights, so that high proportions of newborn will have favorable birthweights of at least 3,000 grams (6.6 pounds).

However, data on the length of gestation as well as birthweight are needed on birth records and official birth certificates. The length of gestation is measured in completed weeks of gestation, starting with the first day of the mother's last menstrual period and ending on the day of delivery. In accordance with recommendations of the World Health Organization (13), a preterm birth is one occurring at less than 37 weeks of gestation. As mortality is higher for preterm births, even those with birthweights of 2,500 grams and over, prevention of early pregnancy termination is important. The quality and completeness of records reporting the weeks of gestation, as well as those designed to give an accurate account of birthweights, need improvement in many areas.

Obviously, the many risk factors associated with low and deficient birthweights are of major concern in maternal and child health programs. Interventions directed at the community include health and nutrition education, accessibility and improvement of the quality of health services, health activities centered in the schools, and effective nutrition programs directed at vulnerable groups. At the individual level, prevention and control actions should be directed, among other things, at teenage pregnancy; the underweight woman; the pregnant woman with medical risks such as infections, anemia, or certain other diseases; the pregnant woman with a history of low-weight deliveries in previous pregnancies; and social factors such as smoking, alcohol consumption, and use of drugs. The result of effective health actions—such as food supplementation and monitoring nutritional status during pregnancy to ensure a satisfactory weight gain—are likely to improve not only the chances of favorable weight at birth but also the prospects for successful breast-feeding and the infant's resistance to certain diseases.

Horwitz (14, 15) has pointed out changes under way in maternal and child health programs. He has also emphasized the importance of nutritional concepts and actions, has noted the abundant grounds for initiating or expanding food supplementation in primary health care services, and has indicated the decline in infant death rates

found to occur where complementary feeding was included. In this same vein, data from three countries dealt with in *Patterns of Birthweights* (Chile, Costa Rica, and Cuba) show a combination of services leading to more favorable birthweights and reduced infant mortality. Given the progressive extension of primary health care to the whole population of the countries involved, it is obvious that this combined multidisciplinary and multisectoral approach is advisable.

Research programs in the United States are revealing the importance of satisfactory prepregnancy weight and weight gains during pregnancy, as well as the damaging influence of smoking upon the outcome of pregnancy (10, 11). Infant deaths have been matched with birth records and the outcome analyzed. Such matching of infant deaths and birth records, combined with analysis of mortality in relation to many variables, provides valuable insight into the problems involved and establishes a basis for actions in many parts of the world. Much more needs to be learned regarding the causation of low and deficient birthweights and preterm births in order to provide an improved basis for preventive programs. Birthweight, length of gestation, and both in combination require further investigation to elucidate their causative factors and their relation to pregnancy outcome around the world.

Much greater attention could be given to educational programs promoting measures designed to encourage healthy growth and development and survival of newborn. People in general—especially adolescent girls, nurses, midwives, and traditional birth attendants—need to know the importance of having a satisfactory weight before pregnancy and a weight gain of 22–27 pounds (10–12 kg) during pregnancy. They should know the dangers for the fetus of smoking, alcohol, and drugs. And they should know that teenage pregnancy should be avoided.

Instruction about these matters could be provided in the schools, together with instruction about prevention of tetanus by immunization. Programs for prevention and treatment of diarrheal diseases and acute respiratory infections of infants could well begin with educational programs promoting weight gains in pregnancy that improve the chances for favorable birthweights of at least 3,000 grams and breast-feeding that helps babies to prevent, resist, or overcome these diseases.

Due to the importance of evolving knowledge and experiences on the relationship between distributions of birthweights and the health and survival of infants, both teaching and research on factors and causes of low and deficient birthweights and their prevention are recommended in schools of medicine, nursing, and nutrition.

Patterns of birthweights and lengths of gestation in any given country constitute a combination of patterns prevailing in heterogenous populations. They thus hide both favorable and unfavorable realities by consolidating markedly distinct patterns. Partly for this reason, administrators should always be concerned with surveillance and monitoring of these indicators in order to identify unfavorable distributions and plan corrective measures. Of course, the range of causative factors involved transcends the health sector. Therefore, due attention should be given

to promoting the intersectoral actions needed to provide health programs, education, access to food supplies of adequate quality, and adequate living conditions for mothers and children. In addition, resolving the problem of low and deficient birthweights requires that the seriousness of the problem be recognized and that political and social leaders implement appropriate policies and establish coordinated programs. Such programs would have as their stated goal the endowment of newborn with favorable birthweights and with optimal chances at birth for the health and intelligence necessary for constructive lives, families, and societies.

