Chapter Three

Social implications of early protein-energy malnutrition*

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In a book on the prevention in childhood of health problems later in life, undernutrition must clearly be a crucial issue. Since childhood undernutrition, with its causes, prevention, and sequelae in adulthood, is such a vast and complex subject and involves so many different disciplines, it was felt appropriate, in the limited space available, to concentrate on one specific aspect—protein-energy malnutrition. Special attention is paid to the developing world, where the consequences of early protein-energy malnutrition may be of particular significance in terms of public health and national development.

Early protein-energy malnutrition is defined as malnutrition suffered before birth and/or during the first 5 postnatal years. Before birth it is defined by low birth weight (i.e., equal to, or less than, 2.5 kg). During the first 5 postnatal years it is defined by weight equal to, or less than, 90 % of the standard weight for age.

Worldwide incidence

Despite the high risk of damage associated with early protein-energy malnutrition, relatively little information is available on the magnitude of the problem (*1*) and its economic cost.

An indicator of the world prevalence of fetal malnutrition is the huge number of babies of low birth weight. On the basis of prior estimations (*14*, *16*) we have concluded that 21 million such babies were born in 1978 (see Table 1). If present trends continue, the annual number of such babies is expected to be 33 million by the year 2000. Data in Table 2 indicate that in

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Table 1. Estimated number of babies of low birth weight (2.5 kg) born in 1978

Region	Population (millions)[a]	Number of births (millions)[a]	Percentage of babies of low birth weight [b]	Number of babies of low birth weight (millions)[b]
Asia	2 434	73 7	21	15 48
Oceania	22	0.5	20	0 10
Africa	436	19.9	15	3.06
Latin America	343	12 3	13	1 60
Northern America	242	3.6	10	0 36
Europe	480	7 1	7	0 50
USSR	261	4 7	4	0 19
Total	4 218	121.8	17.5	21.29
Developing countries	3 235 (76 7%)	106.4 (87 4%)	19 0	20.24 (95%)
Developed countries	983 (23.3%)	15.4 (12.6%)	6.8	1.05 (4.9%)

[a] Computed from unpublished United Nations document ESA P WP.55, and from Population Reference Bureau, Inc. (*23*).
[b] Computed from Lechtig et al. (*17*).

Table 2. Estimated number of children less than 5 years of age with protein-energy malnutrition during 1978

Region	Number of children less than 5 years of age (millions)[a]	Percentage with protein-energy malnutrition[b]	Number of children with protein-energy malnutrition (millions)[b]	Number of deaths at less than 5 years of age (millions)[a]
Asia	350	84	294 0	10 4
Oceania	3	80	2 4	0 01
Africa	79	60	47 4	4.9
Latin America	55	52	28 6	1.5
Northern America	19	3	0.6	0 1
Europe	37	2	0.7	0 1
USSR	22	1	0.2	0 1
Total	565	65.8	373.9	17.1
Developing countries	487 (86.2%)	76.0	372 4 (99.6%)	16.8 (98.3%)
Developed countries	78 (13.8%)	1.9	1.5 (0.4%)	0.3 (1.7%)

[a] Computed from unpublished United Nations document ESA P WP.55, and from Population Reference Bureau, Inc. (*23*).
[b] Defined by weight less than 90% of the standard weight for age.

1978 an estimated total of 374 million children less than 5 years of age had protein-energy malnutrition. If the same trends continue, the figure for the year 2000 will be 573 million.

Early protein-energy malnutrition is thus the most extensive and serious public health problem affecting man. The estimated risk of early protein-energy malnutrition is 40 times lower in developed countries than in developing countries. Further analysis has indicated a clear association between two important socioeconomic variables at national level (*per capita* gross national product, and energy available *per capita* per day) and the proportion of children with early protein-energy malnutrition (*16*). These findings confirm prior observations in urban and rural populations on the relationship between socioeconomic factors and the incidence of early protein-energy malnutrition (*12*).

Cost to society

It is now beginning to be accepted by nutritionists, social scientists, and laymen that, for communities and countries, the cost of early protein-energy malnutrition in terms of development may be enormous. Yet, important as it is for planners to know the nature and extent of this cost, relatively little objective evidence exists concerning the cost to society of the sequelae of early protein-energy malnutrition.

The ultimate implications of a high incidence of early protein-energy malnutrition depend on its adverse effect on mortality, population dynamics, physical growth, morbidity, mental development, school performance, social competence, and economic productivity. In the following paragraphs, we shall try to assess these implications.

