

Childhood Malnutrition: Prevention and Control at the National Level

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NUTRITION A KEY FACTOR FOR HUMAN AND SOCIAL DEVELOPMENT

The nutritional status of children is directly related to their health condition and both in turn are key determinants of the human and social development of communities around the world. Improvement of nutrition and health increase the chances of child survival and is a precondition for economic development. UNICEF has proposed a conceptual model to understand the causation of malnutrition beyond the obvious immediate determinants (Figure 1). Undoubtedly the basic determinants relate to the social, economic, cultural, and political structure of society. These define what resources are controlled by individual families including access to information and education, household food security, care of women and children, access to health and healthy environment. It is within this context that children have inadequate access to

food in terms of quantity and quality; in addition, infection will further compromise nutrition by augmenting nutrient losses and increasing nutrient needs.

Nutrition has been considered a basic human right and expressly recognized by international human rights covenants since 1924,¹ yet this right is commonly the subject of political demagoguery rather than being actively upheld, respected, protected, and promoted. The relationship between poverty and malnutrition has been well established in both directions, that is how poverty conditions nutritional status and vice versa. Moreover, the correlation is by no means linear. There are multiple examples that illustrate how nutrition can improve despite economic limitations. Economic development is by no means sufficient to improve nutrition, especially in countries where wealth is concentrated in a few hands. The UN Human development index illustrates how nutrition and health can be dissociated

with economic status.² For example, Indonesia has a higher per caput gross national product (GNP) than China, but malnutrition is presently rare in the latter whereas it is frequent in the former. Brazil has experienced significant economic growth over the past decade but malnutrition in children less than 6 years of age remains high. Recent analysis of trends reveals significant reductions in malnutrition assessed by underweight or stunted linear growth except in sub-Saharan Africa and Central America. These regions have experienced protracted civil wars and more recently that African region has been stricken by HIV/AIDS and its consequences. On the contrary, Latin America and the Caribbean combined have reduced malnutrition to about a third of the 1970 figure despite the unchanged proportion of families living in poverty (Figure 2).³ This concept should be stressed since health professionals frequently work under the assumption that nothing can be done in terms of prevention and control of protein energy malnutrition (PEM) unless social conditions change and poverty reduction is achieved. Undoubtedly both should proceed in tandem, since improved nutrition will contribute to socio-economic improvement.

WHO, UNICEF, and other International Organizations concerned with malnutrition have recognized for several decades the role of malnutrition in defining infant mortality. The immediate cause of death may be diarrhea or pneumonia but the risk of dying from these conditions is increased by manifold by severe and moderate malnutrition. The work of Puffer and Serrano in the Americas, and more recently Pelletier and Habitch working with data from Africa and Asia have documented with precision the contribution of malnutrition to infant mortality.^{4,5} The conclusion reached by both is that over half of all infant death is determined by malnutrition. UNICEF in its annual World Children Report states "malnutrition is directly related to over half of all infant deaths that occur worldwide."¹ Chapter 12 "International Nutrition" discusses nutrition and infection interactions and the contribution of malnutrition to infant death as a crucial underlying factor.

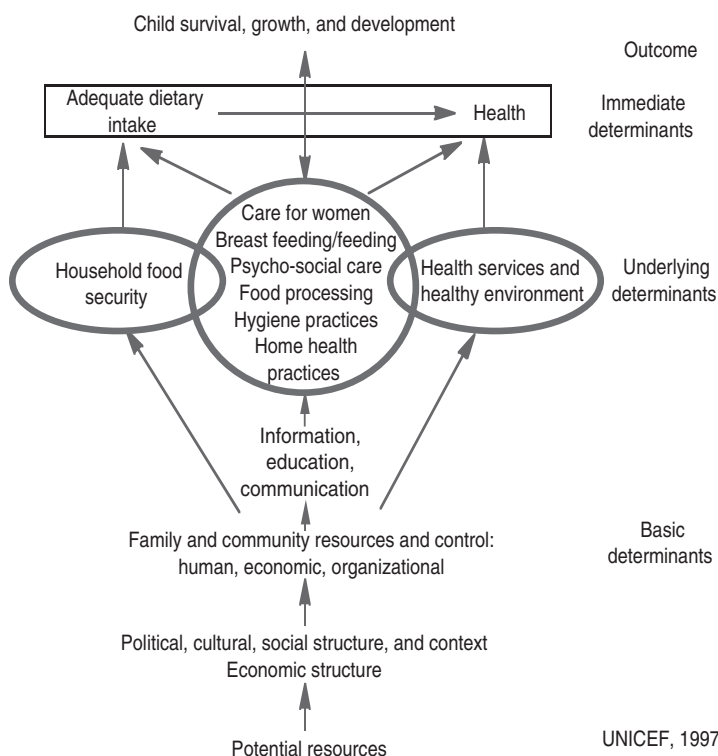


Figure 1 Conceptual model of child development useful in the analysis prevention and control of malnutrition. (Adapted from ACC/SCN Commission on the Nutrition Challenges of the XXI Century.)

UNICEF, 1997

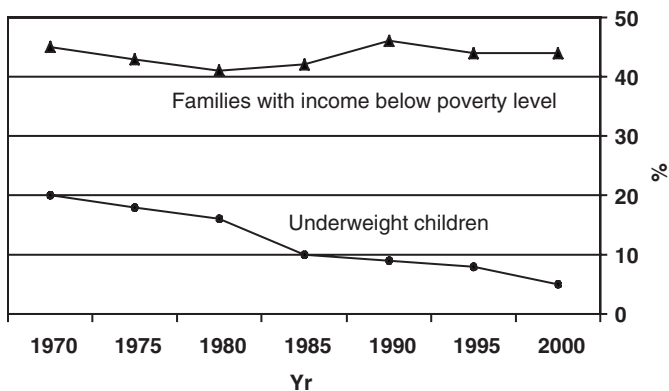


Figure 2 Child undernutrition in Latin America and the Caribbean: trends, reasons, and lessons. Over the past 30 years, population under poverty line has remained stable, but malnutrition has declined significantly.

MALNUTRITION AS A GLOBAL PUBLIC HEALTH PROBLEM

Weight, height, and head circumference measurements have been widely used as indicators of nutritional adequacy. Selection of the indicator to be used influences the magnitude of the prevalence calculated. Weight for age is a sensitive but not very specific indicator of malnutrition since it may overlook stunting. Thus, children may be underweight for age but of normal or even overweight for height. Height for age is the most demanding indicator of nutritional adequacy since it implies adequate weight for age and appropriate weight for height.

Malnutrition as a public health problem is assessed based on growth indices relative to those derived from a standard population. Yet, most growth standards describe what may be considered normal growth based on values obtained in a given normative population. Normal is derived from statistical normalcy, rather than based on specific health and/or quality of life outcomes related to a set of growth parameters. For example the 1979 National Center for Health Statistics (NCHS) growth reference standard, used as the basis for the former WHO international standards for infants 0 to 36 months derived from children growing in a relatively affluent, predominantly artificially fed, rural community from Yellow Springs Ohio over 30 years ago.⁶ New growth standards have been developed by WHO/UNU based on the growth of more than 8,000 healthy infants and children (from middle income, non-smoking, and well-educated mothers from Brazil, Norway, India, Ghana, USA, and Oman), who are exclusively breast-fed for 4 to 6 months and given appropriate complementary foods after weaning. The resulting charts indicate that infants fed according to present WHO recommendations and living in appropriate conditions gain weight less rapidly than the NCHS median reference value, particularly after 4 to 6 months, while their length is slightly greater. The consequences of applying the new charts as shown by de Onis (<http://www.who.int/childgrowth/en/>) are lower rates of undernutrition after the first 6 months of life and higher rates of overweight and obesity, with slightly higher prevalences of stunting than observed with the old WHO standards.⁷ This new reference provides a scientifically reliable

descriptor of physiologic growth and a powerful tool for advocacy in support of good health and nutrition.⁸ Another objective of the new reference is to support, based on actual evidence, the concept that human growth during the first year of life is very similar across groups of children of different ethnic backgrounds. This confirms that existing differences in growth across countries are predominantly environmentally derived and can be narrowed over time. The new reference supports the right of all children to grow equally well and demands that society provides an environment that does not restrict growth. (see also Chapter 2, "Clinical Assessment of Nutritional Status," for a discussion of the new WHO growth curves).

