COMMITTEE V
The Human Food Chain

DRAFT - 9/15/87
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GLOBAL DIMENSIONS AND PHYSIOLOGICAL ASPECTS OF MALNUTRITION

by

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The Sixteenth International Conference on the Unity of the Sciences
Atlanta, Georgia November 26-29, 1987

Malnutrition is the major health problem facing the world today, There is no sound way to arrive at the number of malnourished. This is partly a result of inadequate criteria, seasonal variation and the fact that malnutrition is difficult to define and measure. Widespread malnutrition due to a lack of essential food nutrients has been common throughout modern history. It is worldwide, occuring in almost every country. It is estimated that 50 percent of the world's population will sometime during their lives have suffered from malnutrition, that is, an overconsumption or an underconsumption of nutrients essential for normal development and good health. Children severely malnourished have a 20 times greater probability of dying than their normal peers. A major study by the Pan American Health Organization in Latin American

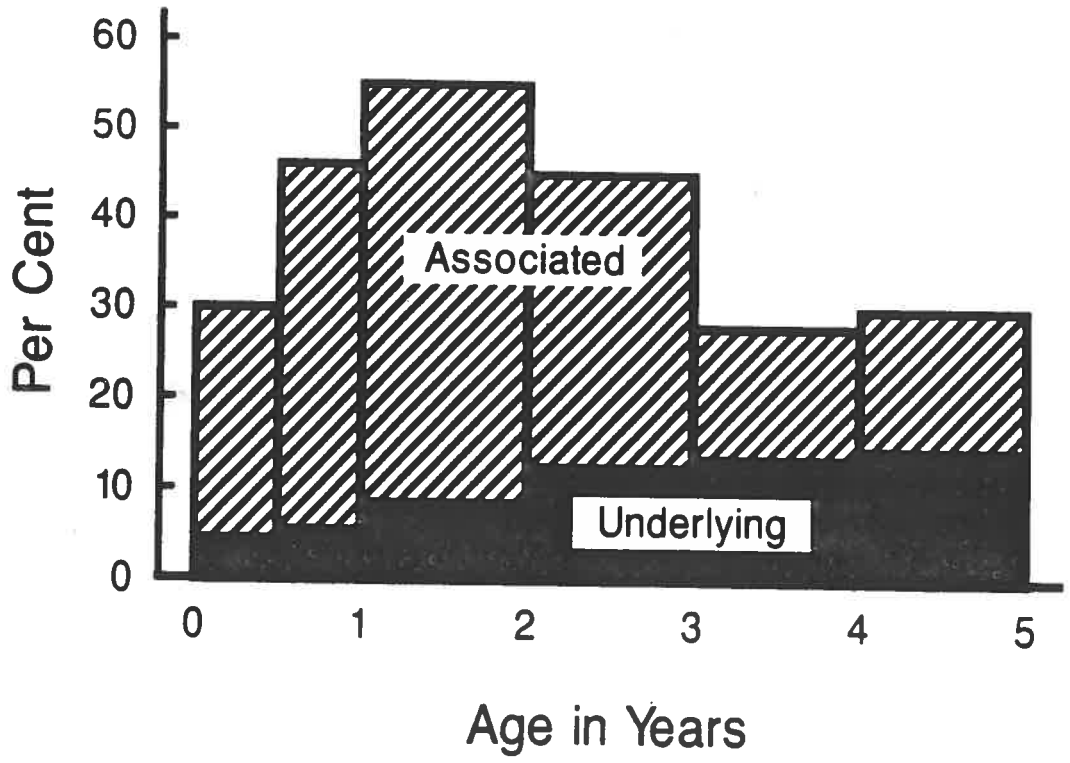


Figure 1.1 Percentage of Deaths of Children with Nutrition as Underlying or Associated Causes.

countries showed (Puffer and Serrano, 1973) malnutrition as the underlying cause of more than 50 percent of the deaths of children. For each death it is estimated that four or five who survive may have possible permanent impairment, physical or mental or both.

Countless millions die from illness because they are too weak to resist disease caused by inadequate nutrition. Infants, children, pregnant and lactating women are most vulnerable to malnutrition. Malnutrition is a major contributing factor to a high incidence of childhood diseases such as diarrhea, measles, whooping cough and others that contribute to high death rates of infants and young children. The problem of widespread malnutrition is not simply a result of inadequate global food production, but rather of the inequable distribution of food resources and of poverty.

The World Bank (1986) estimates that there are 87 countries where malnutrition is prevalant and is a serious problem hindering economic and social progress. In general, these are also food-deficit countries, most of which lack currency for the importation of food.

The major regions of malnutrition are in the tropics, that is, most of Africa, Central and tropical South America, and subcontinent of India (Figure 1.2).

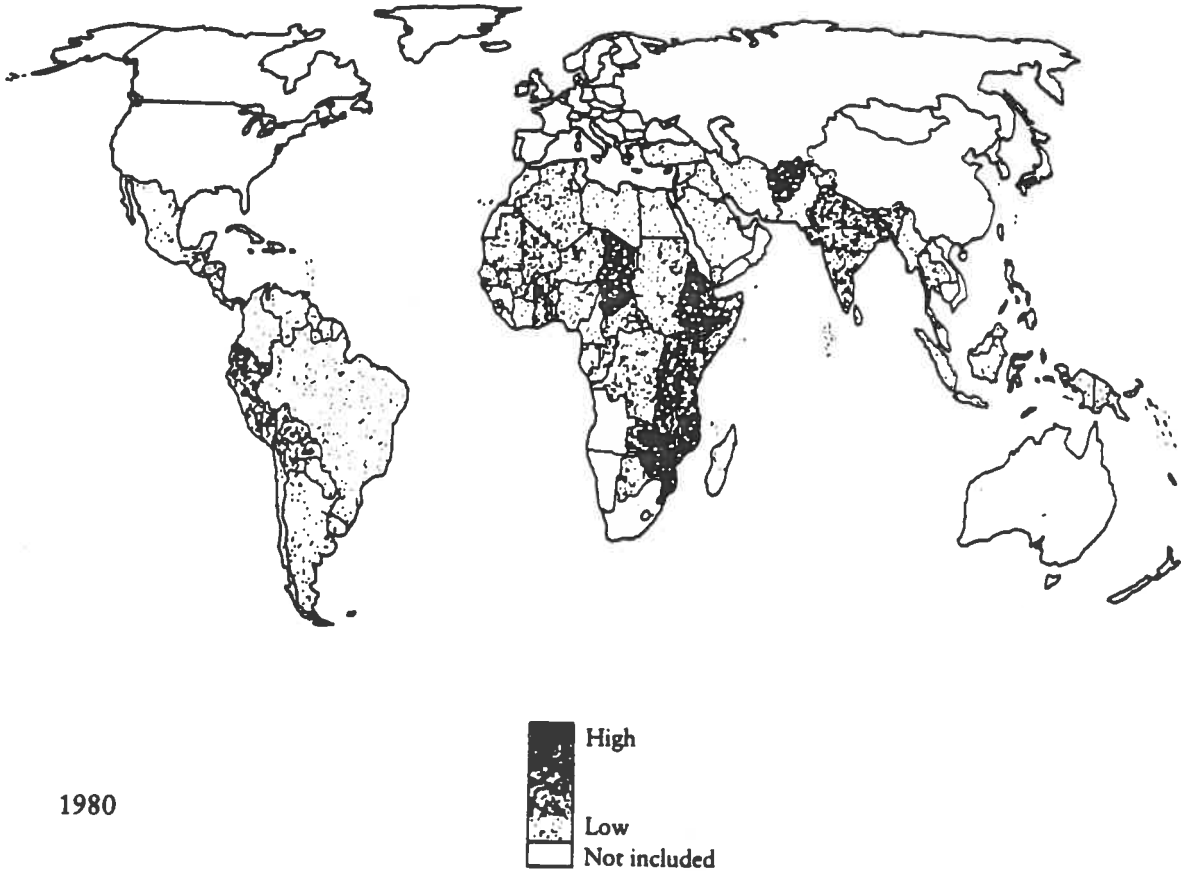


Figure 1.2 Regions of Food Deficient Diets.