Mortality

Infants suffering from protein-energy malnutrition are less likely to survive during the first years of life than normal infants (*11*, *13*). In addition to the human tragedy involved, there is also extensive economic waste due to a reduction in the potential labour force and a consequent loss of productive effort. Thus there is a decreased return on investments made by both individual families and society as a whole during the infant's gestation and early postnatal life. The decrease in return will vary from country to country, depending on such factors as life expectancy, future productivity, and employment opportunities. Here again, the published estimates are few. It is probable, however, that in developing countries the economic cost of infant and preschool mortality may be much greater than that of deaths produced by such major killers of adults as cancer and cardiovascular disease.

Population dynamics

The social mechanisms relating fertility to mortality and early protein-energy malnutrition are poorly understood, and it is difficult to predict what the short-term fertility outcomes might be with changes in infant mortality rates and in the incidence of early protein-energy malnutrition. Preliminary results from recent studies suggest that these may be major factors in altering fertility as well as in accepting family planning (*18*). Consequently, it seems convenient to integrate programmes designed to decrease the incidence of early protein-energy malnutrition with programmes in family planning.

Retardation of physical growth

Although both pre- and postnatal growth retardation are associated

with early protein-energy malnutrition, this relationship has only slight economic implications in itself (*20*).

However, in poor populations growth retardation is a useful indicator of economically important disabilities, such as higher morbidity in preschool children, that entail increases in the cost of medical care services.

Morbidity

Morbidity associated with the occurrence of early protein-energy malnutrition can be divided into two categories: neonatal and postnatal.

(*a*) *Neonatal morbidity*. At birth, the infant suffering from protein-energy malnutrition manifests suboptimum physical development, loss of subcutaneous fat, dry skin with reduced turgor, hypoglycaemia, hypothermia, frequent and severe infections and high mortality (*16*). Early protein-energy malnutrition is also associated with perinatal asphyxia, polycythaemia, elevated levels of erythropoietin, and an increased incidence of congenital malformations.

The lower survival associated with early protein-energy malnutrition is undoubtedly associated with impaired resistance to infection. The increased frequency of infection in the infants concerned is an established clinical observation, and in the last few years it has been shown that babies suffering from protein-energy malnutrition have decreased IgG levels at birth, a significant reduction in the number of peripheral T-lymphocytes, significantly impaired cell-mediated immunity, reduced opsonic functions of plasma because of reduced C3 levels, and severe defects in the bactericidal capacity and oxidative metabolism of polymorphonuclear cells following phagocytosis (*3*).

Given that an infant who has suffered protein-energy malnutrition *in utero* and is thus subject to these infirmities is also likely to be exposed to postnatal malnutrition and high levels of infection, it is hardly surprising that the infants affected are less likely to survive the first year of life (*15*, *21*). If they do survive their first year, maturation of critical tissue such as brain cortex, neuronal cell function, and subsequent development may well be limited, and there is a poorer chance for catch-up if and when nutrition is later improved (*6*, *10*, *15*).

(*b*) *Postneonatal morbidity*. There are almost no data available on the relationship between early protein-energy malnutrition and postneonatal morbidity. However, it is reasonable to expect that the common diseases will be more frequent and of longer duration in the children concerned. If these children are going to experience increased morbidity as adults, this will have highly unfavourable effects on productivity. In addition, children

who have suffered greatly impaired development may, should they survive, have to be supported all their lives by the society to which they belong (*17*).

Mental development

Despite the large number of investigations that have been carried out in the area of malnutrition and mental development, the effects of protein-energy malnutrition on the developing intellect are still not well understood. As reviews by Brožek (*2*), Warren (*27*), and others indicate, most studies which have compared children who have suffered severe early protein-energy malnutrition with control children have reported an association between poorer performances in mental tests and malnutrition. This association has frequently been observed even several years after the reported incidence of malnutrition. Recent studies by Hoorweg & Stanfield (*8*) and Richardson (*24*) suggest that neither age nor the acuteness of the adverse nutritional condition at the time of hospitalization is associated with poorer test performances, but the degree of chronic undernutrition at admission is associated with lower test scores. Thus, wasting appears to be a better indicator of the risk of reduced mental development than stunting.

Serious problems arise in connexion with the interpretation of the associations between malnutrition and poor performance in mental tests. This is largely because malnutrition generally appears in a context of poverty, poor health, and lack of intellectual stimulation, and each of these conditions is known to affect mental development adversely. As Warren (*27*) has pointed out, the relationship between malnutrition and mental development should ideally be investigated through a longitudinal study in which nutrition, morbidity, and social factors are all monitored concurrently with development.

Several such studies have been undertaken during the past decade, in Colombia (*19*, *22*), in Guatemala (*9*), and in Mexico (*4*). Although not all these studies are as yet complete, the results so far provide stronger evidence than ever before that nutritional status, in addition to such factors as health and the level of social stimulation provided by the child's environment, does indeed influence mental development.