The evolution in prevalence of underweight and stunting reveals significant reductions for most countries over the past two decades, yet the rate of progress (0.5%/yr) is insufficient to achieve the stated goal of the world summit for children. While the prevalence of malnutrition in developing countries as a whole fell from 46.5 to 31% between 1970 and 1995, about 15 percentage points in all for this 25 year period, progress in reducing malnutrition has varied greatly from one region to another. Malnutrition has declined the fastest in South Asia (by 23 percentage points) and the slowest in sub-Saharan Africa (4 percentage points), but the rate of progress is decelerating. During 1970 to 1985 the prevalence of malnutrition fell by 0.8 percentage points per year; during 1985 to 1995, it fell by only 0.3 points. The situation is particularly troubling in sub-Saharan Africa where the prevalence of underweight children actually increased from almost 29% in 1990 to 31% in 1995. In West and East African regions the prevalence in underweight and stunting has actually increased over the past three decades. In Central America there is no improvement while in South America progress has been significant. Data on children under 6 years of age by UNICEF (2005) show that in Latin America and the Caribbean the prevalence of low weight/age (< -2 SD) vary from country to country (from 0.7 to 22.7%). In Haiti, Guatemala, and Honduras this prevalence is over 15% and in Ecuador and El Salvador is close to 11%. As for severe malnutrition (< -3 SD weight/age) in Haiti, Guatemala, Honduras, Ecuador, and Bolivia the prevalence vary from 1.7 to 8.1%.

Even under ideal conditions it is hard to obtain drops in prevalence greater than 2 to 3% per year on weight related indicators while drops in stunting prevalence of 1 to 2% per year are the maximum that can be observed. Independent of the improvement of national figures, severe malnutrition including edematous forms can still be detected in hospital settings in some regions of the world.⁹

Since 1970, the prevalence of underweight children has decreased in 35 developing countries, held steady in 15, and increased in 12, with most of the countries with increases in sub-Saharan Africa.¹⁰

The causes behind the insufficient progress are multiple and complex in their interactions. Political strife, government unresponsive to the needs of the community, stagnant economies, low status of women and unequal rights, poor education and inadequate access to health, poor sanitation and unclean water, high prevalence of infections and low birth weight interact in determining poor post natal growth and high rates of malnutrition.¹¹ Since most of these factors are interrelated, it becomes virtually impossible to isolate their effects from retrospective trend data or regression models. Decreases in the prevalence of malnutrition have been described in relation to improvements in household food security, supply of clean water and environmental sanitation, education of women, early treatment of diarrhea with oral rehydration solutions in the community, early treatment of respiratory infections, promotion of breast feeding, appropriate complementary feeding, immunization, growth monitoring, and surveillance for early identification of malnutrition

Smith and Haddad have attempted to explain the key factors responsible for the different rate of progress across regions of the world (see Figure 3).¹² They examined the contribution of national food supply, women's status, women's education, and health environment based on proxy indicators from available country data. Improvements in women's education contributed by far the most, accounting for 43% of the reduction in child malnutrition between 1970 and 1995, while improvements in per capita food availability contributed about 26%. In fact this information served to define the Millennium Development Goals adopted by heads of state and the UN system to be met by 2015 (<http://www.un.org/millenniumgoals/>). Comparisons between regions are quite revealing; the overall reduction in the prevalence of child malnutrition in South Asia for the 25-year-period was estimated to be 16.5 percentage points. The greatest contributions to this reduction came from increased education of women and improvements in health environments; each accounted for about 28%. Gains in the status of women accounted for about 25% of the reduction, and improvements in food availability for about 20%. The total reduction for sub-Saharan Africa's malnutrition rate over the study period was only 4.2 percentage points. Most of these were explained by increases in women's education, followed by improvements in health environments. Increased education of

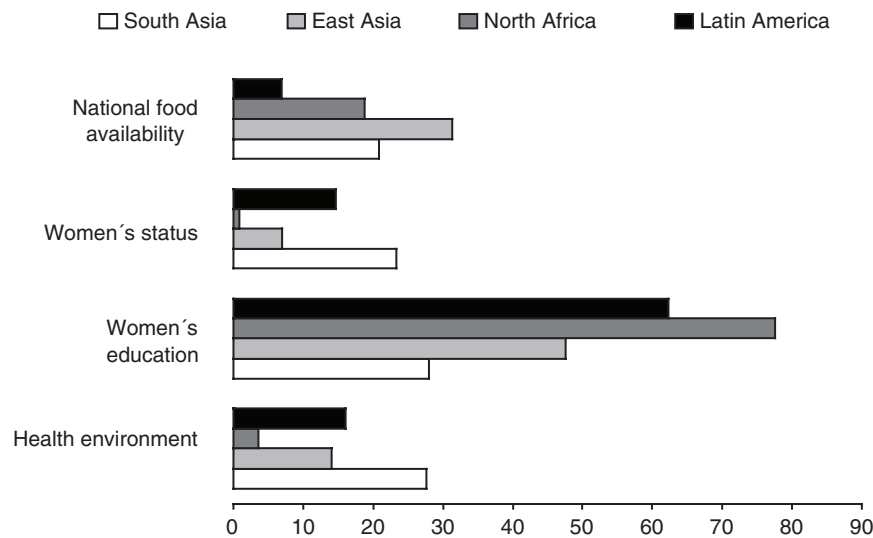


Figure 3 Estimated contributions of underlying determinant variables.

women made strong contributions in all periods except for the late 1980s, when enrollments actually declined. Improvements in health environments have made their greatest contribution after 1985. Women's relative status as evidence by gender differences in life expectancy has continually declined in the region since the 1970s, most precipitously after 1985. The consequence has been a recent worsening in prevalence of child malnutrition in the region. Changes in food availabilities have played a large role in both directions. Substantial improvements in the late 1980s and early 1990s were outweighed by deteriorations during the 1970 to 1985 period.

Latin American and the Caribbean experienced an estimated 11-percentage-point reduction in child malnutrition over the study period, most of which took place during 1970 to 1980. Since then, reductions in child malnutrition have continued at a much slower pace. Like the other regions, the greatest contribution comes from women's education, which explained 62% of the improvement whereas the contribution of environmental health to this improvement has steadily declined. Strong improvements in the status of women in the 1970s were followed by very small improvements in the 1980s. Food availability improved in the 1970s, but declined slightly in the early 1980s.

