

# **MATERNAL NUTRITION AND FAMILY PLANNING IN THE AMERICAS**

**Report of a PAHO  
Technical Group Meeting**



**PAN AMERICAN HEALTH ORGANIZATION  
Pan American Sanitary Bureau, Regional Office of the  
WORLD HEALTH ORGANIZATION**

**1970**

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Report of a PAHO Technical Group Meeting

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This Report expresses the views of the members of the Technical Group and not necessarily the policy of the Pan American Health Organization.

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## I. INTRODUCTION

During recent decades, a voluminous scientific literature has underlined the significance of maternal nutrition for the course and outcome of pregnancy and the health and welfare of the child. In the words of the WHO Expert Committee on Maternal and Child Health (1969): "Nutrition is of fundamental importance to the health of mothers and children. In the world as a whole, the largest part of preventable mortality is due to the combined effect of malnutrition and infection in the first years of life." (1).

Nutritional needs increase during pregnancy and lactation, and pregnant and lactating women form an important "vulnerable group," exposed to special risks if their dietary needs are not met. In nearly all communities, the mother is chiefly responsible for care within the family of infants and dependent children, and poor maternal nutritional status may have serious consequences for such children. Since the mother is the necessary link between any health service and the fetus and young child, maternity and child health services should be combined.

From the immediate nutritional point of view, the maternal diet should provide sufficient of the nutrients required to maintain the mother and the fetus in good health during pregnancy, to support an adequate flow of breast milk without detriment to maternal nutritional reserves, and finally, to maintain maternal health between pregnancies. Yet it should not be forgotten that the children of today are the parents of tomorrow. The maintenance of a good nutritional state among growing children and adolescents is therefore a most important, possibly *the* most important, aspect of long-term nutritional policies. Attention to the immediate needs of mothers is a question of priority, which does not conflict with the need for attention to the dietary requirements of children also.

It is unrealistic to consider the nutrition of pregnant and nursing mothers in isolation. They are members of their family groups and of their social environment. Public health measures should therefore be directed toward the improvement of nutritional conditions in societies as a whole, as well as in family groups.



Many areas of this Region\* are characterized by high birth rates and poor environmental conditions. Shortage of food supplies, especially of the foods which provide high-quality protein, predisposes to maternal malnutrition and to an increase in the incidence of low-birth-weight babies with relatively high mortality and morbidity rates.

The incidence of maternal malnutrition, and of malnutrition among infants and young children, is further increased by the fact that many women become pregnant at intervals which are so short that recovery between pregnancies is incomplete. Such women usually go on to have larger families than they desire or they can adequately support. In the poorest communities especially, most women are pregnant or lactating during a high proportion of their fertile years. Family planning would increase the prospects of reducing maternal, fetal, infant, and childhood morbidity and mortality. It is well established that severe malnutrition among infants and young children—including that which is secondary to diarrheal diseases and other infections—is particularly common in families where births are closely spaced. Enabling mothers to space their pregnancies is thus a most important part of medical services aimed at the reduction of the nutritional disabilities of early childhood. It is likely, also, to improve the quality of family life and to raise the standard of living by decreasing the number of dependents requiring intensive personal care, education, food, and other essentials of healthy existence. The inclusion of birth-spacing activities in community health services is an extremely important aspect of attempts to provide comprehensive care for the individual woman. In several countries of the Region there are many opportunities to introduce family planning, within the existing local services. In this context, it is worth noting that family planning services should take account of pregnancies among adolescents and young girls whose growth has not been completed and who are therefore doubly at risk to nutritional depletion; and also of further—often unwanted—pregnancies among elderly women who are already burdened and worn out by unduly large families.

The importance of nutrition and family planning in health programs has been insufficiently recognized by many health authorities in the past. This may be partly due to the fact that nutrition and family planning are inadequately emphasized in the training of medical and paramedical personnel, and almost totally neglected in schools and other educational establishments.

Relatively little information is available to health services in this Region on the subject of maternal nutrition and its relationship to patterns of reproduction. A Technical Group was therefore convened to consider critically the different aspects of the problem, taking into account biological, socioeconomic, and cultural factors and the interrelationships of program activities in nutrition and family planning. The

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\*The term "Region" is used to signify Latin America and the Caribbean area.

Group met at the Headquarters of the Pan American Health Organization in Washington, D.C., from 20 to 24 October 1969. The present report summarizes the evidence reviewed and the conclusions reached. Since there are at present many gaps in our knowledge, it has been necessary to make recommendations for research which will help to remove ignorance. The report will, we hope, assist in evolving practical standards for nutrition in pregnancy and lactation, and procedures for improving maternal nutrition through local health services in the Region.

## II. GENERAL BACKGROUND

Knowledge of nutrition in relation to pregnancy and lactation has been authoritatively reviewed by several bodies, notably by a WHO Expert Committee on Nutrition in Pregnancy and Lactation (1965). Reference may be made to that report for details (2). Here, it is necessary only to summarize present knowledge.

### The Nutritional Cost of Pregnancy and Lactation

Table 1 summarizes the conclusions of the various FAO/WHO expert groups and committees and United States National Research Council's Recommended Dietary Allowances (RDA) (1968) on the nutritional requirements of non-pregnant, non-lactating women, and of the increased supplies which should be provided during pregnancy and lactation (3-8).

It should be noted that RDA do *not* specify precisely the physiological needs of individuals. The WHO Expert Committee (1965) pointed out that estimates of the nutritional cost of pregnancy, which may seem reasonably satisfactory in one area, cannot be transposed with confidence to areas where the conditions are quite different (2). Those of the National Research Council (NRC) "are intended to serve as goals for planning food supplies and as guides for the interpretation of food consumption records of groups of people. Since the RDA are designed to be adequate for practically all of the population of the United States, they allow a margin of safety for individual variations."

Although it is necessary to take note of their limitations, the data in Table 1 are representative of the best information available at the present time on the nutritional needs of groups of healthy pregnant and lactating women who are to be maintained in a good state of nutritional health. It can be calculated from the recommended allowances, for example, those of the NRC, that the total needs of a woman whose pregnancy lasts 280 days, and who lactates for 180 days, are *increased* by the following amounts over and above the requirements of a similar non-pregnant, non-lactating woman:

Calories:	236,000 kcal
Protein:	6,400 g
Calcium:	202 g
Iodine:	16 mg
Vitamin A:	820,000 I.U.
Ascorbic acid:	2,300 mg

Table 1. Recommended Daily Dietary Allowances

Category	Kcal	Protein (gm)	Vitamin A (IU)	Vitamin D (IU)	Ascorbic acid (mg)	Folacin (mg)	Niacin equiv. (mg)	Riboflavin (mg)	Thiamin (mg)	Ca (mg)	Fe (mg)	Iodine (µg)
Females	2,300	55 <sup>a</sup>	2,500 <sup>b</sup>	100	30	0.2	15	1.3	0.9	450	14 <sup>c</sup>	-
Pregnancy	2,440 <sup>d</sup>	65 <sup>a</sup>	2,500 <sup>b</sup>	400 <sup>e</sup>	50	0.4	16	1.3	1.0	1,100 <sup>f</sup>	14 <sup>c</sup>	-
Lactation	3,300	75 <sup>a</sup>	4,000 <sup>b</sup>	400	50	0.3	22	1.8	1.3	1,100	14 <sup>c</sup>	-
<p>FAO/WHO (3-7)</p> <p>(Reference woman: Age 25 years, weight 55 kg, household duties or light work)</p>												
<p>NATIONAL RESEARCH COUNCIL (USA) (8)</p> <p>(Reference woman: Age 22 years, weight 58 kg, light activity)</p>												
Females	2,000	55	5,000	400	55	0.4	13	1.5	1.0	800	18	100
Pregnancy	2,200	65	6,000	400	60	0.8	15	1.8	1.1	1,200	18	125
Lactation	3,000	75	8,000	400	60	0.5	20	2.0	1.5	1,300	18	150

<sup>a</sup>Net protein utilization (NPU): 70.

<sup>b</sup>As retinol.

<sup>c</sup>Iron stores not depleted; 25 per cent or more of the calories are derived from animal foods.

<sup>d</sup>2,300 + 40,000/280.

<sup>e</sup>During 2nd and 3rd trimester.

<sup>f</sup>During 3rd trimester.

Folacin:	130 mg
Niacin equivalent:	1,820 mg
Riboflavin:	174 mg
Thiamin:	118 mg

Thus, during the postulated 15 months of a single cycle of pregnancy and lactation, the additional nutrients recommended represent large totals; and, of course, the extra needs of a woman who undergoes several such cycles are proportionately greater.

While it is not suggested that women whose intakes fall short of the recommended allowances will necessarily suffer as a consequence, it seems clear that national or regional food policies should use the data as desirable targets; and that any substantial shortfall may be attended by adverse effects on maternal and fetal health.

### **Dietary Intakes and Their Adequacy**

The WHO Expert Committee (1965) summarized the diet survey results available at that time (2). Comparatively little fresh information is available. Information for the Region is summarized in Table 2 of this report, and will be discussed in the next section.

In general, the reported nutrient intakes of pregnant and lactating women are higher in the more affluent than in the poor socioeconomic categories. The interpretation of calorie intakes during pregnancy is complicated by the fact that obstetricians in the developing countries may advise patients to restrict weight gain by reducing food intake. On the other hand some of the intakes reported from poorer countries are so low that, in the absence of confirmation, the suspicion must arise that the surveys have not been complete and accurate.

The WHO Expert Committee concluded that: "By comparison with recommended allowances, diets in developed countries seem likely to be deficient in calcium only, whereas diets in developing countries are likely also to be low in vitamin A, the B vitamins, and ascorbic acid. (2) That conclusion is based on averages. It may well be that important dietary inadequacies are prevalent in the poorer socioeconomic classes of many countries, including the United States of America (9).

### **Clinical Evidence**

It is well established, from extensive international and national vital statistics, that there is a "poverty gradient" in nearly all rates of fetal and infant mortality and in maternal mortality. Similarly, the incidence of premature (low birth weight) births tends to increase as socioeconomic conditions become worse. There are exceptions: for example, the vital statistics of poor class Chinese women in Hong Kong are remarkably good

by any standard (Thomson, Chun, and Baird, 1963), possibly as a result of favorable genetic circumstances (9).

The causes of death and low birth weight are multiple, but there is agreement that severe maternal malnutrition plays some part in producing impaired growth and reduced vitality of the fetus and the newborn. Of particular importance is the relatively high mortality among "grande multiparae" and their babies; many of these are women who are worn out by repeated pregnancies and whose nutritional reserves are likely to have become seriously depleted.