The high incidence of malnutrition in these countries is closely correlated with a deficit in food production. Even in those countries that are self-sufficient in food production, there may be significant numbers of people who are malnourished because of inequitable distribution of food resources within those countries.

However, as a result primarily of advances in agriculture in many countries there is now a substantial world surplus of food. Twenty-five countries including China and India, are exporters of grains (Abelson, 1987). Prospects are that for at least the next decade, world capability to produce food will increase more than population growth.

Not with standing the improved situation in food production, according to the World Bank (1986) there were 87 developing countries where nutrition was inadequate. In these countries 730 million people did not receive enough food in 1980 to allow for an active healthy life (Figure 1.3).

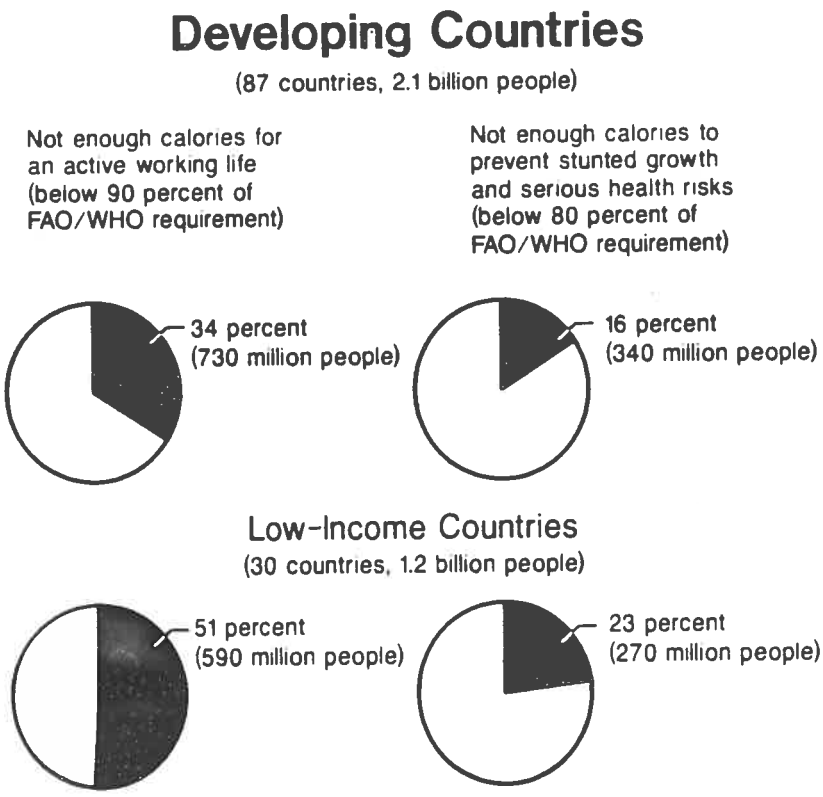


Figure 1.3 Prevalence of Energy-Deficient Diets in Developing Countries.

About two-thirds of the undernourished live in South Asia, one-fifth in Sub-Saharan Africa. Of the 30 lowest income countries, 51 percent of the population, 590 million people, are undernourished. In all, four-fifths of the undernourished live in countries with very low average incomes.

In the 87 developing countries during the period 1970 to 1980, there was a decrease in the percentage suffering from undernutrition from 40 to 34 percent (Figure 1.4)

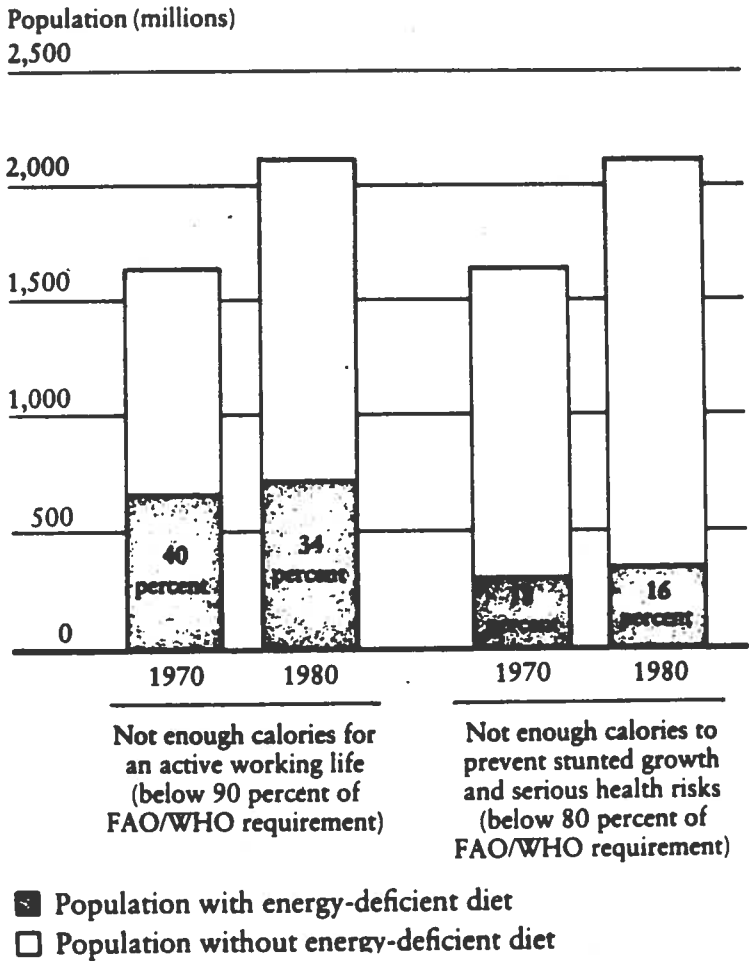


Figure 1.4 Changes in the Size and Share of Population with Deficient Diets in Eighty-seven Developing Countries.

The largest decline in the percentage of people suffering from malnutrition was in East Asia and the Middle East, regions that enjoyed rapid economic growth (World Bank, 1986). However, in South Asia, sub-Saharan Africa, the share of the population with deficient diets increased slightly, and the numbers increased markedly.

However, most of Africa is facing an unprecedented food crisis. Only recently emerging from scourges of drought and continuing wars, the outlook for the next decade is not promising.

POPULATION FACTOR

The earliest and most tangible result of development in Third World countries has been a steep decline in death rates, resulting in a rapid growth of their populations. Infant mortality rates in some Third World

countries may be 40 times that of some industralized countries (Table 1.1). Of the 81-plus million people added to the world's population in 1985, over 74 million were in developing countries where 75 percent of the population live.

From Figure 1.5 it is apparent that in some regions, food production has not kept pace with the increase in population. Thus, the per capita food available has actually decreased during the period 1970 to 1985 in Africa. Food production in the Saharan countries per caput has been declining since the late 1960s. The decrease has been accompanied by several fold increases in food imports, particularly cereals, and in some countries an increase in the rate of population growth. Some of these countries have population growth rates exceeding three percent per annum. At these rates, their population will double within less than a quarter century.

