

The cost of hunger: Social and economic impact of child undernutrition in Central America and the Dominican Republic

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This document is a summary of the report "El impacto social y económico de la desnutrición infantil en Centroamérica y República Dominicana" [The social and economic impact of child undernutrition in Central America and the Dominican Republic], prepared within the framework of the agreement between ECLAC and the World Food Programme: "Análisis del impacto social y económico del Hambre en América Latina" [Analysis of the social and economic impact of hunger in Latin America] (WFP/03/080), coordinated by Rodrigo Martínez, of the Social Development Division of ECLAC and by Judith Thimke and Carlos Acosta Bermúdez of the Regional Office for Latin America and the Caribbean of the World Food Programme (WFP), within the framework of WFP Project 10411.0 "Capacity-Building in Support of Food-Based Social-Protection Programmes".

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Presentation

Undernutrition deprives children of necessary nutrients during the most critical period of their growth, with both mental and physical consequences that are irreversible and permanent. In addition to preventing these children from attaining their full potential, undernutrition also has an impact on economic progress and imposes additional costs on society, with added pressure on the education and health systems.

Children suffering from undernutrition begin life with a terrible handicap, with higher probabilities of dying in the first days or weeks of life than those born with an adequate weight and size. They are also more vulnerable to infections, which reduce their appetite, prolong their undernutrition and inhibit growth.

The cognitive and behavioural growth of these children will probably be affected as well. If they reach school age, their deficient brain development will limit their capacity to learn and will prevent them from concentrating on their studies, thereby barring access to good jobs. The saddest thing is knowing that this cycle will probably be repeated in their children, perpetuating poverty generation after generation, unless we do something to prevent it.

Thus, we can state without a doubt that in addition to the ethical and social problems involved in child undernutrition, there are adverse economic consequences. These costs are not limited to the life cycle of each individual, but affect that person's children, who will also be more vulnerable. This is how undernutrition and poverty are perpetuated.

Concern about undernutrition is even more relevant in Latin America and the Caribbean because this region's food production capacity is higher than what is needed to cover the population's energy needs. Although governments have signed declarations against the scourge of hunger and undernutrition, these problems persist and reflect the serious inequities that plague the region. Indeed, 53 million people in Latin America and the Caribbean now lack sufficient food to meet their needs, 7% of children under 5 are below normal weight, and 16% of these are below normal height for their age.

In view of the serious nature of this situation, the Economic Commission for Latin America and the Caribbean (ECLAC) and the World Food Programme (WFP) have undertaken a joint project to collaborate with the governments of the region to contribute to a better understanding of the magnitude of this problem. For this purpose, a number of descriptive and

analytical studies have been developed, and we have made an effort to estimate the economic cost that this scourge entails for our countries. These studies and estimates are aimed at creating a knowledge base, developing methodology, and sharing experiences.

The study “Social and economic impact of child undernutrition in Central America and the Dominican Republic” presents solid evidence for this effort, emphasizing the importance of nutrition and its impact on a region hit hard by high rates of undernutrition and by the enormous and unnecessary loss of human and economic potential that this entails. The report concludes that for all the countries encompassed by the study, the cost reached US\$ 6.658 billion for 2004. This evidence is not only alarming, but also provides an eloquent argument for strengthening alliances within governments, with the private sector and civil society, with a view to undertaking specific and immediate actions to combat undernutrition.

Eradicating hunger and child undernutrition is, therefore, a tangible and urgent goal. We know that our region produces enough food to cover three times what its population needs.

Thus, there is reason for hope and an opportunity for governments and civil society to help children under five break the vicious cycle of hunger and poverty. With political will and a concerted effort, we can provide universal access for pregnant women and children under five to nutritional food and basic health services, guarantee access to education, and help break the cycle of hunger in the space of a generation.

José Luis Machinea
Executive Secretary
Economic Commission
for Latin America and the Caribbean

Pedro Medrano Rojas
Regional Director for
Latin America and the Caribbean
World Food Programme

Executive Summary

Major figures in Latin America have stressed the urgent need to address the problem of hunger and undernutrition as an ethical responsibility of all citizens and States in Latin America and the Caribbean. This concern is particularly relevant to Central America.

The foregoing is based on the expert opinion of many researchers, who have emphasized the serious individual and collective consequences of having a population that does not have enough food to meet its needs for physical, intellectual and emotional development, which leads to lower achievement and higher health, education and productivity costs.

In view of the social and economic importance of the problem of hunger and child undernutrition in the region, in 2005 WFP and ECLAC agreed to carry out a joint project for the “Analysis of the economic and social impact of hunger in Latin America”. This document presents the results derived from the analyses of the cost of undernutrition in Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama and the Dominican Republic.

The study shows that not only are the effects reported valid for the countries of Central America and the Dominican Republic, but the resultant economic impact is also significant, representing between 1.7% and 11.4% of GDP. In this regard, productivity losses as a consequence of the higher death rate and the lower level of education account for 90% of the costs. Thus, in addition to the ethical imperative, eradicating undernutrition would yield benefits as well. Therefore, any programme that is effective in reducing the prevalence of this problem will have an impact on people’s quality of life, and will also represent major savings for society. The greater the problem, the greater the challenge, but the greater the benefits as well, especially in terms of countries’ production capacity.

1. Theoretical-methodological principles

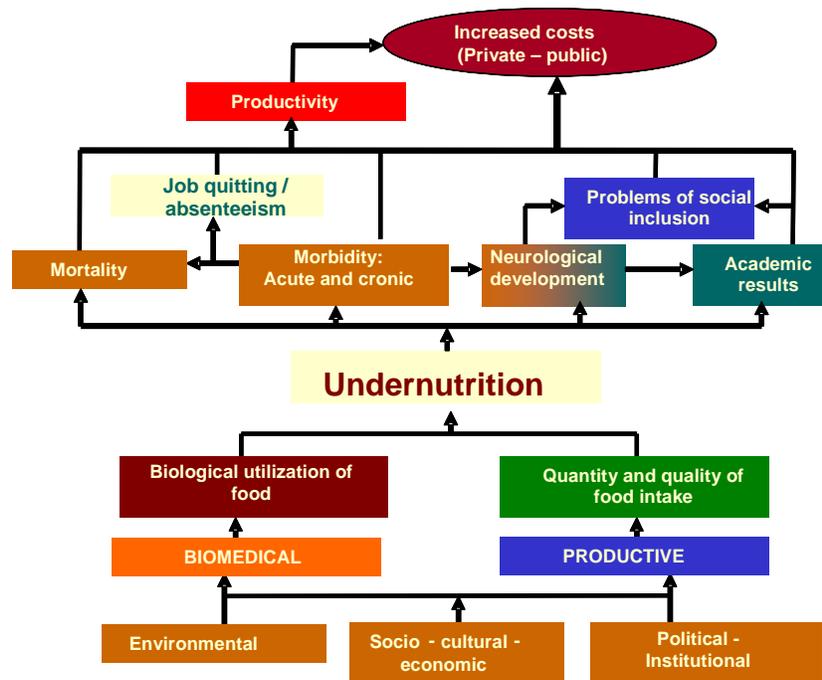
The main factors associated with the emergence of undernutrition as a public health problem can be categorized as: environmental (due to natural or human causes), socio-cultural-economic (associated with problems of poverty and inequality), and political-institutional, which combine to increase or decrease biomedical and productivity vulnerabilities. In turn, these vulnerabilities determine the amount, quality, and absorption capacity of food consumption, all of which are factors in undernutrition.

Each of these factors acts to increase or decrease the probability that a person will suffer from undernutrition. Thus, each person's weight depends on the phase in the demographic and epidemiological transition through which the country is going and where the person is in the life cycle. Together, these aspects determine how vulnerable the individual is.

Moreover, undernutrition has negative effects on different dimensions of people's lives, most notably health, education and the economy (public and private costs and spending, and lower productivity). Consequently, these effects generate more problems for social inclusion and exacerbate or deepen the scourge of poverty and indigence in the population. Thus, the vicious cycle is reproduced as vulnerability to undernutrition grows.

These impacts are seen as increases in probability, and they may appear immediately or throughout a lifetime. They then create a greater risk of undernutrition later in life among those who have suffered in the initial stages of development, and increase the likelihood of other consequences. Thus, problems of intrauterine undernutrition can cause problems from birth through adulthood.

FIGURE 1
CAUSES AND CONSEQUENCES OF UNDERNUTRITION

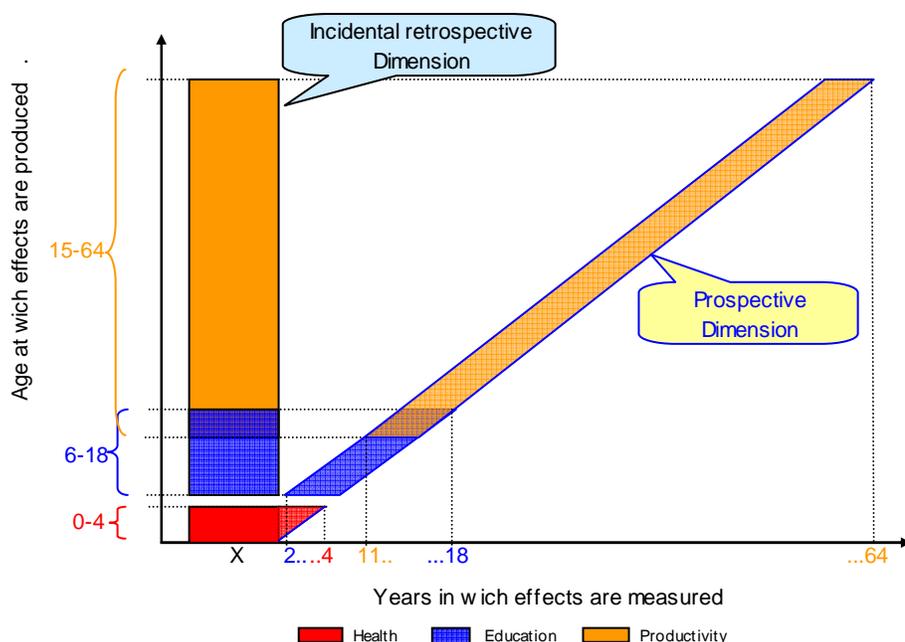


Source: Authors' compilation.

In order to conduct a comprehensive analysis of the phenomenon of undernutrition in the region, the model developed by ECLAC for this type of study (Martínez and Fernández, 2006) first requires that each of the aforementioned consequences (health, education and productivity) be studied and then translated into costs. Two dimensions of analysis are considered for this purpose:

1. *Incidental retrospective dimension.* Allows for an estimate of the cost for a given year of the undernutrition that has affected a country's population. Thus, the health costs for pre-schoolers who suffer from undernutrition during the year of analysis are estimated, as are the economic costs resulting from the loss of productivity by working-age persons who were exposed to undernutrition during the first five years of life.
2. *Prospective dimension or potential savings.* This dimension allows for the projection of present and future losses incurred as a result of medical treatment, repeated grades and lower productivity caused by undernutrition in children under five in each country, in a given year. Based on that, it is possible to estimate potential savings from the implementation of actions needed to achieve nutritional objectives (for example the one defined in Millennium Development Goal 1, cutting undernutrition in half by 2015).

FIGURE 2
DIMENSIONS OF ANALYSIS BY POPULATION AGE AND YEAR WHEN EFFECTS OCCUR



Source: Authors' compilation.

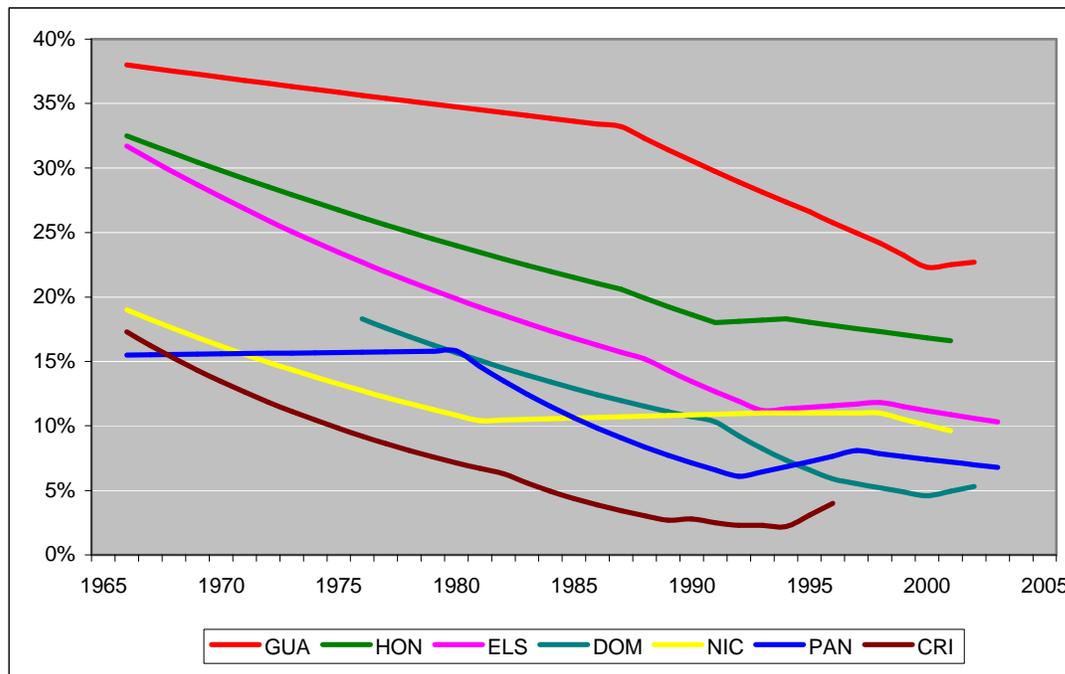
As shown in the figure, the retrospective incidental dimension includes the social and economic consequences of undernutrition in a specific year (X) for several cohorts that have been affected (aged 0 to 4 years for health, 6 to 18 years for education and 15 to 64 years for productivity). The prospective dimension, in contrast, projects the future effects and costs of undernutrition existing in a specific year (X) in a cohort of boys and girls under 5 (between years X and X+4 for health, from X+2 to X+18 for education and X+11 to X+64 for productivity).

2. Socioeconomic and nutritional background

The reality of malnutrition is a reflection of the different stages of demographic, epidemiological and nutritional transition that each country has reached, together with its population's socioeconomic situation and social vulnerability. This is relevant to the present study because Central America is not a homogeneous whole. Therefore, differences can also be expected in the estimated costs for each country.

It should be noted that the historical underweight trend is a process specific to each country. Thus, for example, as can be seen in the figure below, El Salvador and Nicaragua have similar rates today, but between 1965 and 2004¹ the former has seen a much more pronounced decline in prevalence.

FIGURE 3
UNDERWEIGHT TRENDS IN THE COUNTRIES (1965-2004)



Source: Authors' compilation, based on WHO publications, national demographic and health surveys (DHS) in the respective countries and epidemiological monitoring data in the case of Costa Rica.

As has been pointed out in other studies (ECLAC-WFP 2004 and 2005), the problem of undernutrition in Central America is concentrated in the pre-school years. However, low birth weight (LBW) is also relevant, particularly in view of the chain of causality in the life cycle from these initial stages. The most precarious situation can be seen in Guatemala, Honduras and Nicaragua, where between 12.5 and 7 of every 100 live births have low birth weight with intrauterine growth restriction (LBW_{IUGR}).

¹ The earliest records on the nutritional situation in the subregion date back to the middle of the 1960s.

3. Effects and costs of underweight

3.1 The situation in 2004

As a result of the nutritional profiles described in the preceding point, the cost of underweight in 2004, estimated for all the countries combined using the *incidental retrospective* analysis, would be US\$ 6.7 billion.² Guatemala accounts for 47% of that amount, even though during this period it had 28% of the population under the age of 5 and 43% of the population suffering from undernutrition. El Salvador is in second place, with 15% of the cohort's population and 15% of the population suffering from undernutrition, though representing 18% of the total cost mentioned above.

At the opposite end of the spectrum is Nicaragua, with 4% of the cost even though it has 7% of the population suffering from undernutrition during the period. Thus, it has the lowest unit costs of all the countries analysed. This may be attributable to the narrower differential in income among those who have not completed secondary school. It is followed by Costa Rica and Panamá, with around 5% of the cost and 3% of the cases of undernutrition each.

TABLE 1
INCIDENTAL RETROSPECTIVE COST OF UNDERWEIGHT IN EACH COUNTRY (2004)

| | Country | | | | | | | TOTAL |
|---|------------|-------------|-----------|----------|-----------|--------|--------------------|-------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Total (millions of US\$) | 318 | 1 175 | 3 128 | 780 | 264 | 322 | 672 | 6 659 |
| Percentage of GDP | 1.7% | 7.4% | 11.4% | 10.6% | 5.8% | 2.3% | 3.6% | |
| Percentage of Public Social Spending | 9.3% | 136.6% | 185.4% | 80.9% | 64.3% | 8.5% | 59.1% | |

Source: Authors' compilation, based on official data from countries and ECLAC: Social Spending database.

Compared to each country's GNP, the most significant cases are Guatemala and Honduras, with values above 10%; at the opposite end are Costa Rica and Panama, with figures of about 2%.

When comparing the amounts given with each country's Public Social Spending, however, it is found that those with the highest costs (Guatemala and El Salvador) exceed 100% of such spending (185% and 137%, respectively). In Costa Rica, on the other hand, costs amount to less than 10% of this spending. For all of the countries studied, underweight costs amount to 78% of Public Social Spending.

When costs are broken down, it appears that 93% of them correspond to productivity costs, distributed almost equally between losses due to higher mortality (equivalent to 2.6 million cases, with 1.7 million occurring in the working-age population (WAP) in 2004 and representing 6% of the workforce in the subregion for that year) and losses due to less education attained

² In 2004 US\$, unless indicated otherwise.

(estimated at an average differential of about 2 years of school). Health costs amount to only 6.5% (the result of 157,000 additional cases of acute diarrheal disease (ADD), acute respiratory infection (ARI) and anemia, in addition to the treatments specific to undernutrition); and education costs account for less than 1% (the result of 129,000 extra repeated grades).

The proportions vary from one country to another but the form of distribution is the same. Thus, one clear result of the study is that the highest economic cost of having part of a country's population suffer from undernutrition before the age of five is the loss of that group's production capacity.

3.2 Projections for children under five in 2004

When the costs of underweight for the cohort of boys and girls under the age of 5 in 2004 are projected for the seven countries analysed, the result is a present value of US\$ 2.271 billion. Guatemala accounts for 71% of this total, and it and Honduras and El Salvador together represent 90%.

TABLE 2
PROJECTION OF UNDERWEIGHT COST FOR CHILDREN UNDER FIVE (2004)

| | Country | | | | | | | TOTAL |
|---|------------|-------------|-----------|----------|-----------|--------|--------------------|-------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Total NPV (millions of US\$) | 48 | 147 | 1 607 | 291 | 78 | 65 | 35 | 2 271 |
| EAC (millions of US\$) | 3.9 | 11.8 | 129.4 | 23.4 | 6.3 | 5.2 | 2.8 | 182.9 |
| Percentage of Public Social Spending | 0.12% | 1.37% | 7.67% | 2.43% | 1.53% | 0.22% | 0.25% | |
| Percentage of GDP | 0.02% | 0.07% | 0.47% | 0.32% | 0.14% | 0.04% | 0.02% | |

Source: Authors' compilation, based on official data from countries and ECLAC: Social Spending database.

The distribution by type of cost shows that the loss of human capital due to less education is the principal source of costs derived from underweight, with 70% at the subregional level. This is nearly three times the health cost of underweight. However, this preponderance is not seen in Nicaragua or the Dominican Republic, where the costs due to Additional cases of morbidity are higher, and it is lower in Panama, where education costs are only half the total.

The impact of mortality, on the other hand, averages less than 5%, although it is nearly 25% of costs in the Dominican Republic. The cost of repeated grades is less than 1% on average, although it is slightly more in Costa Rica and Panama.

The equivalent annual cost (EAC) in the 65-year period over which the different estimated values are spread amounts to almost US\$ 183 million. This cost represents an average of 1.9% of social spending and 0.15% of GDP in 2004. In Guatemala and Honduras these figures are higher, at 7.7% and 2.5% of social spending and 0.5 and 0.3 percentage points of GDP, respectively.