Among the clinical abnormalities of pregnancy, special mention may be made of toxemia and anemia. Many authorities believe that the malnourished mother is unusually liable to develop pre-eclampsia and eclampsia. These conditions are certainly relatively common among the youngest group of primigravidae, especially those from the poorest socioeconomic strata of society. Anemia, defined as a low concentration of hemoglobin in the blood, is notoriously common among pregnant women, especially those of high parity. Interpretation of hematological data is complicated by the so-called "physiological hemodilution" of pregnancy, and by the prevalence in many communities of diseases such as ancylostomiasis which cause abnormal loss of blood. There is, however, strong presumptive evidence that anemias caused primarily by dietary insufficiency of iron and folate, or by their defective absorption, are widespread. The WHO Scientific Group on Nutritional Anaemias (1968) has gone so far as to say that: "It is clear that the requirements of pregnant women cannot be met during pregnancy by diet alone." (10) Though there is controversy about the significance of moderate degrees of anemia, the seriously anemic woman, whatever the origin of her condition, is likely to suffer from debility and to find it difficult to summon up the physical energy required for the satisfactory care of her household and her children.

### **Anthropometric Evidence**

In most instances, in communities where dietary and related conditions are satisfactory, the children grow well and become physically strong and well-developed adults who reach the maximum stature of which they are genetically capable. Conversely, where the conditions of upbringing are poor, growth is often stunted and adult stature is reduced. While there are genetic complications in interpreting the heights of adults, there is a general correlation between stature and socioeconomic and nutritional conditions, both between and within communities.

This correlation is of considerable importance from the point of view of reproduction. The data of the British Perinatal Mortality Survey (Butler and Alberman, 1969) have confirmed the reports of Thomson (1959) and others that there is a well-marked socioeconomic gradient in maternal stature, and that perinatal mortality rates are lower in tall than in short

Table 2. Calorie and Nutrient Intake of Women in Some Latin American and Caribbean Areas (Pregnant, Lactating, and Other Samples)

Country	Calories	Total protein (g)	Animal protein (g)	Calcium (mg)	Iron (mg)	Vitamin A	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)	Subjects		Year and season (where specified)	Source
											No.	Place and charact.		
Brazil	1,288	53.2	10.5	451	16.0	95 mcg	0.66	0.54	12.4	12	27	Arid NE area (poor)	March 1963	ICNND <sup>a</sup>
Guatemala	1,848	56.74	10.64	926	18.4	940 I.U. 28 mg	1.05	0.64	13.45	54	-	San Antonio La Paz (rural, relatively poor)	1963	INCAP <sup>b</sup>
Guatemala	1,418	39.2	8.0	768	16.9	0.47 mg	0.81	0.68	7.0	36	20	Acatenango (60% Indian)		
1st trimest.	1,723	49.7	7.4	967	16.9	0.53 mg	0.99	0.71	9.7	29	57	Los Planes (Ladimo, poor)		
2nd trimest.	1,819	53.9	8.7	1,012	20.3	0.75 mg	1.07	0.79	10.3	39	57		1967-1968	INCAP <sup>c</sup>
3rd trimest.	1,698	59.7	32.2	450	10.6	-	-	-	-	97	20	Subjects with >12 g Hb	June-August 1964	
Trinidad	1,713	56.1	27.5	490	10.3	-	-	-	-	90	87	Subjects with <10 g Hb		PAHO <sup>d</sup>
<u>PREGNANT WOMEN</u>														
<u>LACTATING WOMEN</u>														
Guatemala	2,012	63.5	7.8	988	17.1	259 mcg 863 I.U.	1.23	0.66	13.6	55	-	San Antonio La Paz (poor)	-	INCAP <sup>b</sup>
Guatemala	1,599	58.0	9.9	887	21.3	0.34 mg	1.03	0.58	9.9	13	36	Acatenango (60% Indian) Los Planes (Ladimo, poor)	-	INCAP <sup>c</sup> *
Trinidad	1,853	62.5	30.7	554	10.8	4,588 I.U. 1,376 mcg	1.2	1.2	13.1	129	93	Subjects from 15 health centers in Port-of-Spain and neighboring areas (lactating 1-6 months)	June-August 1964	PAHO <sup>e</sup>

UNSPECIFIED AND MIXED

Guatemala	1,714	53.4	12.9	778	20.3	1,457 I.U. 437 mcg	0.98	0.60	11.4	45	16	San Antonio. La Paz (Housewives, poor; 2 pregnant, 6 lactating, 8 neither)	February 1963 dry season	INCAP <sup>f</sup>
Puerto Rico (15-19 yrs.)	1,797	45.8	19.0	356	11.1	2,269 I.U.	1.4	0.8	13.4	53	20	Urban slum areas	July-	Univ. of Puerto Rico <sup>g</sup>
(20-29 yrs.)	1,600	48.8	22.6	379	8.2	2,821 I.U.	1.2	0.9	13.1	37	27	(poor living conditions)	October 1965	

<sup>a</sup>Northeast Brazil, *Nutrition Survey*. Report by the Interdepartmental Committee on Nutrition for National Development (ICNND), U.S.A., 1965.

<sup>b</sup>Beteta, C. E. *Embarazo y nutrición*. Thesis. University of San Carlos, School of Medical Sciences, Guatemala, 1963.

<sup>c</sup>Flores, M., M. A. Guzman, E. De León, L. de Gil, and C. Canosa. *Ingesta de las madres embarazadas en áreas rurales de Guatemala*. Institute of Nutrition of Central America and Panama (in preparation).

<sup>d</sup>Chopra, J. G., et al. "Anemia in Pregnancy." *Amer J Public Health* 57:857, 1967.

<sup>e</sup>Chopra, J. G., et al. "Anemia in Lactation." *W Indian Med J* 18:252, 1964.

<sup>f</sup>Flores, M., et al. "Estimation of Family and Mother's Dietary Intake Comparing Two Methods (San Antonio La Paz, Guatemala)." *Trop Geogr Med* 17 (1965).

<sup>g</sup>Fernández, Nelson A., et al. "Nutritional Status of People in Isolated Areas of Puerto Rico." *Amer J Clin Nutr* 17, 1965.

\*1st trimester, 2nd trimester, 3rd trimester.



mothers (11, 12). Analysis of the causes of excessive mortality in the babies of short women showed that the excess exists in nearly all cause-groups and is not limited to birth trauma. In other words, maternal shortness may imply some physiological as well as anatomical impairment. Recent data from Japan have suggested that improving nutritional conditions results in better maternal physique and in higher birth weights (13).

Maternal weight-for-height is also important, both underweight and overweight mothers having reduced reproductive efficiency compared with those nearer standard weight-for-height. Tompkins, Wiehl, and Mitchell (1955) have emphasized the disabilities of the underweight mother in particular (14).

In well-nourished communities, where most women do not have to undertake hard physical work during pregnancy and lactation, and where they are allowed to eat to appetite, the average gain of weight during normal pregnancy is of the order of 20-25 lbs. Eastman and Jackson (1968) have reported that, in general, birth weights tend to increase with the amount of weight gained during pregnancy (15). In the absence of a sufficient gain of weight during pregnancy, the mother may suffer a net loss of weight, so that after delivery and puerperal recovery she weighs less than she did before conception. Lactation may deplete her tissues still further. Surprisingly, there is very little well-documented evidence on the effect of successive pregnancies and lactation on maternal weight. Venkatachalam (1962) has, however, reported a striking fall in the average weight of women in New Guinea when arranged according to the number of previous children born (16).

Reports from India (Venkatachalam, Shankar, and Gopalan, 1960) and West Africa (Nicol, 1959; Thomson *et al.*, 1966) indicate that pregnant women in those countries may gain as little as 5 to 7 kg (17-19). In Gambia, (Thomson *et al.*, 1966) however, there was no evidence of a general loss of weight with increasing parity, nor of a sustained loss during lactation (19).

### Physiological Adjustments during Pregnancy

While there is a great deal of direct and circumstantial evidence of malnutrition among pregnant and lactating women, research during recent years has shown that from a physiological point of view the fetus and the milk supply of the lactating women are protected with astonishing efficiency. This ensures that even under adverse nutritional conditions short of famine, the birth rate and the survival rate of the babies are sufficiently high to safeguard the continued existence of the species; and, indeed, to permit a rapid growth in population, when as in many countries at present reduction in mortality rates is much more effective than efforts to maintain the spacing and ultimate size of the family at an optimum level.

The physiological adjustments of pregnancy are characterized by their anticipatory nature. Thus, the pregnant woman begins to lay down a reserve of body fat at a relatively early stage, before the needs of the product of conception have become unduly large (Hytten and Leitch, 1964) (20). The fat no doubt represents a store of energy which will be available later during pregnancy or during lactation, if the maternal diet is of relatively low energy value. Other types of physiological adjustment appear to alter the osmotic and other properties of blood and other body fluids in order to facilitate the transport of nutrients to the product of conception and the removal of waste products from it. These changes, which become established during early pregnancy, have the unfortunate characteristic that they may mimic changes which, under other circumstances, would be considered clear biochemical evidence of malnutrition. Reduced levels of hemoglobin, albumin, and many other substances in the blood of pregnant women may signify physiological adjustments, not true deprivation.

Yet although the welfare of the fetus is well protected, this protection may be given at the expense of the maternal tissues. Maternal nutritional depletion, especially if it recurs in successive pregnancies without opportunity for replenishment between pregnancies, may result in serious impairment of maternal health and vitality.

Finally, recent research has emphasized the overwhelming importance of satisfactory growth and nutrition during childhood and adolescence. The mother who embarks upon childbearing after a childhood experience of chronic malnutrition or undernutrition is already damaged beyond the possibility of full repair, and will show evidence of impaired reproductive efficiency even if dietary conditions during pregnancy itself are fully satisfactory. Chronically unsatisfactory nutritional conditions cast their shadow forwards as well as backwards. There is no doubt that the undernourished or malnourished mother is more than usually liable to produce children who will experience serious malnutrition and who may be permanently damaged mentally as well as physically.