Prevention and control of infections are clearly a critical aspect of malnutrition reduction efforts. As documented in Chapter 12, "International Nutrition," and Chapter 13, "Protein-Energy Malnutrition: Pathophysiology, Clinical Consequences and Treatment," infection has a definite adverse effect on nutritional status, while malnutrition compromises the host defenses and immune responses increasing case fatality and disease susceptibility.¹³ Relative risk of death from infection is directly correlated with severity of malnutrition: relative risk 8.7 [95% CI 5.5 to 13.7] for severe PEM, 4.2 (95% CI 3.1 to 5.5) for moderate PEM and 2.0 (95% CI 1.7 to 2.4) for mild PEM.¹⁴ Yet, since the severely malnourished represent a small proportion of total population, most malnutrition related death are accounted by moderate mal-

nourished individuals. It has been estimated that close to 80% of all malnutrition infection related death are attributable to moderate and mild malnutrition. Despite the obvious public health implications in terms of preventing death, given the high mortality of the severely malnourished, the cost effectiveness of PEM treatment is greater than that of controlling moderate malnutrition.

The adequacy of breast feeding and weaning foods also plays a key role in malnutrition prevalence, especially after 6 months of life. In most countries where malnutrition prevails the time of onset is after 6 months, this is when breast milk is insufficient to meet the infant needs and also a time when mothers have increased competition for their time/dedication to the infant. This is coupled by inadequate, low energy density, low nutrient density weaning foods. Under these conditions, feeding frequency and added starch or oil to increase energy density becomes crucial to prevent malnutrition.¹⁵ A study in Bangladesh examined the role of education during the weaning period demonstrating that education on complementary feeding given to mothers was effective in enhancing weight gain despite the fact that no foods were actually provided. The authors suggest the educational efforts on what constitutes adequate complementary feeding and on how to prevent microbial contamination of weaning foods are important as malnutrition prevention strategies.¹⁶

There are no easy answers or a magic "silver bullet" in combating malnutrition, several options can be suggested based on the success and accomplishments of some countries in malnutrition reduction. In most cases poverty reduction efforts need to go hand in hand, but should not be considered a precondition for success. Suggesting that poverty reduction is a precondition for success is simply not realistic since malnutrition is not only a determinant but also a consequence of poverty. Thus, the efforts should not be postponed until major political or economic events improve the economic condition of the poor since reducing malnutrition contributes by itself to poverty reduction. The notion of human capital as a major deter-

minant of economic growth has been recognized globally with the award of two Nobel prizes in economics over the past decade.¹⁷

A strategy for action, based on what has worked in different settings around the world (Costa Rica, Thailand, Cuba, Chile, Kerala-India, amongst others), is proposed in Figure 4. This serves to analyze the necessary interactions amongst the key social actors required for successful implementation of malnutrition control and prevention programs. The basic and critical component is social mobilization to establish the demands for action from the political actors; this process should lead to community actions as well as responses by government. A responsive government is one that responds to community demands; this requires some degree of participation by society in government, ideally but not necessarily a government by the people, from the people, and for the people. Communities that are so empowered and able to participate in the political process will be successful in demanding appropriate actions from governments. Malnutrition needs to become unacceptable to society in order to trigger the level of action required to address the issue frontally. What does it take to trigger this process? In most cases, proactive academics and/or NGOs that have a strong voice, independent from government have catalyzed the process and led the way. "Political will" does not come easy nor it is generated from within; professionals, academics, NGOs, community leaders, and the press should act in concert to elicit action. The role of the press in generating public awareness and communicating public concern of malnutrition as a key restriction for national development is crucial. Recruiting and training select journalists will serve to generate widespread recognition of the problem and make people aware that the solutions are credible and feasible by illustrating what has worked elsewhere. Academics and professionals should propose the necessary actions that are required to implement effective programs to control and prevent malnutrition, ideally based on technical consensus rather than political considerations. They should promote a critical review of policy options based on what may work in a given setting; international organizations can assist in reaching a technical consensus by providing evidence and expert advice

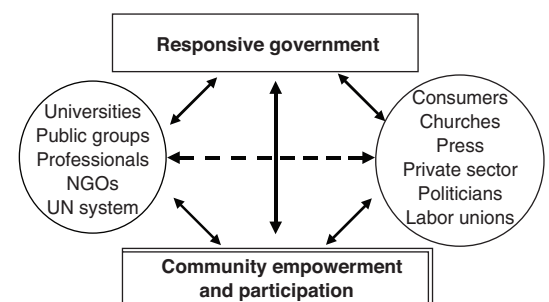


Figure 4 Networks and malnutrition. See text for details on dynamic interactions between stakeholders. NGO = non governmental organization.

on successful examples of malnutrition reduction. The private industrial or business sector is usually a latecomer in this scene. Yet, public private partnerships are a must for sustainable programs since industry is a key partner in the implementation of programs; for example in nutrient supplementation, fortification, and other food based strategies.¹⁸ By the end of the day, unless we activate the political process and include industry we get no action.

Governments must be committed to generate the necessary actions to solve malnutrition as a public health problem. Governments are usually restricted in meeting social demands by the available monetary resources and are not willing to commit funds unless they see a clear return on investment. Thus, it is crucial to clearly present the cost benefit analysis of various programs for nutrition improvement. Moreover, if the community is truly aware and the issue has become a political priority, there may be a clear political benefit as well as an economic gain in terms of human capital formation. The involvement of the press in facilitating social communications is important in open societies. For example, the cost of providing half of all critical micronutrient needs per person per day for a year by fortifying a staple food has been estimated to be less than a dollar per year; this is less than a pack of cigarettes in most countries. The World Bank has estimated the cost benefit ratio of micronutrient fortification to be at least 17:1. On a relative basis not all programs are equal in terms of cost benefit or cost effectiveness, thus the tools of economic assessment should be used in defining policy options. As previously discussed (Figure 4), the mix of policies that will work differs in various settings. Working through networks is particularly helpful in countries where human and material resources are limiting, the potential for complementarity and synergy between groups should be exploited. However, there are multiple pre-conditions to operate successful networks. Groups must share clearly stated objectives, common short and mid term objectives, participants must share decision-making, activities must have continuity and be sustained. It is also helpful to geographically map where the problems are and where agencies are located and programs are in place in order to improve resource utilization.

The impact of maternal education has been shown to work across all regions, yet we must bear in mind that access to education by women is in itself an index of multiple social economic and cultural factors. In Peru, Penny et al working with families living in conditions of periurban poverty, where access to food was not a limiting factor, demonstrated that nutrition education, delivered through preexisting health services, significantly decreased the prevalence of stunting in young children by 11 points.¹⁹ In our experience in Bolivia we have come to realize that understanding the cultural representations of the mother, the family, and the

health team is fundamental to interpret health behaviors that otherwise appear irrational and incomprehensible

Nutrition and food policies should be integrated in the context of national development strategies. Nutritional problems are determined by economic and labor policies, health and education sector policies as well as welfare policies. The integrated approach may be more difficult to implement in most settings, since government structures are sectorial, yet harmonization of policies is a must to avoid duplication, wasteful use of resources and overburden personnel budgets.²⁰ Cost effectiveness evaluation of programs should be included at the outset in the present climate of fiscal policies. Today, program sustainability in a world of competing interests will progressively depend on the capacity to demonstrate cost effectiveness over time. Technical considerations should prevail over political interest in defining what should be done, because this is the best way to optimize chances of success. This is true at all levels, national and international programs are not always guided by best technical advice but many times, respond to politically motivated actions.