When this distribution is compared with that corresponding to the incidental retrospective dimension, a significant difference can be seen, although in both cases productivity accounts for the highest costs. Whereas in the incidental retrospective dimension, mortality and education represent a similar weight, in the prospective analysis the latter weighs five times more than the former. This is a reflection of progress made in reducing mortality and the increase in educational levels, which is why the alternative cost of education is increasing.

3.3 Analysis of scenarios

Based on the estimate of the costs incurred by the seven countries studied as a result of the current rate of underweight in the population under the age of 5 in 2004, three alternative scenarios are analysed for 2015:

- The underweight rate reported in 2004 is maintained.
- Target 2 of the Millennium Development Goal (MDG) is achieved, that is, underweight levels are cut in half from 1990.

Underweight is eradicated in the country (prevalence of 2.5%).

In scenario 1, factoring in the countries' population growth, the cost in 2015 would be about 10% higher than in 2004. Should the countries achieve target 2 of MDG1, the cost in 2015 would be 40% less than that of scenario 1 (65% of the reduction would be seen in Guatemala). On the other hand, the cost in scenario 3 would be 88% less than that of scenario 1.

The potential savings, calculated by comparing scenarios 2 and 3 with scenario 1, would grow progressively between 2004 and 2015. For scenario 2, the present value of savings would be US\$ 1.019 billion in 2004 dollars for the seven countries, and it would rise to US\$ 2.271 billion if eradication is achieved.

TABLE 3
ESTIMATE OF SAVINGS ACCORDING TO COUNTRY SCENARIOS, 2004 TO 2015
NPV IN MILLIONS OF US\$)

| | Country | | | | | | | TOTAL |
|---------------------------|-----------------|-------------|-----------|----------|-----------|--------|--------------------|--------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Achieve MDG (50% of 1990) | 49 ^a | 133 | 525 | 118 | 25 | 99 | 71 ^a | 1 019 |
| Eradication (2.5%) | 49 | 203 | 1 534 | 243 | 46 | 125 | 71 | 2 271 |

Source: Authors' compilation.

^a The achievement of the target established in the MDG is less than the value estimated for eradication. For this reason, costs have been estimated as equivalents of those in the latter scenario.

4. Conclusions

This study represents the first attempt to apply a model of analysis developed expressly for the purpose of estimating the effects and costs of undernutrition, thus proving the feasibility of reliably implementing this type of experience in the region. However, the state of the art with respect to the knowledge and operationalization of the risks associated with this scourge, along with the limited data on the countries, also lead to the conclusion that much remains to be done in developing knowledge, methodologies and information systems oriented towards decision-making.

Consequently, the estimates presented here, though significant, are conservative in terms of both the effects and costs currently being incurred by the countries analysed and the future projections based on existing prevalences of undernutrition. In fact, micronutrient deficiencies and other complementary impacts have not been considered because of the low reliability of estimating the marginal costs and effects for each year, given currently available knowledge.

In spite of this, these estimates confirm the hypothesis that, aside from the ethical imperative, the commitment by the governments in the region to eradicate the scourge of hunger and undernutrition will yield major social outcomes and significant economic savings. All of society will benefit, not just the direct recipients of the goods and services provided by these programmes. Indeed, the highest costs correspond to lower productivity. Clearly, fighting hunger and undernutrition is good business for all.

The subsequent challenge will be to identify interventions that maximize impact and efficiency while strengthening systems to monitor the administration of projects and the evaluation of impacts in order to minimize risks and accelerate the eradication of the scourge of hunger. It is a long-term process that requires stable government and financing policies, a well-defined framework of intersectoral institutions and a commitment by all those involved in this social problem, that is, all of society.

Introduction

At present Latin America is in a paradox, as the effects of both extremes of poor nutrition (obesity and undernutrition) are present simultaneously in a region where the food supply is much greater than it has been historically and in most cases exceeds the population's dietary energy requirements.

The prevalence of poor nutrition is not a mere accident in the region, but a reflection of huge disparities in income and the lack of priority given to food and nutrition issues on the countries' political agendas.

Aside from the ethical imperative and the goals the countries set for themselves in the Millennium Declaration, it is necessary to analyse more carefully the economic consequences in order to support decision-making and allocate the resources needed to eradicate this scourge.

In view of the social and economic importance of the problem of hunger and child undernutrition in the region, in 2005 WFP and ECLAC agreed to carry out a joint project for the "Analysis of the economic and social impact of hunger in Latin America".

In this document, the results of the analyses for Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama and the Dominican Republic are presented in aggregate and comparative formats on the basis of the methodology developed especially by ECLAC.

The study takes an incidental retrospective approach that makes it possible to determine the health, education and productivity effects and costs that the history of undernutrition over the last few decades has generated for the entire population of each country as of 2004. It then presents a prospective analysis to estimate the present and future consequences for the population under the age of five suffering from undernutrition in that year.

The estimates undertaken in this study are based on official data on health care, educational results, productivity and costs for 2004. Given the intertemporal nature of the study, however, these estimates are based on records from 1940 to 2004 and contain projections up to 2068.

The document is divided into two parts. In the first part, there is a brief description of the theoretical-methodological principles on which the study is based. Then the results are presented at the subregional level, meaning that the seven countries are described and analysed comparatively, both in relation to their social, economic and nutritional backgrounds and with

respect to their results in the incidental retrospective and prospective dimensions and the projection of scenarios to the year 2015. In the second part, individual reports are presented for each country, with an in-depth look at the specific characteristics of their context, results and projections.

Part One

I. Model of analysis

Hunger is associated with food and nutritional insecurity, which occurs when part of the population does not have assured physical, social and economic access to safe and nutritional food to satisfy people's dietary needs and preferences for a healthy and active lifestyle.

Thus, there are people with food vulnerability when there is “the probability of an acute decline in food access, or consumption, often in reference to some critical value that defines minimum levels of human well-being” (WPF 2002).³

One of the first things that must be considered in the analysis is that hunger is related to vulnerability, which is the result of a combination of a high risk of having limited access to food (due to social, environmental or economic problems) and little response capacity (individual and collective) to contend with that limitation. Moreover, the direct consequence of this combination is undernutrition, the clearest manifestation of which is boys and girls with low birth weight, underweight and/or lower than normal height for their age.

Another element of the analysis to take into consideration is demographic, epidemiological and nutritional transitions, which can be used to obtain more reliable assessments of the scenarios in each country and hence the consequences that can be foreseen for the population's nutritional situation.

A third element to bear in mind is the fact that a person's nutritional situation is part of a process that is expressed differently depending on the stage of the life cycle: intrauterine and neonatal life, infancy and pre-school, school years, or adult life. This is because the nutrient requirements and the needs are different for each stage.

Below is a discussion of the central elements considered in the model of analysis developed to estimate the effects and costs of child undernutrition, with a brief description of the causes and consequences, as well as the dimensions of analysis and the principal methodological aspects that must be taken into account in order to correctly interpret the results presented later on.⁴

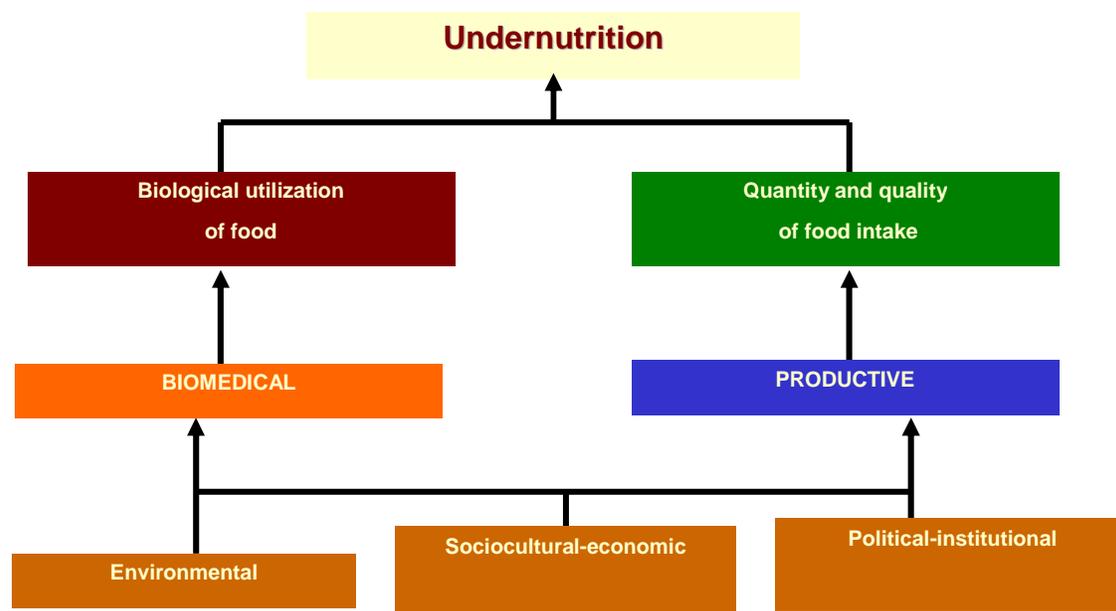
³ VAM Standard Analytical Framework. World Food Programme 2002.

⁴ A summarized version of the theoretical background and the basic characteristics considered in the model of analysis is presented here. For a more detailed discussion of the model, see Martínez and Fernández, (ECLAC-WFP 2006), “Modelo de análisis del impacto social y económico de la desnutrición infantil en América Latina”. *Serie Manuales* N° 52.

A. Causes of undernutrition

The main factors associated with the emergence of undernutrition as a public health problem can be grouped as follows: environmental (from natural or entropic causes), sociocultural-economic (associated with the problems of poverty and inequality), and political-institutional. Together, they increase or decrease biomedical and productivity vulnerabilities, through which they determine the quantity and quality of dietary intake and the absorption capacity that are elements of undernutrition.

FIGURE I.1
FACTORS ASSOCIATED WITH THE DEVELOPMENT OF UNDERNUTRITION



Source: Authors' compilation.

Each of these factors helps increase or decrease the likelihood that a person will suffer from undernutrition. Thus, the importance of each of these factors depends on where the country is in the demographic and epidemiological transition and the person's current stage in the life cycle, which together determine the intensity of the resulting vulnerability.

Environmental factors define the surroundings in which the subject and his or her family live, including the risks stemming from the natural environment itself and its cycles (from floods, droughts, frosts, earthquakes, and other phenomena), and those produced by humans themselves (such as the contamination of water, air, and food, the expansion of agriculture into new territories, etc.).

The socio-cultural-economic determinants include elements associated with poverty and equality, education and cultural norms, employment and wages, access to social security, and coverage of aid programmes.

The political-institutional factors encompass government policies and programmes aimed specifically at solving the population's food and nutritional problems.

Production factors include those directly associated with the production of food, as well as the access that the at-risk population has to them. The availability and autonomy of each country's dietary energy supply depend directly on the characteristics of production processes,

the degree to which they utilize natural resources, and the extent to which these processes mitigate or aggravate environmental risks.

And finally, biomedical factors take into account the individual's susceptibility to undernutrition, insofar as deficiencies in certain elements limit the capacity to make biological use of the food consumed (regardless of quantity and quality).

B. Consequences of undernutrition

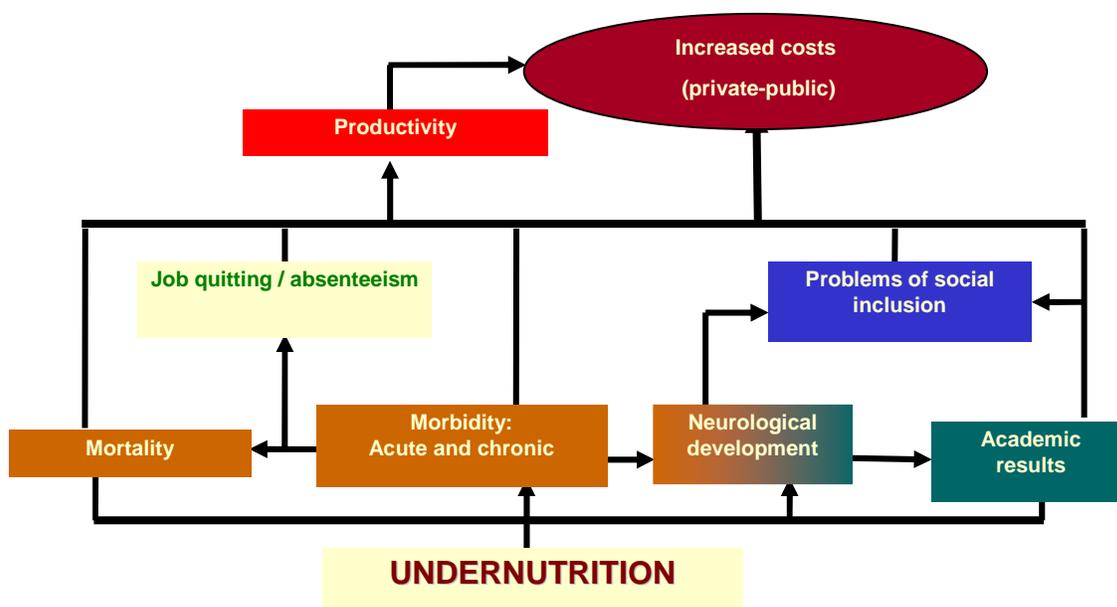
Undernutrition has negative effects on various aspects of people's lives, most notably health, education, and the economy (costs and expenditures in the public and private sectors, and lower productivity). Consequently, these effects exacerbate problems with social integration and increase or intensify the poverty and indigence that plague the population. The vicious cycle is then perpetuated as vulnerability to undernutrition grows.

These effects may appear immediately or throughout a person's lifetime, and they increase the chances of later undernutrition in those who have already suffered it during the early years of the life cycle. Other consequences are more likely to ensue as well. Thus, intrauterine undernutrition can create difficulties from birth to adulthood.

Various health studies have shown that undernutrition makes certain pathologies more likely to appear and/or intensify, and it increases the chances of death in different stages of the life cycle. How these consequences materialize depends on the epidemiological profile of each country.

With respect to education, undernutrition affects student performance because of disease-related deficits and the limited learning capacity associated with deficient cognitive development. This translates into greater probabilities of starting school at a later age, repeating grades, dropping out of school, and ultimately a lower level of education.

FIGURE I.2
CONSEQUENCES OF UNDERNUTRITION



Source: Autor's compilation

Undernutrition and its effects on health and education also translate into heavy costs for society at large. Thus, the total cost of undernutrition (TC^U) is a function of higher health-care spending (HC^U), inefficiencies in education (EC^U) and lower productivity (PC^U). Thus, to account for the total cost (TC^U), the function can be summed up as:

$$TC^U = f(HC^U, EC^U, PC^U)$$

In the area of health, the higher probability resulting from the epidemiological profile of individuals suffering from undernutrition proportionally increases costs in the health-care sector (HSC^U), which at the aggregate level is equal to the sum of the interactions between the probability of undernutrition in each human group, the probability that this group will suffer each of the diseases because of that undernutrition, and the costs of treating the pathology (diagnosis, treatment, and control). To this are added the costs paid by individuals and their families as a result of lost time and quality of life (IHC^U). Thus, to study the variables associated with the health cost (HC^U), the formula is:

$$HC^U = f(HSC^U, IHC^U)$$

In education, the reduced attention and learning capacity of those who have suffered from child undernutrition increases costs to the educational system (ESC^U). Repeating one or more grades commensurately increases the demand that the educational system must meet, with the resulting extra costs in infrastructure, equipment, human resources and educational inputs. To these costs are added the private ones (incurred by students and their families) derived from the larger quantity of inputs, external educational supplementation, and more time devoted to solving or mitigating low performance problems (IEC^U). Thus, in the case of the education cost (EC^U), the formula is:

$$EC^U = f(ESC^U, IEC^U)$$

Undernutrition's cost to productivity is equal to the loss in human capital (HK) suffered by a society, stemming from the lower educational level achieved by individuals with undernutrition (ELC^U) and the loss of productive capacity resulting from the higher number of deaths caused by undernutrition (MMC^U). Thus:

$$PC^U = f(ELC^U, MMC^U)$$

To carry out a comprehensive analysis of the phenomenon of undernutrition in the countries, the model first undertakes to study each of the consequences indicated (health, education and productivity) and then translates them into costs.

C. Dimensions of analysis

Considering that a country's undernutrition situation and the consequences thereof reflect a specific epidemiological and nutritional transition process, a comprehensive analysis of the matter involves making estimates of the current situation by extrapolating from previous transitional stages, as well as estimates of the future, predicting potential cost and savings scenarios based on the prospects for intervening to control or eradicate the problem.

On this basis, a two-dimensional analysis model has been developed for estimating the costs arising from the consequences of child undernutrition in health, education and productivity:

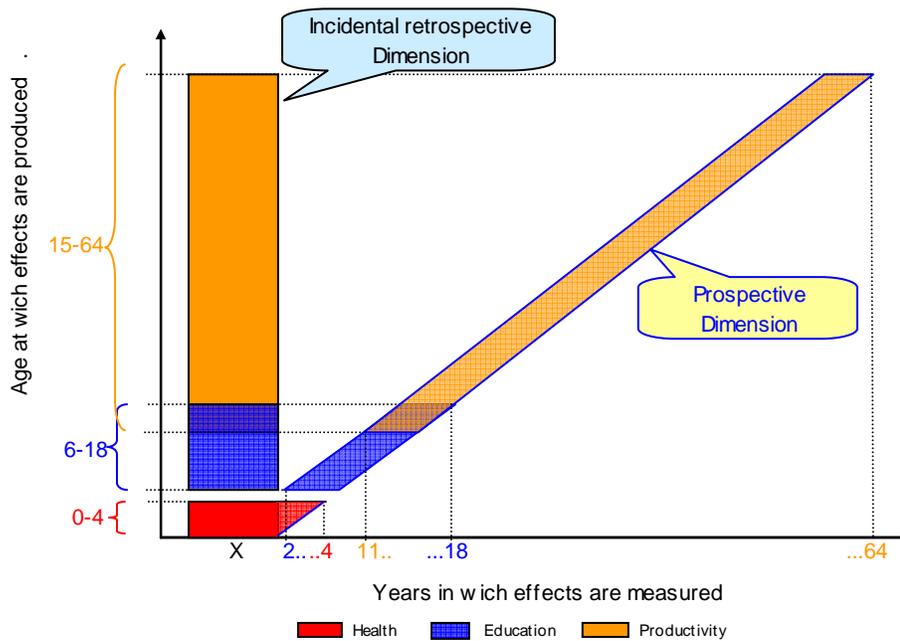
1. *Incidental retrospective dimension* Makes possible an estimate of the cost of undernutrition in a country's population for a given year. Thus, it is possible to estimate the health costs of pre-school boys and girls who suffer from undernutrition during the year of analysis, the education costs stemming from the undernutrition children now in

school suffered during the first five years of life, and the economic costs due to lost productivity by working-age individuals who were exposed to undernutrition before the age of five.

2. *Prospective, or potential savings dimension.* This dimension makes it possible to project the present and future losses incurred as a result of medical treatment, repetition of grades in school, and lower productivity caused by undernutrition among children under the age of five in each country, in a specific year. Based on that, potential savings derived from actions taken to achieve nutritional objectives can be estimated (for example, to attain MDG1, reducing undernutrition by half by 2015).

As the following figure shows, the incidental retrospective dimension includes the social and economic consequences of undernutrition in a specific year (X) for different cohorts that have been affected (0 to 4 years of age for health, 6 to 18 years for education, and 15 to 64 years for productivity). The prospective dimension, on the other hand, projects future effects and costs of the undernutrition that exists in a specific year (X) in a cohort of children less than 5 years old (between years X and X+4 for health, X+2 to X+18 for education, and X+11a to X+64 for productivity).

FIGURE I.3
DIMENSIONS OF ANALYSIS BY POPULATION AGE AND YEAR WHEN EFFECTS OCCUR



Source: Authors' compilation.