### **Family Planning and Nutritional Status**

In the words of the WHO Expert Committee on Maternal and Child Health (1969):

“All over the world, there is a statistical relation between the number of pregnancies and maternal and infant death rates. High infant and child mortality rates reflect the dangers of excessive pregnancies for the health of mothers and children and the inability of large families in developing areas to support all their offspring. Large families often cannot adequately feed and nurture all their children, and those who survive are often stunted in their growth and development. On the other hand, high infant mortality is one reason for consecutive pregnancies that debilitate the

mother and result in high maternal morbidity. It is well known that maternal mortality rises with each successive pregnancy. Repeated pregnancies are not only a drain on maternal nutrition and haemoglobin level, but may also cause serious pelvic disease. The result is too often an anaemic malnourished mother whose already inadequate reserves are further depleted by almost continuous pregnancy and nursing, and an infant of low birth weight who dies if the breast milk fails or is curtailed by another pregnancy, or whose growth and development are stunted if he survives" (1).

Bishop (1964) found in Philadelphia that the incidence of prematurity was 8 per cent in those cases where the interpregnancy interval (birth to conception) was more than 23 months; where the interval was 12 to 23 months, the incidence rose to 10 per cent and where it was below 12 months, the incidence was 18 per cent (21). Hedayat *et al.* (1969) found the five-year survival rate of children to be 30 per cent in those conceived within three months of the previous delivery, and 80 per cent in those where the interval had been 12 months or more (22). Rueda-Williamson (1967) reported that kwashiorkor and other forms of protein-calorie malnutrition were much more common in families with closely-spaced pregnancies (23). From such evidence, it seems reasonable to conclude that the optimum interval between successive pregnancies is not less than two years.

The ideal method of contraception has not yet been discovered. Two widely used methods are the hormonal contraceptives of various types and the intrauterine contraceptive devices. In this discussion we are focusing upon possible side-effects on lactation and other aspects of reproductive efficiency. The hormones in oral contraceptives are substances which have multiple effects on maternal metabolism (Lancet, 1969) (24). Dr. Edwin M. Gold\* reviewed for the Technical Group evidence on effects on lactation. He noted that lactation by itself is not an efficient protection against ovulation and consequent fertility (Das and Mitra, 1966) (25); Tietze, 1964) (26). Drill (1966) (27) and Goldzieher and Rice-Wray (1966) (28) reported that high doses of norethynodrel and other ovulatory regulators may reduce or inhibit lactation in many women. The evidence from these and other workers is complex and by no means consistent, and cannot be detailed here. But it seems reasonable to conclude that, in general, some forms of contraceptive pill, especially those which rely chiefly on estrogen action, may have some adverse effects on lactational efficiency. On the other hand, the intrauterine contraceptive device (IUCD) appears to stimulate lactation, possibly through its mechanical action provoking a neuroendocrine reflex which increases the secretion of endogenous oxytocin (Gómez Rogers *et al.*, 1967) (29). From the data on hand one may conclude that the relation between lactation performance and contraceptive practice requires further elucidation and study.

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\*See appendix, pp. 42-47.

The existing data raise many provocative questions:

Is there a dose-relationship between oral and parenteral contraception and lactation performance?

If so, is it related to the estrogen or the progestogen component of the contraceptive agent?

Is lactation performance related to the time contraception is started in relation to the termination of pregnancy and the initiation of lactation?

What influence do psychological factors play in relation to lactation performance during the use of contraception—for example, the desire to nurse versus the desire for conception protection?

Are significant amounts of the hormones in oral contraceptives excreted in breast milk?

It may be noted, in conclusion, that much published information is difficult to interpret owing to lack of definition, or varying definitions, of the term "weaning." It is necessary to distinguish clearly between lactation, which is a physiological phenomenon, and breast-feeding, which is an aspect of behavior (Hyttén and Thomson, 1961) (30).

### III. THE SITUATION IN THE AMERICAS

A systematic and comprehensive review of relevant data from the Americas is not available. What follows is a summary of the material which was presented to the Technical Group, together with some additional information. Evidence from the United States of America is too wide-ranging and extensive to be dealt with here. A convenient synopsis, prepared by Dr. Edwin M. Gold is presented in the Appendix; this includes references to some other recent reviews and original papers. In the present chapter, the main concern will be with Latin America and the Caribbean territories.

#### Dietary Information

Quantitative information on calorie and nutrient intake of pregnant and lactating women is scanty in the Region, as it is throughout the world. Data on family intake are more numerous, and certain inferences relating to pregnant and lactating women can be drawn from the family data. If foods in a family where the diet was deficient were divided proportionally to physiological needs of the various members, no member of the family, including the mother, would receive an adequate diet. If any member, because of social custom or other reason, took more than his share, the diets of the other members would be the more deficient. Mothers are known to sacrifice their needs to those of their husbands and children.

In samples from 14 Latin American countries representing 130 localities and about 3,500 families, 58 per cent of the families had intakes under 2,000 calories per person per day (31). Twenty per cent had less than 45 grams of protein, and in 29 per cent animal protein was less than one-fifth of the total. Forty-one per cent had less than 2,000 I.U. vitamin A per person per day, and in 66 per cent of the places more than two-thirds of this vitamin was of vegetable origin. In families ranged by economic level, the diets most deficient were at lower economic levels. In the deficient family diets mentioned, the diets of the women were probably no better than the average and, more likely, worse.

Figures on intakes of pregnant and lactating women exist for a few places in South and Central America and the Caribbean, and are summarized in Table 2 (p. 8). All the intakes are low compared with the recommended allowances specified in Table 1 (p. 5). In one Guatemalan village where the nutrient intake of pregnant and lactating women was assessed and compared with that of the general population, it appeared

that these women increased their intake in some respects, but not sufficiently to meet their increased physiological requirements. In another Guatemalan community where intake in pregnant women was measured longitudinally, there was some increase in the second and third trimester over the first, but it was insufficient to meet the larger requirements of pregnancy.

## Vital Statistics

In some parts of the Region, the collection of vital statistics is still incomplete and published figures must be regarded as approximations only. Unexpectedly low death rates reported from certain countries may have reflected incomplete data collection rather than a favorable health situation.

Table 3 summarizes some relevant vital statistics from certain countries where data collection is thought to be satisfactory. It also includes official estimates of the available supply of animal protein per capita, and of the average national income per capita. It is evident that there is a tendency for the wealthier countries, which also have a relatively high animal protein content in diets, to have relatively low mortality rates, and vice versa. The four Latin American countries listed have the lowest incomes, the lowest animal protein supplies per head, and also have mortality rates many times higher than those of the U.S.A. and Canada. Those, in turn, are considerably higher than the Swedish rates.

The data in Table 3 are presented merely to illustrate the general relationship between high mortality rates associated with maternity and infancy, and low socioeconomic and nutritional resources. Since the causes of death are multiple, a more exact correspondence cannot be expected. The exceptionally low death rates in Sweden are no doubt attributable to the contribution of past as well as present prosperity, a very high standard of nutrition among the population at large, excellent medical services deployed so as to serve the whole community, and very successful application of family planning. Despite its even greater prosperity, the U.S.A. suffers from uneven distribution of resources of all kinds, and this probably accounts for its mortality statistics being worse than those of Sweden. Puerto Rico has had a transfusion of resources in recent years, and pioneered the use of the hormonal contraceptive; and its mortality experience is now becoming reasonably satisfactory. The high mortality rates in the vital statistics of the Latin American countries reflect the combination of poverty, nutritional inadequacy, and insufficiently developed health services, especially outside the larger centers. Even in the larger centers, it is notorious that a flood of impoverished immigrants from rural areas is presenting a major problem of general and nutritional health.

The large differences of maternal mortality shown in Table 3 probably reflect, in the main, differences in the efficiency of obstetric services,

Table 3. Selected Vital Statistics for Sweden, United States of America, and Canada, and Certain Latin American and Caribbean Countries, with Data on National Income and Nutritional Resources, 1966<sup>a</sup>

Country	Births per 1,000 pop.	Maternal mortality per 1,000 live births	Perinatal mortality per 1,000 live births	Infant mortality all causes per 1,000 live births	Infant mortality from immaturity, etc. (B44) per 1,000 live births	Estimated animal protein content of national average food supplies (gm/day/capita) <sup>b</sup>	Per capita national income in U. S. dollars (1964)
Sweden	15.8	0.1	19.0	12.6	3.5	54.1	1,696
United States of America	18.4	0.3	31.2	23.7	7.5	65.6	2,707
Canada	19.3	0.3	25.8	23.1	7.6	62.4	1,691
Puerto Rico	28.2	0.4	38.0	37.6	9.4	42.0	...
Trinidad and Tobago	30.2	1.3	44.6	41.8	16.9	...	498
Mexico	44.3	1.5	35.8	62.9	15.3	23.8	410
Guatemala	45.4	2.0	...	89.5	19.7	8.7	248
Chile	31.9	2.7	47.5	101.9	24.2	28.9	451
Colombia	35.6	2.4	43.7	80.0	10.2	23.9	197

<sup>a</sup> Country reports to PAHO for PAHO/WHO publications, 1965-1968.

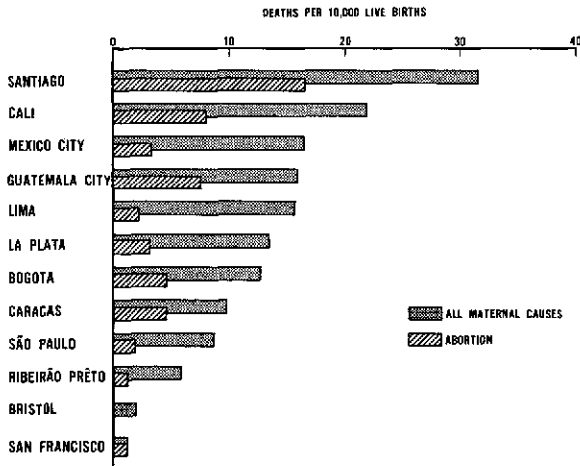
<sup>b</sup> *World Health Statistics Annual* Vol. 1, 1966.

<sup>c</sup> *World Health Statistics Report* Vol. 22, Nos. 1, 6, 7, and 9, 1969.

<sup>d</sup> *The State of Food and Agriculture*. Food and Agriculture Organization of the United Nations, Rome 1967, pp. 176-177.

including antenatal services, social differences in patterns of childbearing, and variations in family planning services. Of relevance to the concept of family planning is the high contribution of deaths from abortion to total maternal mortality. Figure 1, taken from Puffer and Griffith's (1967) report on patterns of mortality in 12 cities, mostly in Latin America, shows clearly that abortion is a major cause of maternal mortality (32). This almost certainly reflects the desperate lengths to which some mothers will go to get rid of unwanted pregnancies. Clinical experience shows that such cases are most common among the poorest, least educated, and worst nourished sectors of urban populations. In Puffer and Griffith's report, the ratio of deaths from abortion and deaths from other maternal causes was 74/89 among lower-paid workers, and 24/62 among better paid workers.