The emerging orientation to guide nutrition and food policy by the ethical dimension and human rights concern can no longer be ignored. In a world of plenty malnutrition can no longer be justified as a problem of the poor or a problems that affects others but not us. Globalization should be not only about business and trade; but mostly about how we as humans face a common future. We cannot afford to have over a third of the people in the planet under conditions of poverty and malnutrition. Pediatricians should be concerned with the status of children worldwide. As we are convinced that our research should not ignore that we are citizens of a common planet, our advocacy and our research should not only serve those around us but children around the world. Funding for applied research in nutrition and health of children should be as important as the present emphasis given to protection from bio-terrorism and the war on terrorist activity worldwide. Providing for a better future for children across the world will do more for peace than the massive bombings that have recently taken place. Controlling and preventing malnutrition should top the list.

POTENTIAL STRATEGIES FOR THE TREATMENT AND CONTROL OF SEVERE AND MODERATE MALNUTRITION

First, we should clearly establish that prevention and treatment of malnutrition are complementary. Although the adage “prevention is better than cure” is a public health imperative, it cannot be used to withhold treatment from those already affected by malnutrition. Both strategies must work in tandem to avoid malnutrition from occurring and to recuperate those who are moderately or severely malnourished and at risk of

death and/or severe disability. Although the actions for prevention differ from those necessary for effective treatment, they should be seen as part of the spectrum of efforts needed to combat malnutrition. What can we learn from experience, either success or failure, in the treatment of malnutrition?

Hospital Treatment

Even though severe malnutrition (ie, severe wasting and/or edema) is commonly seen in pediatric wards in developing countries, few doctors and nurses have been trained in its management. Consequently case-fatality rates are high. Severely malnourished children die in large numbers if treatment does not take into account the physiological and metabolic changes that arise during reductive adaptation.²¹ (For details of treatment see Chapter 13, “Protein Energy Malnutrition: Pathophysiology, Clinical Consequences and Treatment”). One way to try to prevent children dying during treatment is to provide case-management guidelines. WHO first produced such guidelines in 1981. These encapsulated the basic principles of care that are still recognized today, namely stabilization with small frequent feeds day and night, rehydration with low-sodium fluids, provision of potassium, magnesium, and micronutrients, and antibiotics for all children as infections are often silent, followed by rehabilitation with a high-energy, high-protein diet to rebuild wasted tissues. With advances in knowledge, notably the importance of withholding iron during the stabilization phase and providing zinc and other trace nutrients and psychosocial stimulation, WHO updated the guidelines in 1999,^{22,23} and developed a training course.²⁴ Where the guidelines have been fully implemented, deaths among hospitalized severely malnourished children have fallen dramatically; for example, case-fatality rates of 30 to 45% have fallen to <10%.²⁵

In some hospitals, staff have accessed the WHO guidelines and implemented them with no outside help, and the improvements in the children’s rates of recovery and survival have led to the guidelines becoming hospital policy. In other hospitals, training courses have been the trigger for change. There are also examples, however, where training courses have led only to a transient or partial adoption of improved practices. The reasons are varied and include high staff turnover and lack of motivation. Factors that favor adoption of improved practices and sustainability are:-

- A functioning health system, and basic resources
- Leadership, mentoring, and managerial support
- In-service education so that everyone is confident about what to do
- Induction of new staff
- Supervision of junior staff and carers
- Regular audit and feedback, and discussion of critical incidents and lessons learned
- Good teamwork.

A major hindrance to reducing case-fatality rates is that treatment of severe malnutrition is not included in many medical and nursing curricula. The consequence of this omission is illustrated by experiences in a South African hospital where the case fatality rate increased from 18 to 38% with the arrival of newly qualified doctors who had no specific training in the management of severe malnutrition. The sudden rise in case-fatality coincided with lower prescribing of potassium (13% vs 77%), antibiotics with gram-negative cover (13% vs 46%), and vitamin A (76% vs 91%).²⁶ In many hospitals in developing countries, severely malnourished children comprise the majority of pediatric deaths, so it is imperative to train young doctors and nurses to care for these children correctly. This will require recognition of the importance of malnutrition in clinical practice, establishing a severe malnutrition ward or “corner” where correct treatment is provided day and night, having adequate supplies, and having ward and emergency staff trained in malnutrition case-management.

Community-Based Treatment

Some of the lowest case-fatality rates for severe malnutrition are to be found in humanitarian emergencies where well-trained staff systematically follows treatment protocols. When thousands of families congregate in crowded camps the risk of disease increases so, as far as possible, case-management should be provided in their communities.^{27,28} Community outreach workers screen children for wasting and edema. A mid-upper arm circumference of <110 mm is used to assess wasting in those aged 6 months to 5 years. Children identified as having mild/moderate edema or are wasted, but have a good appetite and are alert and appear clinically well, are treated at home with ready-to-use therapeutic food (RUTF). Only those who have poor appetite or are ill, or have severe edema, or edema plus wasting, are referred for inpatient care.²⁹

The components of community-based care include:

- Community sensitization and active case-finding to identify malnourished children early, before their condition deteriorates
- Community mobilization to improve access to care and achieve high coverage
- Treatment of moderately malnourished cases
- Treatment of severely malnourished children with good appetite and who are clinically well (uncomplicated severe malnutrition).

Carers are instructed how to manage their child’s recovery at home. Antibiotics, antihelminthics, vitamin A, and RUTF are provided. The child’s progress is monitored every week for programs implemented in an emergency context, or every 2 weeks in nonemergency settings. In 21 programs in Malawi, Ethiopia, and Sudan, more than 22,000 children have been treated in this way, with a case-fatality rate of 4.8% and coverage rates of more than 70%.³⁰

Where an effective system of community-based care is in place, children requiring inpatient management can be discharged after completion of the stabilization phase and their rehabilitation completed at home with supervision by a trained health worker at a health post, or health centre, or by home visits where these are feasible.³¹ Treatment in the community can:

- Benefit children by reducing their exposure to hospital-acquired infections
- Benefit families by reducing the time carers spend away from home and the risk of possible neglect of siblings
- Benefit families by reducing the opportunity costs associated with hospital treatment
- Act as a catalyst for strengthening nutrition activities within clinics for treatment and prevention of malnutrition
- Lead to community action to prevent malnutrition.

Rehabilitation at home can be achieved by provision of RUTF or by families using their own resources to make specific mixtures of family foods. High energy intakes (>150 kcal/kg/d), high protein intakes (4 to 5 g/kg/d), and provision of micronutrients are essential for rapid weight gain. Protein and energy intakes should be adjusted according to rate of growth and stage of recovery. RUTFs are specially designed for home-feeding in the rehabilitation phase: they contain electrolytes, minerals, and vitamins and have low water content so pathogens cannot grow in them.

Advantages of well-run, effective community-based programs are that:

- Timely action should reduce the number of cases requiring inpatient treatment
- The rehabilitation phase can be completed in the community rather than in hospital, which should reduce length of stay
- Discharged children can be provided with continuity of care
- Treatment is more cost-effective.

Early discharge must always be linked with effective follow-up, but at present there are many countries where this is nonexistent. Hospitals with a policy of early discharge and no system of follow-up are usually unaware of high rates of postdischarge mortality. Failure of children to appear at outpatient clinics is easily misinterpreted as parental irresponsibility, rather than to child death.

Nutrition Rehabilitation Centers and Day-Care Centers

There is a long tradition of treatment of moderate and severe cases of malnutrition in residential or day-care nutrition centers, but their low coverage and high opportunity cost make these the least favoured option in many settings. Nevertheless, such centers could be a “half-way-house” between hospital and home. For example, attendance for 1 week could achieve rapid

weight gain and provide practical education sessions for mothers and carers and precede rehabilitation at home. Center staff could monitor progress during home rehabilitation through home visits and/or having children return to the center for assessment. Centers could also receive moderately wasted children and treat uncomplicated severe malnutrition. In urban areas with high numbers of severely malnourished children, well-resourced nutrition centers could be alternatives to hospital admission if staff is sufficiently trained. The centers should be integrated into the child health services and could be attached to a clinic.