D. Methodological aspects

The analysis focuses on the initial stages of the cycle and its consequences throughout life. This limits the study of undernutrition and health to the foetus, the infant, and the pre-schooler (those aged 0 to 59 months).⁵ The effects on education and productivity are analysed in the other demographic groups.

The universe of children suffering from undernutrition has been divided into sub-cohorts (0 to 28 days, 1 to 11 months, 12 to 23 months, and 24 to 59 months) in order to highlight the specificity of certain effects during each stage of the life cycle.

The undernutrition indicators used in this study depend on the stage in the life cycle. For intrauterine undernutrition, what is estimated is low birth weight (LBW) due to intrauterine growth restriction (IUGR, defined as a weight below the tenth percentile for gestational age). For the pre-school stage, the concepts of moderate and severe underweight (weight-for-age score below -2 standard deviations) are used, taking the National Center of Health Statistics (NCHS) distribution as a comparison pattern.⁶

Estimates of the impacts of undernutrition on health, education, and productivity are based on the concept of the relative (or differential) risk run by individuals who suffer from undernutrition during the first stages of life. This is valid both for the incidental-retrospective analysis and for the prospective-savings analysis. However, its operationalization has specific characteristics in each case, so they are detailed separately in the document.

To estimate the costs, in the first case the values occurring in the year of analysis are totaled, and estimates are made of the process undergone in the different cohorts of the population. In the second case, on the other hand, a future cost flow is estimated and updated (to present value), and for purposes of comparison with public social spending (PSS) and gross domestic product (GDP), it is translated into an equivalent annual cost.

The countries analysed are Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama and the Dominican Republic, taking the year 2004 as a reference, with estimates of costs and potential savings based on different scenarios through 2015.

The study relied on data available between September 2005 and April 2006 from official sources in the respective countries, and from international organizations' databases.⁷

⁵ In the original design, the idea of analysing direct information on the nutritional and health situation of pregnant women was considered, but the lack of reliable information on the incidence of undernutrition and the gestation times led to its exclusion from the analysis.

⁶ Standard of the National Center of Health Statistics, United States.

⁷ See Annex.

II. Subregional panorama: comparative analysis

A. Background

The reality of malnutrition is a reflection of the different stages of demographic, epidemiological and nutritional transition that each country has reached, together with its population's socioeconomic situation and social vulnerability. This is relevant to the present study because Central America is not a homogeneous whole. Therefore, differences can also be expected in the estimated costs for each country.

Accordingly, without attempting to describe the social panorama exhaustively in this document, we present here some of the social, economic and demographic elements and characteristics of the countries that are necessary for putting the analyses in context.

1. Countries' population and underweight statistics

The total population in the seven countries studied was 48 million in 2004. Guatemala had the largest share (26%), with nearly four times the population of the smallest country in the subregion, Panama.

TABLE II.1
TOTAL POPULATION AND POPULATION UNDER FIVE, 2004
(In millions)

| Country | Total population | | Children under five | |
|--------------------|------------------|-------------|---------------------|-------------|
| | Millions | Percentages | Millions | Percentages |
| Costa Rica | 4.2 | 9 | 0.4 | 6 |
| El Salvador | 6.8 | 14 | 0.8 | 13 |
| Guatemala | 12.4 | 26 | 2.0 | 32 |
| Honduras | 7.2 | 15 | 1.0 | 16 |
| Nicaragua | 5.4 | 11 | 0.7 | 12 |
| Panama | 3.2 | 7 | 0.3 | 5 |
| Dominican Republic | 8.9 | 18 | 1.0 | 16 |
| Total | 48.0 | 100 | 6.3 | 100 |

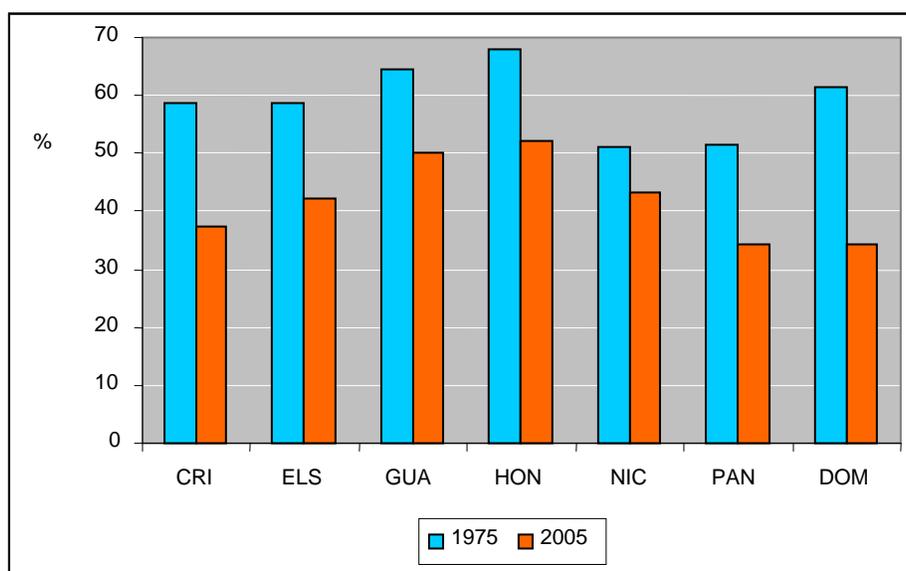
Source: CELADE

With regard to the universe of analysis, between 9% and 16% of the population of the countries in the region is in the age bracket of 0 to 59 months. Guatemala is the country with the largest percentage of children in that age group, while Costa Rica has the smallest one. Guatemala is followed, in descending order, by Honduras and Nicaragua (14%), El Salvador (12%) and Panama and the Dominican Republic (11%).

In addition, the countries also have particular characteristics in terms of rural population and ethnicity. In 2005, according to CELADE estimates, the rural population of the subregion amounted to approximately 40% of the total, representing a decline of about 20 percentage points in the last 30 years. Honduras and Guatemala had and continue to have the highest percentage of rural population.

The country with the largest indigenous population is Guatemala, with estimates varying from 50% to 73%. It is followed by Honduras with 11% to 17%, Panama with 5% to 9%, and Nicaragua with 4% to 7%. In El Salvador, the estimates range widely (between 2% and 11%), whereas in Costa Rica the indigenous population is estimated at less than 2% (UNDP, 2004).

FIGURE II.1
PERCENTAGE OF RURAL POPULATION IN THE COUNTRIES (1975 AND 2005)



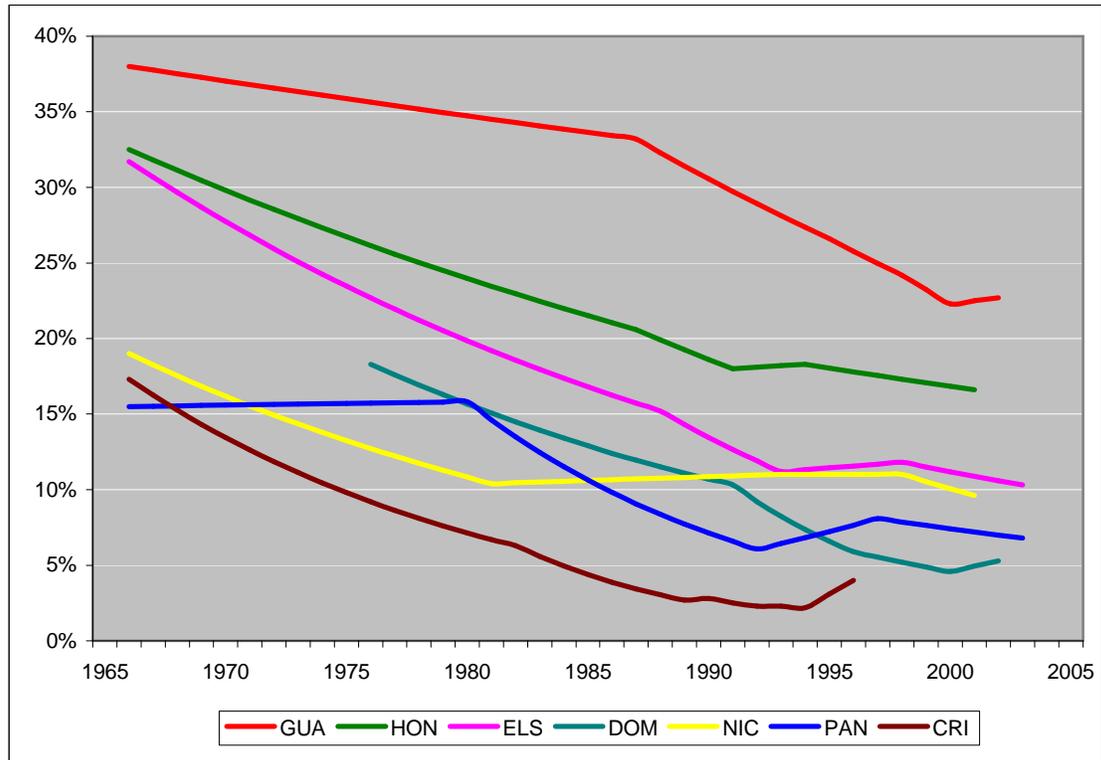
Source: CELADE

According to the latest measurements available, three of the seven countries analysed have prevalences of underweight in the two-digit range in the population under the age of 5. Guatemala has the highest prevalence (22.7%), followed by Honduras (16.6%), El Salvador (10.3%) and Nicaragua (9.6%). The situation is better in Panama (6.8%), the Dominican Republic (5.3%) and Costa Rica (4.0%).

It should be noted that the historical underweight trend is a process specific to each country. Thus, for example, as shown in Figure 2, El Salvador and Nicaragua have similar rates

today, but between 1965 and 2004⁸ the former had a much more pronounced decline in the prevalence.

FIGURE II.2
UNDERNUTRITION TRENDS IN THE COUNTRIES (1965-2004)



Source: Authors' compilation, based on publications, national demographic and health surveys (DHS) in the respective countries and epidemiological monitoring data in the case of Costa Rica.

As has been pointed out in other studies, the problem of undernutrition in Central America is concentrated among pre-schoolers. However, low birth weight (LBW) is also relevant, particularly in view of the chain of causality in the life cycle from these initial stages.

The most precarious situation can be seen in Guatemala, Honduras and Nicaragua, where between 7.0 and 12.5 of every 100 live births have low birth weight with intrauterine growth restriction (LBW_{IUGR}).

Unofficial data indicates that undernutrition among pregnant women also poses serious problems, which means that the cycle of undernutrition begins in-utero.

⁸ The earliest records on the nutritional situation in the subregion date back to the middle of the 1960s.

2. Undernutrition and associated diseases

In the countries studied, the pathologies most affected by undernutrition in the first 59 months of life are Acute Diarrheal Disease (ADD), Acute Respiratory Infections (ARI) and iron-deficiency anemia. In addition, there are the pathologies specific to critical nutritional deficiencies in calories and proteins, such as marasmus and kwashiorkor.

It is important to point out that according to official information and the reports from the national Demographic and Health Survey (DHS),⁹ the prevalence of pathologies associated with undernutrition in children under five varies significantly from one country to another. Thus, whereas there is more undernutrition in Guatemala, Honduras, El Salvador and Nicaragua, the prevalence of ADD and ARI is higher in Guatemala, Honduras and Panama. The greatest prevalences of iron-deficiency anemia are in Nicaragua and Panama. And finally, as could be expected, cases of protein and calorie deficiencies manifested in marasmus and kwashiorkor, though fewer in number, are most common in countries with the highest rates of underweight.

This situation can be seen in the following table.

TABLE II.2
PREVALENCE OF UNDERWEIGHT AND ASSOCIATED DISEASES, PER COUNTRY (2004)

| Pathology | Prevalence per country | | | | | | |
|-----------------|------------------------|-------------|-----------|----------|-----------|--------|--------------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic |
| Underweight | 4.0% | 10.3% | 22.7% | 16.6% | 9.6% | 6.8% | 5.3% |
| Anemia | 0.6% | 22.5% | 22.8% | 23.1% | 37.2% | 36.0% | 13.2% |
| ADD | 11.5% | 15.3% | 24.3% | 22.7% | 13.0% | 21.3% | 14.3% |
| ARI | 9.5% | 44.4% | 54.2% | 48.4% | 77.3% | 46.9% | 34.0% |
| Kwashiorkor (N) | 9 | 14 | 299 | 127 | 20 | 0 | 0 |
| Marasmus (N) | 0 | 11 | 792 | 224 | 5 | 3 | 0 |

Source: Authors' compilation, based on the latest DHS available and official statistics on cases of disease in each country.

3. Relevant education factors

According to data from UNESCO 2004, basic education coverage is quite high in the countries of the region: between 85.5% (Nicaragua) and 99.6% (Panama). However, the situation is different at the secondary school level; coverage fluctuates between 30% (Guatemala) and 63% (Panama).

Accordingly, the proportion of persons in the working-age population (WAP) who have completed primary and secondary education¹⁰ is less than 50%, with Panama reporting the best situation in this regard. The lowest rates of school completion are found in Nicaragua, Guatemala and Honduras, also the three countries with the highest rates of underweight in the group analysed.

⁹ Demographic and Health Survey (DHS).

¹⁰ In Costa Rica and Nicaragua public education comprises 11 years, whereas in the other countries it is 12 years.

TABLE II.3
PERSONS IN WAP WHO HAVE COMPLETED SECONDARY EDUCATION, BY AGE (2001-2004)

| Age bracket | Percentage of completion per country | | | | | | |
|---------------------------|--------------------------------------|-------------|-----------|----------|-----------|--------|--------------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic |
| 25 – 64 | 33 | 26 | 11 | 15 | 10 | 41 | 30 |
| 25 – 34 | 36 | 35 | 13 | 17 | 21 | 47 | 36 |
| 45 – 54 | 31 | 18 | 9 | 13 | 12 | 38 | 24 |
| Variation in 20 years (%) | 16 | 92 | 45 | 32 | 73 | 24 | 48 |

Source: Authors' compilation, latest household survey available for each country.

As shown in table 3, the situation is not stagnant, as important advances can be seen when comparing cohorts 20 years apart. The most noteworthy case is El Salvador, which nearly doubled the proportion of adults who have completed secondary education during those years and nearly caught up with Costa Rica and the Dominican Republic. It is followed by Nicaragua, which has also had a significant increase, but it faces a greater challenge, similar to what Honduras must deal with.

4. Social spending

In response to the problems, in 2004 the countries of the region allocated an average of 11% of GDP to public social spending (PSS), with an average of 4% earmarked for education and 3% for health.¹¹ The largest amount of public social spending was seen in Costa Rica and Panama (both at 18% of GDP). At the opposite end of the spectrum are the Dominican Republic¹² and Guatemala, with 6% of GDP, followed by El Salvador (7%) and Nicaragua (9%). In other words, with the exception of Honduras, which devotes 13% of GDP to PSS, the countries with the highest prevalence of undernutrition have the lowest PSS.

This assertion is supported by analysing per capita public social spending, which averages US\$ 308 in current dollars among the countries, equivalent to US\$ 660 in 2004 purchasing power parity (PPP). The individual figures range from less than US\$ 300 PPP in Guatemala and Honduras, the two countries with the highest prevalence of undernutrition, to US\$ 1,700 PPP in Costa Rica, the country with the lowest prevalence.¹³

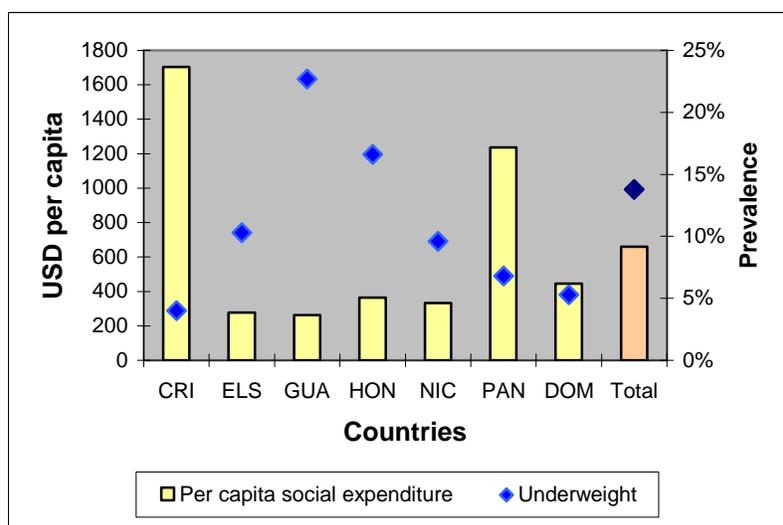
This occurs in a scenario in which most of the countries spend less than 1% of their PSS on financing food programmes (ECLAC, 2005).

¹¹ In some countries health spending is recorded together with social welfare and/or nutrition figures.

¹² Corresponding to the latest year available (2003).

¹³ The cost comparisons are made in 2004 PPP dollars. The conversion factors for that year have the most significant impact on the estimates in current dollars for Nicaragua, the Dominican Republic and Honduras (0.23, 0.29 and 0.37, respectively), while Costa Rica and El Salvador have a factor of 0.46, Guatemala 0.52, and Panama 0.62.

FIGURE II.3
UNDERWEIGHT AND PER CAPITA PUBLIC SOCIAL SPENDING (2004)



Source: Authors' compilation, ECLAC Social Expenditure database and latest national nutrition survey available in each country.

B. Effects and costs of underweight in 2004: analysis of the incidental retrospective dimension

As indicated in the methodology developed for these studies, this dimension is used to estimate and analyse the effects and costs on education, health and productivity incurred as a result of undernutrition in a specific year, in this case 2004.

Thus, the consequences analysed focus on:

- health*, caused by undernutrition in the cohort of boys and girls aged 0 to 59 months who suffered from undernutrition in 2004.
- education*, for children between 6 and 18 years of age who in 2004 were in primary or secondary school and who had suffered from undernutrition between 0 and 59 months of age.
- productivity*, involving young people and adults who in 2004 were aged 15 to 64 and had suffered from undernutrition in the first 5 years of life.

1. Undernutrition and health

The health effects of undernutrition are measured based on the differences in the incidence of mortality and morbidity prevalences that can be found between persons without undernutrition and those who have suffered from undernutrition at some point before turning five years old. The value of these differences is specific to each pathology and age group; it depends on the extent of the undernutrition, and in general it varies by location, region and country.

In the majority of countries in the region, it is not easy to identify differential morbidity and mortality indicators according to the nutritional state. On the one hand, there is the problem

of underreporting in official statistics, which are biased by the coverage of the health-care system. This problem is most acute in the most vulnerable countries. On the other hand, the records do not identify the concomitant presence of different pathologies, so there is no segmentation of the universe between those who suffer from undernutrition and those who do not. Nor is it possible to identify in these databases which persons suffer from undernutrition and also have other illnesses.

To fill these information gaps, this study relies on estimates based on some longitudinal studies, external sources and the Pan-American Health Organization (PAHO) and World Health Organization (WHO) estimates of morbidities, as well as the mortality statistics of the Latin American and Caribbean Demographic Centre (CELADE-Population Division). For some diseases, the absence of data has required the use of differential prevalences estimated in studies conducted outside the region.

1.1. Health effects

1.1.1 Morbidity

The numbers of boys and girls under the age of 5 who contract different diseases as a result of undernutrition are quite variable. They depend on the population size and the differences in prevalence (DP) that apply to each case. As shown in table 4, however, the general trend is for ADDs to be the most prevalent, amounting to an additional 87,000 Central Americans and Dominicans suffering from these pathologies because of undernutrition. Added to that are 39,000 cases of ARIs and nearly 31,000 cases of iron-deficiency anemia.