**Fig. 1. Deaths from Complications of Pregnancy, Child-birth, and the Puerperium and from Abortion per 10,000 Live Births in Each City, 1962-1964 (32)**



## Growth and Development

Published information on the physique of representative adults in the Americas is scanty; it may be that there is a fund of data lying unanalyzed in the archives of various clinics and research institutions.

A recent paper by Frisch and Revelle (1969) confirms impressions gained from samples measured by the Interdepartmental Committee on Nutrition for National Defense (ICNND) that average adult statures in the rural areas of Latin America mostly resemble those in Asia rather than those in North America, Europe, or Africa (Table 4) (33). According to the same authors, however, average body weight in Latin America is about 9 kg greater than in Asia.



Table 4. Mean Height of Females Aged 25 to 29 Years (unless otherwise specified) in Certain Latin American and Asian Countries (Data from Frisch and Revelle (33), 1969)

Country	Height (cm)	Country	Height (cm)
Bolivia	151.0	Burma	150.7 <sup>a</sup>
Brazil (Northeast)	150.4 <sup>a</sup>	India	150.7 <sup>c</sup>
Chile	151.9	Japan	151.9
Colombia	151.2 <sup>a</sup>	Malaya	149.8
Ecuador	146.3 <sup>b</sup>	Thailand	151.0
Uruguay	155.5 <sup>a</sup>	Vietnam	147.6
Venezuela	152.5		
Mean	151.3 ± 0.96	Mean	150.2 ± 0.72

<sup>a</sup>Ages 15 years +.

<sup>b</sup>Averages 20 years +.

<sup>c</sup>Ages 20-21 years.

Dr. G. Arroyave reported evidence from Guatemala suggesting that lactating women tended to weigh less than those of non-pregnant, non-lactating women, both sets of data being expressed as percentage of standard weight for height and age (Figure 2). This suggests that pregnancy and lactation may result in a net loss of maternal tissue.

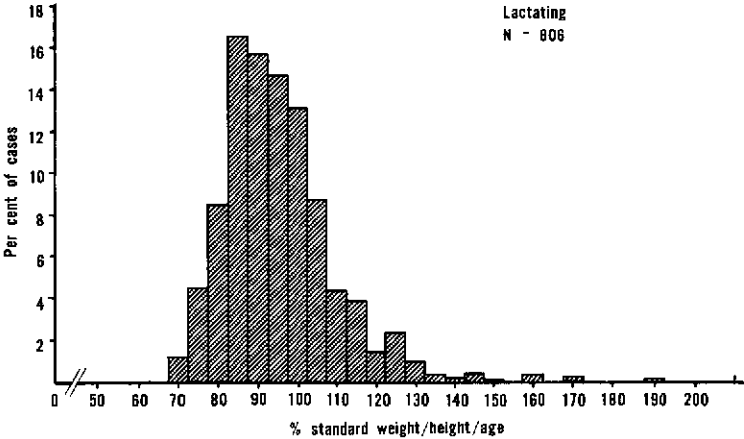
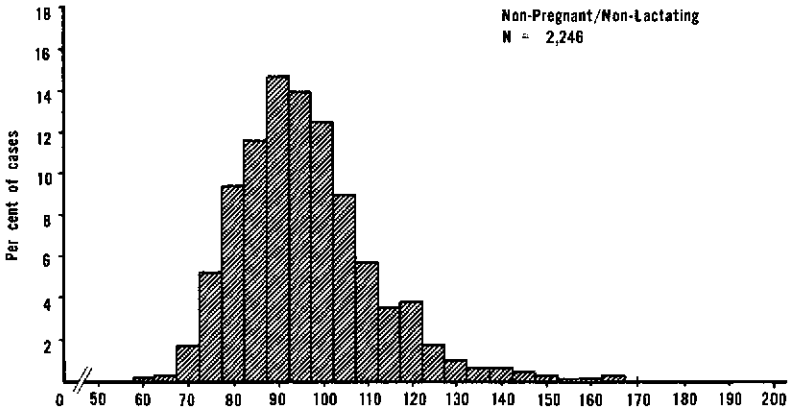
Dr. Arroyave also reported that 19 pregnant women of low economic status, measured longitudinally, gained only 6.5 kg during pregnancy, compared with 10.5 kg in 12 women for the upper income groups. Body weight at 6 weeks post-partum was higher than weight before conception in both groups, the net gain being 1.7 kg in the low and 2.6 kg in the high socioeconomic group.

Other members of the Technical Group confirmed, from their experience, that low weight gains during pregnancy, of the order of 8 kg, are fairly typical in the poorer countries of Latin America.

Statistics of birth weight are scanty, but the Group learned that in various hospitals of Santiago, Chile, the incidence of birth weight under 2,500 g is about 13 per cent, half of such children being born at full term. In Trinidad, 13.7 per cent of newborn infants in the general population were of similarly low birth weight; in a group of higher socioeconomic level, the incidence was 4.3 per cent. In rural Guatemala, the mean weight of 364 babies at birth was 2,920 g, compared with an average of 3,260 g for 417 babies of private patients in Guatemala City (34). In the U.S.A. the mean birth weight is about 3.4 kg.

Information on the growth and development of infants and young children is more abundant, and continues to be collected in several centers, notably in Mexico, Colombia and Chile. Although the rate of growth of the breast fed infant during the first few months is generally satisfactory, even where maternal nutritional conditions are poor, in many Latin American and Caribbean countries, and probably among the poorer

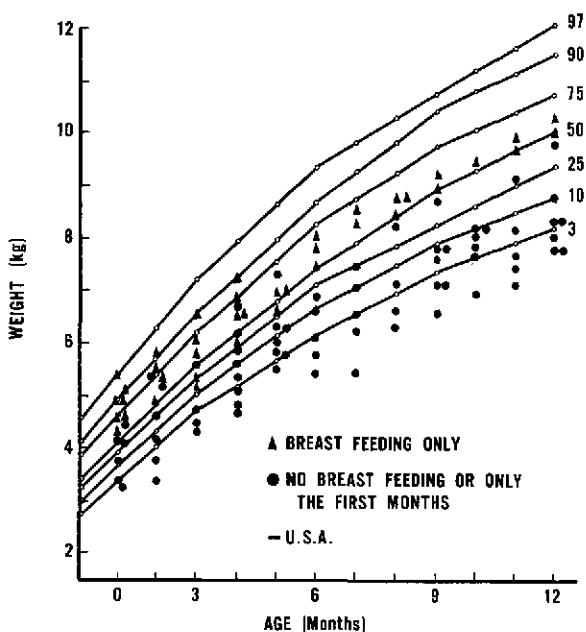
Fig. 2. Distribution of Non-Pregnant/Non-Lactating Women and of Lactating Women by Their Per Cent Standard Weight/Height/Age\*



\*Unpublished data obtained during the Nutrition Survey of Central America and Panama, Institute of Nutrition of Central America and Panama, Guatemala, 1965-1967.

strata of wealthier countries too, there is a marked falling off in growth thereafter, by comparison with the standards of healthy children. There is evidence also that such deterioration is especially marked among infants who have not been breast fed at all, or only for a short time. Figure 3 illustrates this in a sample from Chile reported by Dr. Fernando Mönckeberg. It is probably facile to assume that this is entirely due to

Fig. 3. Weight of Infants of the Province of Curicó, Chile, Related to Those of the United States of America



inadequate feeding patterns among infants. After its first few months of life the infant has lost most of the passive immunity inherited from its mother, and is increasingly exposed to infection. The work of Mata (1967) in Guatemala demonstrates the great importance of gastrointestinal infections and infestations as causes of impaired growth and secondary malnutrition, especially when associated with unsatisfactory feeding practices (34).

Current research in many countries, among them Guatemala, Mexico, and Chile, is producing strong evidence that such impairment of physical development is paralleled by defective neurophysiological development, probably leading to impaired mental function, which may be incurable. Dr. Mönckeberg concluded, in his report to the Group, that the social repercussions of these facts necessarily draws attention to the nutritional requirements of pregnancy and lactation, especially in the developing countries where malnutrition is prevalent.

The importance of breast feeding for the health of infants in communities where nutrition and the hygiene of the environment are poor can scarcely be overestimated. In some rural areas of Colombia, there is significantly less protein-calorie malnutrition in children receiving breast milk. Moreover, it is evident that breast feeding favors the nutritional status of the child, while it continues, but once weaning has occurred

there is little evidence of a "carry over" effect in this population. In Chile, especially, the average duration of breast feeding is now only three months, and the decline in the incidence of breast feeding during the past 20 years has been accompanied by a shift toward earlier ages in the peak prevalence of severe forms of malnutrition among infants and young children. For this reason, programs of supplementary feeding of such children with substitutes for breast milk should be carefully planned, as they may have undesirable effects by discouraging breast feeding and by causing increased exposure to gastrointestinal infection where sanitary and educational improvements are primitive. Severe primary or secondary malnutrition at an early age is more likely to produce permanent damage than if it takes place at a later age.

### Clinical and Biochemical Evidence

Only fragmentary clinical evidence relating to the Region appears to exist. Table 5 gives the incidence of three signs related to malnutrition in seven Latin American and Caribbean countries, in relatively small samples of pregnant, lactating, and other women examined during the course of ICNND surveys. There is some suggestion that the facial lesions may be more common in pregnant and lactating women. Similarly the incidence of thyroid enlargement appears to increase during pregnancy. Goiter due to iodine deficiency presents an important problem in certain mountainous regions of Latin America.

With regard to biochemical data, evidence collected during ICNND surveys and by workers at the Institute of Nutrition of Central America and Panama (INCAP) show beyond doubt that blood levels of most substances of nutritional importance are relatively low during pregnancy. However, in reporting data collected in INCAP countries to the Group, Dr. Arroyave concluded that, with a few exceptions, pregnancy and lactation do not result in nutritionally-determined characteristic abnormalities in urinary excretion levels. The same is true, in general, of levels in blood, the patterns being dominated by the physiological adjustments which occur during pregnancy. Iodine excretions were indicative of intakes well below requirement levels, except in Guatemala, where iodization of salt has been instituted.