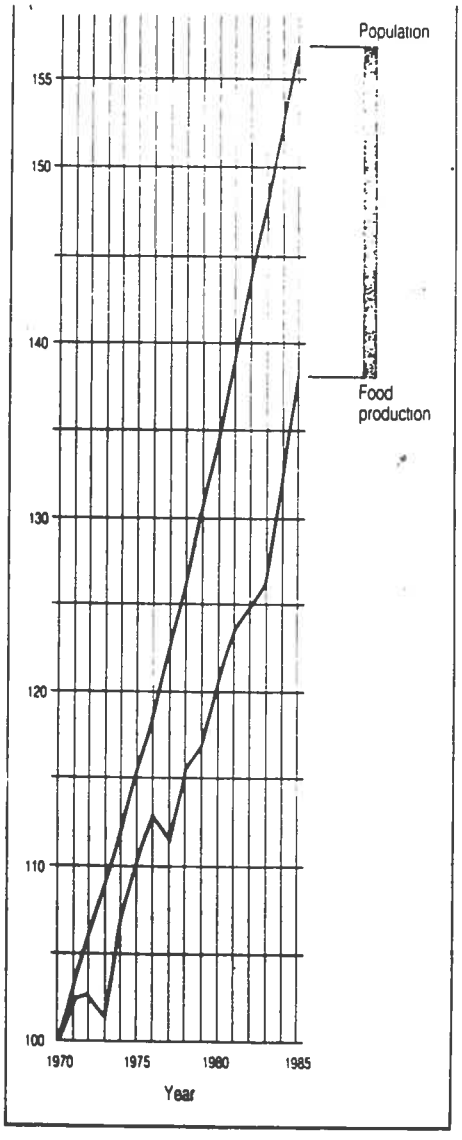


Figure 1.5 Gap Between Population Growth and Food Production, Africa, 1970 - 85.

INFANT MORTALITY

Infant mortality is highest in those countries having the lowest per capita income. It is here that malnutrition is most serious and, also, where health care is most lacking. Infant mortality in these countries may be 30-fold that in industrailized countries (Table 1.1)

Table 1.1 Infant Mortality/1000 Live Births 1986*.

Finland	6.0	Cuba	16.8
Japan	6.2	Costa Rica	19.3
Sweden	7.0	Kuawit	22.8
Iceland	7.1	Chile	23.6
Switzerland	7.7	South Korea	29.0
Norway	7.8	USSR	32.0
Denmark	8.2	Argentina	35.3
Netherlands	8.4	Thialand	51.1
France	9.0	Mexico	53.0
Canada	9.1	Guatemala	62.4
United Kingdom	9.4	Equador	70.0
West Germany	9.5	Brazil	71.0
Spain	9.6	Iraq	72.0
East Germany	9.6	India	118.0
United States	10.5	Pakistan	120.0
		Sierra Leone	200.0

*Population Reference Bureau.

Several countries have been successful in reducing infant mortality and malnutrition without solving the underlying problem of poverty. Several Third World countries, for example Chile, have been able to achieve substantial reduction in infant mortality (80 to 21 per 1000) with concurrent improvement in nutrition by food intervention programs. This is essentially a welfare program too costly for most Third World countries.

There is a high correlation between infant mortality and rate of population increase as well as GNP per capita (Table 1.2). In general those countries that have a high infant mortality have a low GNP per capita and a high rate of population increase (Population Reference Bureau, 1986). Low birth weight is much more prevalant in poor countries than in industralized countries. There is a strong association between birth weight and neonatal death rates. There is a post-neonatal mortality 11-fold differential between those weighing less than 2000 grams and those weighing 3500 grams or more at birth. There is a high correlation between the nutritional status of the mother and the weight of the newborn.

There are wide variations in child mortality within countries. Thus, in India, the state of Kerala has an annual death rate of children from birth to four years of 12.6 per thousand and 38.1 percent of the population with moderate to severe undernutrition. The corresponding figures for the state of Madhya Pradesh are 61.5 and 51.7 percent (Gopalan 1985). Country figures do not reveal the situation within individual countries, as practically all of them have pockets of malnourished caused by the inaccessibility to them of excess food produced within the country. While such countries as India and China with 38 percent of the world's population, have within recent years become essentially self-supporting in food production, malnutrition still exists, particularly in India, because of the inequitable distribution of resources.

The rate of population increase is much more rapid in the less developed countries than in the industrialized countries. In 1970, 67

Table 1.2. Population, Growth and GNP.*

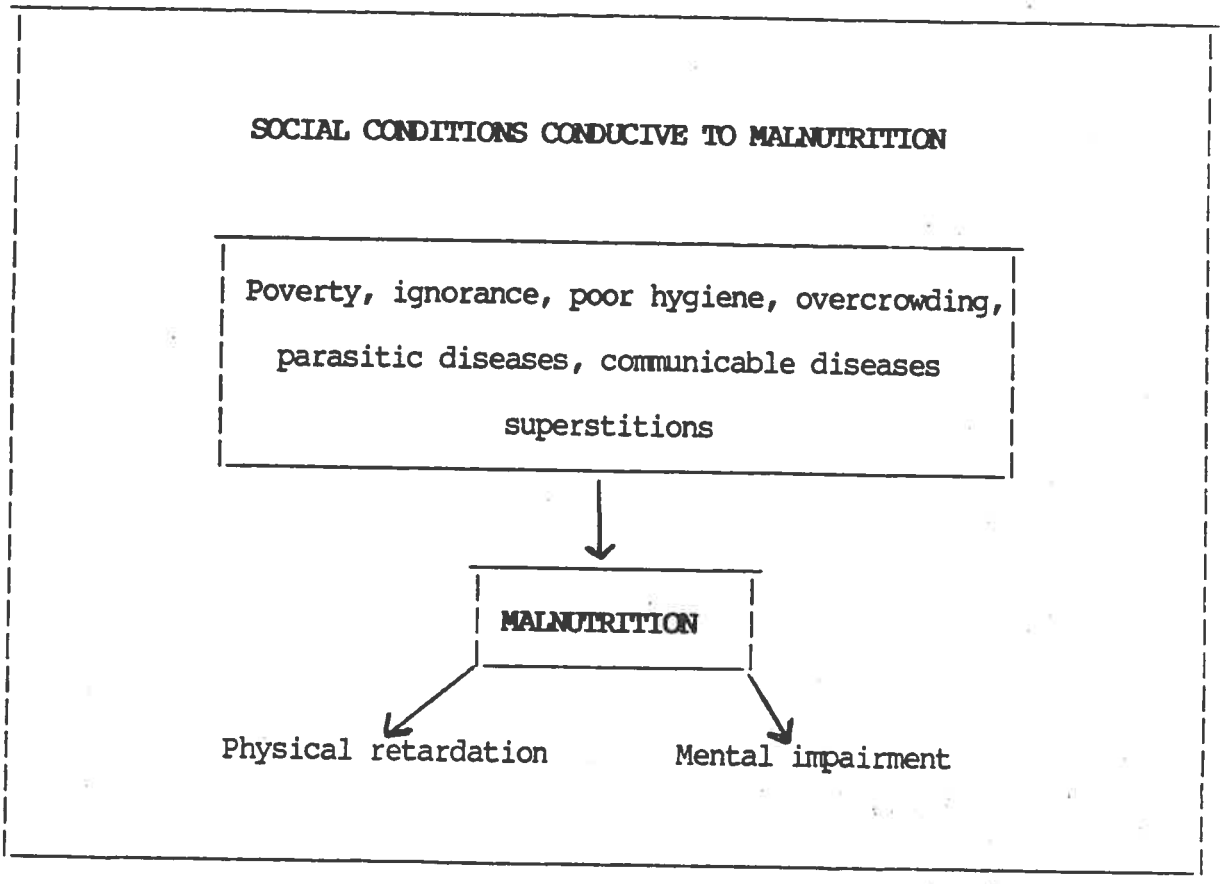
Country	Rate of Population Growth %	Years to Double	GNP per Capita U.S. $
Kenya	4.2	17	340
Egypt	2.6	27	690
Ghana	3.4	21	320
Liberia	3.0	23	710
Venezuela	2.7	25	3,830
Guatemala	3.1	22	1,110
Bolivia	2.8	25	480
Jordan	3.7	19	1,720
Syria	3.8	18	1,790
Pakistan	2.8	25	390
India	2.3	31	1,269
Mexico	2.6	27	2,180
Kuwait	3.2	22	16,200
China	1.1	65	3,705
Japan	0.7	107	10,100
Canada	0.8	87	12,280
United States	0.7	99	14,080
Sweden	0.0	6,930	12,440
United Kingdom	0.2	462	9,180

* Population Reference Bureau 1986.

percent of the world's population lived in the less developed countries, whereas at the present rate of population increase it is projected that by the year 2000, 79 percent will live in the less developed countries where malnutrition is most prevalent. Correspondently, the proporation of the world's population living in the industralized countries will decrease from 33 percent to 21 percent.