TABLE II. 4
NUMBER AND DISTRIBUTION OF CASES OF DISEASES ASSOCIATED WITH
UNDERWEIGHT (2004)

| Pathology | Distribution by country (%) | | | | | | | TOTAL (N) |
|-----------------------------|-----------------------------|-------------|-----------|----------|-----------|--------|--------------------|--------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Underweight | 1.9 | 9.4 | 51.8 | 18.9 | 9.3 | 2.7 | 5.9 | 856 335 |
| Anemia | 3.4 | 7.9 | 49.4 | 19.9 | 10.9 | 3.8 | 4.8 | 30 687 |
| ADD | 1.3 | 7.7 | 56.0 | 20.7 | 6.8 | 2.9 | 4.5 | 87 351 |
| ARI | 0.7 | 9.7 | 54.2 | 19.6 | 6.6 | 3.1 | 6.1 | 39 078 |
| Kwashiorkor | 1.9 | 3.0 | 63.8 | 27.1 | 4.3 | 0 | 0.0 | 469 |
| Marasmus | 0.0 | 1.1 | 76.5 | 21.6 | 0.5 | 0.3 | 0.0 | 1 035 |
| Population aged 0-59 months | 6.3 | 12.8 | 32.0 | 15.8 | 11.7 | 5.4 | 16.0 | 6 271 494 |

Source: Authors' compilation, based on the latest national nutrition survey available in each country and official data on cases of disease in each country.

In the country-to-country comparison, Guatemala stands out as the country with the largest number of children under 5 in 2004 (32% of the total), the largest proportion of underweight children (52%), and associated diseases accounting for between nearly 50% and 77% of the distribution. In contrast, Costa Rica, the Dominican Republic and Panama report cases

of undernutrition and associated diseases that represent between one half and one third of their relative share of the population under 5 in the countries as a whole.¹⁴

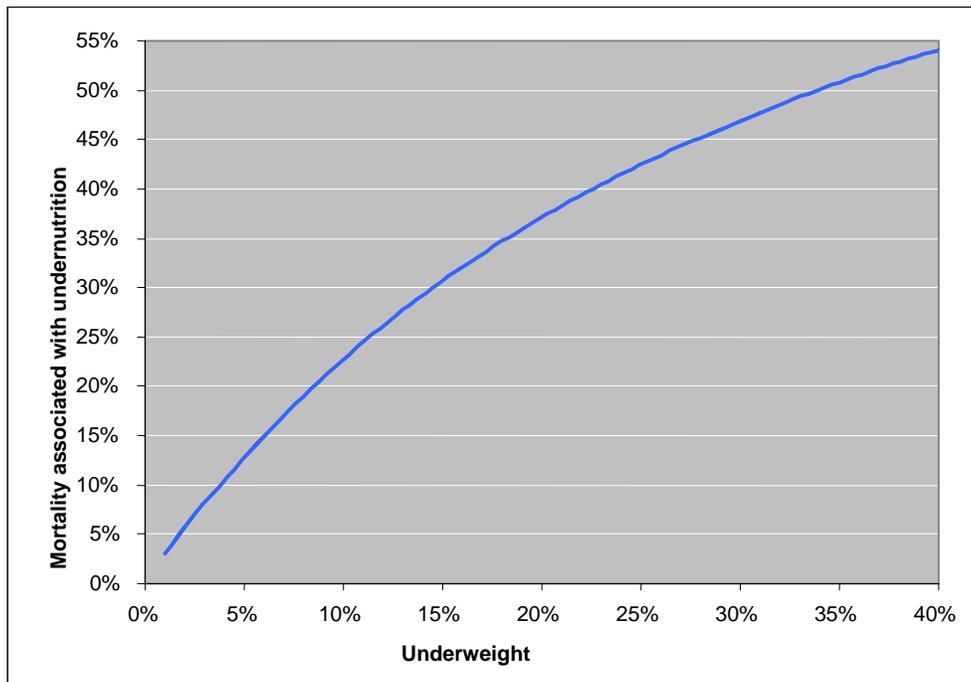
1.1.2. Mortality

Based on the relative risk results obtained by Fishman et al (2004), the effects of undernutrition on the mortality of children under 5 have been estimated for the seven countries studied. Figure II.4 shows how mortality rises along with underweight in the range of 1% to 40%.

Considering the specific data for each country analysed, it has been estimated that in 2004 just over 77,000 deaths were associated with undernutrition in children under 5, that is, nearly 30% of the total mortality for the cohort. This situation, similar to what has been seen with other indicators, varies considerably among the countries in question, from 515 cases in Costa Rica (11% of the total) to 39,000 in Guatemala (40% of the national total).

When these values are contrasted with the size of the population in each country, the mortality rates associated with underweight average 59 per 1,000 live births (90 in Guatemala, 80 in Honduras, 45 in Nicaragua, 40 in El Salvador, 32 in the Dominican Republic, 22 in Panama and 7 in Costa Rica).

FIGURE II. 4
MORTALITY PERCENTAGE OF CHILDREN UNDER FIVE ASSOCIATED WITH UNDERWEIGHT



Source: Authors' compilation based on official health statistics, latest national survey available in each country, CELADE mortality estimates and estimates of differential relative risks (DP) by Fishman et al.

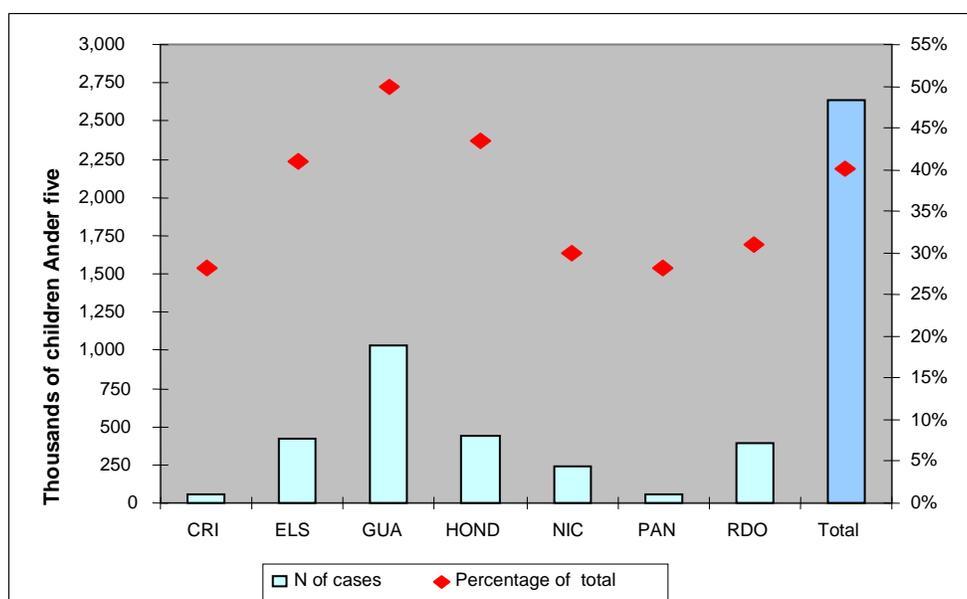
¹⁴ The effect of deficits in micronutrients such as zinc, iodine and Vitamin A is also significant in the subregion. However, to date no methodologically reliable procedure has been developed to incorporate them into the cost estimate.

From a historical perspective, between 1940 and 2004 (64 years) it is estimated that there were just over 2.6 million deaths associated with undernutrition in the region, which represents 40% of all cases of mortality in the cohort for that period.

As figure II.5 shows, Guatemala had the largest absolute number and proportion of deaths associated with underweight during the period under study, with 1 million cases (50% of the total number of deaths of children under 5 nationally). It is followed by Honduras and El Salvador with slightly more than 400,000 deaths each (43% and 41% of the national totals, respectively).

In keeping with their lower prevalence of undernutrition, Costa Rica and Panama are at the other end of the scale, with about 60,000 cases each. At the same time, however, deaths associated with underweight account for a relatively large share of total deaths in the cohort, more than 28%. This figure is slightly lower than those of the Dominican Republic and Nicaragua, although they have significantly higher absolute numbers of deaths from undernutrition (393,000 and 236,000, respectively, or around 30%).

FIGURE II.5
MORTALITY ASSOCIATED WITH UNDERWEIGHT (1940-2004)



Source: Authors' compilation, based on official health statistics, latest national nutrition survey available in each country, CELADE mortality and population estimates and estimates of differential relative risks (DP) by Fishman et al.

1.2 Health costs

The study's estimates indicate that the institutional costs (those incurred by the health-care system) and private health costs incurred as a result of treatment sought for pathologies associated with undernutrition¹⁵ in children under 5 amount to US\$ 433.5 million.

¹⁵ In the case of public costs, indicators were estimated based on information reported by various agencies of the health ministries. Private costs were estimated using the official minimum wage and urban public transportation fares.

The costs are concentrated among children aged 24 to 59 months (46%), followed by those under 1 year (22%) and newborns (21%). This order applies to Guatemala, Nicaragua and Honduras. In the Dominican Republic, Costa Rica, Panama and El Salvador, however, the costs are highest for newborns, with shares of total costs ranging from 39% to 78%.

These differences can be interpreted as the result of the nutritional profile, considering that as the prevalence of underweight increases at early ages, so do the concomitant health consequences. They also stem from the additional hospital resources required by the treatment of pathologies associated with the youngest members of the cohort, who weigh relatively more in the countries with lower prevalences of undernutrition.¹⁶ When the countries are compared, it can be seen that in terms of purchasing power parity (PPP), the health costs in Guatemala are 20.5 times those of Costa Rica, 13 times those of Panama, 12 times those of the Dominican Republic, 10.5 times those of El Salvador, almost 5 times those of Nicaragua, and 4 times those of Honduras.

In 2004, the region's health costs amounted to an average of 0.41% of GDP and 15.3% of public spending on health (2004 figures). In keeping with what was stated earlier, it is Guatemala where these health costs represent the largest share of GDP (1%) and of public spending on health (114%), whereas Costa Rica lies at the opposite extreme among the seven countries analysed (0.05% of GDP and 1.1% of public spending on health).

TABLE II.5
HEALTH COSTS OF UNDERWEIGHT, PER COUNTRY (2004)

| Age group | Country | | | | | | | TOTAL |
|---|-------------|-------------|--------------|-------------|-------------|-------------|--------------------|--------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Total (Millions of US\$) | 10.0 | 24.4 | 285.3 | 47.5 | 26.9 | 26.4 | 13.0 | 433.5 |
| Total (Millions of US\$ PPP) | 21.7 | 53.0 | 549.8 | 128.8 | 116.8 | 42.5 | 45.3 | |
| Newborn | 75% | 69% | 12% | 5% | 3% | 75% | 78% | 21% |
| 1 to 11 months | 8% | 5% | 12% | 17% | 10% | 4% | 4% | 11% |
| 12 to 23 months | 17% | 6% | 23% | 29% | 28% | 6% | 5% | 21% |
| 24 to 59 months | 1% | 20% | 53% | 49% | 59% | 15% | 13% | 46% |
| Percentage of public spending on health | 1.1% | 10.4% | 114.4% | 18.3% | 20.0% | 3.3% | 6.3% | 15.3% |
| Percentage of GDP | 0.1% | 0.2% | 1.0% | 0.6% | 0.6% | 0.2% | 0.1% | 0.41% |

Source: Authors' compilation, based on official morbidity data and health costs recorded in each country; Public Social Spending, ECLAC database.

¹⁶ The system costs include consultation, treatment (procedures and medications), hospitalization and use of the infrastructure. Private costs include the travel and time involved. In other words, the administration of the health-care system is not taken into account, given the difficulty of attributing specific administrative costs to certain pathologies. Therefore, the costs reflected here underestimate the costs to the system.

An analysis of the breakdown of these costs reveals that public costs account for an average of 90.7% of total costs. Private costs are highest in Nicaragua (38%), and fluctuate between 0.8% and 6.7% in the other countries.

2. Undernutrition and education

Undernutrition affects academic performance because of the deficits caused by diseases and the limitations on learning capacity associated with deficient cognitive development. This translates into greater probabilities of late entry into school, repeated grades, high dropout rates and low levels of schooling.

A greater propensity towards illness means that boys and girls suffering from undernutrition enter the school system at a later age and miss school more often, which increases the likelihood that they will repeat grades and drop out. Thus, child undernutrition leads to lasting educational disadvantages that are exacerbated when access to food continues to be limited during the school-age years. These disadvantages also bear a strong correlation to micronutrient deficiency.

The effects and costs resulting from underweight in the specific case of Central America and the Dominican Republic were analysed using information from official statistics and household surveys in each country, along with data from the United Nations Educational, Scientific and Cultural Organization (UNESCO) and CELADE population data.

2.1 Education effects

Applying special processing techniques to longitudinal data on the vulnerable population (ECLAC, 2006), it has been possible to estimate the effects of undernutrition on educational outcomes.

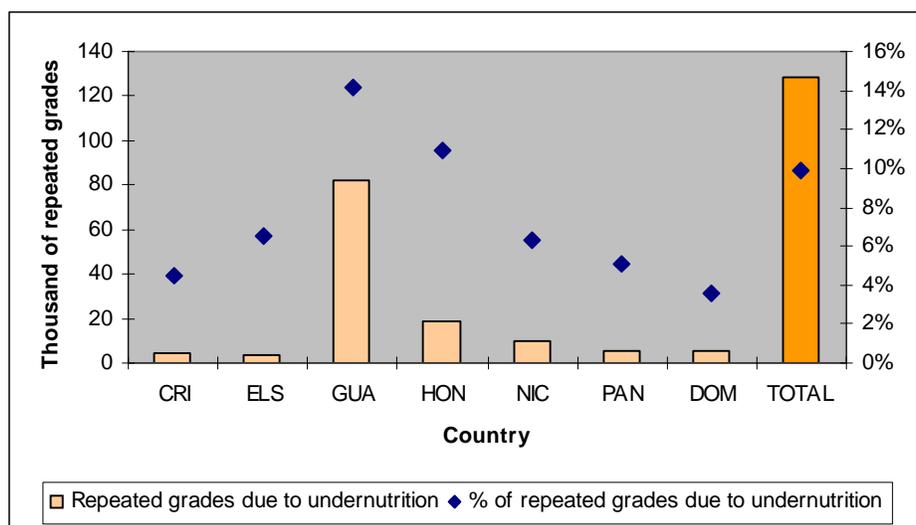
Among the countries studied, the population not suffering from undernutrition repeats grades at an average rate of 9% in primary education and 17% in secondary education. Of children who did suffer from undernutrition, an average of 14% of those attending primary school fail grades at that level, and 26% of those who attend secondary education fail grades. In both groups, Guatemala and Nicaragua have the highest proportions of repeated grades in primary education (over 50% above the average), whereas Guatemala and Panama have relatively more cases at the secondary level (around twice the average).

The total number of children repeating grades for reasons associated with undernutrition was 128,695 in 2004 (71% occurring in primary school). This represents 9.9% of the total number of repeated grades in the system that year.

Nearly two thirds of the total number of repeated grades occurred among Guatemalan children, who account for 14% of the total in that country. It is followed by Honduras, which has one seventh of the total number of cases in the subregion and a figure of 11% of repeated grades caused by undernutrition. In contrast, the Dominican Republic, Panama and Costa Rica have lower levels of undernutrition and higher education coverage, and in those countries no more than 5% of all repeated grades are due to undernutrition.

In the case of attrition, for all of the countries together, 39% of the students who have not suffered from undernutrition will fail to complete primary school, as is the case with 49% of those entering secondary school.

FIGURE II.6
GRADE REPETITION ASSOCIATED WITH UNDERWEIGHT, BY COUNTRY (2004)



Source: Authors' compilation, based on official data from the countries.

Among those who did suffer from undernutrition, on the other hand, these figures rise to 59% for primary education (over 50% in 5 of the 7 countries) and 72% in secondary education. Guatemala and Nicaragua report figures higher than 90%, whereas Panama, the Dominican Republic and Costa Rica range from 72% to 82%, and the corresponding figures in Honduras and El Salvador are under 50%.

From a historical perspective, it is estimated that approximately one million Central Americans and Dominicans who were part of the WAP in 2004 had dropped out of school as a consequence of underweight, which translates into an education gap that amounts to two years of school¹⁷ compared to students who did not suffer from undernutrition. Thus, the latter average 5 to 9 years of schooling, while the population suffering from undernutrition averages between 3 and 7 years of education.

2.2. Education costs

Education costs have been estimated on the basis of the private and public values reported for this sector in each country. Among them, costs derived from additional education activities made necessary by repeated grades figure prominently.

Estimates for private costs are derived from the average per-student cost of inputs not provided by the school system, at values prevailing in the public materials provision programme, and from the transportation costs required to go to school,¹⁸ based on current urban rates in each country.

Estimates for the public system are derived from records reflecting the operation of the system per student per academic year.¹⁹ Among these costs, the use of the infrastructure and

¹⁷ This gap takes into account only the primary and secondary levels of education.

¹⁸ Two trips per day are assumed for each student, whether the student traveled alone or with an accompanying adult.

¹⁹ This cost includes subcategories of costs by grade and education level.

equipment of the establishments making up the country's education system is taken into consideration whether the ultimate provider is public or private.

Considering the values indicated, the fact that nearly 129,000 additional students were in school in 2004 because of the differential rates of grade repetition produced by undernutrition in the region translates into US\$ 30.9 million in current dollars. This total amounts to 0.74% of public spending on education and 0.03% of the aggregate GDP of the seven countries for that year.

As shown in table II.6, the highest cost is seen in primary education (70%), a proportion which climbs significantly in Honduras, the Dominican Republic and El Salvador. In contrast, the figures are totally reversed in Panama and Costa Rica.

Comparing these results with the educational coverage rates published by UNESCO, this situation could just be a reflection of the low coverage of secondary education in these countries, where the average is only half that of primary education. While all the countries together report official coverage figures of 85% to 99%, the three countries with the highest secondary school coverage are Panama, Costa Rica and El Salvador (63%, 53% and 49%, respectively).

TABLE II. 6
EDUCATION COSTS OF UNDERWEIGHT, PER COUNTRY (2004)

| | Country | | | | | | | TOTAL |
|--|------------|-------------|-------------|------------|------------|------------|--------------------|-------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Total (millions of US\$) | 2.6 | 1.0 | 16.5 | 5.0 | 1.7 | 3.7 | 0.5 | 30.9 |
| Total (millions of US\$ PPP) | 5.6 | 2.2 | 31.8 | 13.4 | 7.2 | 6.0 | 1.7 | |
| Percentage of cost in primary | 48.3% | 80.8% | 69.1% | 93.7% | 77.4% | 20.5% | 92.1% | 69.8% |
| Percentage of cost in secondary | 51.7% | 19.2% | 30.9% | 6.3% | 22.6% | 79.5% | 7.9% | 30.2% |
| Percentage of public spending on education | 0.25% | 0.21% | 2.45% | 0.93% | 0.95% | 0.61% | 0.12% | 0.74% |
| Percentage of GDP | 0.014% | 0.006% | 0.060% | 0.067% | 0.037% | 0.03% | 0.003% | 0.03% |

Source: Authors' compilation, based on official data and education costs recorded in each country; Schooling, household survey in each country; Public Social Spending, ECLAC database.

3. Productivity

3.1. Effects on productivity

One effect of undernutrition is the loss of human capital. The countries' labour force may lose productivity because of the lower skill level attained by the population surviving child

undernutrition, the greater probability that this population will drop out of school, or the higher incidence of mortality due to pathologies associated with undernutrition.

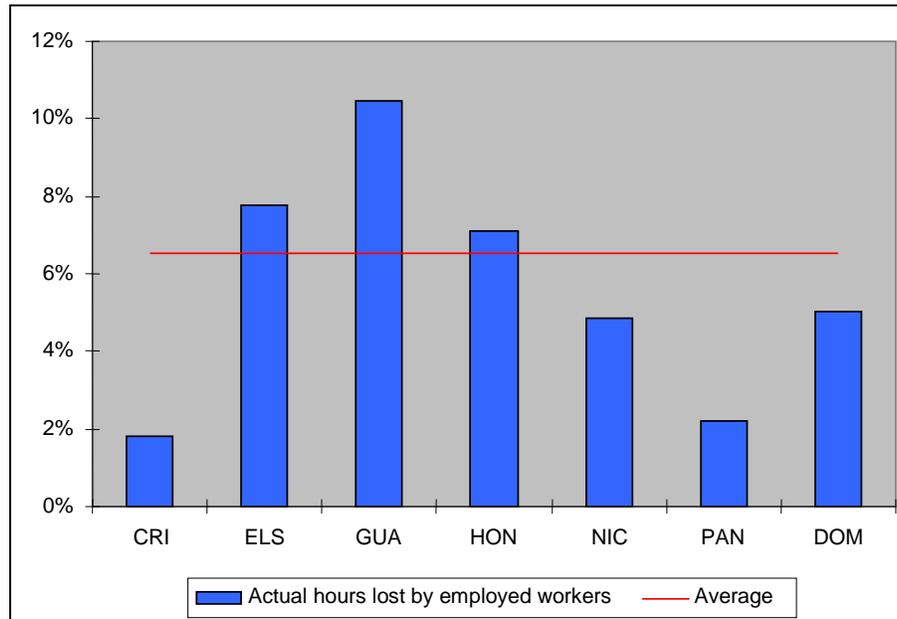
Poor school performance by boys and girls affected by undernutrition at an early age, compared with those not suffering from it, leads to higher attrition rates. As noted above, there is an average education gap of two years in the countries analysed, which limits the production capacity of these individuals and reduces their potential earnings.