In a recent collaborative study of nutritional anemias in Latin America and the Caribbean, organized by the Pan American Health Organization, the incidence of anemia, defined as hemoglobin level below 11 g in pregnancy and below 12 g in non-pregnant women, was found to be twice as high during pregnancy as in non-pregnant controls (35). Table 6 summarizes the data, which have been adjusted for differences of altitude. Most of the anemias were considered to be of iron-deficiency type, on the basis of measurements of transferrin saturation levels.

Beteta (1963), in a very complete study of a group of pregnant women of low socioeconomic level in San Antonio La Paz, Guatemala, found low

Table 5. Per Cent Prevalence of Selected Clinical Findings  
(ICNND Surveys)

Country	No.	Nasolabial seborrhea	Angular lesions	Enlarged thyroid
Bolivia				
NPL	2,145	0.1	—	34
P	33	—	—	36
L	129	—	—	25
Brazil (Northeast)				
NPL	728	10	—	42
P	66	11	—	49
L	32	6	—	53
Colombia				
NPL	231	—	0	43
P	109	—	1	42
L	144	—	0	57
Paraguay				
NPL	866	9	1	32
P	29	7	0.0	38
L	17	18	0.0	53
Uruguay				
NPL	545	3	14	32
P	84	5	19	36
L	85	4	20	47
Venezuela				
NPL	501	6	4	14
P	48	4	8	15
L	69	12	4	15
West Indies				
NPL	186	17	10	26
P+L	34	35	21	46

NPL—Non-pregnant/non-lactating.  
P—Pregnant.  
L—Lactating.

urinary excretion and reduced levels of red blood cell riboflavin (36). Furthermore, he found a pattern of plasma free-amino acids suggestive of inadequate protein intake, as shown by a low ratio of valine to glycine. The newborn children from these mothers (cord blood) also showed this alteration, indicating an effect on the fetus of maternal nutritional status.

Canosa *et al.* (1968) have studied the chemical composition of 13 placentas from a group of Guatemalan mothers of low socioeconomic rural level, and compared them with 23 placentas from 23 well-nourished mothers from Iowa City (37). The Guatemalan placentas had a lower nitrogen concentration and from determination of DNA and cellular protein also appeared to contain fewer cells, which were also larger cells when evaluated by the quantity of cellular protein associated with each nucleus.

Although it appears that the calorie value and protein content of breast milk is little affected by low nutritional status of the mother, Contreras, Arroyave, and Guzmán (1962) found that milk from village women in

**Table 6. Incidence of Anemia in Several Latin American Countries**

Country	No. of subjects	Per cent anemic
PREGNANCY		
Argentina	59	62.7
Brazil	70	28.6
Guatemala	87	47.1
Mexico	129	50.4
Peru	72	33.3
Venezuela	103	57.3
Composite	755	45.8
FEMALE CONTROLS		
Guatemala	51	19.6
Mexico	108	20.4
Peru	73	13.7
Venezuela	99	30.3
Composite	331	21.8

Guatemala had low riboflavin and even lower vitamin A concentrations, which were only one-third to one-quarter of the levels found in milk from mothers of high socioeconomic status, (38). Hence, maternal malnutrition may reduce the quality of breast milk, even if its quantity is little affected.

### Cultural Aspects

Dr. A. Rubel, in reporting to the Technical Group on sociocultural factors, emphasized that it is not possible to specify *the* cultural rules regulating food patterns in Latin America, because that region of the world is composed of many cultures, each with variations in rules. However, certain examples can be given which are widespread, and which are relevant to the theme of maternal health. (39). Such cultural phenomena are stronger in poorly-educated and economically deprived groups than in their opposite, and stronger in rural than in urban societies.

Neither pregnancy nor parturition are equated with illness, but are thought to be conditions which are particularly stressful to the woman, weakening her and making her vulnerable to "natural" or "unnatural" causes of illness. Such beliefs of increased susceptibility place pregnant women within a category for which generalized preventive health measures are felt justified.

In the period following delivery, a woman's especially vulnerable condition is circumscribed by a 40-day period of preventive care, known

as the *cuarentena*. Although today the *cuarentena* is honored more in the breach than the observance, it remains as a strong and visible part of the belief system and provides a framework within which more highly specific preventive practices are prescribed and accepted. For example, if a 10-day regimen is to be prescribed, it may help if the woman is advised that a 40-day treatment is usual, but is not necessary in her case.

Another belief is that during lactation a mother loses strength unless she eats those foods which her culture prescribes as contributing to bodily strength, and other foods which help to promote an easy, abundant flow of sweet-tasting milk. Foods such as corn gruels, which are liquidy and filling, as well as juicy and sweet-tasting fruits such as papaya, may be considered to be particularly appropriate during lactation.

The need to understand local cultural rules before making efforts to change them cannot be overemphasized. The introduction of innovations in nutritional practice depends upon the assumption that the people themselves will be responsive to change if they understand it to represent a solution to a felt need, and the new model should not be so alien as to be unacceptable. If, through lack of local substitutes, it is necessary to prescribe exotic foods or medicinals, the regimen should be couched in the rhetoric of the woman's unusual exposure to risk and those qualities of the foodstuff which will provide strength and protection from threatening illness.

#### **IV. THE NUTRITION OF PREGNANT AND LACTATING WOMEN: ULTIMATE GOALS AND PRACTICAL AIMS**

A major public health problem is how to improve the quality of human reproduction. The ultimate quality of the product of gestation can only be as good as the quality of the ingredients which produce it; and that is why the promotion of good nutrition should form an essential aim in maternal and child health and family planning services. The need exists not only for nutrition supervision of the infant and child, but also for nutrition education of the parents on behalf of their children's physical, emotional, and intellectual growth, since formation of good dietary habits early in life, as well as during pregnancy, cannot be overemphasized.

Thomsom (1959) has suggested that the long-term nutritional history of the mother may frequently be of greater importance than the nature of the diet taken during pregnancy itself; and that the best means of safeguarding nutritional health during pregnancy is to safeguard the growth and health of children (12). In other words, healthy, well-fed girls become healthy, well-fed adults and physiologically efficient mothers. This is a basic nutritional axiom for maternal and child health. But more important, it becomes the reason for expanding nutrition education and counselling for the mother during the interval between pregnancies, aimed at improving the diet and dietary habits not only of the mothers themselves, but of the children and rest of the family as well.

Nutritional status is difficult to define and even more difficult to measure. However, any successful maternal and child health service program has as its major responsibility the identification of potentially high risk to mothers and/or infants.

On the basis of past broad experience one can delineate the most vulnerable groups. It has become accepted that low socioeconomic status is equated with poor nutrition, and that poor maternal nutrition is associated with high infant mortality, high prematurity rates, and high levels of physical impairment, possibly of mental impairment also, in children. These correlates represent, therefore, a constellation of abnormalities, which are most frequent among families living in poverty, no matter where, geographically, they are.

Within this context, it is desirable to specify norms which will assist in the evaluation of maternal nutritional status by indicating the extent of the gap between the current and ideal situation. It is, occasionally, possible to define targets which, so far as present knowledge goes, can be assumed to represent the ideal. In practice, and particularly in the poorer



countries and communities, it may be necessary to make progress toward such an ideal by prescribing intermediate goals. Such practical goals should be feasible, reproducible, and readily used by personnel who do not have advanced technical skills and resources.

### Weight for Height

Experience has shown that patients who are markedly overweight or underweight at the beginning of pregnancy constitute a "high-risk" group with unfavorable obstetric experience. Underweight patients form a group which is particularly vulnerable.

Standards of weight for height in adults have been specified in a WHO monograph and in the ICNND manual (40, 41). A simpler form of standard, for females, which has been found satisfactory in the U.S.A., is given in Table 7. In general, women whose weight for height is near the standard may be regarded as in a satisfactory nutritional state. In default of data relating to national or community standards, these may be useful until local standards can be developed and tested for validity.

### Gain in Weight during Pregnancy

In the U.S.A. a gain in weight of 20-25 lbs during the whole of pregnancy has been found to be compatible with the most favorable reproductive efficiency.

Table 7. Standard Weight for Height, Adult Females  
(17 Years)<sup>a, b</sup>

Height (cm)	Standard weight (kg)
140	44
142	45
144	46
146	47
148	48
150	49
152	50
154	51
156	53
158	54
160	55
162	56
164	57
166	59
168	60

<sup>a</sup>Figures from U.S. Society of Actuaries, 1959.

<sup>b</sup>Figures corrected for shoe height and clothing weight.

It is useful, at antenatal clinics, to chart the weights of patients so that the trend can be seen at a glance. Tompkins and others have devised a chart based on a total gain of weight of 24 lbs, which has been successfully used in the U.S.A. (14). It has, perhaps, the disadvantage that it is necessary to know the patients pre-pregnant weight and to calculate the gain from that starting point before plotting the record. A somewhat different design (Figure 4) has been used in Aberdeen, Scotland (Thompson, 1965) which overcomes this difficulty: it is based on a total gain of 27.5 lbs, and a rate of gain during the second half of pregnancy of about 1 lb per week (42). The "norms" are shown as a series of parallel lines, and the actual weights at each clinic attendance are recorded directly against the appropriate week of gestation. A patient who is gaining weight more slowly than the standard will show a trend downwards across the parallels, while one who is gaining weight faster than the standard will show a trend upwards.

It is recognized that the trends indicated in such charts may represent gains in weight which are seldom attained by women in very poor communities, especially if they undertake hard physical work during pregnancy. Nevertheless, the mere recording of actual observations against an "ideal" trend helps to focus attention on possible defects in the nutrition of patients under care.