Factors for successful rehabilitation. Successful programs share several features:

- All follow the basic principles of treatment of severe malnutrition (ie, high-energy, high-protein intakes in the rehabilitation phase along with potassium, magnesium, minerals, and vitamins)
- All provide frequent meals (at least 5), comprising specific food mixtures that families can afford, or RUTF
- Those not giving RUTF make considerable efforts to teach mothers about child feeding in a memorable way, using a variety of teaching methods and providing opportunities for mothers to practise preparing children’s meals
- Most address the wider social, economic and health issues that face poor families: some integrate rehabilitation with poverty alleviation activities
- All have motivated and carefully trained staff.

The advantages and disadvantages of (1) residential and day-care nutrition centers, (2) home rehabilitation with no free food given, and (3) home rehabilitation with RUTF are summarized in Table 1.

Each option has advantages and disadvantages: some options may be better suited to particular contexts, such as urban families, mothers working for a wage, or food insecure communities. Health system infrastructure, accessibility, and staff competencies must also be taken into account. For successful rehabilitation, the system chosen should:

- Achieve intakes that will promote catch-up growth and improve immune function
- Provide timely treatment of infections and close monitoring of progress.

Ideally the system should integrate both the treatment and prevention of malnutrition.

Khanum and Ashworth compared the cost-effectiveness of three treatment modalities in 437 severely malnourished Bangladeshi children aged 12 to 60 months. The children were allocated either to (1) inpatient treatment, (2) day-care treatment, or (3) 1 week of day-care followed by home care. The three groups were comparable at admission: most (98%) had edema and the mean weight-for-height was

Table 1 Characteristics of Different Treatment Modalities for Malnutrition: Advantages and Disadvantages According Need

At home with RUTF	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Independent of home resources • RUTF contains electrolytes and micronutrients; needs no cooking or refrigeration • Liked by carers/children: few defaulters • Can achieve high coverage, rapid scaling-up • Responsive to fluctuating numbers • Avoids need for formative research as to which home foods to promote • Avoids need for intensive teaching of carers on what to give 	<ul style="list-style-type: none"> • Little opportunity to learn about good child feeding practices and malnutrition prevention • Need clinic/health post nearby for monitoring progress etc • Need efficient transport and distribution networks • Need quality control measures if RUTF is locally made
At home using own resources	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Cost-effective • Liked by carers: few defaulters • Teaches mothers about child feeding • Potential to prevent malnutrition in the long term by learning to make good food mixtures and feed frequently and responsively • Potential ripple effect • Responsive to fluctuating numbers 	<ul style="list-style-type: none"> • Families must have food resources • Carer must be at home full-time • Need formative research to develop educational messages • Need clinic/health post nearby to monitor progress and provide timely treatment when ill • Need to provide micronutrient supplements • Need motivated staff; good communicators
Residential or day-care nutrition centers	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Supervised feeding with high chance of success • Opportunity for teaching mothers • Potential for preventing malnutrition in the long term • Circumvents poor primary health care system 	<ul style="list-style-type: none"> • Need high malnutrition prevalence, or a center attached to a clinic • High institutional cost if “stand-alone” • Burdensome to carers, with risk of defaulting • Low coverage

RUTF = ready to use therapeutic feeding.

<70%. The costs to reach the target of 80% weight-for-height were compared. The days required to reach the target in the three groups were 18, 23, and 35 days respectively. Although the home-treated group took the longest time, it was the most cost-effective treatment. The

respective costs expressed in US\$ were \$156, 59, and 29 per treated child. Mortality was equally low (<5%) in all three groups (Figure 5). Home treatment was the option most preferred by parents: day-care was the least preferred option.^{32,33}

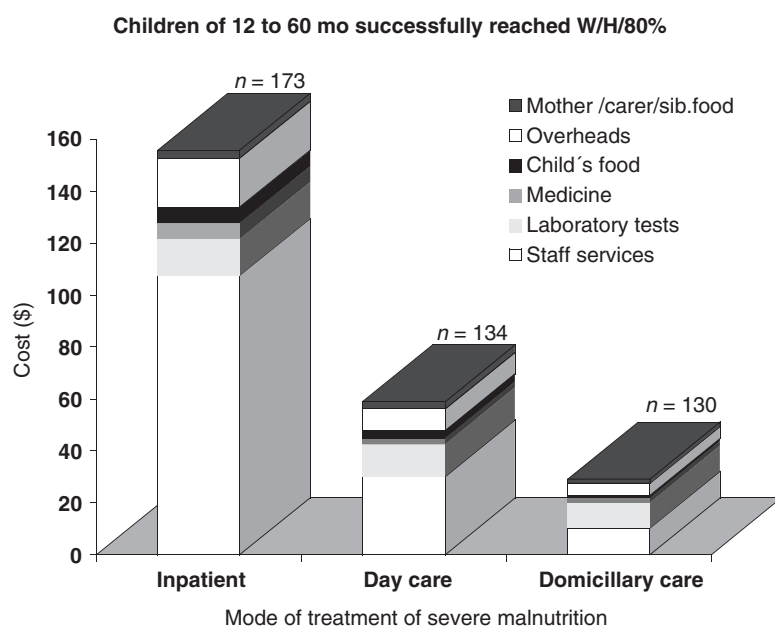


Figure 5 Cost-effective treatment in severe malnutrition. Children were allocated to hospitalization ($n = 173$), day care nutrition recovery center ($n = 134$), and ambulatory treatment ($n = 130$). All achieved a similar degree of recovery (weight for height 80% of World Health Organization Standard). Cost is expressed in US dollars per treated child for treatment to reach the goal.

IMPLEMENTATION OF PROGRAMS TO PREVENT AND REDUCE MALNUTRITION AT THE NATIONAL LEVEL: THE EXPERIENCE OF CHILE

We need to examine not only the specific actions to treat severely and moderately malnourished children to understand how Chile succeeded in reducing malnutrition, but also assess the multiple programs that acted in synergy to achieve this goal. A key component was the primary health infrastructure with wide coverage and the human/material resources necessary for effective action. The capacity to identify and refer the severely malnourished to nutrition recovery centers when appropriate is vital for success. A nutrition recovery program focused on treatment of the severely malnourished working in isolation will have a little or no impact unless it is coordinated with an effective primary and secondary prevention program working through the primary health system.³⁴

Chile stands out among countries of Latin America and the Caribbean for the notable improvement of its health and nutrition situation, particularly in pregnant women and young children. This improvement has been achieved progressively and continuously through comprehensive health, nutrition, sanitation, education, and reproductive health strategies initiated in the 1940s. Results came 30 to 40 years later but much earlier than the considerable economic progress experienced by the country during recent decades. A key element in the success of the Chilean experience has been the uninterrupted application of programs defined based on technically consensus independent of major political, social, and economic changes. The programs remained in place and were even expanded in periods of social instability, radical political changes, and serious economic crisis. Only recently, poverty reduction has contributed to improved food security and to the improvement of the quality of life of low-income groups.