Although discussions of the effects of malnutrition on mental development aimed at laymen, notably in the media, have frequently suggested that malnutrition causes profound mental retardation, it is important to note that studies like those reviewed here do not show this to be the case. The effects recorded in these studies, including the longitudinal studies described above, are typically modest in size, although statistically significant. Nevertheless, these studies do suggest that children who have suffered from chronic protein-energy malnutrition, even in a mild to moderate degree, are likely to fail to reach their true intellectual potential.

Performance in formal and informal learning

Although educational wastage is an ever-present problem for schools in less developed countries, there have been no studies specifically relating school drop-out or year repetition to early protein-energy malnutrition. A number of authors have identified family factors associated with school failure, including parental background and income (*7*). But in none of these studies have data concerning early protein-energy malnutrition been presented. This is unfortunate, since such data are often available, particularly in developed countries in which they are routinely collected.

It is apparent, however, that children from families of low socioeconomic status have a relatively poor chance of success at school, a higher incidence of early protein-energy malnutrition, and a generally less stimulating social environment. An unsatisfactory level of learning at school, the repetition of the first school year by an unduly high proportion of children, and high drop-out rates can thus be considered as possible consequences of impaired development. In such conditions, the return on educational expenditure is appreciably diminished, and the resultant economic wastage can involve a substantial proportion of the budget for education.

The likelihood that the incidence of early protein-energy malnutrition is an important determinant of poor school attendance and performance has significant implications for both nutritional and educational planning. In the less developed countries, educational wastage is enormous, high drop-out rates, repetition, and school failure being endemic. Under such conditions, it is generally the poorer children who are most likely to suffer. If early protein-energy malnutrition is, at least in part, a factor in poor performance, there is little sense in investing large sums on the improvement of educational systems in isolation from other systems; if children of low socioeconomic status are to benefit from increased government investments in education, their chances of school success must be improved by attacking such basic problems as early protein-energy malnutrition.

Competence for social development and economic productivity

The relationship of early protein-energy malnutrition to economic activities and general competence in adults is not well understood. Only a limited number of studies investigating the relationship between nutritional status and the work productivity of adults have been performed (*25*, *26*). In particular, the relationship of early protein-energy malnutrition to level of participation in the domestic economy, the acquisition of skills and information both in and out of school, and the development of abilities beyond those demanded and displayed at home and school has been practically unexplored.

The association between early protein-energy malnutrition and suboptimum learning during childhood and adolescence, especially when the

family is of low socioeconomic status, may contribute to inequity in employment opportunities, lower productivity, lower income, and poor quality of life. It is very difficult to estimate to what extent early protein-energy malnutrition is a determinant of this chain of unfavourable events and what the whole vicious circle costs society. However, it seems clear that human resources, or human capital, are the main determinants of technological development and economic growth. As development proceeds, such characteristics as initiative and receptivity to, and understanding of, technological innovation become critical determinants of productivity in both urban and rural populations. Thus, human quality becomes more important than physical work for social and economic development.

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Although it is very difficult to disentangle early protein-energy malnutrition *per se* from interrelated cultural, familial, and institutional influences, the available evidence suggests that it has a negative effect on intellectual, physical, and social development. A high incidence of the condition may entail a heavy economic burden and be a serious obstacle to development in many countries.

From this it may be inferred that investment in programmes designed to decrease the incidence of early protein-energy malnutrition will yield an economic return important enough to stimulate social and economic development. Such an investment is justified not only because the ultimate goal of development is to improve the quality of human existence but also because human quality is a key to development. It seems particularly warranted in view of the fact that investment in other sectors, such as education, has traditionally been made without consideration of the complex interrelationships between the factors involved in development. Thus, for example, international agencies have encouraged the expansion of formal educational systems in less developed countries although it is known that many children in such countries never attend school, or attend for a short time only, or fail their examinations. It is probable that an increase in educational opportunities alone will not raise educational attainment, although investment in programmes designed to decrease early protein-energy malnutrition, combined with investments in education, may do so. Finally, a clear need exists for evaluation to be carried out in conjunction with such programmes, since only by this means can the cost-benefits of programmes containing educational, health and nutrition components in various combinations be accurately determined.

The negative impact of early protein-energy malnutrition on physical, intellectual and social development has been well documented in recent years. Although the implications for national development have yet to be systematically explored, it is likely to contribute largely to continued

underdevelopment, through inequality in employment opportunities, lower productivity, lower income, and poorer quality of life. Investment in programmes aimed at decreasing the incidence of early protein-energy malnutrition will thus operate synergistically, by helping not only individuals but also poorer countries to reach their true potential for development.

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