## Height

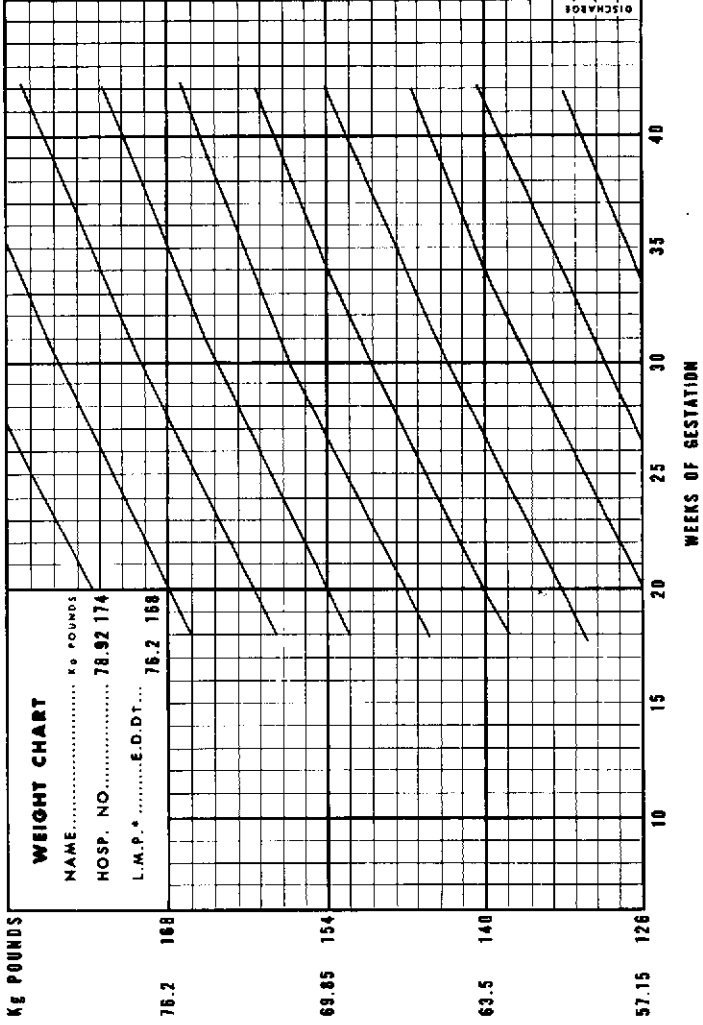
While it is not possible to alter stature among adults, it has been established that the distribution of heights in a community is a useful index of previous socioeconomic conditions; furthermore, women who are unduly short by the standards of their community have more unfavorable reproductive experience than relatively tall women (Thomson, Chun, and Baird, 1963) (9). Given the large variation of heights in different communities, it is recommended that community standards be evolved on the basis of local data.

## Biochemical Measurements

Although biochemical parameters have proved to be useful in the nutritional investigation of non-pregnant adults, they are less reliable during pregnancy because of the influence of physiological adjustments to the composition of blood. Nevertheless, certain estimations may be useful. It is assumed that, wherever possible, routine antenatal investigations such as urinalyses for albumin and sugar will be undertaken.

Hemoglobin or hematocrit levels should be determined wherever possible. Carefully standardized methods should be used. It is desirable to repeat estimations at intervals during pregnancy, in order to detect major falls in the hemoglobin or hematocrit levels.

Fig. 4. Weight Chart (42)



\*Last menstrual period.

†Expected date of delivery.

In conformity with the PAHO Scientific Group on Nutritional Anaemias, it is suggested that a hemoglobin level below 11 g per 100 ml or a hematocrit below 33 per cent (corresponding to the mean cell hemoglobin concentration of 34) should be regarded as signifying anemia during pregnancy (35). These values refer to the venous blood of persons living at sea level. At high altitude, the values should be modified.

## **Recommended Dietary Allowances**

The recommendations of the United Nations agencies and of the U.S. National Research Council for pregnant and lactating women have been summarized in Table 1 of this report (page 5). The Group considered that such standards should serve as guidelines in the Region. Since in many areas current supplies and food habits fall far short of the ideal, it may be necessary to adopt, as an immediate practical aim, standards which conform more closely to the present situation. Such practical standards have been devised locally in several of the countries concerned. In ordinary use, it is helpful to translate nutrient requirements into terms of foods in local supply.

## **Family Planning**

Sufficient evidence now exists that too many pregnancies too closely spaced result in impairment of fetal growth, increased infant and maternal mortality, potentially greater poverty and malnutrition for the present as well as the future generation. The need to space pregnancies therefore forms an essential part of nutritional rehabilitation.

Family planning services should be available as a part of all health programs. It is important also that such services should cater to adolescents whom in many societies are contributing an increasing proportion of pregnancies and who form a well recognized high-risk group.

Pregnancies in adolescents, pregnancies which are so closely spaced as to prevent adequate nutritional recovery, and an excessive number of pregnancies among mothers who are already burdened by their family responsibilities can all be causes of malnutrition.

Successful family planning procedures gain time which is essential for the successful implementation of nutritional services.

According to present evidence, intervals between pregnancies (birth to conception) of less than 24 months are associated with definite impairment of reproductive efficiency and, almost certainly, with a mounting incidence of maternal malnutrition.

## V. LOCAL HEALTH ACTIVITIES IN RELATION TO MATERNAL NUTRITION AND FAMILY PLANNING

The health services in the different countries of the Region vary considerably in level of services provided, coverage, and available resources. This section refers to those located in rural areas, in urban centers and, increasingly, in marginally urbanized areas adjoining the major cities. In all cases, however, local health services are understood to be those where trained health personnel and resources actually reach the people in the community.

Within the framework of a general health program, there is need for better utilization of the full range of basic services for the implementation of family planning activities. One of these services is maternal and child care, where nutrition and family planning are especially needed for pregnant and lactating women. These activities are also of the utmost importance for future parents of all ages, particularly the adolescent, a previously much neglected group. This need is increasingly appreciated as evidence is accumulated of the high incidence of maternal mortality, low birth weight babies, infant mortality, and the potential long-term harmful effects on mental development and maternal nutritional depletion. The high incidence of malnutrition in preschool children occurs particularly in families where mothers are both malnourished and whose pregnancies have been too closely spaced. Although the specific and detailed ways that nutrition exerts its influence on the outcome of a pregnancy for both the mother and her child are still poorly understood, the knowledge and insights already at hand are sufficient to point out the empiric steps required to remedy the situation.

Combined nutrition and family planning activities in health services are rare anywhere, and there is an urgent need to undertake all necessary steps to activate this program area by means of suitable training and orientation of personnel and the development of appropriate guidelines. These efforts should include the whole regional health team—that is, professionals in all aspects of public health, from physician to nutritionist to social service worker, together with nurses, dietitians, health aides, midwives, and other relevant staff.

The incorporation of maternal nutrition and family planning within basic health services offers a greatly increased opportunity for education in nutrition and in family life, including sex education. Additionally, the collection of data concerning the nutrition of pregnant women and the

outcome of their pregnancies not only assists in the collection of regional and national vital statistics, but also offers an opportunity for very important research into community nutrition and health problems.

### **Selection of High-Risk Cases**

Obstetricians have long recognized that certain categories of women fall into a high-risk group which can be defined without special laboratory resources. These include women with an unsatisfactory previous obstetric history, primiparae (especially when unusually young or old), cases of high parity, and women of poor physique and general health, especially when pelvic abnormalities may be present. The nutritional significance of some of these categories is obvious.

Further evidence of possible nutritional handicaps should be sought by inquiry into the size and composition of the family, the number of working members and the income available, and the state of housing with special reference to cooking facilities. It is also useful to find out whether the mother has duties outside the home, which—although they may add to her material resources—may prevent her from spending enough time on the care and feeding of herself and her family.

### *Physical Examination*

The physical examination should include a search for physical signs and symptoms of nutritional importance, as well as for signs that are usually considered during antenatal and postnatal care. These have been described by a WHO Expert Committee (43) and in a WHO Monograph (40). Selection of the appropriate signs to look for will depend on local nutritional problems in the area, as judged by the health authorities.

Measurements of height and weight should always be made, using reliable equipment which is periodically checked, and taking care to standardize the conditions (especially shoes and other clothing worn) as much as possible. Measuring height and weight accurately is not as easy as it sounds, and clinical personnel should be trained in the procedures and in the evaluation of the resulting records.

Height (in relation to the distribution of heights in the community) is a useful general indicator of past growth and hence of long-term food habits. Unusually small height may indicate subsequent obstetric difficulties, especially in women who have not previously borne children. The weight for height ratio should be determined, using a standard such as that in Table 7 (p. 26), to quantify undue obesity or thinness. Weight should be measured at each examination to assess the gain during pregnancy, the data being recorded on a chart such as that shown in Figure 4 (p. 28). An unduly poor gain is suggestive of poor nutrition, while an unusually rapid gain, especially if it starts abruptly after a previous lower rate of gain, may indicate incipient pre-eclampsia. It is useful to weigh mothers attending

child welfare clinics, to see if lactation is associated with excessive loss of weight (some weight loss during the first two or three months of lactation is probably to be regarded as physiological).

Measurement of arm circumference may be a useful and relatively simple indicator of depletion of protein, in the form of muscle, or of calories in the form of subcutaneous fat (40).

### *Biochemical Investigation*

If facilities permit, estimation of hemoglobin (or micro-hematocrit reading) should be included, in addition to routine urinalysis.

### *Dietary History*

Exact dietary surveys involve methods which are time-consuming and require highly-trained personnel. In clinical circumstances, it is useful to take a short (24-hour recall) dietary history which will serve to give some idea of the ordinary eating habits of the mother, and which may reveal defects that require correction. Such diet histories should be obtained routinely at an early stage of pregnancy and again, if possible, at a later stage and also during lactation.

## **Dietary Supplementation**

In situations where there is a clearly defined and widespread dietary deficiency of calories and nutrients, especially protein, at the community level, it may be assumed that such restrictions will have an important impact on pregnant and lactating women in view of their increased physiological requirements. Under such conditions the utilization of dietary supplements should be considered on a temporary or permanent basis depending on the nature of the problem and the resources available. Such supplements can take the form of foodstuffs, preferably of local origin, specific nutrient preparations, or the fortification of dietary staples. Regardless of the form that such supplements take, where there are serious dietary deficiencies in the pregnant and lactating groups procedures should be initiated to assure that the necessary dietary supplements are made available to them, in relation to measurable nutritional needs. For convenience these supplements can be considered under the headings of foods, nutrient supplements, and fortification procedures.

### *Foods*

These are usually provided to meet needs of calories and protein and should be preferably derived from local sources and be an accepted

element of the traditional diet. Rations of foods destined for use by the mother should realistically take into account their probable distribution within the entire family. When local resources are not available, external assistance should be considered, as substantial supplies of specific foodstuffs are available through bilateral and international technical assistance agencies. The World Food Program (WFP) offers potential food resources for maternal and child feeding programs which are of a magnitude to guarantee extensive coverage and long duration (five years). To date several countries have initiated widespread feeding programs using WFP commodities, always however with careful attention to phasing out these resources and replacing them with local products at the end of the period specified.

### *Nutrient Preparations*

These may include various vitamin and mineral supplements, depending on the nature of identified deficiencies or potential needs. For the prevention of deficiencies conducive to nutritional anemias, the PAHO Scientific Group (1968) on this subject recommended: "Pregnant and lactating women should receive supplements containing 60 mg of elemental iron and 100 micrograms of folic acid per day throughout pregnancy and during lactation" (35).