The achievements obtained in children's health can be appreciated in the declining rates of infant mortality, mortality due to acute diarrhea and to bronchopneumonia. Infant mortality dropped by approximately 90%, and mortality due to respiratory infections and acute diarrhea by over 95%. Between 1940 and 1960, total infant mortality was reduced in Chile from 193 to 120 per thousand live births. From 1960 to 1990 it fell to 17 per thousand and over the past decade it dropped to around 10 per thousand. See Table 2 for degree of achievements of 2000 goals for nutrition of children and women, note the virtual eradication of malnutrition and the rise of obesity as the major diet and nutrition related public health problem.^{35,36}

A key strategic factor in the development of nutritional programs in Chile has been the emphasis placed on the political dimension of nutritional problems. Nutrition of the population, and especially its more vulnerable sectors, has been at the center of the political debate for the past 40 or 50 years. It has been transformed

Table 2 Degree of Achievement of Nutritional Goals Chile 2000 to 2005

Indicator (%)	Base 87–89 (%)	Goal 2000 (%)	2005* (%)
Pregnant women with low W/H	25	15	12
Anemia in infants	30	10	3
Anemia in pregnant women	25	10	25
Newborn with low birth weight	6.9	6.0	5.0
Newborn with insufficient weight	21	15	12.5
Breastfeeding exclusively to 4 mo	44	80	60
Breastfeeding to 12 mo	20	35	34
Student gr. 1 elem. with height <−1 SD	33	20	10.4
Under 6 yr old with W/A <−2 SD	2.2	2.0	0.8
Food insecure households	35	20	14
Indigent population	18	15	5
Obesity in preschool children	4.6	3	14
Obesity in children entering school	6.5	4.5	19.5
Obesity in pregnant women	12	8	36

Source: Plan Nacional de la Infancia, UNICEF 1994.

*Latest figures Ministry of Health Chile 2001.

into a key indicator to assess social justice and equal opportunity for all. The 1970 Presidential election campaign is a good example of this. All three main candidates to the Presidency (one representing the conservative right, a second representing the center left Christian Democratic, and the third representing the Socialist left) proposed the eradication of malnutrition as a key target of their respective future governments. Salvador Allende, the socialist candidate was elected on that occasion with the promise of providing half a liter of milk per day to every child up to 15 years of age in the country.

The community demanded access to health and food, not only to meet this basic need but as a fundamental human right. The process initiated by academic researchers led to policy development and implementation of nutritional programs. The expansion of these programs became part of the social demands made by the population to the governments, and those politicians that satisfied these demands of providing more food to the economically vulnerable groups were elected and maintained in office.

Community organizations, political parties, the Catholic Church, concerned academics, labor unions as well as multiple social organizations played key roles in demanding action. Most of the nutrition programs were eventually built into the law specifying universal coverage and the respective yearly budget allocations. Any changes to the supplementary feeding programs have always been undertaken with extreme caution by governments, since they are reluctant to take risks on a matter of such high political sensitivity.^{35,36}

The National Supplementary Feeding Program (PNAC) is the main nutritional program for the prevention and control of malnutrition. It consists of the distribution of milk and other food products free of charge to children less than 6 years of age, pregnant women, and breast-feeding mothers, with the sole condition of complying with the scheduled out patient visits and preventive health actions determined by the Ministry of Health. In its present form, PNAC began operating in 1954 for the purpose of protecting

and improving the nutritional state of pregnant women and children. Until 1974 it provided milk with variable fat content as the sole product. During the period from 1974 to 1981, studies were conducted with various milk-cereal blends for children after 2 years of age, in an effort to reduce cost and to prevent the dilution of the product within the family. This alternative based on milk/wheat blends fortified with micronutrients has remained in place till now. All products are distributed in water-soluble dry powder form (except rice which is given to families with greater need). PNAC's coverage was extended to all children under 14 for a brief period (1971 to 1973), to return later to its original target population.³⁷

Between 1975 and 1993, when the criterion for diagnosing "malnutrition" was based on weight for age below 1 SD of the median for age and gender, using as Standard of Reference described by M. Sempé, the preschool population was under control at the primary health care units of the National System of Health Services and was equivalent to close to 75% of the total population of children under 6 in the country. These standard and diagnosis criteria were maintained over a period of almost 20 years, which made easy to appreciate the rapid reduction of malnutrition in this population.³⁸

The National Nursery Schools Council (JUNJI), just like National Council for Students Assistance and Scholarships (JUNAEB), is an autonomous public Corporation created by law in 1971 that is functionally dependent on the Ministry of Education. JUNJI plans, promotes, coordinates, provides incentives, and supervises the organization and functioning of day care centers which, as the name implies, provide day care for preschool children until they are old enough to start attending elementary education. JUNJI coordinates and supervises preschool education in the context of integral attention of preschool-age children. Together with food and education in accordance with the child's age, this program also provides social assistance to the family when required.

The programs of food and social assistance to school children were initiated in 1929 by the Stu-

dent Assistance and Scholarships Committees, which operated at the municipal level with local financing and some resources from the central government. In 1952, the Ministry of Education assumed, at the central level, the administration of these programs. This situation continued until 1964 when this and other responsibilities were handed over to an autonomous public corporation created by law for that purpose: the JUNAEB.

Conceived as a state assistance organization to support the work of the Ministry of Education, JUNAEB works on the basis of integral assistance, for the purposes of providing maximum support to poor students, not only in terms of nutrition but also through programs of health, housing, educational recreation, scholarships, etc.

JUNAEB provides orientation, plans, and coordinates the execution of these social and economic assistance programs directed to students at the preschool, elementary, and high school level, in order to make effective the equal opportunities in education. Program activities are aimed at providing incentives for incorporation and permanence in the educational system, preventing school desertion, and improving academic results of children in municipal and subsidized private schools. The school feeding program (PAE) take up most of the institution's resources.

In 1951 fortification of wheat flour with B complex vitamins was established for the purpose of "improving the nutritional situation of the Chilean population." The only product available for this fortification contained iron and calcium, in addition to thiamin, riboflavin, and niacin. Iron was added in low concentration and, due to the presence of calcium and the type of compounds used, it was probably poorly absorbed. In 1967, regulations on iron fortification were amended, making the process much more effective from a nutritional point of view. Even now, bread made from wheat flour is the main source of calories in the Chilean diet. The main source of calories in the lowest income quintile is wheat flour (bread and pasta) about 40% while in the highest income group only 20% is obtained from wheat. Quality control carried out by the Ministry of Health serves to monitor the iron content in flour samples obtained in a regular and random manner in the mills. A study on iron content in bread obtained at commercial bakeries indicates that 87% of bakeries in the Metropolitan Region use flour with iron. Although it has been impossible to fully assess the efficacy of the fortification program, its impact has produced a change in the prevalence rates of iron deficiency anemia. Bread alone supplies 0.36 mg/d in children 2 to 6 years of age and almost 1 mg/d in adolescents.³⁹ In fact, anemia problem has virtually disappeared in school children (7% in 1974 to less than 1% in 1994) and adolescents (5 to 1%).

The first law that established mandatory iodination of salt was passed in 1959, and the Food Sanitary Regulations of 1960 determined the obligation of salt fortification. This measure did not really become effective until 1982 when the same Regulations, in a new version, allowed the existence of

both iodized and noniodized salt in the market. In 1989, the Ministry of Health declared that edible salt must contain iodine added in the form of sodium or potassium iodates or iodides, in concentration of 100 ppm. One single producer supplies approximately 90% of the edible salt market and has managed to maintain a good level of iodination for the salt that is consumed. As a result, endemic goiter has been eradicated as a public health problem. A study conducted in 1994 in four surveillance areas showed that less than 10% of school children between 6 and 16 years of age had goiter. When present, it is type I-a with high levels of urinary iodine. At present, an inter-sector commission, with the participation of PAHO, UNICEF, the salt industry and the Ministry of Health, work to safeguard this achievement and are making efforts to amend the regulations currently in force, which establish extremely high levels of fortification (100 ppm) in the finished product.^{40,41}

National Program of Nutrition Recovery Centers (CNRCs). Severe malnutrition of the marasmic type was concentrated, in 1975, on children under 12 months of age. In fact, among the cases of severe malnutrition that were admitted to hospital, 76% were under 6 months of age. The population of these children, estimated at that time at around 15,000 at the national level, had an important effect on child mortality rates and overburdened pediatric hospital services, where their mortality, due to concurrent infections, was extremely high. Belonging, in general, to homes in extreme poverty, the severely malnourished infants that survived their hospital stay were discharged only partially recovered, or even with yet greater nutritional deterioration, to return their homes where the existing poverty and marginality conditions determined their death or re-admittance to hospital very shortly thereafter.