Mortality associated with undernutrition, on the other hand, causes a direct economic loss to society, because that boy or girl will fail to reach working age. Based on the analysis presented in point 1.1.2, it is estimated that 1.7 million persons would today belong to the working age population (WAP) if not for undernutrition, as they would be between 15 and 64 years of age in 2004. This total represents 6% of the WAP in the subregion in that year.

As can be seen in figure II.6, in keeping with the magnitude of its nutrition problem, Guatemala has suffered the greatest impact on its production capacity (10.5%), followed at a considerable distance by El Salvador and Honduras (just over 7%). At the opposite end are Costa Rica and Panama (around 2%).

Taking into account the effective employment rate of the WAP and the average number of hours worked by those who are employed²⁰ in each country, it is estimated that the subregion has lost a total of 2.5 billion hours of work in 2004, equivalent to 6.5% of the total number of hours worked by the economically active population (EAP)²¹ in the subregion.

FIGURE II.7
EFFECT OF UNDERNUTRITION ON THE EAP OF EACH COUNTRY (2004)



Source: Authors' compilation, based on the latest household survey available for each country.

²⁰ Declared in household surveys.

²¹ All men and women aged 15 to 64 years who work or are looking for work are considered to be in the WAP.

3.2 Productivity costs

The highest productivity costs arising out of undernutrition are derived from the economic value of the working hours lost due to mortality and lower levels of education.

Based on the data presented above, in the seven countries analysed the loss of productivity due to mortality associated with undernutrition is valued at US\$ 6.194 billion, of which US\$ 3.2 billion corresponds to lost productivity due to fewer years of education and US\$ 2.994 billion to mortality-caused productivity losses.

As shown in table II.7, there is considerable variation in the weight of each component in the productivity cost, which reflects differences both in historical undernutrition and mortality trends and in the varying income differential at each level of education. In this regard, it is noteworthy that while in Panama nearly two thirds of the cost is attributable to lower levels of education, the opposite is true of Nicaragua. In the Dominican Republic, the ratio is one to four.

In keeping with the magnitude of the effects of underweight in the respective sectors, productivity costs as a percentage of each country's GDP reveal three categories. The highest figures are found in Guatemala and Honduras, with about 10%. The next category, which is more heterogeneous, is made up of El Salvador and Nicaragua, with over 5%. The Dominican Republic is in a sort of "transition" period, heading toward the lowest category, in which Costa Rica and Panama report figures of 1.6% and 2.1%, respectively.

TABLE II.7
ESTIMATED PRODUCTIVITY COST OF UNDERWEIGHT (2004)

| | Estimate per country | | | | | | | TOTAL |
|---------------------------------------|----------------------|----------------|----------------|--------------|--------------|--------------|--------------------|----------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Total (millions of US\$) | 305.0 | 1 150.0 | 2 826.6 | 727.6 | 235.8 | 291.4 | 658.0 | 6 194.4 |
| Total (millions of US\$ PPP) | 660.2 | 2 499.7 | 5 447.5 | 1 970.8 | 1 023.5 | 469.8 | 2 287.8 | |
| Cost due to lower levels of education | 52.5% | 48.0% | 59.0% | 56.8% | 35.6% | 65.3% | 20.1% | 48.8% |
| Cost due to mortality | 47.5% | 52.0% | 41.0% | 43.2% | 64.4% | 34.7% | 79.9% | 51.2% |
| Percentage of GDP | 1.6% | 7.3% | 10.3% | 9.9% | 5.2% | 2.1% | 3.5% | 5.7% |

Source: Authors' compilation, based on official data and education costs recorded in each country; Income and schooling, from household surveys in each country.

4. Summary of effects and costs

Combining all the estimates for each of the seven countries analysed in this study, the total cost of underweight in 2004, the result of the undernutrition that has prevailed in the last six decades, amounts to nearly US\$ 6.7 billion.

Guatemala accounts for 47% of that amount, even though it has 28% of the population under 5 and 43% of the population suffering from undernutrition for this period. El Salvador is in second place; with 15% of the population in the cohort and 15% of those suffering from undernutrition, it accounts for 18% of the total cost mentioned above.

At the opposite end of the spectrum is Nicaragua, which represents 4% of the cost but has 7% of the population suffering from undernutrition for this period. Thus, it has the lowest unit costs of all the countries studied. This is probably due to the lesser degree of variability in the ratio between income and education level before the completion of secondary school. It is followed by Costa Rica and Panama, each of which represents about 5% of the cost and 3% of the cases of undernutrition.

When the aforementioned figures are compared with each country's public social spending, the average is 78%. In the countries with the highest costs, Guatemala and El Salvador, this figure exceeds 100% (185% in the former and 137% in the latter). It is less than 10% in Costa Rica, by contrast.

In comparison with each country's GDP, given the weight of productivity in total costs, the distribution is similar to that described in the preceding paragraph. Thus, the most significant cases correspond to Guatemala and Honduras, with values above 10%, as opposed to Costa Rica and Panama, with about 2%.

TABLE II.8
ESTIMATED TOTAL COST OF UNDERWEIGHT (2004)

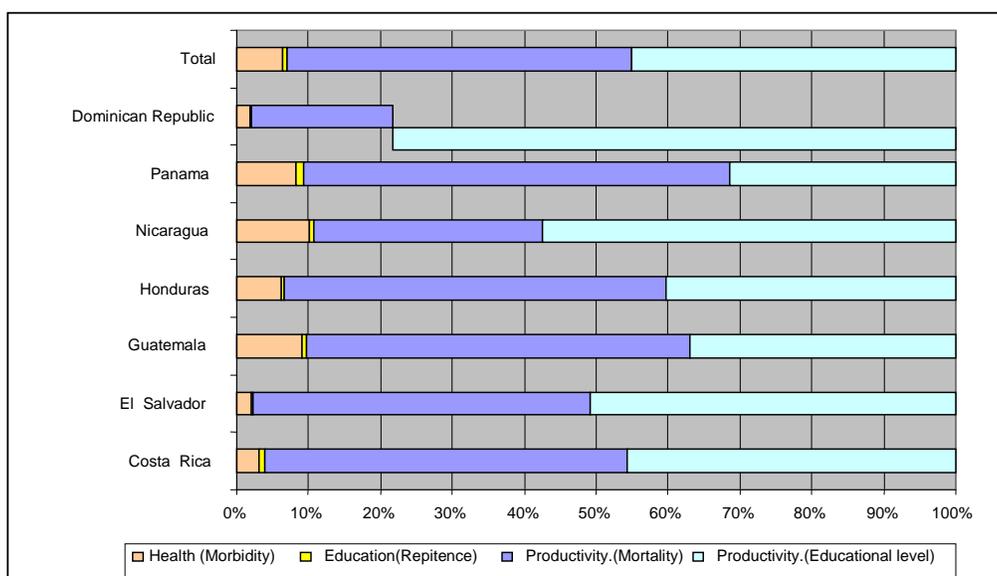
| | Estimate per country | | | | | | | Total |
|--|----------------------|----------------|----------------|--------------|--------------|--------------|--------------------|----------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Total (millions of US\$) | 317.6 | 1 175.3 | 3 128.4 | 780.1 | 264.3 | 321.5 | 671.6 | 6 658.8 |
| Total (millions of US\$ PPP) | 687.5 | 2 554.8 | 6 029.1 | 2 113.0 | 1 147.6 | 518.3 | 2 334.8 | |
| Percentage of GDP | 1.7% | 7.4% | 11.4% | 10.6% | 5.8% | 2.3% | 3.6% | |
| Percentage of Public Social Spending | 9.3% | 136.6% | 185.4% | 80.9% | 64.3% | 8.5% | 59.1% | |

Source: Authors' compilation, based on official data from the countries and ECLAC: Social Expenditure database.

An analysis of the breakdown of costs reveals that productivity costs account for 93%, with losses due to mortality about the same as those due to lower levels of education. Health costs represent only 6.5%, and education costs less than 1%. These proportions vary from one country to another, but the distribution pattern remains the same.

Thus, it can be concluded that if we know the size of the population under 5 with low weight for their age and the correlations between undernutrition and the two dimensions of productivity, we can estimate more than 90% of the costs incurred in a given country.

FIGURE II.8
DISTRIBUTION OF UNDERWEIGHT COSTS IN THE COUNTRIES (INCIDENTAL RETROSPECTIVE DIMENSION, 2004)



Source: Authors' compilation.

C. Effects and costs in the cohort aged 0-59 months in 2004: analysis of the prospective dimension

1. Health effects and costs

Based on the population census data for each country, it is possible to estimate that in the cohort aged 0 to 59 months in 2004, just over 24,000 deaths associated with underweight will occur, with 15,315 cases (63%) in 2004.²²

Given the greater incidence of undernutrition in Guatemalan boys and girls compared to their counterparts in the other countries, nearly half of the cases can be expected to occur among them; one in 5 of these cases will be in Honduras. In contrast, less than 1% of the cases correspond to Costa Rican children, and only 2% to Panamanians.

²² All estimates for the cohort aged 0-4 years in 2004 will gradually decrease through 2008 as a result of the members moving up into higher age groups.

TABLE II.9
MORTALITY ASSOCIATED WITH UNDERWEIGHT IN CHILDREN UNDER FIVE (2004-2008)

| | Country | | | | | | | TOTAL |
|-----------------|------------|--------------|---------------|--------------|--------------|------------|--------------------|---------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| TOTAL | 139 | 2 111 | 11 926 | 5 088 | 2 136 | 486 | 2 252 | 24 138 |
| 0 to 11 months | 86 | 999 | 6 490 | 2 079 | 983 | 239 | 955 | 49% |
| 12 to 59 months | 53 | 1 112 | 5 436 | 3 009 | 1 153 | 247 | 1 297 | 51% |
| % | 0.6% | 8.7% | 49.4% | 21.1% | 8.9% | 2.0% | 9.3% | 100.0% |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks reported by Fishman et al, and the prevalence of undernutrition according to the latest national nutrition survey available for each country.

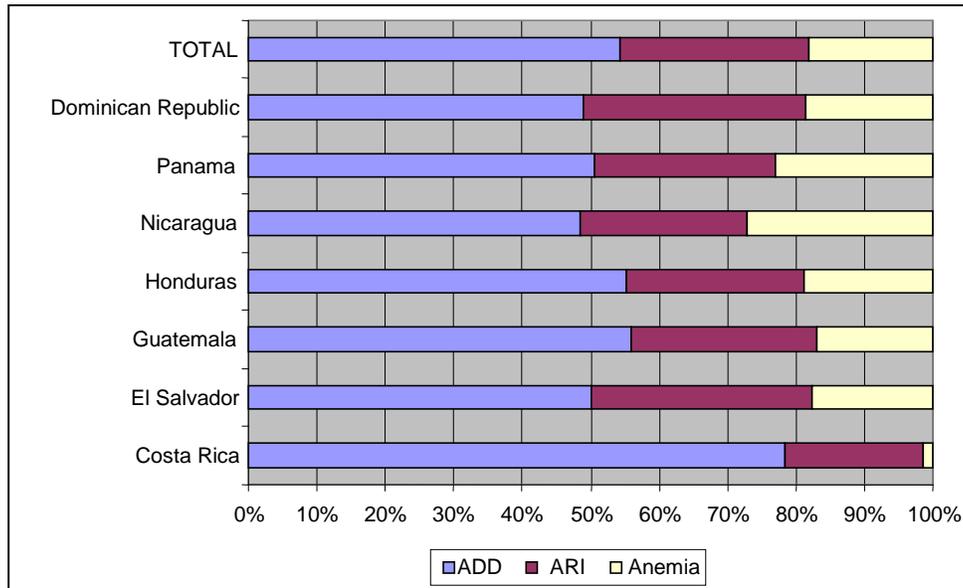
Considering the total number of cases in the seven countries, half of the deaths can be expected to occur before the first birthday, although the figure rises to 62% in Costa Rica and 54% in Guatemala. It is about 41% in Honduras and the Dominican Republic. Thus, although undernutrition is at its most lethal during the first year of life, half of all cases occur in the remaining four years of the cohort.

The estimated impact on the morbidity of underweight children under 5 in 2004 amounts to nearly 225,000 cases, 70% of which are expected to occur in 2004 and the rest between 2005 and 2008. This does not take into account the direct impact on treatments required for children with undernutrition to recover, which is 62,000 due to LBW_{IUGR} and 1.2 million due to underweight.

As can be seen in figure II.9, most of the additional cases of disease correspond to ADD, reaching a total of 54% for all seven countries and 79% in Costa Rica. ARIs amount to half the total for ADDs, reaching 32% in the most significant cases, El Salvador and the Dominican Republic. Anemia, in contrast, amounts to a third of ADDs, and is most prevalent in Nicaragua and Panama (27% and 23%, respectively).

Despite some similarities, it is not possible to identify patterns in the morbidity consequences in the different countries. Therefore, each case needs to be followed up specifically to minimize the adverse impacts of undernutrition.

FIGURE II.9
DISTRIBUTION OF ADDITIONAL CASES OF DISEASE DUE TO UNDERWEIGHT (2004-2008)



Source: Authors' compilation, based on official Health statistics, CELADE population projections, the latest national nutrition survey available for each country, and estimates of differences in prevalence (DP).

As could be expected, the distribution pattern of morbidity in these countries is similar to that of undernutrition in the region. Thus, it is estimated that half (56%) of the cases of diseases associated with undernutrition will occur in Guatemala and one fifth in Honduras, while less than 1% will be in Costa Rica. The distribution of mortality is also similar.

When analysing the distribution of disease cases by age group, it can be seen that more than two thirds are found among children aged 24 to 59 months, with smaller variations among the countries.

TABLE II.10
MORTALITY CASES ASSOCIATED WITH UNDERWEIGHT (2004-2008)

| | Estimate per country | | | | | | | TOTAL |
|------------------|----------------------|---------------|----------------|---------------|---------------|--------------|--------------------|----------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Total (N) | 2 034 | 18 623 | 124 785 | 44 870 | 16 667 | 6 910 | 10 920 | 224 809 |
| 0 to 11 months | 8% | 15% | 16% | 13% | 16% | 17% | 17% | 15% |
| 12 to 23 months | 26% | 16% | 17% | 12% | 14% | 14% | 15% | 16% |
| 24 to 59 months | 66% | 69% | 68% | 75% | 70% | 69% | 67% | 69% |
| % | 0.9% | 8.3% | 55.5% | 20.0% | 7.4% | 3.1% | 4.9% | 100.0% |

Source: Authors' compilation, based on official Health statistics, CELADE population projections, the latest national nutrition survey available for each country, and estimates of differences in prevalence (DP).

The cost to the health sector of the added burden of diseases caused by undernutrition in 2004 is estimated at a present net value (PNV) of US\$ 566 million,²³ which includes both diseases associated with undernutrition and the recovery of individuals suffering from undernutrition. This is particularly important in the cases associated with intrauterine growth restriction in countries with lower levels of undernutrition, such as Costa Rica, Panama and the Dominican Republic.

More than two thirds of the aforementioned costs are incurred in Guatemala. Thus, while undernutrition in that country represents 52% of the total for all the countries and associated diseases account for 56% of the total, the resulting costs is equivalent to 68%, which can be explained in part by the fact that Guatemala has the highest purchasing power parity (PPP) coefficient.

Moreover, while the cost in Costa Rica has twice the weight of the morbidity rate and represents 60% more in Panama, in the remaining four countries the situation is the reverse, with that cost accounting for as little as half the weight of morbidity.

The above-mentioned values are based on an equivalent annual cost (EAC)²⁴ of nearly US\$ 142 million for the 2004-2008 period for the seven countries combined, which represents 5% of public spending on health in 2004 and 0.13% of GDP for that year. Once again, these proportions are significantly higher in Guatemala.

TABLE II.11
ESTIMATED COST OF MORBIDITY ASSOCIATED WITH UNDERWEIGHT (2004-2008)

| | Estimate per country | | | | | | | TOTAL |
|-----------------------------------|----------------------|-------------|--------------|-------------|-------------|-------------|--------------------|--------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| NPV (millions of US\$) | 11.1 | 27.1 | 384.8 | 63.6 | 36.8 | 28.7 | 14.0 | 566.1 |
| NPV (millions OF US\$ PPP) | 26.7 | 59.6 | 787.5 | 181.5 | 168.5 | 45.7 | 71.9 | |
| EAC (millions of US\$) | 2.8 | 6.8 | 96.4 | 15.9 | 9.2 | 7.2 | 3.5 | 141.8 |
| % of public spending on health | 0.3% | 2.9% | 38.7% | 6.1% | 6.9% | 0.9% | 1.7% | 5.0% |
| % of GDP | 0.015% | 0.043% | 0.351% | 0.216% | 0.203% | 0.052% | 0.019% | 0.134% |

Source: Authors' compilation, based on official morbidity data and health costs recorded in each country; Public Social Spending, ECLAC database.

2. Education effects and costs

By projecting the characteristics the educational process may have for Central American and Dominican boys and girls under the age of 5 in 2004,²⁵ it is possible to estimate the number of students who may have to repeat grades in the future because of underweight and its associated costs. For this purposes, the differential probability estimates of scholastic achievement described in the preceding chapter are used.

²³ With an annual discount rate of 8%.

²⁴ Ibid.

²⁵ This projection is based on education coverages of the school-age population and educational levels achieved by the cohort aged 20 to 24 as of the latest household survey (2003).

Among the seven countries analysed, it is predicted that between 2007 and 2022 there will be nearly 97,000 additional cases of repeated grades, about 70% of which will be in primary school. Guatemala will account for approximately the same percentage of this total.

Given the different combinations of undernutrition, education coverage and school completion rates, between 2,100 and 2,500 cases are projected for four of the seven countries.

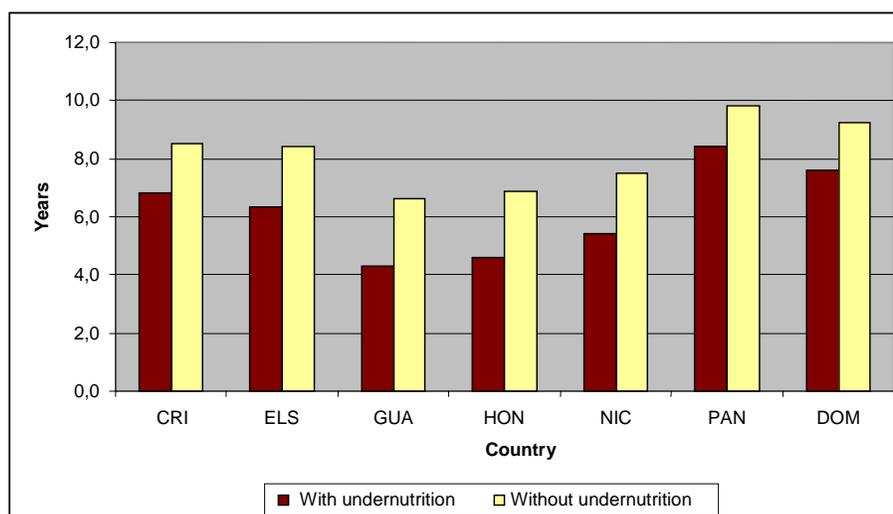
TABLE II. 12
REPEATED GRADES AND ATTRITION ASSOCIATED WITH UNDERWEIGHT (2004-2008)

| | Estimate per country | | | | | | | TOTAL |
|------------------------|----------------------|---------------|----------------|---------------|---------------|--------------|--------------------|----------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Total repeaters | 2 116 | 2 330 | 68 254 | 11 363 | 7 823 | 2 543 | 2 395 | 96 824 |
| % | 2.2% | 2.4% | 70.5% | 11.7% | 8.1% | 2.6% | 2.5% | 100.0% |
| Total dropouts | 7 499 | 13 166 | 118 230 | 67 741 | 14 705 | 3 533 | 5 701 | 204 575 |
| % | 3.3% | 5.7% | 51.3% | 29.4% | 6.4% | 1.5% | 2.5% | 100.0% |

Source: Authors' compilation, based on official Education data and household surveys in each country.