The PAHO Technical Group on Hypovitaminosis A in the Americas (1968) does not recommend administration of vitamin A to pregnant women beyond the daily allowances recommended by the Joint WHO/FAO Expert Group on vitamin requirements which are those for the normal adult (31). On the other hand, the PAHO Technical Group does suggest that lactating women be given an oral dose of 100,000 I.U. of water-miscible vitamin A immediately after delivery, to protect the child during the first weeks of life. This can easily be done through maternity services. The same Group also suggests that the collaboration of traditional midwives be enlisted in referring lactating mothers to health centers for preventive dosage (31).

The newborn child should not be given a high dose of vitamin A since the very young seem particularly susceptible to hypervitaminosis A.

In areas where endemic goiter and cretinism exist, special attention should be given to assuring an adequate intake of iodine. In many countries, iodization of salt has been effectively implemented, but in others large segments of the population at risk have no supplement of this mineral. In such areas alternate methods may be considered such as the use of intramuscularly injected iodized oil to all the female population of child-bearing age. Trials in Ecuador and Peru have demonstrated that this method is effective in preventing goiter in young subjects and substantially reducing the prevalence of goiter in the general population. Present evidence indicates that it is completely effective in preventing classical endemic cretinism in the offspring of affected populations.



### *Fortification and Enrichment*

A further method by which nutrient supplements can be made available to the mother is through fortification and enrichment of certain foods. Clearly this approach is not specific for any group within the population; however, the deficiencies prevalent in the women of child-bearing age are likely to affect the rest of the population. Also any investment in this area will therefore carry general nutritional benefits for the community as well as helping to meet the specific needs of the mother.

### **Education in Nutrition and Family Life**

Nutrition education should be geared to existing dietary patterns and intake recommendations for pregnancy and lactation. The emphasis should be on the use of locally produced foods and within the range and constraints of family economics and the indigenous patterns and food customs. For the "new townsman" (rural migrant recently settled in an urban or periurban community) this would incorporate consumer education.

Education should be undertaken through local health services, especially prenatal and pediatric clinics, nutrition rehabilitation centers, etc. In addition, approaches should be made through primary and secondary schools (where it would include home economics), women's clubs, and community centers, groups and clubs for both males and females.

The need to reach the adolescent is recognized to be of great importance, and in addition to the approaches previously mentioned the organization of special groups must be considered, together with the full use of mass media.

### **Family Planning**

Spacing of pregnancy is needed to allow complete nutritional recuperation, permitting dietary supplementation and nutrition education to become effective. This usually requires at least two years (birth to conception).

The total number of children is also important and consideration should be given to family size limitation after the desired number of children has been reached, to protect both the mother and her family on a permanent basis.

## VI. THE NEED FOR FURTHER KNOWLEDGE

The evidence cited in previous chapters—and much that has not been mentioned in this report—leaves no doubt as to the importance of nutrition in relation to maternity and family planning. Further action can and should be based on existing knowledge. Yet so much of this knowledge is fragmentary and incomplete that the importance of further research can scarcely be overemphasized.

It is not possible, in a report of this kind, to specify in detail what work needs to be done, how it should be organized, and what priorities should be allocated. Attention will be drawn to some of the general topics which assumed importance during the deliberations of the Technical Group.

*Operational research*—in which the basic data may often be collected during routine clinical and public health work—is perhaps first in importance. The effect of every new health program should be evaluated, and this means collecting the necessary information and analyzing it at intervals in order to assess progress made, if any. There should be systematic collection of birth and death statistics, anthropometric statistics relating to parents and the development of their children, clinical statistics which will help to delineate the main medical problems, and information relating to the economic, environmental and dietary background of communities. The routine data-collecting machinery should be established, so far as possible, on a continuing basis, by using regular health personnel as the principal collectors. By such means, it becomes possible not only to assess the current situation, but also to measure changes which occur with time, and to estimate the effect of new factors as they are introduced into the community. Such systematic data collection not only helps health personnel to monitor their activities, but also sharpens observation and assessment by such personnel during the course of routine work.

To be useful, however, the data collected must be analyzed. The Group was of the opinion that in many areas of the Region there are probably useful data lying, unused, in the archives. This appears to be true even of research institutions, since financial support is more readily obtained for the collection of information than for its systematic analysis. Thorough analysis of data may be as expensive and time-consuming as the original collection, and usually requires the advice and services of experienced investigators as well as the necessary analytical equipment. It is almost certainly true to state that the analysis of existing data would provide

answers to several questions on which there is at present, remarkably little information: for example, the heights and weights of adults in various communities, the amount of weight gained by pregnant women in different groups, the effect of repeated maternities on maternal weight-for-height, the birth weights of babies and their subsequent growth and development.

The assembly of such "basic" information—not only with regard to the physical measurements of parents and children but also with respect to their dietary habits, hemoglobin levels, and so on—must be regarded as a matter deserving the highest priority. It is the only way of developing practical norms which are related to the present situation and the immediate possibilities in various communities. As has been indicated in Chapter IV, it is necessary in the absence of practical, locally relevant guides to action, to rely upon standards intended primarily for application in technically advanced countries which may be remote from the immediately practical possibilities in poorer countries.

*Basic research*—into such problems as, for example, changes in body composition during pregnancy; the composition of the placenta in relation to its function; the quantity and chemical composition of breast milk and their relation, if any, to breast feeding habits and the development and health of the child; the effect of contraceptive practices on lactation and on maternal physical and psychological health—should not be neglected either. While it is probably inevitable that much of such work will be carried out in technologically advanced countries, the point should be made that certain nutritional problems can only be fully and economically studied where serious malnutrition is widespread. Fundamental research in developing countries is of general, and not merely of local importance. Since such research usually involves complex scientific skills and resources, it must necessarily be undertaken by universities and research institutions, preferably in close collaboration with their local health service organizations. The practical problems encountered in service often stimulate and focus "basic" research; and, conversely, the products of basic research often suggest ways of improving services.

It follows, from what has been said, that research is most profitable when it involves teamwork, whereby many different types of scientific discipline are brought to bear on a constellation of problems in one community. It is highly desirable to encourage the development of a few centers (by which we do not necessarily mean centers of advanced scientific technology), rather than to dissipate energy and resources over disparate problems and geographic areas in which circumscribed pieces of work are undertaken in isolation from each other. In the words of the WHO Expert Committee on Nutrition in Pregnancy and Lactation (1965): "Without well-organized and sustained teamwork, the problems of nutrition in relation to human pregnancy and lactation will continue to be elucidated in a piecemeal, erratic, and sometimes misleading fashion."(2)

The best research will be undertaken where there are people with the necessary curiosity and the desire to undertake investigations. The Group

urged that PAHO should continue its attempts to locate such people, to help them to initiate and develop worth-while research activities, and to coordinate their efforts. At the same time, available research results, which can be applied through health services, should be tested under field conditions in pilot projects.

## VII. CONCLUSIONS

The evidence reviewed leaves no doubt that the nutrition of pregnant and lactating women is seriously defective in most, and perhaps all the countries within the Region. This results in poor physique and health among the mothers and in poor growth and development and very high mortality rates among their infants. Mothers who are unable to plan and limit the size of their families contribute disproportionately to the toll of morbidity and mortality.

There is, accordingly, an urgent need for all possible measures, at the local as well as the national level, to improve the situation. In addition to measures which will enable families to obtain diets of better nutritive value, it is necessary to disseminate education which will increase the effectiveness with which available supplies are used. This means using all possible media and not merely increasing the flow of advice given by health authorities. To be effective, education should be realistic in terms of the resources, customs, and beliefs of the communities concerned.

There is ample evidence that pregnancies in rapid succession can seriously affect both the mother and subsequent offspring. Further, families with very large numbers of children have the added difficulty of obtaining sufficient quantity of nourishment.

It is evident, then, that the inability to plan and limit the size of families in accordance with the wishes and resources of the parents is a major cause of nutritional impairment, especially among mothers and young children. The removal of barriers to family planning should be an essential aim of all health services, and of educational services in general. Progress toward this goal may make a bigger contribution to nutritional and other types of welfare than any other single measure.

There is already sufficient factual information to justify a sustained effort toward improved health, nutritional, and family planning services, but to make progress possible serious inadequacies of information remain to be corrected. For this reason, "operational" as well as "basic" research should be actively promoted in order to uncover new possibilities and to measure present achievements.

Progress cannot be made without an adequate supply of skilled manpower. Though much can be done with present resources, by improved orientation and organization, it will be necessary in many areas to assess the manpower needs before embarking on expansion of services, and to provide for the education of the medical, paramedical, and other service personnel that will be required.

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## Appendix

### REPORT OF CURRENT STUDIES OF MATERNAL NUTRITION STATUS IN THE U.S.A.

Edwin M. Gold, M.D.\*

The impetus for current studies of maternal nutrition status in the United States stems from the growing realization that the ultimate quality of the product of gestation can only be as good as the quality of the ingredients which produce it, and that the reproductive efficiency of the parents is dependent upon their total health experience. This involves not only their growth, development, and educational, emotional, and socio-cultural experiences up to the time of conception, but also their nutritional background and know-how as well. Thus, expanded pre- and interconceptional nutritional guidance and therapy are emerging as integral parts of total maternity care, relative to the mother, the infant, and the family.

Most nutrition surveys in the United States have revealed that the nutritive values of diets show an obvious gradient with socioeconomic status, whether in or out of pregnancy. Low birth weight incidence in any obstetric population likewise shows a gradient with socioeconomic status and ethnicity as well. Right now, in this country, low birth weight incidence has steadily risen to the current level of 10 per cent of live births, but with a figure of 7.5 per cent for the white versus almost 16 per cent for non-white births. Infant mortality likewise shows a 2 to 1 differential, with a rate of 22.3 for white births and 41.3 for the non-white.

At a recent meeting on "Why Babies Die," sponsored by the National Institute of Child Health and Human Development, a group of leading clinical investigators reached consensus that poor maternal nutrition, whether from insufficient food or bad eating habits, plays an important role in our nation's high infant mortality rate. Dr. G. B. Avery, of Johns Hopkins University, reiterated that women from the lower socioeconomic

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groups have an infant mortality nearly twice that of the more affluent members of society. Dr. P. Andrews, of the University of Louisville School of Medicine, suggested that improving maternal nutrition with multivitamins, iron, and protein supplements very early in pregnancy, preferably before conception in high-risk women, would reduce the number of high-risk infants and infant mortality. He also suggested that, in the light of the greatly increased numbers of teenage pregnancies, pediatricians must share in the responsibility of assuring the adequate nutrition of teenagers in this country. Dr. M. Valdés-Dapena, reporting from Temple University on the results of autopsies in 501 neonatal deaths, indicated that she believed maternal nutrition has an important effect on infant mortality. Many of the mothers of the infants that died were 13-16 years old and came from areas with deprived living conditions. To reduce neonatal mortality in this group, she recommended protein supplementation and nutrition education. Dr. B. Weisskopf, from the Child Evaluation Center at the University of Louisville, concluded that insufficient protein intake is a major cause of toxemia of pregnancy and thus responsible for many premature births and high-risk infants (1).