For the purpose of putting an end to this problem, in 1975 the Chilean Nutrition Foundation (CONIN) was created, a private nonprofit foundation that established throughout the country a system of 33 closed nutrition recovery centers (CNRC) with 1,400 beds destined to the integral treatment of children with severe malnutrition. This treatment includes as basic elements: pediatric and nutritional attention; psychomotor, social, and emotional stimulation of the child; the incorporation of the mother to the child's recovery process; and integral child care training for the mother. At the same time, efforts are made to improve the socioeconomic situation of the family as well as the conditions existing at home.

The CNRCs are directed by a pediatrician in collaboration with a professional team made up of nurse, nutritionist, social worker, child care worker, nurse's aids, and a variable number of volunteer workers. At the central level, CONIN provides support on technical aspects of the program through pediatricians with experience in public health and nutrition, psychologists and physical therapies that monitor the psychomotor stimulation program, and a social assistance and training unit that designs strategies for education

and social reinsertion of the mothers and family group of the children under treatment.

The CONIN program is to a great extent financed with funds provided by the Ministry of Health on the basis of annual projections of treatments. CONIN, through various mechanisms, generates supplementary resources. Volunteer workers play an important role in the institution, participating both in the care of the children and in the search for resources to assist the family group. In this task, CONIN centers generally count on the support of local governments.³⁴

The program applied by CONIN has been successful. The reduction of malnutrition has led to the closing of many CNRCs, with only 12 remaining throughout the country. Of these, only some maintain their original objectives, although the children being treated today are, almost exclusively, suffering from moderate malnutrition due to social deprivation and/or maternal neglect. Some other centers have destined their beds to reinforcement of the work of the Ministry of Justice with minors under socially deprived environment or due to maternal neglect. As primary malnutrition subsided, five of the existing centers are now concentrating their effort to the study and treatment of children with secondary malnutrition.

SELECTING THE BEST APPROACH TO TREAT SEVERELY MALNOURISHED CHILDREN

The selection of treatment modality for malnourished children starts by defining the severity of the malnutrition. Gomez in the late 1940s proposed the first classification of PEM based on weight expressed as a percentage of normal value for age, despite the limitations of this expression it is still used by many because of its simplicity. First degree or mild PEM is defined as between 75 to 90% of norm, second degree or moderate 60 to 75%, and third degree or severe as <60% of expected for age.⁴² Bengoa with his functional classification in the mid 1950s established treatment modalities based on the Gomez criteria, indicating that those with first degree should be treated in the primary health or outpatient health clinic by providing education and dietary advice; those with second degree should be treated in the day care nutrition recovery center using complementary foods in addition to education. Finally, third degree PEM should be treated in the hospital. To a great extent with the caveats described in the corresponding sections, the Bengoa approach remains valid.²⁰ Hospitalization should last for strictly the minimal time required to treat complications and stabilize the patient, then feed nutrient and energy dense foods as tolerated. Closed nutritional recovery centers should be reserved to situations where PEM is highly prevalent, particularly in young infants and family conditions do not permit recovery at the home. The choice of treatment modality should also consider parental choice, cost effectiveness of

treatment under real life situations, access to primary health care system, availability of health infrastructure, social support system available in the community, maternal education and overall condition, and psychosocial interactions within the family. See Chapter 13, "Protein Energy Malnutrition: Pathophysiology, Clinical Consequences and Treatment."

The main barriers or impediments in control and treatment of malnutrition relate to the multiple conditioning factors presented earlier. Translating theoretical concepts into practices that lead to improved nutrition and health of children is also a challenge. Treatment norms and preventive strategies may be well known but they are harder to establish as standards of practice. In addition, physicians commonly depart from rules to demonstrate their autonomy and status, or challenge specific aspects of the norm based on anecdotal personal experience rather than on firm evidence. Health professionals often consider malnutrition as an unavoidable consequence of poverty, thus may accept it as a social problem outside the health realm. The common acceptance of malnutrition by communities and the political leadership as a chronic unsolvable problem inherent to social structure for ages leads to passive acceptance and inaction. Physicians often define health expenditure priorities, particularly by those with greater financial status such as surgeons and internists; they choose based on what is more attractive for medicine per se, rather than basing decisions on objective measures of impact on burden of death and disease. Physicians are more interested and have greater incentives in providing individual health care rather than addressing public health problems.

The organizational environment is also an important barrier, physician lead administration usually centered on medical interest rather than on patients needs. Moreover, other health professionals are seen as subservient to the physician rather than team members with equal participation. Physicians in general have limited skills for networking and to develop partnerships, they are poorly trained for teamwork; they associate success with individual recognition rather than group effort. These traits can prevent physicians from leading multiprofessional multidisciplinary teams such as those needed to address malnutrition effectively. Promoting new attitudes and skills, training for team work, active listening, and defining funding priorities based on public health needs of the community are mandatory to establish effective malnutrition prevention and treatment programs.

FACTORS THAT CAN EXPLAIN THE EFFECT OF NUTRITION PROGRAMS IN RISING OBESITY TRENDS

The transit from undernutrition to good nutrition often leads to increasing rates of overweight and obesity, as observed in Table 2. Countries may reach the goals linked to reduced undernutrition

but at the same time have rising prevalence of obesity and related chronic disease.⁴³ In order to prevent this from occurring, PEM prevention programs should include from the outset the need to consider obesity prevention strategies. For example, there is a need to monitor not only of weight-for-age, but also of length-for-age as well as weight-for-length. The use of combined indicators should permit identification of the stunted overweight or obese child. Beneficiaries should not be selected based solely on socioeconomic conditions, but on true assessment of nutritional status. Stunted children of low weight-for-age but normal weight-for-length should not be given excess energy, since this will lead to obesity. The quality of the foods provided is crucial in preschool and school feeding programs; fruits and vegetables should be included in the diet of children to provide micronutrients and prevent energy excesses. Obesity prevention requires optimizing linear growth and lean tissue mass gain; thus micronutrients and quality of the protein source are important.

PEM prevention programs need periodic evaluation, including targeting of beneficiaries, definition of real needs, and impact on obesity. Food products may need to be modified in urban settings. For example, in situations where stunting and obesity coexist, providing Fe and Zn fortified skimmed milk in preschool feeding programs, rather than full-fat products, is highly recommended.