There is a vicious cycle of malnutrition and poverty as shown in Figure 1.6. Poverty, illiteracy, poor hygiene, parasitic disease, communicable diseases and superstitions all lead to malnutrition, which in turn leads to impaired physical and mental performance.

Figure 1.6



A very marked gap exists in the resources of the less developed countries and those of industrlized countries (Figure 1.7). The per capita income of industralized countries may be 15 or more times that of the less devoped countries (LDC). Deaths per 1000 live births may be ten or more times that of the devloped countries. Literacy rate in the LDC may be less than half of that in industralized countries. The lack of capital, an illiterate population and of other resources severely impede agricultural and industrial development.

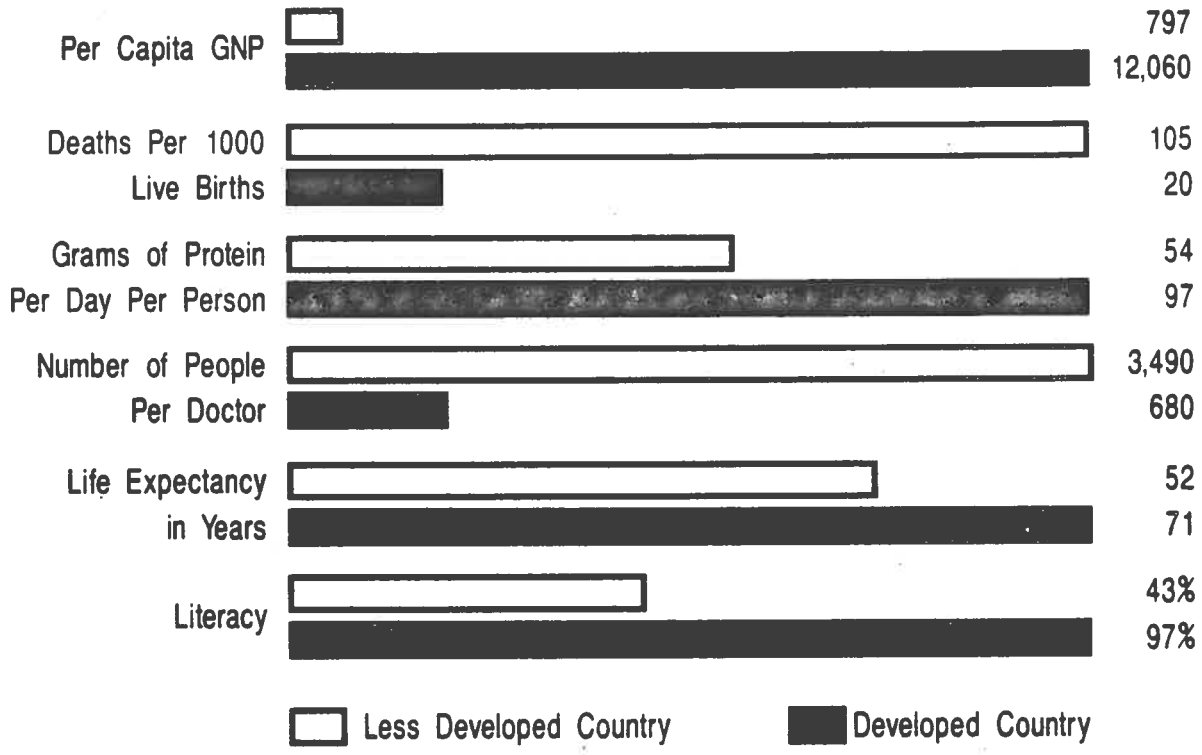


Figure 1.7 Gaps Between Developing and Developed Countries.

The vast majority of the world's population depends on cereals, including rice, as their main source of food. In those regions where soil and climatic conditions are suitable for cultivation, more edible nutrients can be produced per hectare by producing food crops that can be consumed directly than can be yielded by producing animals. For example, in the United States, of each thousand kilograms of maize available for use domestically it is estimated that not more than 75 kilograms are consumed directly in some form of food, while over 900 kilograms are fed to livestock, particularly swine and cattle. In Mexico about 900 kilograms are consumed directly as food. These figures are fairly representive of other regions of the world, including South Asia and Africa.

It is recognized that there are vast areas of land in all hemispheres that is not suitable for cultivation but which can best be used for grazing of meat livestock. The utilization of animals for the conversion of edible cereals into meat for human consumption is not an economical means of utilizing food resources. As seen in Figure 1.8

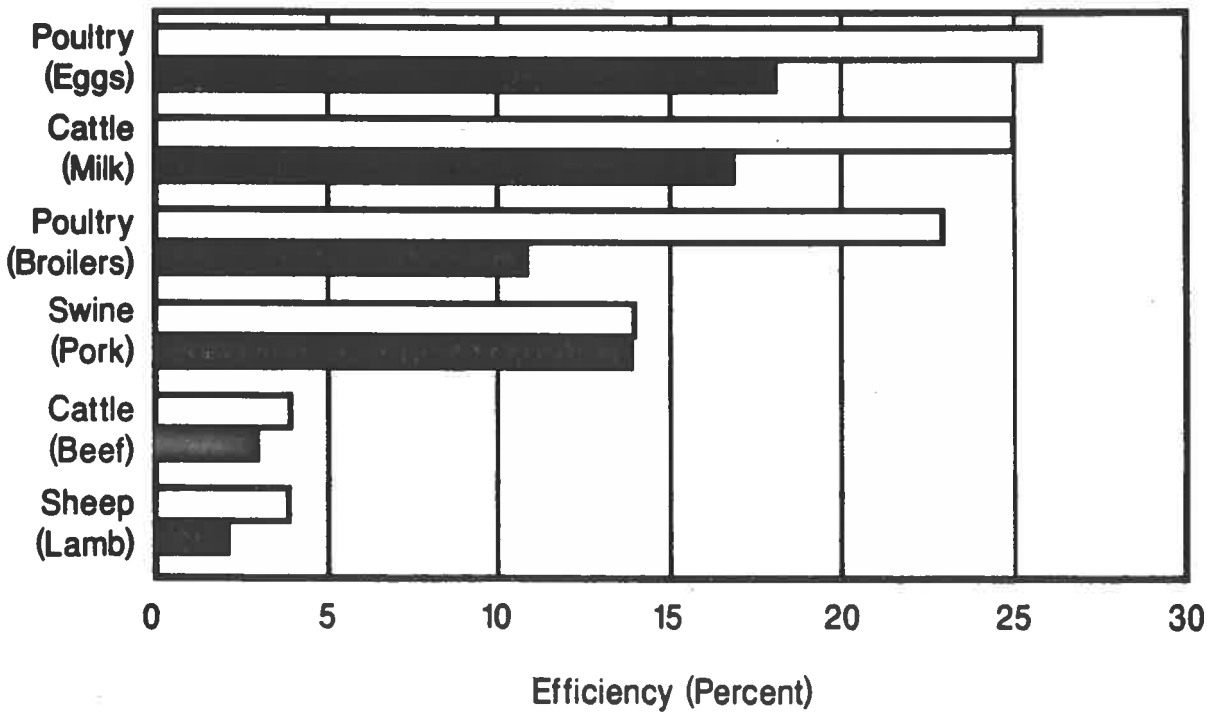


Figure 1.8 Efficiency of Animals in Converting Feed to Human

poultry convert 20 and 25 percent of feed consumed into edible food products as eggs. The cow as a producer of milk ranks second, while beef cattle convert less than five percent of the feed consumed into edible meat products. However, beef cattle and dairy cattle to a lesser extent consume forage which is not edible by humans.

In the U.S. the average per capita consumption of red meat is 34 kilograms annually, and the amount would be of a similar order of magnitude for other industralized countries. However, even in the more affluent segment of society in Third World countries, the per capita consumption of red meat is much higher than that of the country average. It is well established, that as income increases, the consumption of meat and dairy products also increases. Those countries with the highest per capita income also derive the highest proportion of energy and protein from animal products.