As we can observe in table II.12, it is estimated that nearly 205,000 future students will drop out of school early as a consequence of the undernutrition affecting them in 2004, which suggests an average difference of two years in the schooling of those suffering from undernutrition and those who are not, in the 11 or 12 years that make up the countries' school requirements. The range is from 1.4 years in Panama to approximately 2.3 years in Honduras and Guatemala.

FIGURE II.10
AVERAGE LEVEL OF EDUCATION ESTIMATED FOR THE COHORT AGED 0-59 MONTHS IN 2004, WITH AND WITHOUT UNDERWEIGHT



Source: Authors' compilation, based on household surveys in each country.

As a result of the additional repeated grades estimated for the cohort, education costs expressed in present value (at a discount rate of 8%) are estimated at US\$ 12.1 million in 2004 dollars.

The equivalent annual cost (EAC) for the period of 15 to 16 years during which the cohort under study would be of school age (2006-2021), would be US\$ 1.4 million in 2004 dollars, which would represent 0.08% of the public spending allocated to education in the countries of the region in 2004.

TABLE II.13
ESTIMATED COST OF REPEATED GRADES ASSOCIATED WITH UNDERWEIGHT
(2004-2008)

| | Estimate per country | | | | | | | TOTAL |
|-----------------------------------|----------------------|-------------|-----------|----------|-----------|--------|--------------------|-------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| NPV (millions of US\$) | 0.62 | 0.31 | 7.64 | 1.85 | 0.78 | 0.80 | 0.14 | 12.14 |
| NPV (millions of US\$ PPP) | 1.50 | 0.68 | 15.62 | 5.29 | 3.58 | 1.27 | 0.71 | |
| EAC (millions of US\$) | 0.07 | 0.04 | 0.89 | 0.22 | 0.09 | 0.09 | 0.02 | 1.42 |
| % of public spending on education | 0.007% | 0.008% | 0.128% | 0.039% | 0.050% | 0.015% | 0.005% | 0.08% |

Source: Authors' compilation, based on official data and education costs recorded in each country; Schooling, household survey in each country; Public Social Spending, ECLAC database.

When Guatemala is compared to the other countries, in light of its population size and the prevalence of undernutrition, it accounts for an estimated 63% of the costs in the subregion, followed by Honduras with 15%.

3. Productivity effects and costs

One direct consequence of the schooling gap caused by undernutrition in the first years of life can be seen in workers' productivity. Their reduced human capital affects their individual well-being as well as the economic capacity of society as a whole.

In addition, taking into account the 24,138 young people who will die as a result of undernutrition in Central America and the Dominican Republic between 2004 and 2008, it is possible to estimate a potential loss of 2.191 billion hours of work in what would have been their working life (between 2014 and 2068).

The impact of the underweight prevailing in 2004 on the productive population of the countries analysed is estimated at losses equivalent to US\$ 1.582 billion due to the education gap and US\$ 111 million due to mortality, at present 2004 values. Thus, the productivity losses in the cohort would amount to US\$ 1.693 billion.

Considering the entire period in which these values would be produced (2014-2068), the equivalent annual cost is approximately US\$ 138 million. Of that total, US\$ 9 million

corresponds to mortality costs and US\$ 128 million represents losses due to lower levels of education.

As shown in table II.14, the loss of productivity is equivalent to 0.13% of the seven countries' GDP in 2004. There are significant differences among the countries, ranging from 0.01% in the Dominican Republic to 0.36% in Guatemala.

Furthermore, these figures represent 1.3% of total public social spending in 2004. Whereas in Guatemala this cost amounts to nearly 6%, in Costa Rica, Panama and the Dominican Republic it is around 0.1%.

TABLE II.14
ESTIMATED PRODUCTIVITY COST OF UNDERWEIGHT (2004 - 2008)

| | Estimate per country | | | | | | | TOTAL |
|----------------------------------|----------------------|--------------|----------------|--------------|-------------|-------------|--------------------|----------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| NPV (millions of US\$) | 36.3 | 119.5 | 1 214.7 | 225.6 | 40.6 | 35.8 | 20.7 | 1 693.2 |
| NPV (millions of US\$ PPP) | 79.3 | 262.7 | 2 483.8 | 613.1 | 176.0 | 57.0 | 77.6 | |
| EAC (millions of US\$) | 2.9 | 9.7 | 98.6 | 18.3 | 3.3 | 2.9 | 1.7 | 137.5 |
| % of public social spending | 0.09% | 1.13% | 5.84% | 1.90% | 0.80% | 0.12% | 0.15% | 1.27% |
| % of GDP | 0.02% | 0.06% | 0.36% | 0.25% | 0.07% | 0.02% | 0.01% | 0.13% |

Source: Authors' compilation, based on official data and education costs recorded in each country; Income and schooling, from household surveys in each country.

4. Summary of effects and costs

By projecting the costs of underweight in the seven countries analysed for the cohort of boys and girls under 5 in 2004, it is estimated that their present value is US\$ 2.171 billion. Guatemala accounts for 71% of that total, and together with Honduras and El Salvador it makes up 90% of the total.

In terms of purchasing power parity (PPP), the costs represent higher values in all countries, but the increase in the equivalent value is significantly higher in Nicaragua and the Dominican Republic, where the figure is triple the current cost.

The equivalent annual cost for the 65-year period over which the different estimated values are distributed is nearly US\$ 183 million. On average, this cost represents 1.9% of public social spending and 0.15% of GDP in the countries in 2004. As a consequence of what was noted earlier, Guatemala and Honduras report the highest figures in this regard, nearly 7.7% and 2.5% of social spending and 0.5 and 0.3 points of GDP, respectively.

TABLE II.15
PROJECTION OF UNDERWEIGHT COST
FOR CHILDREN UNDER FIVE (2004)

| | Estimate per country | | | | | | | TOTAL |
|--|----------------------|-------------|--------------|------------|-----------|-----------|--------------------|--------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Total NPV (millions of US\$) | 48 | 147 | 1 607 | 291 | 78 | 65 | 35 | 2 271 |
| Total NPV (millions of US\$ PPP) | 105 | 323 | 3 286 | 791 | 339 | 104 | 131 | |
| EAC (millions of US\$) | 3.9 | 11.8 | 129.4 | 23.4 | 6.3 | 5.2 | 2.8 | 182.9 |
| % of public social spending | 0.12% | 1.37% | 7.67% | 2.43% | 1.53% | 0.22% | 0.25% | |
| % of GDP | 0.02% | 0.07% | 0.47% | 0.32% | 0.14% | 0.04% | 0.02% | |

Source: Authors' compilation, based on official data from the countries and ECLAC: Social Spending database.

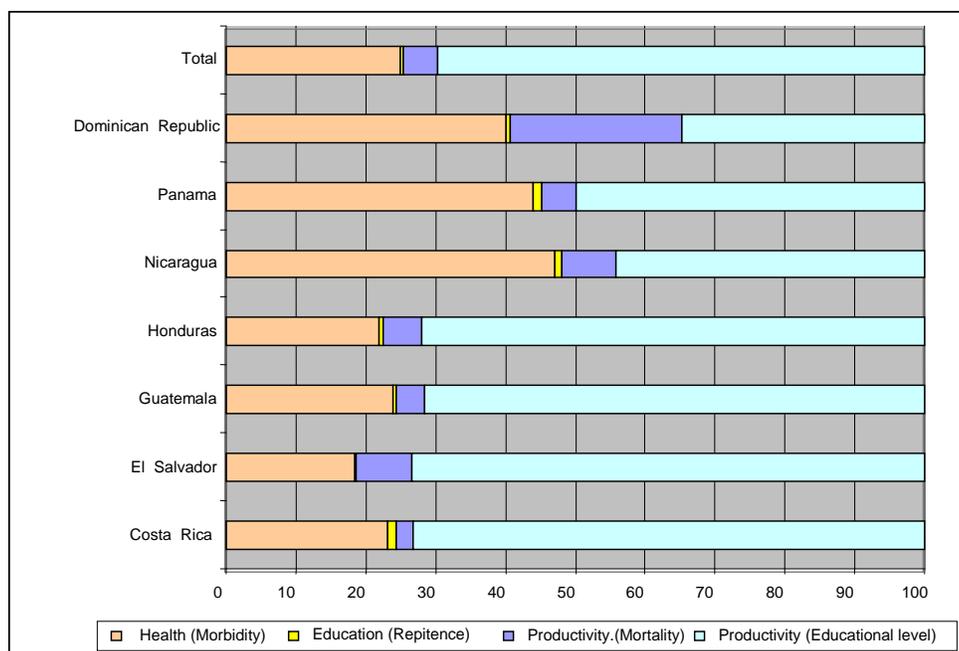
The breakdown of costs reveals that the loss of human capital due to less education is the principal source of costs derived from underweight, accounting for 70% of them at the subregional level. This figure is nearly three times higher than the next category, health costs. However, this preponderance is not seen in Nicaragua or the Dominican Republic, where costs due to higher morbidity are greater. It is also attenuated in Panama, where human capital losses represent half of total costs.

The impact on mortality is less than 5% on average, although its weight is almost four times higher in the Dominican Republic.

Finally, the cost for the school systems associated with repeated grades is less than 1%, although it is slightly more in Costa Rica and Panama.

When this distribution is compared with that reflected in the incidental retrospective dimension, a significant difference can be seen, although in both cases productivity accounts for the greatest costs. In the incidental retrospective dimension, mortality and education levels hold similar weights, whereas in the prospective analysis the latter weighs five times more than the former. This is a reflection of the advances that have been made in cutting the mortality rate and boosting school completion, which means that the alternative cost of the latter is higher.

FIGURE II.11
DISTRIBUTION OF UNDERWEIGHT COSTS IN THE COUNTRIES (PROSPECTIVE
DIMENSION, 2004)
(In percentages)



Source: Authors' compilation.

5. Analysis of scenarios: costs and savings

Relying on the databases and procedures used to estimate the effects and costs with the prospective dimension of analysis in the seven countries, a number of different scenarios can be projected. Below are the results of the simulations corresponding to three undernutrition scenarios and their effects on costs for 2015:

1. The latest figures available on the prevalence of underweight used in this study remain the same in 2015.
2. The Target established in the Millennium Development Goals for reducing underweight in each country to half the 1990 figure is attained in 2015.
3. Underweight is eradicated in the country by 2015, which for purposes of this analysis means achieving a prevalence of 2.5%, the “normal” proportion of cases according to the measurement parameters published by the National Center of Health Statistics (NCHS).

Table II.16 shows the estimated costs for the three scenarios, considering not only the prevalence of undernutrition but also the effect of the variation in population size of the cohort and mortality projections,²⁶ with all other variables remaining constant.

In scenario 1, just because of the variation in population size in the countries, costs in 2015 will be about 10% higher than in 2004. This increase is attributable primarily to the greater

²⁶ According to CELADE estimates.

relative weight of Guatemala. Honduras and Nicaragua show a slight increase in their costs. El Salvador, in contrast, projects a downturn in costs as a result of the progressive decline in its population aged 0-4 years.

Should the countries reach MDG Target 2, the cost in 2015 will be 40% less than in scenario 1, with Guatemala accounting for 67% of that reduction.

Finally, the cost of underweight in 2015 will be 88% less than in scenario 1 if a prevalence of 2.5% is achieved. Nearly US\$ 1.65 billion of this decline would be seen in Guatemala, which would incur less than 10% of the cost for the scenario in which the prevalence does not change at all. Next in order would be Honduras, with 13%.

TABLE II.16
ESTIMATED COST OF UNDERWEIGHT FOR THE BASE YEAR AND THREE SCENARIOS
(NPV in millions of US\$; 2004 and 2015)

| | Country | | | | | | | TOTAL |
|----------------------------|-----------------|-------------|--------------|------------|-----------|-----------|--------------------|--------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| Year 2004 | 48 | 147 | 1 607 | 291 | 78 | 65 | 35 | 2 271 |
| No change in prevalence | 48 | 143 | 1 817 | 308 | 80 | 65 | 35 | 2 496 |
| MDG attained (50% of 1990) | 15 ^a | 84 | 1 161 | 175 | 42 | 28 | 10 ^a | 1 515 |
| Eradication (2.5%) | 15 | 28 | 170 | 40 | 19 | 15 | 10 | 297 |

Source: Authors' compilation.

^a Given that the MDG target calculated for Costa Rica and the Dominican Republic implies an undernutrition prevalence that is less than the value considered to be eradication, the costs for that scenario have been estimated as equivalent to those of the third scenario.

Based on the cost trends shown, it is possible to estimate potential savings that would be generated as soon as actions aimed at achieving the targets are initiated.

As indicated in figure II.12, the potential savings resulting from a year-to-year comparison between scenarios 2 and 3 and scenario 1 rise steadily over time. In the case of scenario 2, the savings generated in 2005, in dollars for each year, would be multiplied by more than 7 by 2015, that is, going from US\$ 35 million to US\$ 253 million.

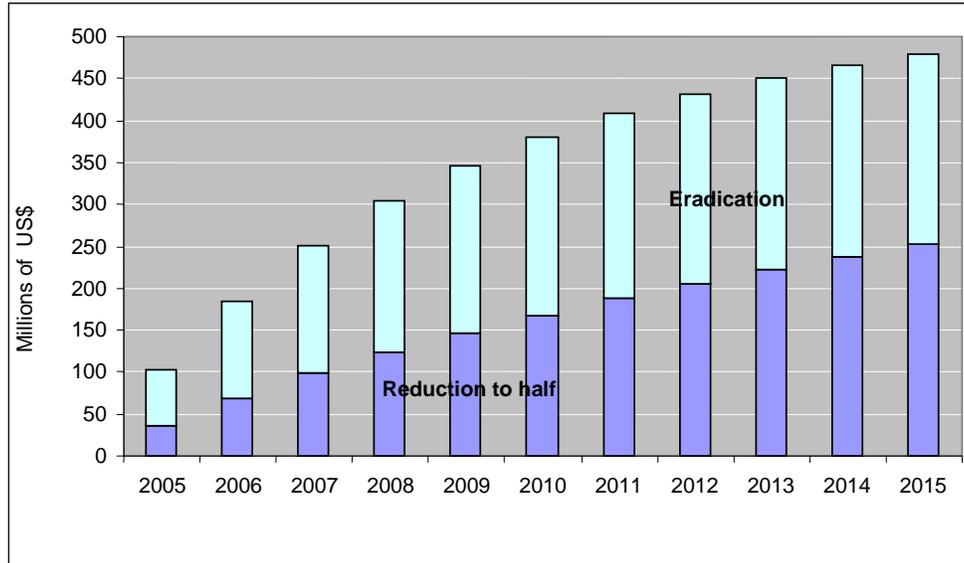
If eradication is achieved, the growth rate is somewhat smaller, not quite 5 times, but savings would total US\$ 481 million by the end of the period. Both scenarios would continue yielding savings, but at declining growth rates. Future benefits from the eradication of undernutrition can be expected to stabilize.

As of 2004, the present value of the yearly savings for the period under study in the seven countries would be US\$ 2.271 billion²⁷ if eradication were achieved. Of this total, 52% would be produced in Guatemala, and 50% would have accumulated by 2010.

²⁷ The fact that the total amount of potential savings is equal to the costs in 2004 is just a coincidence in the results for Central America; there is no theoretical basis for it.

In addition, achieving MDG1 Target 2 would yield savings of US\$ 1.019 billion, with Guatemala accounting for 68% and 46% being attained by 2010.

FIGURE II.12
ESTIMATED SAVINGS FOR EACH YEAR IN TWO UNDERWEIGHT SCENARIOS IN
CENTRAL AMERICA AND THE DOMINICAN REPUBLIC, 2005-2015
(millions of US\$ in current dollars for each year)



Source: Authors' compilation.

This implies that not only could costs be significantly lower in 2015, but major savings could be achieved throughout the process of attaining the proposed targets. In turn, if appropriate policies remain in place, the projected benefits could continue to accumulate beyond 2015.

The foregoing is a reflection of the economic benefits that could be derived from progress towards eradicating undernutrition in the countries. Any programme that is effective in reducing the prevalence would have impacts on individuals' quality of life and would also yield major savings for society.

TABLE II.17
ESTIMATED SAVINGS ACCORDING TO SCENARIOS, 2004 TO 2015
(NPV in millions of US\$)

| | Country | | | | | | | TOTAL |
|----------------------------|-----------------|-------------|-----------|----------|-----------|--------|--------------------|--------------|
| | Costa Rica | El Salvador | Guatemala | Honduras | Nicaragua | Panama | Dominican Republic | |
| MDG attained (50% of 1990) | 49 ^a | 133 | 525 | 118 | 25 | 99 | 71 ^a | 1 019 |
| Eradication (2.5%) | 49 | 203 | 1 534 | 243 | 46 | 125 | 71 | 2 271 |

Source: Authors' compilation.

^a Given that the costs of both scenarios would be the same for Costa Rica and the Dominican Republic (note to table 16), the savings would also be the same.

D. Conclusions and final comments

This first part has presented in a comparative format the results of the application of the Model for Analysing the Social and Economic Impact of Child Undernutrition in Latin America developed by ECLAC.

In view of the limited sources of information and specialized studies on these matters in the region, this model takes an undoubtedly conservative approach, insofar as scientific doubt about the reliability and validity of some associations has led to their exclusion to guard against erroneously overestimating the results. Thus, for example, the definitions of micronutrients and other complementary impacts have not been included in the model of analysis.

Nevertheless, the estimates that were made, both of the cost each country is incurring today and of those it will have to pay in the future as a result of existing prevalences of undernutrition, make it possible to confirm the hypothesis that aside from the ethical imperative and the commitment undertaken by the governments, the challenge of eradicating this scourge from the region will yield significant savings of economic resources and social impacts.

Based on the results obtained, it should be noted that the beneficiaries of eradication programmes would not just be the direct recipients of the goods and services provided by them, but all of society, the public sector and private industry. In fact, it is the production sector that is paying the highest costs. Thus, it is clear that fighting against hunger and undernutrition is good business for everyone.

The challenge the region faces next is to identify specific interventions that will allow it to maximize the impact and efficiency in each country and each region, while also strengthening systems to oversee management and evaluate impacts. This will mean that it can minimize risks and eradicate the scourge of hunger as soon as possible. This is not a short process, but a long-term endeavour that requires stable institutions, government policies and financing, with the involvement of all sectors. All of that requires all actors affected by this social problem, that is, all of society, to commit themselves fully.

Part Two

III. Results of the study in Costa Rica

A. Background

Costa Rica is one of the countries with the lowest prevalence of undernutrition in Latin America and the Caribbean, with a weight deficit affecting approximately 1 in every 25 boys and girls under 5 years of age, and stunting that in 1982 affected 1/16 of that population.

This situation is occurring in a country with one of the lowest rates of undernourishment in the region, since Costa Rica has attained 67% of the target established in the Millennium Development Goals between 1990/1992 and 2000/2002. It also has one of the lowest indices of poverty and indigence (ECLAC, 2005).

TABLE III.1
POPULATION AND UNDERWEIGHT IN COSTA RICA

| Age | Size of population (2004) | Population affected (2004) ^b | Prevalences | | |
|------------------------------|---------------------------|---|-------------------|---------|-------------|
| | | | 1996 | 1982 | 1965 / 1967 |
| Newborn (IUGR) | 78 005 ^a | 1 480 | 1.9% ^c | No data | No data |
| 0 to 11 months | 78 005 | 1 648 | 2.1% | 2.5% | 11.5% |
| 12 to 23 months | 78 089 | 3 904 | 5.0% | 5.8% | 21.5% |
| 24 to 59 months ^d | 236 542 | 10 408 | 4.4% | 7.0% | 17.8% |
| TOTAL | 392 636 | 17 439 | | | |

Source: Authors' compilation, based on National Surveys, Dept. of Statistics, Costa Rican Social Security Fund (CCSS) and WHO and CELADE estimates.