Geographic areas in the United States with the lowest per-capita income and the greatest poverty have the highest infant mortality rates. In general, states with the highest per-capita incomes have the lowest infant mortality and those at the bottom of the economic ladder, the highest (2). Illustrative of this are data compiled in the *Statistical Abstract of the United States 1967* (3). In 1965 Connecticut was ranked number one as the state with the highest per-capita income (\$3,401) and the lowest infant mortality per 1,000 births: 20.3 for white births and 36.9 for the non-white. Mississippi, ranking 50 among the states, had the lowest per-capita income (\$1,608) and the highest infant mortality: 24.5 and 54.4 for white and non-white births, respectively.

Increasing attention is being focused on the effect of poverty on the health of the mother and the development of her offspring. Early in 1969, Dr. Charles U. Lowe, scientific director of the National Institute of Child Health and Human Development and Chairman of the Food and Nutrition Council of the American Academy of Pediatrics, testified before the Senate Select Committee on Nutrition and Human Needs. He stated that "malnutrition, high infant mortality and prematurity rates, and high levels of mental deficiency coexist as a constellation of abnormalities that are most frequent among families living in poverty." (4) There is now evidence, he said, that:

a) When a fetus receives inadequate nutrition *in utero*, the infant is born small, the placenta contains fewer cells than normal to nourish him, and his growth is compromised.

b) When an infant undergoes nutritional deprivation during the first months of life, his brain fails to synthesize protein and cells at normal rates and consequently suffers a decrease as great as 20 per cent in the cell number.

c) Severe malnutrition suffered during early infancy affects learning ability, body growth, rate of maturation, ultimate size, and if prolonged, productivity.

Current research indicates that maternal deprivations before and during pregnancy, as well as infant deprivations in the neonatal period, can seriously, and possibly irreversibly endanger the mental and physical development of the child. R. L. Masland, in a preliminary review of data on 60,000 expectant mothers and their babies collected during the Cerebral Palsy Collaborative Study, recently reported (5), among other findings, that:

a) Nineteen mothers on protein deficient diets during pregnancy had children whose IQ's at age 4 were 16 points below the average of children born to women on more normal diets. Non-whites outnumbered whites more than four to one among the protein deficient. This suggests that some slow learning responses observed among children living in poverty could be accounted for by the malnourished state of their mothers during pregnancy.

b) Most neurological problems were due to increased prematurity (frequently caused by malnutrition of the expectant mother). The 3-year-old children in the study who survived severe hypoxia during birth showed only minor neurological defects.

Zamenhof and his associates at the University of California School of Medicine, in a series of experiments with rats, demonstrated that maternal dietary protein restriction has a significant effect on brain-cell number of the offspring. These investigators point out that neurons essentially do not divide after birth. Thus, a neuron deficiency at birth may persist throughout life and may contribute to impaired behavior of the offspring of protein-deficient mothers. In their experiments, groups of rats were pair-fed diets containing 8 per cent and 27 per cent protein, respectively, throughout gestation. Offspring of low-protein mothers had significantly lower body weights, brain weights and most significantly, low DNA and protein contents in the brains, as compared to offspring of the high-protein group. It is not known if these changes are irreversible or merely represent a delay in maturation, but abnormalities of gait and response to stimuli in the deficient animals when evaluated at 3 months of age were noted (6).

Churchill and his associates from the Wayne State University School of Medicine in Detroit further corroborate the effects of protein deprivation during human gestation. These investigators (7) reported the following in a recent study of the relationship between maternal dietary intake, blood levels of free alpha amino acids, serum proteins, and infant birth weight, length and cranial volume:

a) Mothers with amino acid levels above 4.0 mg/100 ml during the last trimester were matched with mothers with lower amino acid levels,

according to dietary intake, serum albumin, serum globulin, height, pre-pregnancy weight, weight gain during pregnancy, and length of gestation.

b) Mean birth weight of infants whose mothers had high amino acid levels was 3.43 kg, versus 3.06 kg for mothers with low amino acid levels. These differences were statistically significant.

c) The mean cranial volume associated with high amino acid levels was 472 cc, and with low amino acid levels only 426.2 cc, which was statistically significant.

d) Duration of pregnancy, infant length, and plasma albumin content were not statistically different between the two groups.

e) While birth weight, cranial volume, and fetal length were not significantly related to the estimated dietary intake of protein or to blood albumin levels, dietary diaries did show a trend toward a relationship between amounts of ingested amino acids and birth weights. Of the mothers with high blood amino acid levels, 46 per cent ingested more than 70 gm of protein daily. Only 33 per cent of the mothers with low amino acid levels had protein intakes of 70 gm daily.

Another current study relates maternal malnutrition to reduced numbers of placental cells. On this cooperative study made in Guatemala by the Institute of Nutrition of Central America and Panama, the National Institute of Child Health and Human Development, and the University of Iowa, Dayton and his associates reported the following at a recent meeting of the Federation of American Societies for Experimental Biology (8):

a) In order to establish placental differences that could result from maternal nutrition status, placentas from a malnourished, low-income group of mothers in Guatemala, whose diets were significantly deficient in calories, protein, riboflavin, and vitamin A, were compared to placentas from a well-nourished, middle class group of mothers in Iowa City, U.S.A.

b) The two groups of placentas, all from term pregnancies, were analyzed in the University of Iowa Laboratories, for water, fat, protein, ash, DNA, hydroxyproline, and trace minerals.

c) The Guatemalan placentas (G) contained only 70 per cent of the number of cells found in the Iowa placentas (I). Despite containing fewer cells, the G placentas were equal in cell mass to the I placentas. The cells of the G placentas were 139 per cent as large as those in the I placentas.

d) The G placentas contained less protein, DNA, potassium, sodium, magnesium, iron, and selenium.

e) The G infants weighed 388 gm less at birth than the I infants.

At the same meeting, Dr. M. Winick, of Cornell University Medical College, reported (9) that malnutrition either *in utero* or immediately after birth retards the rate of cell division and results in a permanent deficit in total brain cell number. He reported further that the smaller the infant at birth the more severe the effect on ultimate brain cell number.

Human as well as animal studies demonstrate that fewer brain cells develop in fetuses and newborn infants deprived of adequate nourishment, resulting in retarded brain growth which is irreversible.

Winick, also, in a recent publication (10) critically reviewed the pertinent studies relating to nutritional deprivation and brain development. In his comments, the author poses three questions: (1) Does malnutrition itself produce significant brain changes? (2) If so, are these changes functionally important? (3) Is there a time during development when the brain is most susceptible to these changes? In his answers, Winick points out that both animal evidence and human data demonstrate physical and chemical changes in the brain and isolate malnutrition as the offending agent. However, the human data are weakest in answering the first question because the complex of existing socioeconomic pathology and other consequences of poverty in the U.S.A. and other countries make it impossible to isolate malnutrition as the sole etiologic agent. That the brain changes are functionally important seems to be increasingly clear, yet here too, more proof should be collected. The data reviewed does support the thesis that the time element is critical. The evidence appears definite that the earlier the malnutrition, the more severe and the more permanent are the effects.

In recent years we have come to recognize the greater obstetric vulnerability of certain population groups in the U.S.A., particularly the medically indigent, the nutritionally deprived, and predominantly non-white. This segment of the obstetric population has been identified as "high-risk." The nutritionally vulnerable cohort, due to environmental and other factors, includes most prospective mothers from lower socioeconomic groups, teenagers who become pregnant during adolescence, and those who are either overweight or underweight.

Time does not permit me to document the obstetric pathology, fetal wastage, and neonatal mortality and morbidity prevalent in the pregnant adolescent. Suffice it to say that in this country, irrespective of socioeconomic strata, the adolescent girl tends to have the poorest diet of any member of the family. In these girls the stresses of pregnancy are added to their nutritional needs for body maturation and are often superimposed on pre-existing poor nutritional status.

The other important segment of the nutritionally vulnerable cohort is the underweight woman. The immediate pregravid weight is probably a good reflection of nutritional and metabolic status. Many studies of the underweight gravida reveal an association between their deficient nutritional status and pregnancy outcome. Again, time does not permit complete documentation, but one recent study is most germane.

Eastman and Jackson (11) studied the relationship of pre-pregnancy weight to birth weight in full-term pregnancies terminating between the 39th and 42nd week inclusive, at the Johns Hopkins Hospital. The retrospective study included 6,675 white gravida and 5,236 non-white. Birth weight in 100 gm groupings was available in all cases. Among the major findings in the study were:

a) Low pre-pregnancy weight (under 120 lbs) coupled with low weight gain (under 11 lbs) is associated with a high incidence of low weight newborn in white women and with an extremely high incidence in non-white.

b) Progressive increase in pre-pregnancy weight was also paralleled by progressive increase in mean birth weight and a corresponding decrease in the incidence of low weight newborn.

c) These two factors, weight gain and pre-pregnancy weight, act independently of each other. Therefore, when acting jointly, they become additive in their effects—large infants resulting when both are high, small infants when both are low, and average sized babies when one is high and the other low.

Finally, I would call attention to the exhaustive review of folic acid deficiency in pregnancy, in which Kitay (12) critically reviews an extensive literature on the recognition, pathogenesis, consequences, and therapy of this deficiency state in human reproduction. The author points out that folic acid deficiency, incorrectly considered an uncommon pregnancy complication, is in truth probably the most common water-soluble vitamin deficiency state in the U.S.A. It is an even greater cause for concern among pregnant women, not only because it is such a common pregnancy complication caused in part by malnutrition, but also because folate requirements in pregnancy are 10 times greater than in the non-pregnant woman. In addition, closely spaced pregnancies and multiple pregnancies further accentuate the problem of increased demand.

These studies not only imply the association between maternal malnutrition and protein deprivation and pathological fetal physical and neurological growth and development, but also present clues relating to prevention. This would suggest that elimination of malnutrition, prenatally and in infancy, should be a top-priority public health objective.

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