The quality of protein is determined by the content of essential amino acids. All nine essential amino acids must be present and in the proportion necessary to optomize tissue growth and maintenance. If a food is low in one or more essential amino acids, then that becomes the limiting factor in the use of other amino acids. L-lysine is the first limiting amino acid in rice, corn, wheat, sorghum and millet. The ranking of foods in terms of protein quality are: first, animal and animal products; second, legumes; and third cereals. On the other hand, the amounts of edible protein that can be produced on one acre of productive land is lowest for meat animals and highest for legumes.

Estimates indicate that one acre would provide man's protein requirements in the form of beef for only 77 days, 236 days as milk, 654 days as white rice, 877 days at whole wheat flour, and 1785 days at split peas.

Thus, an acre of land devoted to growing legumes is capable of producing enough protein per annum to satisfy the requirements of an adult for three to six years depending on the particular legume produced. Some legumes, especially soybeans need more processing before eating than others such as beans and peas. It is apparent that the majority of the world's population will have to continue to live primarily on a plant based diet.

The proteins in legumes provide a combination of the nine essential amino acids that complements or supplements very well the amino acid deficiency of the cereals. Thus, the combination of cereals and beans provides protein of fairly good quality. The essential amino acids must be present simultaneously in the food in order to permit the synthesis of new body protein. It is important that diets based primarily on cereals include some legume or animal products to provide a good balance of essential amino acids.

NUTRITIONAL PRIORITIES

Based on prevalence, social significance, and feasibility of prevention, the nutritional diseases of high priority are:

1) protein-energy malnutrition
2) xerophthalmia
3) nutritional anemias
4) goitre

These and other serious deficiencies, some regional, will be covered in more detail.

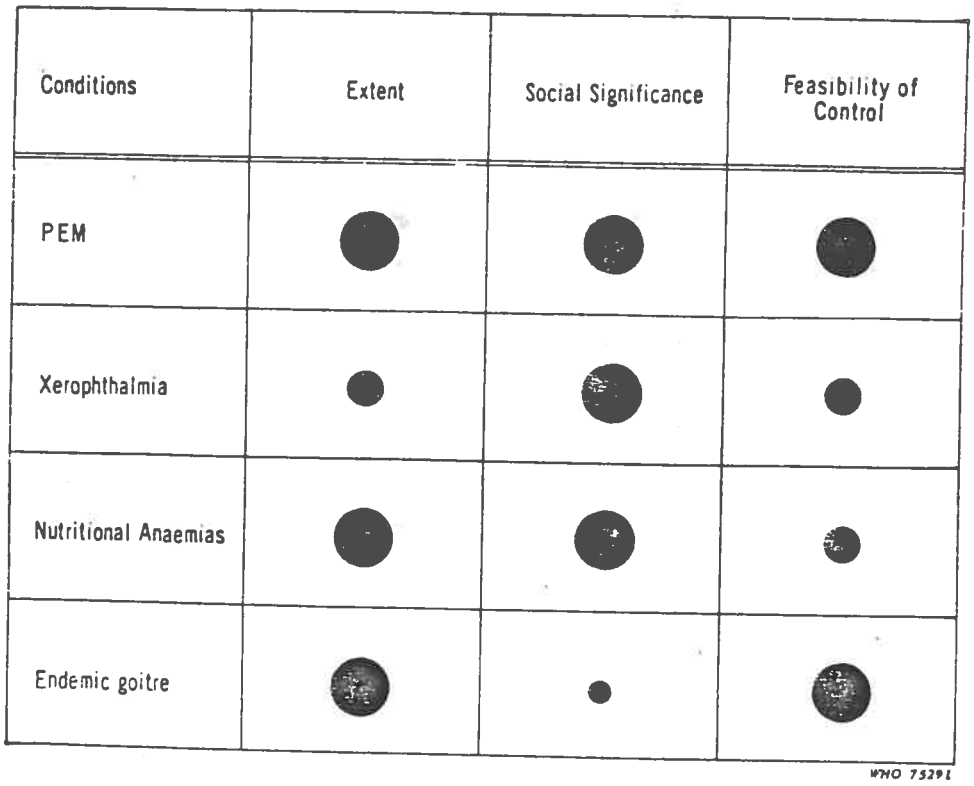


Figure 1.9 Priorities Among Nutritional Deficiency Conditions. Size of circle indicates extent of deficiency, social significance and feasibility of control.

Protein-energy Malnutrition (PEM)is the most serious and prevalent cause of morbidity and mortality and is the most difficult to prevent of all nutritional diseases. It particularly affects infants and young children in almost all developing countries. Even in the non-fatal forms, it may have permanent adverse effects on growth, development and performance. The highest incidence occcurs during the first six months of life in infants who are not breast fed. The condition is characterized by oedema, a wasting of body tissues both muscle and subcutaneous fat, lassitude, anorexia, and episodes of diarrhea. Parasitic infestation is frequent, accentuates the condition and is usually accompanied by diarrhea. Chronic or frequent recurring bouts of diarrhea have potentially severe consequences for infants and young children as their protein resources are usually limited. In severe diarrhea, protein loss may amount to as much as 20 percent of the intake. Thus, due to this wastage, there is need for additional dietary protein. In this weakened condition, children are more susceptible to infectious diseases. The ultimate outcome, unless cases are treated, usually in a hospital or clinic, is death of hundreds of thousands annually. PEM is the most intractable of nutritional diseases to prevent. This is because it is wide-spread, and because, compared to other nutritional deficiences, relatively large amounts in grams of protein and energy foods are required.

For infants age six to eight months, between 14 and 23 grams of protein are required daily, depending on the quality of protein and size of the infant; whereas, for most nutrients other than protein and

energy, the daily requirements are in milligrams or less. The protein requirements are particularly high during the early months of life and after weaning when growth is most rapid. Inadequate protein and energy intake during pregnancy is highly corralated with low birth weight infants.

Xerophthalmia is first manifest by impaired vision, particularly in the dark, and consequently is frequently refered to as night blindness. It is due to a lack of Vitamin A or carotene, a form of provitamin A in the diet. Carotene is widely distributed in green leafy vegetables, yellow fruits and vegetables. Xerophthalmia is widespread throughout various regions of the world (Figure 1.10).

Carotene is converted by the liver into Vitamin A and stored in this organ. Long before the discovery of vitamins, it was known that fish oils would prevent xerophthalmia and cure the condition in its early stages. It is particularly prevalent in those regions that have long dry seasons and inadequate means of preserving fruits and vegetables. Hundreds of thousands of children go blind annually or have permanently impaired vision as a result of a lack of Vitamin A. Mortality from a lack of Vitamin A is not high. However, the social significance is high because of the demands on the family and society to care for the afflicted individuals.

The feasibility of preventing xerophthalmia is fairly high. A striking example of a successful program to eliminate xeropthalmia was that undertaken by the Institute of Nutrition of Central America and Panama (Arroyave et al. 1979). It was first demonstrated by extensive