^a In a given year, the population of newborns is the same as that of babies aged 0 to 11 months.

^b Estimated based on the latest available prevalence figure.

^c Estimated using the De Onis equation, with official data from the CCSS Dept. of Statistics for low birth weight in 2004.

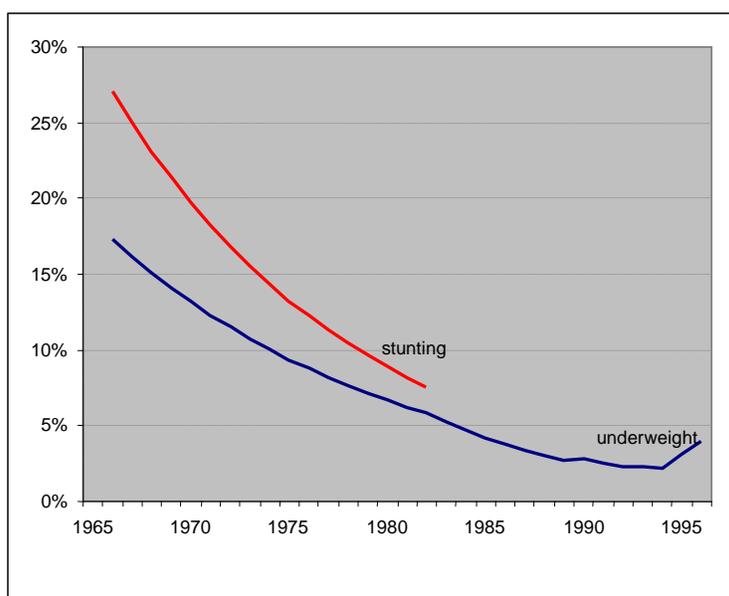
^d The prevalence of undernutrition for 1965/67 corresponds to 24-47 months.

According to the most recent national estimate available (Health Ministry, 1996), about 4% of boys and girls aged 1 to 59 months suffer from “moderate” to “severe” undernutrition with low weight for their age.

In the case of newborns, 7 in 100 have low birth weight and 2 in 100 have intrauterine growth restriction. These percentages mean that Costa Rica has one of the lowest incidences of all the countries belonging to the Central American Integration System (SICA).

Although rates may be a little higher, in view of the limited information available,²⁸ underweight in Costa Rica declined steadily between 1966 and 1994. Thus, it is possible to estimate an average reduction of just over 0.5 percentage points for each year during that period. The likely underestimation noted above makes a reliable interpretation difficult, but the change in the trend observed in 1996 would appear to represent an increase of up to 80% in the rate compared to 1994.

FIGURE III.1
ESTIMATE OF UNDERNUTRITION TRENDS IN CHILDREN UNDER FIVE
COSTA RICA, 1966-1996

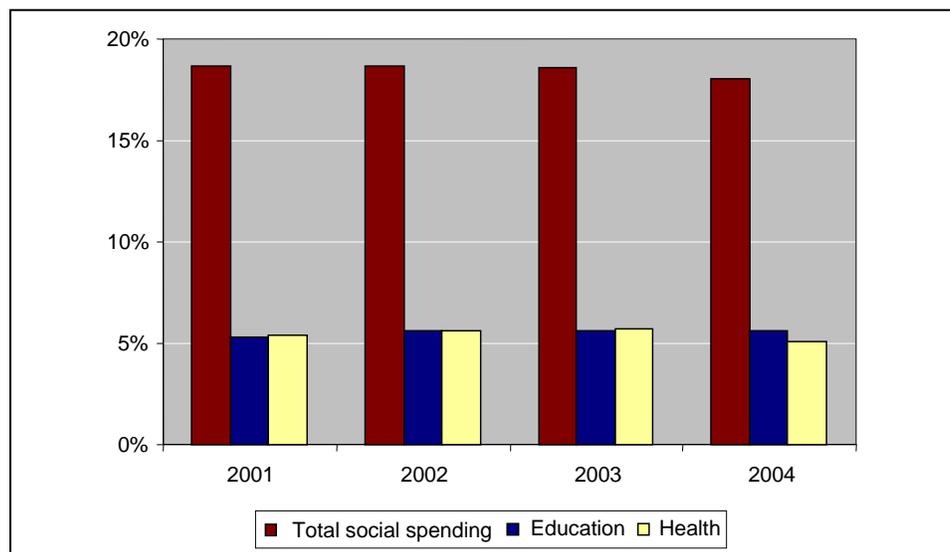


Source: Authors' compilation, based on DHS (1965/1967, 1982, 1996) and National Monitoring System (1989, 1990, 1991, 1992, 1993, 1994).

In response to the problems of undernutrition, between 2000 and 2004 Costa Rica devoted 18.3% of its GDP to public social spending, with an average of 5.4% going to both education and health. These two categories account for nearly 60% of total public spending. As a percentage of GDP each year, since 1990 total public social spending has increased by 13% (33% for education and 8% for health).

²⁸ There are major differences in the information available on the epidemiological profile and undernutrition. The historical data on undernutrition for the 1989-1994 period have been compiled on the basis of information from the national epidemiological monitoring system, which is available in WHO electronic publications. The main characteristic of these data is that they report aggregate undernutrition rates for children under 6 years of age, so the prevalence in the cohort aged 0-4 may be underestimated. Moreover, the most recent measure of underweight available in the aforementioned publications corresponds to 1996, but there is no information on the prevalence for children under 1 year old. This figure was estimated by using a probability distribution. With respect to stunting, the latest measure available dates back to 1982.

FIGURE III.2
PUBLIC SOCIAL SPENDING AS A PERCENTAGE OF GDP BY SECTOR
COSTA RICA, 2001-2004



Source: ECLAC, social spending database.

B. Effects and costs of underweight in 2004 (Analysis of the incidental retrospective dimension)

This part describes the results of the estimates of health, education and productivity consequences of underweight in Costa Rica as of 2004,²⁹ based on the incidental retrospective dimension. That is, the health effects and costs for pre-school boys and girls (0 to 59 months old) who suffer from undernutrition in that year; the education effects and costs derived from the undernutrition suffered in the first 5 years of life by those who are of school age (7 to 18 years) during the year of analysis; and the economic costs derived from the loss of productivity in persons of working age (15 to 64 years) who were exposed to undernutrition in the first 5 years of life.

As indicated in the methodology developed for these studies, this dimension makes it possible to estimate and analyse the education, health and productivity effects and costs generated by undernutrition in a specific year, in this case 2004.

1. Undernutrition and health

1.1. Effects on health

Undernutrition at an early age predisposes people to a higher risk for morbidities as well as mortality, which can be analysed through probability differentials.

To estimate these effects, we have consulted data from epidemiological follow-up studies and official health statistics for the country, complemented by information gathered through interviews with national specialists.

²⁹ The baseline information used in this study comes from data available as of November 2005.

1.1.1 Morbidity

The effects of undernutrition on morbidity rates among the various associated pathologies amounted to close to 1,385 additional cases in 2004. Of these, the most noteworthy are acute diarrheal disease (ADD), with 1,101 cases; acute respiratory infections (ARI) with 262; and iron deficiency anemia with 22 cases.³⁰ This situation arises from the differences in prevalences³¹ that are shown in table III.2.

TABLE III. 2
HEALTH EFFECTS OF UNDERWEIGHT, COSTA RICA, 2004

| Age | Pathology | Differences in prevalences |
|-----------------|-----------|----------------------------|
| 0 to 11 months | Anemia | 0.1% |
| | ADD | 3.1% |
| | ARI | 6.6% |
| 12 to 23 months | Anemia | 0.02% |
| | ADD | 6.5% |
| | ARI | 1.0% |
| 24 to 59 months | Anemia | 0.2% |
| | ADD | 7.6% |
| | ARI | 1.1% |

Source: Authors' compilation, based on official health statistics, relative risks from specialized studies on Central America.

In addition to the above, there are the pathologies specific to critical nutritional deficiencies in calories and proteins. In this regard, 9 cases of kwashiorkor were reported for 2004.³²

1.1.2 Mortality

There are several pathologies through which undernutrition affects mortality, most notably diarrhea, pneumonia, malaria and measles. In order to reduce the errors derived from the poor quality of official records on causes of death, the situation in each country is assessed by using the estimates made by Fishman et al (2004), which define differential relative risks for all causes of death in children under five, and the mortality rates estimated by the Latin American and Caribbean Demographic Centre (CELADE-Population Division).

Based on the foregoing, it is estimated that between 1940 and 2004, just over 60,000 children under 5 died from causes associated with undernutrition. Considering the survival rates of the different cohorts throughout the entire period, a little over 80% would still be alive in 2004 if they had not suffered from underweight (see table 3). Moreover, it is estimated that of the total number of deaths in the population under 5 years of age in 2004, 515 (11%) were associated with underweight.

³⁰ The estimates of effects and costs presented in this report are averages, and are subject to the original sources' margins of error.

³¹ "Differences in prevalences (DP)" refers to the higher probability that those suffering from undernutrition will have a pathology (i) as a "consequence" of their condition.

³² The direct effects of deficiencies in micronutrients are not considered, only those associated with underweight.

In addition, as demonstrated in table III.3, between 1940 and 1989 undernutrition was responsible for the deaths of 46,000 children under 5 who would be between 15 and 64 years of age in 2004, and therefore would be part of the working-age population (WAP).³³ As indicated in section 3 of this chapter, this has a major impact on productivity in the country.

TABLE III.3
MORTALITY OF CHILDREN UNDER FIVE ASSOCIATED WITH UNDERWEIGHT,
ADJUSTED FOR SURVIVAL RATE, COSTA RICA, 1940-2004

| Period | No. of deceased children |
|--------------|--------------------------|
| 1940s | 8 487 |
| 1950s | 14 073 |
| 1960s | 15 820 |
| 1970s | 6 189 |
| 1980s | 1 845 |
| 1990s | 1 026 |
| 2000-2004 | 515 |
| TOTAL | 47 954 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al, and national surveys (1965/67, 1982, 1989, 1990, 1991, 1992, 1993, 1994 and 1996).

1.2. Health costs

The institutional costs (paid by the public health care system) and private health costs, incurred as a result of more care required for pathologies associated with undernutrition³⁴ in children under 5 are concentrated in the newborn age group: 8% of the population affected and 75% of the total health cost for the cohort in 2004, a reflection of the higher unit costs in this age group.

Public and private health costs for Costa Rica are estimated at US\$ 10 million, which represents 0.05% of GDP and is equivalent to 1.1% of public spending on health.

When these costs are broken down, it can be seen that 94% are paid by the public sector and 6% by the private sector.

³³ For purposes of comparing the cost estimates, in this study the WAP is defined as the population between 15 and 64 years of age.

³⁴ In the case of public costs, indicators were estimated based on information reported by various agencies of the Health Ministry. Private costs were estimated using the official minimum wage and urban public transportation fares.

TABLE III.4
HEALTH COSTS OF UNDERWEIGHT, COSTA RICA, 2004

| Age | Number of cases | Millions of ₡ | Millions of US\$ |
|-----------------|-----------------|---------------|------------------|
| Newborn (IUGR) | 1 480 | 3 299.3 | 7.5 |
| 0 to 11 months | 1 811 | 348.0 | 0.8 |
| 12 to 23 months | 4 200 | 727.1 | 1.7 |
| 24 to 59 months | 11 343 | 23.5 | 0.1 |
| TOTAL | 18 834 | 4 398 | 10.0 |

Source: Authors' compilation.

The more than 18,000 cases requiring health care for diseases associated with undernutrition, shown in table III.4, include 17,000 boys and girls needing direct care just because they are underweight.

2. Undernutrition and education

2.1. Effects on education

According to the 2004 household survey, the average level of education of the adult population (20 to 64 years of age) is 7.6 years of schooling, reflecting a progressive increase in school attendance. Thus, among those aged 55 to 64, the average is 2.4 years less than among those aged 20 to 24.

In primary and secondary school, the Costa Rican population suffering from undernutrition averages 1.6 years less schooling than those who have normal nutrition. This is probably due in part to the fact that of those who suffered from undernutrition in their pre-school years, a larger share do not even complete the first grade of primary school.

The population suffering from undernutrition that entered school and managed to finish at least one year has a greater number of students who complete only their primary education (76%) than the population with no undernutrition (43%). The correlation gradually reverses in secondary education, with 13% of those with undernutrition completing secondary school, compared to 38% of those with normal nutrition. These differences are very important indicators of the gaps in opportunities for employment and income between the two groups during their working life.

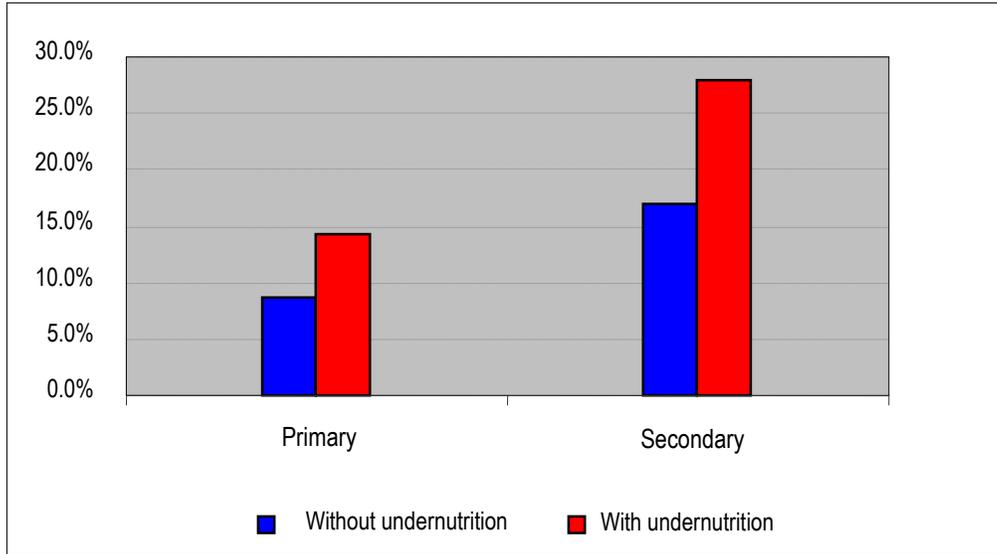
Furthermore, underweight in Costa Rica is responsible for 4,215 additional repeated grades in 2004, which boosts costs accordingly. Of these repeated grades, 52% occur in primary school.³⁵

It is worth noting that children who have suffered from undernutrition are more likely to repeat the early grades of primary school than “normal” children. However, as shown in the

³⁵ The estimate of educational gaps caused by undernutrition is based on an adaptation of the estimates made in a longitudinal study conducted in Chile between 1987 and 1998 (Ivanovic, 2005). According to these estimates, in socioeconomically similar populations, persons who have suffered from undernutrition in their pre-school years run a risk of repeating (a grade in school) equivalent to 1.65 times the risk run by those with normal nutrition. In the absence of estimators for Central America, and in view of the characteristics of the educational systems, comparative estimates among the Central American countries were arrived at by using this relative risk for repeated grades and an attrition differential during the years of schooling of approximately 1.4 for Costa Rica.

figure below, in both groups the rates are higher at the secondary level, though there is always a gap that primarily affects those who have suffered from undernutrition.

FIGURE III. 3
EFFECTS OF UNDERWEIGHT ON GRADE REPETITION
COSTA RICA, 2004



Source: Authors' compilation, based on official education statistics (2004), Health Ministry (1996) and CELADE population estimates (2004).

2.2. Education costs

The additional cost of operating the school system as a result of more grades being repeated by students who suffered from undernutrition is a critical factor in education costs. The 4,000-plus extra students accommodated in 2004, given the differential probability of repeating grades, cost US\$ 2.6 million. This figure represents 0.25% of social spending on education and 0.01% of GDP for that year.

TABLE III.5
COSTS RESULTING FROM GRADE REPETITION DIFFERENTIAL DUE TO UNDERWEIGHT
COSTA RICA, 2004

| | Level of education | |
|------------------------------------|--------------------|-------------|
| | Primary | Secondary |
| Annual cost per student (2004 ₡) | 241 821 | 284 812 |
| Additional annual cost (2004 ₡) | 546 178 515 | 585 629 486 |
| Additional annual cost (2004 US\$) | 1 247 236 | 1 337 325 |
| | 2 584 562 | |
| % Social spending on education | 0.25% | |
| % GDP | 0.01% | |

Source: Authors' compilation, based on official education statistics (2004) and Health Ministry (1996).

3. Productivity

3.1. Effects on productivity

As shown previously, undernutrition has a negative impact on a country's production capacity as a result of a higher prevalence of mortality among children under five, caused by pathologies associated with undernutrition, as well as a lower level of education attained by the population suffering from undernutrition.

Table III.6 depicts the magnitude of the productivity losses resulting from the aforementioned 46,000 deaths of children under 5 years of age. Considering the country's employment rates by cohort, the resultant cost is equivalent to 72 million work hours, around 1.8% of the hours worked by the economically active population (EAP).

TABLE III.6
PRODUCTIVITY EFFECTS OF MORTALITY DUE TO UNDERWEIGHT
IN COSTA RICA

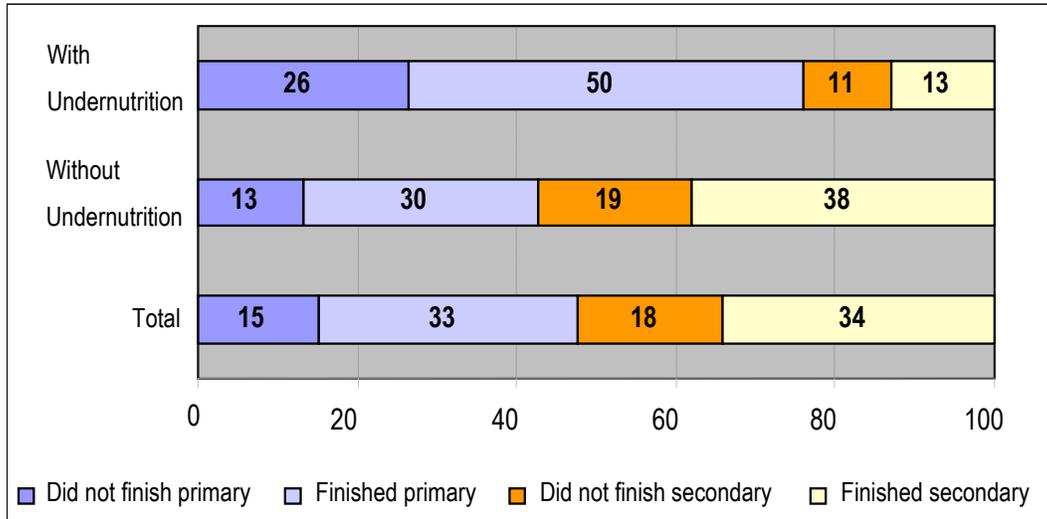
| Age group | Mortality due to undernutrition (No. of cases, 1940-1989) | Lost work hours (2004) |
|--|---|------------------------|
| 15 to 24 years | 1 845 | 1 769 810 |
| 25 to 34 years | 6 189 | 10 861 918 |
| 35 to 44 years | 15 820 | 27 706 938 |
| 45 to 54 years | 14 073 | 22 965 784 |
| 55 to 64 years | 8 487 | 9 132 182 |
| TOTAL | 46 413 | 72 436 633 |
| % hours lost as a function of EAP | | 1.8% |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al, and Health Ministry (1996).

If labour potential is considered to be 2,400 hours of work per year, these deaths associated with undernutrition mean an estimated loss of 111 million hours, equivalent to 2.6% of EAP hours worked.

The lower productivity resulting from the education gap corresponds to the differences in the distribution of the population by years of primary and secondary schooling among those who have suffered from underweight and those who have not. The figure below reflects the levels attained by those who had access to school.