Programs should be redesigned on the basis of actual need, considering the rapid transition of most urban communities in developing countries. Planners should consider the assessment of physical activity; if low, increased activity should be promoted. Food programs designed to combat PEM may become outdated as rapid improvements in socioeconomic and environmental conditions occur. Slashing social benefits without redirecting them is always unpopular. Policy makers can prevent this reaction by reallocating these funds to alternative social programs that enhance the quality of life of the poor. Thus, the changes will not be seen as taking away benefits from the poor, but rather as responding to a new situation where other needs become more relevant. Ideally the right to food should be upheld by providing access to safe and nutritious foods, based on what people can buy or grow for themselves.⁴⁴

CONCLUSIONS

Presently the world produces enough food to feed the 6 billion inhabitants of the planet. Food production has increased by 25% over the past decade reaching a daily availability of 2,750 cal and 76 g of protein per person.¹⁰ Yet, undernutrition affects close to a billion people, stunting and underweight affects close to 180 million children under 5 years of age, especially in South Asia and sub-Saharan Africa. The overall trend is toward a small decrease in the proportion of undernour-

ished children with a minute decrease in the absolute number. Unfortunately the goal established by the UN for year 2000 two decades ago to reduce malnutrition by 50% was not met. The present level of progress (0.72% per year) is only half of the 1.5% decrease required to reach this goal in the next 20 years. Moreover some regions like sub-Saharan Africa show a rising prevalence of malnutrition. This situation is worse in countries affected by civil strife and draught, where death of children during famine is 20 to 40 times greater than those found in the general population. We can firmly state that malnutrition and growth failure of children remain an issue, which affects not only survival but also the quality of life of children in many parts of the world. Prevention is the best form of treatment. There is no doubt that sufficient knowledge exists to treat and prevent primary malnutrition in virtually all children. The condition should be considered a preventable disease, but its eradication requires full commitment by society to assign a high priority to the well-being of children. Changing the social, economic, and political forces that condition abnormal growth and development in PEM goes beyond the realm of specific medical action but concerted participation of physicians as advocates for children in the political process. Placing demands on political leaders is essential to assure that children from the time of conception throughout their various development stages are provided adequate nutrition to allow for the full expression of their genetic potential. Acceptance of this basic premise by the community is essential before appropriate prevention strategies can be successfully undertaken.³

Treatment of childhood malnutrition initiated as a response to a basic humanitarian duty to prevent death during the first half of the past century remains a problem in many regions of the developing world. Presently the mandate is based on the right to adequate food and nutrition for all children as part of the global human and social development agenda. National and International Nutrition and Food Programs developed over the past 50 years have been implemented as integral components of broader strategies of primary health care and education, oriented toward preventing deaths and improving quality of life of low socioeconomic groups. Pediatricians worldwide should also be aware of malnutrition as a conditioning factor delaying recovery from illness and as a major determinant of the quality of life of children with chronic disease.³

The key for effective malnutrition prevention is integrating, health care, household food security, and care as proposed by the UNICEF model presented at the outset. The following are some of the components of malnutrition primary prevention programs that have been developed and tested over past decades throughout the world in a variety of political and social settings:

1. Promote early contact between mother and infant to improve chance for successful breast feeding. Establish hospital and other health

routines that support breast feeding while in the maternity ward and later, successful early bonding and documented breast feeding is vital. Support breast feeding by health team and by legal framework that promotes, protects, and sustains the right of working women to practice it.

2. Monitor growth and development with adequate standards (present standards are being revised based on present recommended feeding modes). Intervene only when appropriate to prevent malnutrition and specific micronutrient deficits. Mothers should be familiar with growth monitoring cards and be ready to take appropriate actions when growth faltering occurs. The degree of actions taken by the community will depend on the strength of the primary health care.
3. Introduce appropriate micronutrient rich complementary foods and supplements at 6 months of age. If complementary foods are needed earlier, consider the risks associated with interference of breast feeding. Ideally these should be based on local foods that are accessible to the population. Micronutrient will be required in most cases, new developments include fortification at the household level either with tablets, sauces or sprinkles. Food donations should be incorporated into existing programs and not be dependent on whether surplus exists in industrialized countries. Occasional food donations no matter how well meaning can have adverse consequences in the long term when they disappear.
4. Identify infants at risk for malnutrition and growth failure based on biological and social risk factors. Provide adequate social and medical support for families with children at risk. Early identification should be based on community surveillance not only of growth but of caring practices and of critical food insecurity. Early interventions at this level are significantly more cost effective. This area is presently receiving insufficient attention despite being at the core of the problem.
5. Educate parents and adolescent girls (who will be mothers) on how to promote growth and development through appropriate home environment, care, and stimulation. Verbal and cognitive stimulation for malnourished children results in higher growth rates than for children without such stimulation. Interactions with parents, caregivers, and other children are essential for the young child and these interactions can be improved by education of parents and other caregivers. Care initiatives should go beyond focusing on individual practices and behaviors to bring in dimensions of care for the family and the community.
6. Provide universal coverage of children to basic health care services, full coverage for all children with immunizations to prevent infectious disease, and avoid their adverse effects on nutritional status and provide early diagnosis and treatment of diarrheal disease at the

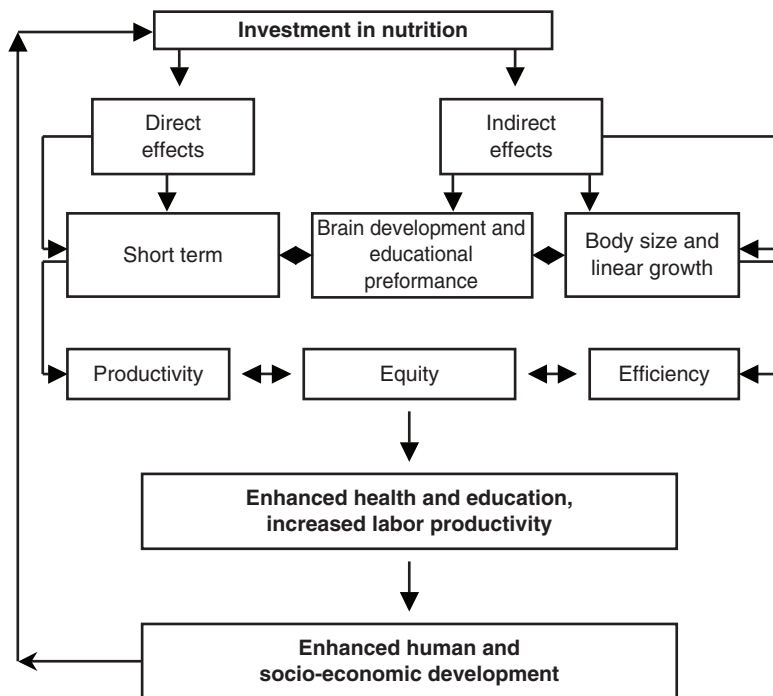


Figure 6 Model to explain how investment in nutrition contributes to economic growth and national development. Short-term improvement in food intake is coupled to better linear growth and enhanced mental development. These translate into better health, decreased infectious morbidity and mortality, enhanced educational performance, and increased capacity for physical work. These interactions in the appropriate social and political conditions lead to increased efficiency, productivity and increased equity. The product of the investment is better health, education and productivity; thus generating economic growth and greater human and social development. This virtuous cycle is closed as more investment in nutritional improvement takes place.

community level using oral rehydration. Linking this effort to the community based surveillance for effective prevention and control of mild and moderate PEM. Depending on what is available in the country the approach may not require expensive infrastructure but rather be community based and sustained.

Treating hundreds or thousands of affected children will not solve the problem of malnutrition as a global public health problem. Unless society at large confronts this issue in its full dimension the problem will continue. Access to adequate amount and quality of food represent a basic human right and is a necessary precondition for health. In turn good nutrition and health are prerequisites for human, social, and economic development (Figure 6). Physicians and especially pediatricians should not be passive bystanders but rather be activists in this process. Reducing malnutrition of infants and young children means a brighter future for all humankind.

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