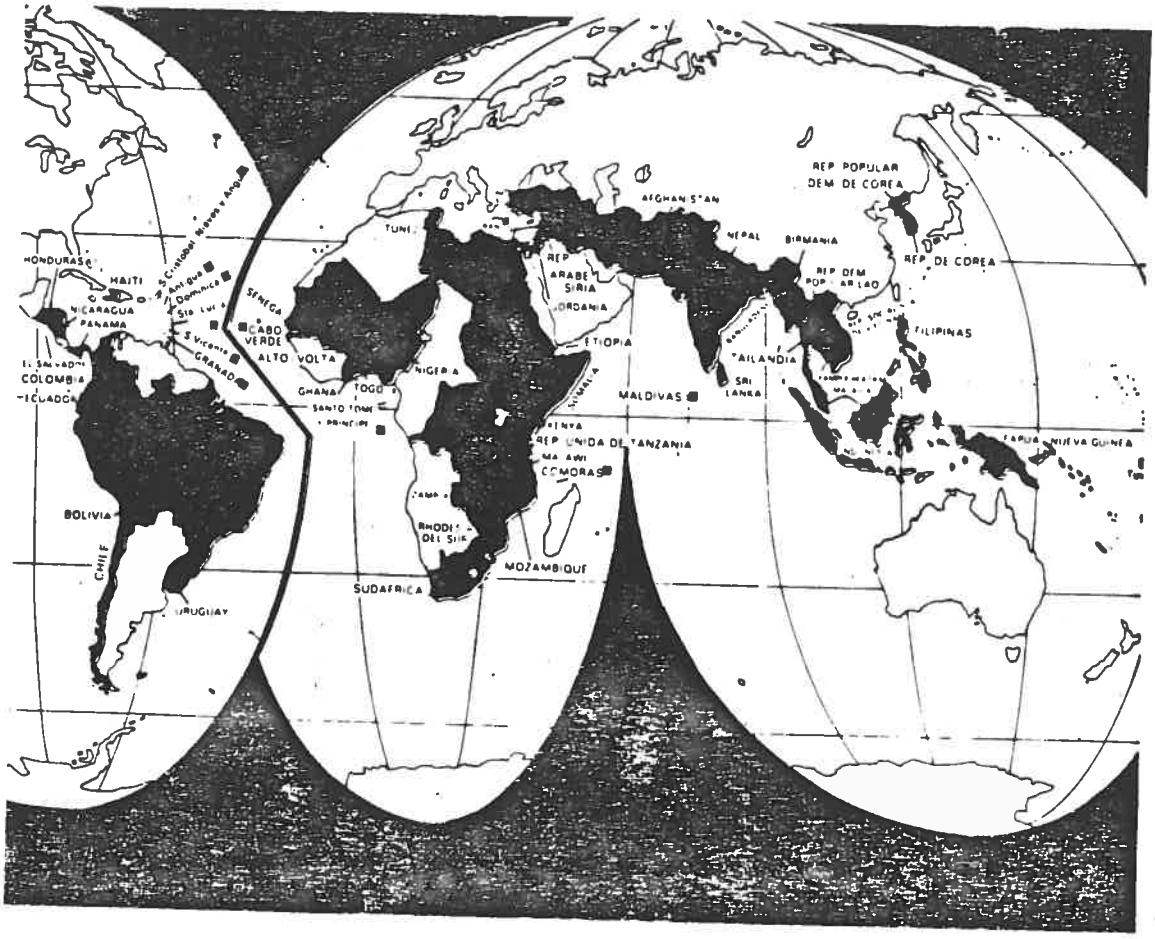


Figure 1.10 Regions Where Vitamin A Deficiency Constitutes a Public Health Problem.

field and laboratory studies which showed that 40 percent or more of the children in some Central American countries were consuming diets deficient in Vitamin A. Numbers of the population, particularly children, were not ingesting in their diets sufficient Vitamin A to meet their needs. Then an enrichment program was implemented through governments of the various countries. Sugar, which is universally consumed in these countries, was selected as the common food carrier. A premix of sugar containing adequate amounts of retinol palmitate was added to commercial sugar at a level calculated to provide the daily needs of between 300 to 1000 micrograms. Laws have been passed in Central American countries and Panama requiring the enrichment of commercial sugar with a suitable form of Vitamin A or provitamin A. As a result of these investigations and actions taken by the individual countries, xerophthalmia has ceased to be a major nutritional problem.

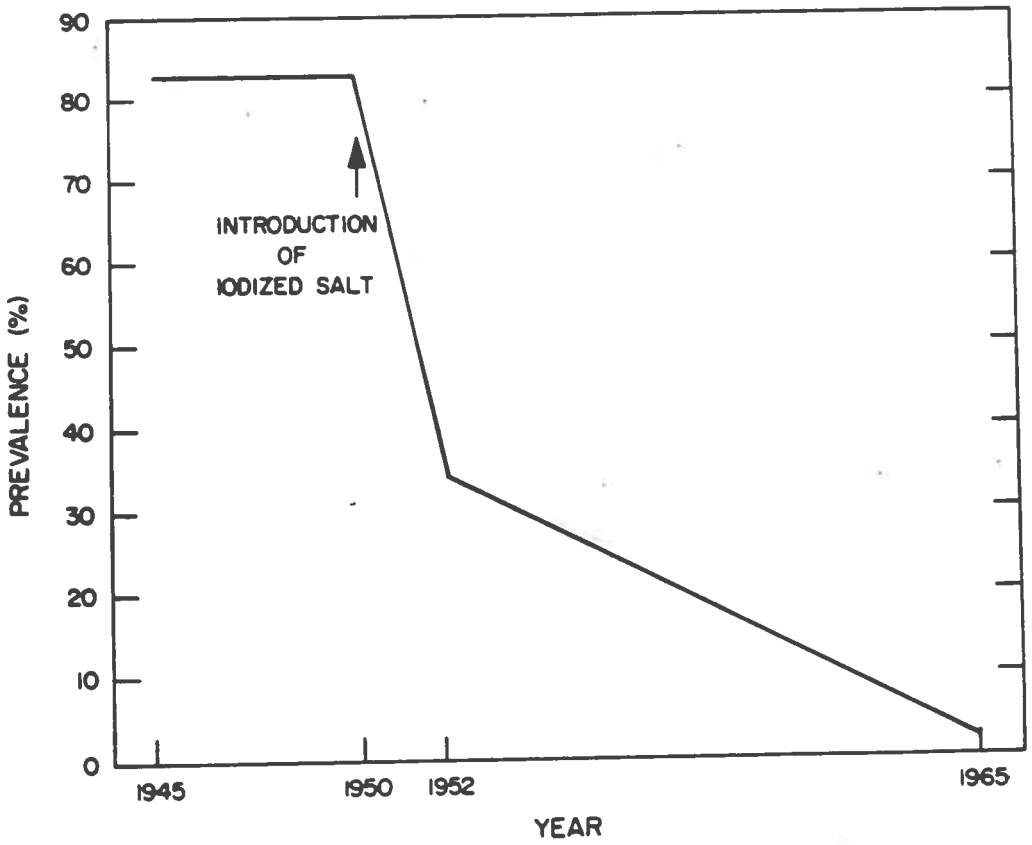
Other means of preventing xerophthalmia are massive dosing of children at six month intervals with large amounts of Vitamin A, which can be stored in the liver for several months and utilized by the body as needed. An educational program to encourage the production and comsumption of foods high in provitamin A can also be effective.

Nutritional Anemia is one of the most widespread of nutritional deficiency diseases, affecting primarily children, pregnant and lactating women. It is characterized by low hemoglobin blood levels, and is caused primarily by a lack of iron in the diet. However, other dietary deficiencies, such as Vitamin B_{12} and folate, also inhibit the formation of hemoglobin. Intestinal parasites contribute to anemia

because of malabsorption of nutrients and fecal blood loss. Anemia reduces work capacity. Low blood hemoglobin reduces the oxygen carried to the tissues essential for metabolic processes. Thus, the capacity for physical work is reduced, and there is good evidence that the period of attention of anemic children is reduced and their learning capacity impaired. There is also evidence that anemic subjects are more susceptible to infections because of impairment of the production of antibodies. Dietary iron requirements are in the order of 14 to 25 milligrams daily, being higher for women and children than for men. There are wide variations in the percentage of iron ingested that is absorbed. Iron from red meat is absorbed much more efficiently than is iron from most plant sources. For example, iron from rice and spinach is absorbed only to the extent of two percent or less, compared with 20 percent from liver and muscle. Iron can be provided in the form of tablets. Also, common foods such as bread can be fortified with iron by adding it to flour during the milling process.

Goitre, an enlargement of the thyroid gland is due to a lack of iodine in the food. It is particularly prevalent in mountainous regions, and generally absent in costal regions. Marine organisms and sea salt are generally high in iodine. In high goitrous regions, most of the adult population exhibit thyroid enlargement. Endemic goitre has been reported in all major land areas of the world, especially in mountainous regions. In areas of severe iodine deficiency, cretinism occurs. This is a condition of stunted growth, mental retardation, deafness and other abnormalities. Cretins pose a considerable economic burden on the family and community.