REFERENCES

- 1 Puffer, R. R., and C. V. Serrano. *Patterns of Mortality in Childhood*. Scientific Publication 262. Pan American Health Organization, Washington, D.C., 1973.
- 2 Institute of Medicine. *Preventing Low Birthweight*. National Academy of Sciences, Washington, D.C., 1985.
- 3 National Research Council, Subcommittee on Maternal and Infant Nutrition in Developing Countries. Maternal and infant nutrition in developing countries, with special reference to possible intervention programs in the context of health. *Food and Nutrition Bulletin* 6:43-65, 1983.
- 4 Minkoff, H. Prematurity: Infection as an etiologic factor. *J Am Coll Obstet Gynecol* 62:137-144, 1983.
- 5 United States Department of Health and Human Services. Press Release, Washington, D.C., 10 August 1983.
- 6 Mardones-Restat, F. Beneficios de la seguridad social en el cuidado de la nutrición y salud de la madre y niño en Chile. *Rev Chil Nutr* 12:23-27, 1984.
- 7 Rosero-Bixby, L. Infant mortality in Costa Rica: Explaining the recent decline. *Stud Fam Plann* 17:57-65, 1986.
- 8 Pan American Health Organization. *Health Conditions in the Americas, 1981-1984*. Scientific Publication 500. PAHO, Washington, D.C., 1986.
- 9 Weiss, W., and E. C. Jackson. Maternal Factors Affecting Birthweight. In: Pan American Health Organization. *Perinatal Factors Affecting Human Development*, pp. 54-59. Scientific Publication 185. PAHO, Washington, D.C., 1969.
- 10 Taffel, S. M., and K. G. Keppel. Implications of mother's weight gain on the outcome of pregnancy. In: *Proceedings of the Social Statistics Section of the American Statistical Association*, pp. 238-243. Washington, D.C., 1984.
- 11 Keppel, K. G., and S. M. Taffel. Maternal Smoking and Weight Gain in Relation to Birth Weight and the Risk of Fetal and Infant Death, United States, 1980. (National Center for Health Statistics.) Paper presented at the International Conference on Smoking and Reproductive Health held at San Francisco, USA, on 15-17 October 1985.

- 12 de Nóbrega, F. J. Anthropometria, patologias e malformações congênitas do recém-nascido Brasileiro e estudos de associação com algumas variáveis maternas. *Jornal de Pediatria (Suppl 1)* 59(2), 1985.
- 13 World Health Organization. *International Classification of Diseases, Ninth Revision*. WHO, Geneva, 1977.
- 14 Horwitz, A. Changing concepts of health and health services: New opportunities for nutrition promotion. *Bull Pan Am Health Organ* 17:61-70, 1983.
- 15 Horwitz, A. Comparative Public Health: Costa Rica, Cuba, and Chile. Paper presented at the Conference on Nutrition and Health Services in the Americas held at the University of Kentucky, Lexington, on 6 March 1986 (unpublished).

BIOTECHNOLOGY AND HEALTH IN LATIN AMERICA AND THE CARIBBEAN

The recent explosive expansion of knowledge in microbiology, molecular biology, biochemistry, genetics, and other disciplines has set off unprecedented advances in biotechnology and has given the field of biotechnology an increasingly important part to play in nations' socioeconomic progress. Judicious application of techniques for gene-splicing, production of monoclonal antibodies, protein engineering, and so forth to solve problems in the fields of health, food production, energy, and the environment has given birth to noteworthy technologies in the industrialized countries. The effort to control diseases and improve health through these technologies has already scored triumphs whose implications are publicized almost daily in the mass media.

Biotechnology is a general term for any technique that uses living organisms (parts of organisms or products obtained from such organisms) to produce or alter products, improve animals or plants, or develop microorganisms for specific purposes.

Traditional biotechnological processes arose out of empirical practices such as the production of fermented liquids and bread. Today, the advances made in cell biology, molecular genetics, and biochemistry have spurred the development of a new biotechnology that uses organisms modified by the recombinant DNA technique and also by cell fusion (principally fusion of plant protoplasts and production of hybridomas that secrete monoclonal antibodies).

Among other things, these new techniques permit the cell (or viral) genome to be dissected, yielding organisms without the genes that make them pathogenic. This opens up a new strategy for vaccine production and new ways of controlling animal and plant diseases by substituting modified microorganisms for harmful ones in certain ecologic niches.