Since dietary iodine requirements are small, from three to seven milligrams daily, it is relatively easy to prevent the development of goitre in entire populations. The daily physiological requirements are estimated to be between 100 and 300 micrograms. Ordinary salt is the most commonly used carrier for providing iodine to populations. Some countries have passed legislation requiring the iodization of commercial salt. The effectiveness of providing iodine by the iodization of salt is shown in Figure 1.11. The occurence of new cases of goitre was essentially eliminated in Colombia within a decade after the iodation of



1.11 Decrease in Incidence of Goitre with Incidence of Iodized Salt in Village in Colombia.

salt was instituted as a health measure by the government. China has reduced the prevalence of goitre in Jixian county from 65 percent in 1978 to four percent in 1986. The rate of iodization ranges from one part iodine to from 10,000 to 130,000 parts of salt, the average being between 1:25,000 and 1:50,000. In the early 1830's Boussingault, a French chemist, at the suggestion of Von Humbolt, analyzed the salt from the coastal and the mountain areas of Colombia. He found low iodine levels in salt from the mountain deposit where goitre was prevalent. Based on these findings he recommended to the government of Colombia that only sea salt be used. Yet it was a hundred years before Colombia took measures requiring the iodization of commercial salt. A century ago goitre was prevalent in industralized Western countries. The Great Lakes area, Applalachian and Rocky Mountains in the United States were considered goitreous belts. The use of iodized salt has now made goitre very rare in the United States. To iodate all of the edible salt in India would cost less per person than one cup of tea daily for a year (Grant, 1987). But it could prevent a deficiency which lowers the productivity of millions of adults, and a deficiency which may irreparably damage the mental capacity and physical growth of hundreds of thousands of children.

Other Nutritional Diseases There are several other nutritional deficiency diseases that occur, particularly in Third World countries. Among these are rickets a disease of the growing skeleton, characterized by defective calcification due to a deficiency of Vitamin D, which is formed in the skin by the action of ultraviolet rays. In northern and southern regions during long winter months, exposure to ultraviolet rays

is greatly reduced and rickets is more likely to occur, particularly in the developing bones of infants and children. It also occurs in countries with high levels of sunshine where infants and small children are kept covered for protection against the cold or sun. Most foods have a very low content of Vitamin D. Liver and fish oils are high in Vitamin D. Rickets is easily prevented by adding Vitamin D to baby foods and weaning foods, and also to commercial milk.

Beriberi, which is caused by a lack of thiamine, was once a major disease of children, particularly in countries with a predominately rice diet. The malady may occur in infants, children and adults, and may be fatal. In the adult, edema of the face and lower extremities is common. Neurological and cardiovascular symptoms are common, and may terminate in heart failure. Beriberi infants are pale, odematous, are subject to gastrointestinal disorders such as loss of appetite and vomiting. Facial expression may be apathetic, and in advanced cases convulsions are frequently accompanied by cardiovascular symptoms. Beriberi can be prevented or cured by providing thiamine or foods high in this vitamin. In rice eating populations the use of undermilled or parboiled rice is an effective means of preventing the disease.

In some regions, nutritional diseases occur because of a lack of a specific element in the soil and food grown theron. Two of these are of sufficient frequency to merit mention. Keshan Beck disease which occurs in well delineated areas of China, has been shown to be the result of a lack of selenium in the diet. Low selinium has also been reported in New Zealand, Finland, USSR, Korea and other countries. A deficiency of selenium in the diet leads to hypertension and cardiovascular

malfunction, to muscular dystrophy, and to abnormal bone development particularly at the joints. Twenty-five countries have reported a high correlation between coronary disease and low levels of selenium in the soil and foods grown thereon (Masisoni, Parr and Perry, 1984).

Zinc deficiency in humans is fairly prevalent in several countries. It has been reported in Iran, Egypt, Turkey, Portugal, Yugoslavia, China and other countries. It is particularly likely to occur in countries where cereals are the main source of protein, as they are generally low in zinc. The effects of a zinc deficiency are growth retardation, male hypogonadism, poor appetite, mental lethargy, delayed wound healing, decreased taste acuity, and a dermatitis of the extremities. There is evidence that zinc deficiency during pregnancy may increase maternal morbidity, prolonged gestation, and increased risks to the fetus. Human requirements for zinc are high during periods of rapid growth, such as embryonic life, infancy, and puberty. Delayed puberty as a result of zinc deficiency has been observed in both sexes. Geophagia is frequently seen in individuals who show characteristic symptoms of zinc deficiency syndrome. The syndrome can be prevented or alleviated by a daily supplementation of 20 milligrams of zinc.

OVERCONSUMPTION

Overconsumption or obesity is the major nutritional problem of the industralized affluent countries. While some obesity occurs in practically all countries, it is a much more serious problem in the developed countries. Contrary to what might be expected, in Third World countries obesity is less prevalent in the affluent than in the low

income segment of the population. This is a result of a combination of factors. The affluent can afford more meat and other high protein foods, and also they are more concerned about aesthtics. A change in life style from that of physical labor to a sedentary type of life has been a major factor contributing to the increase in obesity over the last half century.

Overweight occurs most frequently and affects greater numbers of people in the age category between 45 and 65 years. Obesity and overweight are not identical concepts. Obesity is defined as an excess of body fat, and overweight is an excess of body weight relative to a specified standard for height. Millar and Stephens (1987) report that 40 to 50 percent of the men in Canada, Britian and the United States are overweight. For women, the comparable figures are 29 to 48 percent. The percent of the population classified as obese in the three countries range from 9 to 21 percent, being highest in American women. The criteria for obesity is not specific, thus different standards may be used in different countries. Kluthe and Schubert (1985) have reported on the incidence of obesity in European countries. Figures combined for both sexes are: Bulgaria 19.1 percent of the population, Federal Republic of Germany 17.4 percent, Denmark 20, and Norway 25 percent.

It is well established that there is a high correlation between the degree of overweight and life span. Obesity is a risk for a wide range of diseases, including adult diabetes, hypertension, coronary heart disease, stroke, certain cancers, gout, gall bladder disease and other maladies. In agrarian countries where the population at all age levels is engaged

primarily in physical activities, and especially where women do much of the cultivating of food crops, obesity is rare. In these countries, under nutrition rather than over consumption is ususally the major problem.

Changes in the life style in indeginous populations have led to a marked increase in obesity. The native Indians of the Americas prior to the advent of the white man, were primarily nomadic, hunting and gathering their food. Records of early European settlers to the Americas show the natives as agile and of trim figure. With the gradual adoption of the white man's food, many of them receiving food under government programs, and with a change to a sedentary life pattern, there has been a marked increase in obesity. It is estimated that in some tribes of Indians of North America, the incidence of obesity among adults may exceed 60 percent. Concurrently, there has been a marked increase in the incidence of diabetes to the extent that this is a serious problem on some reservations.

BREAST FEEDING

Throughout the history of mankind, except for about the last century, the newborn infant has depended upon human milk, primarily that of the mother, for nourishment during the first several months of life. The composition of the milk of various mammalian species differ significantly. In milk, nature has provided the nearly perfect food; its composition varies depending on the growth, patterns of each species. The human infant has a relatively slow rate of growth doubling its weight in about 180 days. Human milk contains about one percent

protein, whereas rabbit milk contains about 10 percent protein, providing for the young to double its weight in six days. Bovine milk contains over three percent protein, which is commensurate with the more rapid growth of the calf than the human infant.

The protective effect of breast feeding against infections of the newborn has been recognized for decades, particularly in relation to diarrheal diseases. Various protective factors are present in human colostrum. The probability of survival of the bottle fed infant is about a third less than for breast fed infants. Breast feeding in the industralized countries has declined until about the last decade. For example, in the United States by the 1960s, less than one-fourth newborns were breast fed. This practice has now been reversed and more mothers are nursing their infants. However, in Third World countries there has, over the past several decades, been a decrease in the percent and duration of breast feeding in urban areas. Factors contributing to this are increased opportunities for women to work away from home. A similar decline in breast feeding is also becoming apparent in rural areas in some countries.

The failure to breast feed also has an origin in the the inadequacies of medical support during and after childbirth. A common practice is for the mothers and newborns to be separated until the time of discharge. Frequently the infant is given a bottle to supplement the mother's milk. The suckling process is important in stimulating the flow of the mother's milk. Preterm and high risk neonatals are often fed glucose and infant formula. The incidence and frequency of diarrhea is much higher in bottle fed than in breast fed infants. The frequent

lack of facilities for sterlization of bottles and water and lack of refrigeration are inducive to the growth of organisms that cause diarrhea. In addition to the nutritional and protective benefits, breast feeding has very significant economic benefits. Purchasing adequate amounts of infant formula foods could take as much as a fourth of the family income. This encourages the excessive dilution of the formula food so as to provide the prescribed volume but not the adequate level of nutrients to meet the infants needs.

The distribution of literature and free samples of infant formula foods has encouraged bottle feeding. A few years ago measures were taken by the World Health Organization (1981) to counteract this practice. The recommendation of the WHO was adopted by the Thirty-fourth World Health Assembly in May 1981 with only one dissenting vote. The objective of the Code was to foster safer and adequate nutrition of infants by the protection of breast feeding and by insuring the proper use of breast milk substitutes. The Code encouraged countries to enact legislation or take action so that manufactures and distributors would not provide, directly or indirectly, to pregnant women, mothers or members of their families, free samples of infant formula and promotional literature, and further, that no facility of a health care system should be used for the purpose of promoting the use of infant formula food. There were added features to the Code designed to promote breast feeding. Many member countries of the World Health Assembly have taken action to implement the recommendations of the Code. To the credit of several major manufactures of baby foods, they have supported the recommendations of the Code and have adhered to them.

Weaning Foods The most critical period for the breast fed child is that of weaning, when it no longer has access to the mother's milk and when also as a member of the family it is less likely to be able to fend for itself. The nutrient requriements for growth at this time are still relatively high. The family diet is likely to be high in carbohydrates, such as cereals and root crops, which frequently do not provide adequate protein. To meet this problem, specific weaning foods have been developed (Cameron and Hofvander, 1971). Basic indigenous foods are used, in so far as possible, in proportions designed to provide the maximum of essential nutrients at the minimum cost. Frequently, it has been necessary to add some high quality protein source such as dried skim milk. One of the best known weaning foods is Incaparina, so named because it was developed by the Institute of Nutrition for Central America and Panama. It is not a specific formula, but is a mixture of predominantly vegetable protein, having a nutritional value similar to that of milk, and suitable for mixed feeding of infants and young children. The first mixture that came into commercial production was made of corn flour, sorghum, cottonseed flour, torula yeast, calcium carbonate, and fortified with Vitamin A. Other formulas have been developed using soy, peanut, and seasme as alternate vegetable protein sources, with adjustments according to costs of local ingredients and taste preferences. While incaparina and other weaning foods have not eliminated malnutrition in young children, even subsidized by the government, they can be viewed as a means of alleviating malnutrition if implemented as a national measure. Only political and economic policies

that improve the puurchasing power of the lowest income groups will resolve the problem. So long as there is poverty and lack of purchasing power there will be malnutrition.

DENTAL CARIES

Dental Caries is prevalent in all countries affecting populations inrespective of economic and social status. There is ample evidence that the nature of the diet and the pattern of eating are important factors contributing to the incidence of dental caries. The prevalence of caries among native populations such as Australian Aborigines, New Zealand Maories, Eskimos and others was very low prior to their exposure to European-type diets. Native diets did not contain any sucrose other than the relatively small amounts found in fruits and vegetables. As their diets changed to include products containing sugar, caries prevalence increased. Records in England of the last 100 years show a steady increase in per capita consumption of sucrose from about 2.2 to over 44 kilograms from 1820 to the present. The current intake of sugar (carbohydrate sweetness) in the United States is 56 kilograms per capita annually, or about 124 grams per day (Glinsmann, W.H., H. Irausquin and Y.K. Park, 1986). Concomitant with the increased consumption of sucrose there has been an almost parallel rise in the prevalence of caries. During periods of war when sugar importation was restricted and when frequency of meal eating decreased, there was a significant decrease in caries. Data from 18 countries on the domestic disappearance of sugar reveal that the amount of sugar consumed is highly correlated with the numbers of decayed, missing and filled teeth of children 10 to 12 years

of age (Newborn, 1983). Controlled human studies in southern Sweden and N.S.W., Australia provide strong evidence that the amount, frequency of ingestion and type of high sucrose food are factors in the incidence of dental caries.

A condition known as mottled enamel of permanent teeth is common in many countries of the world. This condition occurs where the water contains levels of fluoride of five or more parts per million. Slight mottling does not increase the prevalence of dental caries. However, the higher levels do lead to an increase in caries and to deterioration of the teeth. The opposite occurs, that is, an increase in caries, when the fluoride levels of water is low. In classical early studies it was shown that in villages where the water contained less than 0.5 parts of fluroide per million that the incidence of dental caries was high, and that it would be significantly reduced by the fluoridation of water to provide one part per million. The fluoridation of water is now common in cities, particularly in industralized countries where there is a common source of water. The evidence that this reduces caries is irrefutable. Still there is resistance in some cities and localities to fluoridation.

GREEN REVOLUTION

Green Revolution is referred to as the technoloical development of high yielding varieties of cereals, particularly rice, wheat and corn. The high yielding varieties were developed over a period of two decades of breeding from a large genetic germ bank collected from various countries. Primarily this involved selecting for disease resistance

short stemed varieties that produced more grain per plant and less of the non-edible stalks. Concurrently, the new improved varieties would have to respond to modern methods of farming with higher inputs of water, fertilizer and insecticides. The high yielding varities of rice were developed primarily at the International Rice Research Institute in the Philippines, while work on wheat and corn was centered in Mexico.

Yields per hectare with the improved varieties represent an increase of three fold or more. It is estimated that between one-third and one-half of the rice areas of the developing world is now planted with high yielding varieties.

In the Philippines about 78 percent of the three million acres of rice are of the improved high yielding varieties. In China (PRC) which produces about 24 percent of the world total, over 66 percent is in improved varieties (Pinstrup-Anderson, and Hazell, 1985). It is estimated in Latin America that 90 percent of the three million acres of rice are of the improved varieties and that this results in production increase of 2.5 million tons annually.

Semi-dwarf varieties of wheat have greatly increased production because of their response to fertilizer, water and pesticides. India, Pakistan and Turkey began importing seed of the improved varieties from Mexico in the 1960s. The new varieties increased yields by two to three times that of the native varieties. The percentage of the total wheat growing area devoted to the improved high yield varieties are: Mexico 80, India 79, Argentina 91 and Pakistan 88. Some of these countries are now self sufficient in wheat or even exporters (Vocke, 1986).

Because of the profitability of the high yielding varieties, these crops have in some cases replaced high protein food crops such as pulses and legumes. Consequently, there is some concern that the Green Revolution may have a negative nutritional effect.

SUMMARY

Malnutrition is widespread and is the major health problem of the world. It is a major or contributing factor to the death of infants and young children. It is most prevalant in the less industralized countries. The vulnerable segments of the population are children, pregnant and lactating women. Malnutrition adversely affects development and productivity and may permanently impair the capacity for learning. It is most prevalant among populations with low per capita income and high rates of population increase. While there has over the past decade been an increase in food production, in many countries the rate of population increase has exceeded the increase in food production. The major cause of malnutriiton is not a world shortage of food, but rather inequitable distribution of food resources.

The major nutritional maladies are protein-energy deficiency, xerophthalmia due to a lack of Vitamin A, anemia due primarily to a lack of iron, and goitre due to a lack of iodine necessary for the body to produce thyroxine.

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