FIGURE III.4
EFFECTS OF UNDERWEIGHT ON EDUCATION-LEVEL DISTRIBUTION
COSTA RICA, 2004 (POPULATION AGED 25 TO 64)
(In percentages)



Source: Authors' compilation, based on Household Surveys (2004), Health Ministry (1996) and CELADE population estimate (2004).

3.2. Productivity costs

The higher productivity costs reflect the economic value into which the aforementioned effects translate. For 2004, it is estimated that lower levels of education caused losses amounting to US\$ 160 million, which is equivalent to 15.3% of public spending on education and about 0.9% of GDP.

In addition, the loss of productivity due to deaths assumed to be caused by undernutrition in the population that would have been of working age in 2004 is estimated at US\$ 145 million, or approximately 0.8% of GDP. Thus, if the country had not suffered any undernutrition in recent decades, productivity in 2004 would have been 1.7% higher.

4. Summary of effects and costs

In summation, the underweight to which the population in the different cohorts was exposed during early childhood generated a cost of approximately 133.385 million colones, or US\$ 318 million, in 2004. These values amount to 1.7% of GDP and about 9.5% of total social spending in the country for that year.

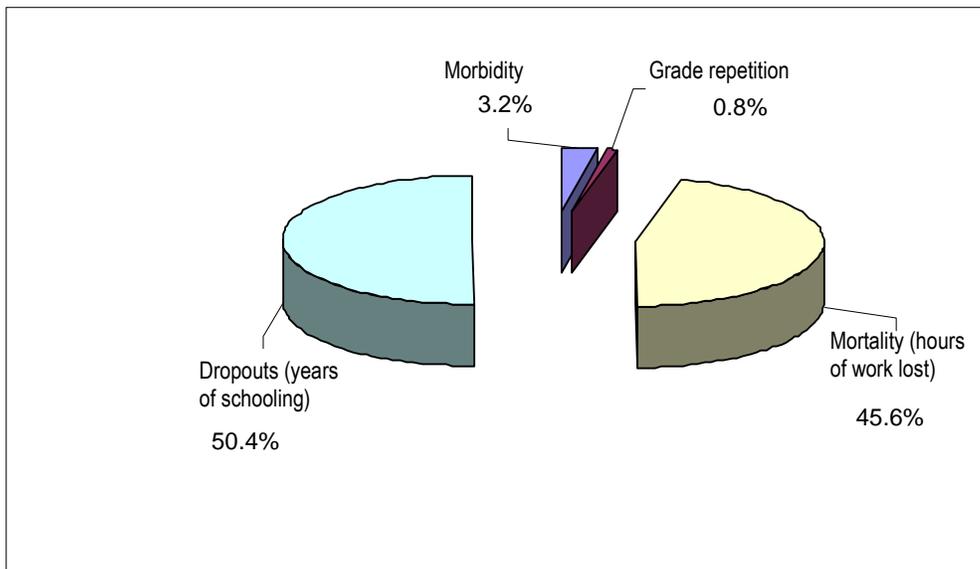
TABLE III.7
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERNUTRITION
COSTA RICA, 2004 (INCIDENTAL AND RETROSPECTIVE DIMENSION)

| | Units | Millions of ₡ | Millions of US\$ |
|--|------------|----------------|------------------|
| HEALTH | | | |
| <i>Additional cases of morbidity</i> | 18 834 | 4 398 | 10.0 |
| <i>Number of additional deaths</i> | 47 954 | | |
| EDUCATION | | | |
| <i>Additional repeated grades</i> | 4 315 | 1 131.8 | 2.6 |
| <i>Differential number of dropouts</i> | 100 690 | | |
| PRODUCTIVITY | | | |
| <i>Hours lost due to mortality</i> | 72 436 633 | 57 789.5 | 145.0 |
| <i>Fewer years of schooling</i> | 1.7 | 70 065.8 | 160.0 |
| TOTAL | | 133 385 | 318 |
| % of social spending | | | 9.5% |
| % of GDP | | | 1.7% |

Source: Authors' compilation.

As shown in the figure below, the costs of lost productivity due to mortality and years of schooling amount to 96% of total costs, whereas those associated with morbidity due to undernutrition represent 3.2% and repeated grades less than 1%.

FIGURE III.5
COST DISTRIBUTION OF UNDERWEIGHT BY FACTOR
COSTA RICA, 2004 (INCIDENTAL AND RETROSPECTIVE DIMENSION)



Source: Authors' compilation.

C. Effects and costs in the cohort aged 0-59 months in 2004 (analysis of the prospective dimension)

This dimension makes it possible to estimate present and future losses (and potential savings) due to medical treatments, repeated grades and lower productivity stemming from the prevalence of underweight in Costa Rica among children under five in 2004.

1. Health effects and costs

As demonstrated in the preceding chapter, undernutrition at an early age increases the risk of dying and of suffering from certain diseases.

Based on projections made from census data, it is estimated that the cohort aged 0 to 59 months in 2004 will have 1,318 deaths before the age of 5 years. Of these, 139 (11%) will be associated with the prevalence of undernutrition, with 101 cases in 2004.³⁶ Therefore, whereas undernutrition affects 4% of children, this figure rises to 11% of the resulting mortality, because of the greater risk of mortality incurred by those who are underweight.

As table III.8 shows, the highest incidence of deaths occurs within the first year of life, during which the probability of dying is 6 times greater than in the remaining years of the cohort. However, 53 children could also die of causes associated with underweight between 1 and 4 years of age.

TABLE III.8
MORTALITY ASSOCIATED WITH UNDERWEIGHT IN CHILDREN UNDER FIVE
COSTA RICA, 2004-2008

| Age | 2004 | 2005 | 2006 | 2007 | 2008 | % |
|------------------------|------------|-----------|-----------|----------|----------|------------|
| 0 to 11 months | 86 | | | | | 62% |
| 12 to 59 months | 15 | 15 | 11 | 8 | 4 | 38% |
| TOTAL | 101 | 15 | 11 | 8 | 4 | 139 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks reported by Fishman et al, and Health Ministry (1996).

With respect to morbidity, it is estimated that the cohort aged 0 to 59 months in 2004 in Costa Rica will suffer from 2,000 additional cases of diseases associated with underweight before they turn 5 years old. The main diseases are anemia, ADD and ARI. Of these, 66% will be in the group aged 24 to 59 months.

³⁶ All estimates for the cohort aged 0-4 years in 2004 will gradually decrease through 2008 as a result of the members moving up into higher age groups.

TABLE III.9
MORBIDITY ASSOCIATED WITH UNDERWEIGHT IN CHILDREN UNDER FIVE
COSTA RICA, 2004-2008

| Age | Estimated total cases of disease | | | | | |
|-----------------|----------------------------------|------------|------------|-----------|----------|--------------|
| | 2004 | 2005 | 2006 | 2007 | 2008 | % |
| 0 to 11 months | 163 | | | | | 8% |
| 12 to 23 months | 295 | 225 | | | | 26% |
| 24 to 59 months | 935 | 273 | 114 | 23 | 4 | 66% |
| TOTAL | 1 394 | 499 | 114 | 23 | 4 | 2 034 |

Source: Authors' compilation, based on CELADE population and mortality statistics, differences in prevalences, and Health Ministry (1996).

In addition to the cases of morbidity shown in table III.9, the direct treatment required by underweight boys and girls is also taken into consideration. The 2004 total is 17,439 cases, and the figure for 2005 to 2008 is 6,777 cases. Of these, 1,480 correspond to children who suffered from low birth weight caused by intrauterine growth restriction (LBW-IUGR).

The additional health cost resulting from the increased cases of disease caused by undernutrition amounts to US\$ 10 million in 2004 alone, with a present value³⁷ of US\$ 11 million for the 2004-2008 period.

TABLE III.10
COSTS OF MORBIDITY ASSOCIATED WITH UNDERWEIGHT
COSTA RICA, 2004-2008 (MILLIONS OF 2004 US\$)

| Age | 2004 | 2005 | 2006 | 2007 | 2008 |
|-----------------|-----------------|----------------|------------|------------|------------|
| Newborn | 7 534.2 | | | | |
| 1 to 11 months | 793.4 | | | | |
| 12 to 23 months | 1 660.3 | 1 136.6 | | | |
| 24 to 59 months | 53.8 | 14.0 | 5.8 | 1.2 | 0.2 |
| TOTAL | 10 041.7 | 1 150.6 | 5.8 | 1.2 | 0.2 |
| PNV | 11 113.1 | | | | |

Source: Authors' compilation.

The values indicated in table 10 translate into an equivalent annual cost (EAC)³⁸ of US\$ 3 million for that period, which represents about 0.3% of public spending on health and 0.02% of GDP.

³⁷ With an annual discount rate of 8%.

³⁸ Ibid.

2. Education effects and costs

When the education process is projected for those under the age of 5 in 2004,³⁹ the differential probability of scholastic achievement can be estimated, along with the additional costs generated by the approximately 31,000 future students who are now suffering from undernutrition in Costa Rica.

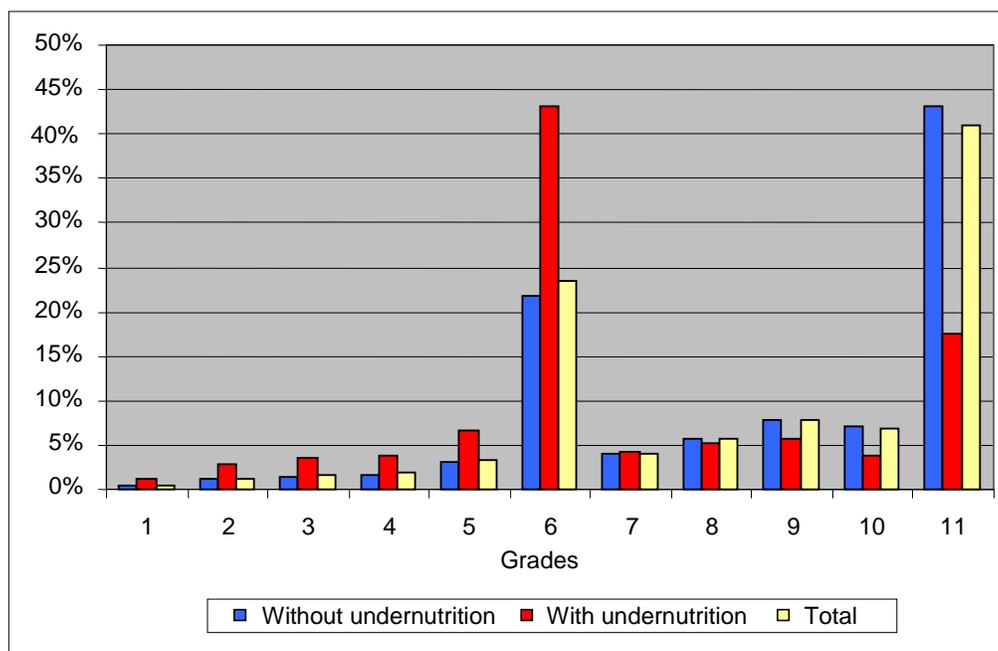
Based on official data, it is possible to estimate that between 2006 and 2021 there will be 2,000 additional grades repeated. Of these, 52% will be in primary school and 48% in secondary school.

As a result of the additional repeated grades, education costs expressed in present value (at a discount rate of 8%) are estimated at 273 million colones, equivalent to US\$ 623,000 in 2004 dollars.

Estimating these values as an equivalent annual cost for the 16-year period during which the cohort in question would be of school age (2006-2021) results in a figure of 32 million colones, or US\$ 73 million in 2004 dollars.

Moreover, the greater risk of school attrition by children suffering from undernutrition will mean that 7,499 students will terminate their education early.

FIGURE III.6
ESTIMATED DISTRIBUTION OF GRADE COMPLETION FOR THE COHORT AGED 0-59
MONTHS IN 2004, WITH AND WITHOUT UNDERWEIGHT
COSTA RICA



Source: Authors' compilation, based on Household Surveys (2004), Health Ministry (1996) and CELADE population estimates.

³⁹ This projection is based on education coverages of the school-age population and educational levels achieved by the cohort aged 20 to 24 as of the latest household survey (2004).

Finally, for the cohort as a whole, it is estimated that 18 of every 100 children who have suffered from undernutrition will complete 12 years of school, in contrast to the 43 per 100 of those with normal nutrition who will complete their full education.

3. Productivity effects and costs

The schooling differential discussed in the previous section translates into less human capital accumulated by persons suffering from undernutrition, and has a direct negative impact on their productivity.

Consideration must also be given to the 139 additional deaths estimated to be caused by undernutrition in the cohort aged 0 to 59 months during the 2004-2008 period. They represent a potential productivity loss of 14 million work hours during this cohort's working life (between 2014 and 2068).

Against this backdrop, economic losses in productivity associated with underweight in the population under the age of 5 in Costa Rica are estimated at 15.875 billion colones in 2004, equivalent to US\$ 36 million.⁴⁰ Of this total, US\$ 35 million can be attributed to the lower level of education and US\$ 1 million to differential mortality.

Considering the entire period during which these values will be produced (2014-2068), the equivalent annual cost (EAC) is 1.289 billion colones, equivalent to US\$ 3 million, of which US\$ 2.8 million represents losses due to lower education levels. This equivalent annual cost amounts to 0.02% of GDP.

4. Summary of effects and costs

When all sources of costs related to undernutrition are grouped together for the cohort of boys and girls under 5 who suffer from undernutrition in 2004, they yield a present value of 21.015 billion colones, or US\$ 48 million.

This means that the loss of human resources due to lower education levels and higher health costs attributable to morbidity account for the lion's share of estimated undernutrition costs, 73% and 23%, respectively.

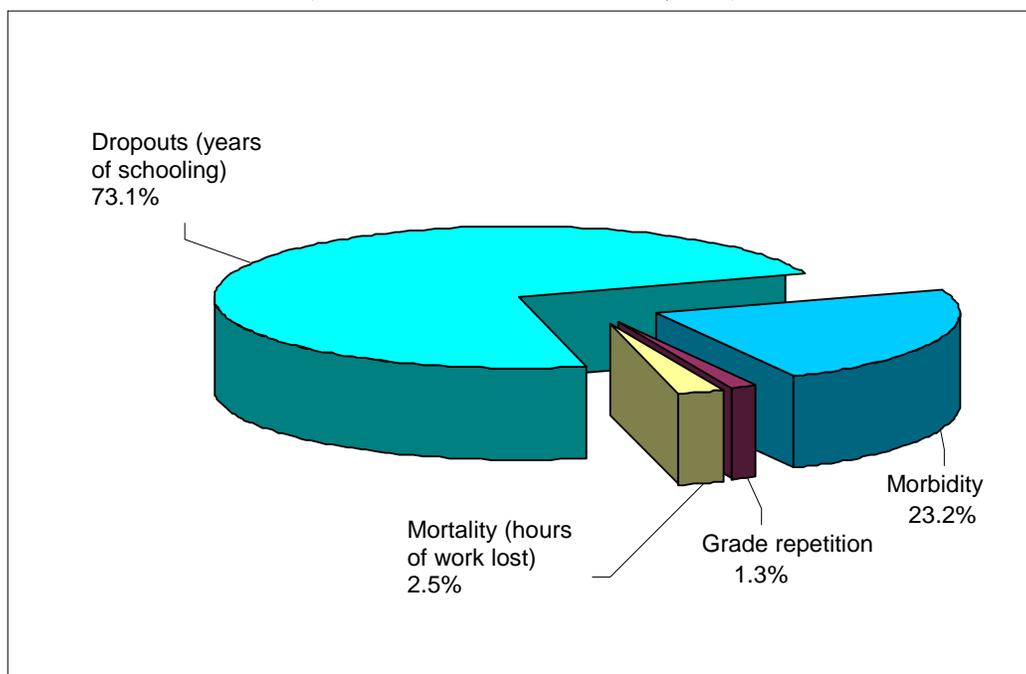
⁴⁰ Considering an annual discount rate of 8%.

TABLE III.11
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERWEIGHT FOR THE COHORT
AGED 0 TO 59 MONTHS IN 2004 IN COSTA RICA

| | Units | Costs (Present value) | |
|--|-----------|--------------------------|------------------|
| | | Millions of ₡ | Millions of US\$ |
| Health | | | |
| <i>Additional cases of morbidity</i> | 24 486 | 4 866.6 | 11.1 |
| <i>Number of additional deaths</i> | 139 | | |
| Education | | | |
| <i>Additional repeated grades</i> | 2 116 | 273.0 | 0.6 |
| <i>Differential number of dropouts</i> | 7 499 | | |
| Productivity | | | |
| <i>Hours lost due to mortality</i> | 9 698 420 | 515.4 | 1.2 |
| <i>Fewer years of schooling</i> | 1.7 | 15 360.0 | 35.1 |
| Total | | 21 015 | 48 |

Source: Authors' compilation.

FIGURE III.7
ESTIMATED COST DISTRIBUTION OF UNDERNUTRITION IN COSTA RICA BY FACTOR
(PROSPECTIVE DIMENSION, 2004)



Source: Authors' compilation.

D. Analysis of scenarios: costs and savings

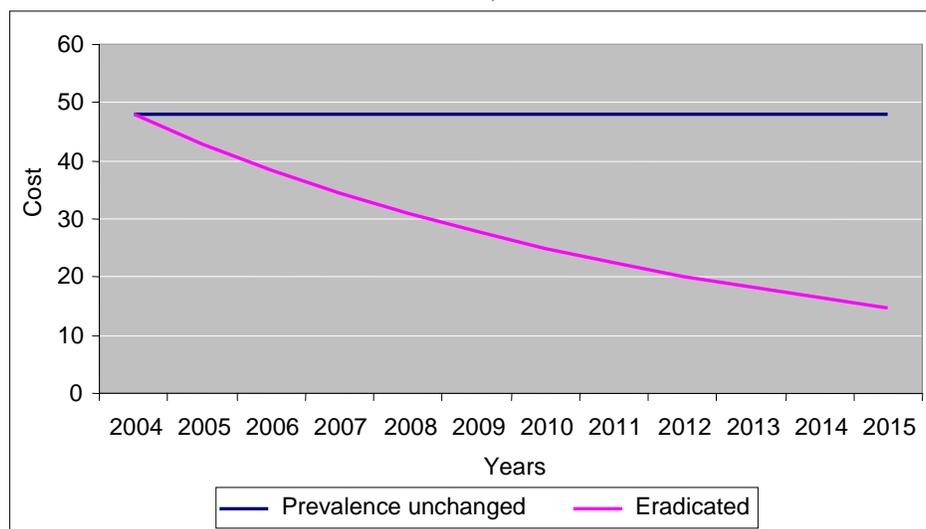
Based on the estimated costs incurred by Costa Rica as a result of the prevalence of underweight in the population under five, it is possible to project different scenarios. Below are the results of the simulations corresponding to two undernutrition scenarios and their effects on costs for 2015:

The scenarios considered are the following:

1. The latest figures available on the prevalence of underweight used in this study remain the same in 2015 (see table 1).
2. Underweight is eradicated in the country by 2015, which for purposes of this analysis means achieving a prevalence of 2.5%, the “normal” proportion of cases according to the measurement parameters published by the National Center of Health Statistics (NCHS). To achieve this figure, a decline of just over 0.15 percentage points per year will be required.

Figure III.8 shows how a progressive reduction in the prevalence of underweight also leads to a progressive reduction in associated costs. If the prevalence remains constant (scenario 1), since Costa Rica has a tendency to increase the size of the cohort aged 0 to 4 years, the costs will increase slightly. If eradication is achieved (scenario no. 2), the costs of underweight in 2015 will be US\$ 14.8 million.⁴¹

FIGURE III.8
TREND IN ESTIMATED UNDERWEIGHT COSTS IN TWO SCENARIOS (MILLIONS OF US\$)
COSTA RICA, 2004-2015



Source: Authors' compilation.

Table III.12 depicts a comparison of estimated costs for 2004 with those projected for 2015 for each scenario. It can be seen that the highest variation in costs occurs in health and productivity.

⁴¹ Value updated to 2015, with an annual discount rate of 8%.

TABLE III.12
ESTIMATED TOTAL COST OF UNDERWEIGHT
FOR THE BASE YEAR AND TWO SCENARIOS (MILLIONS OF US\$)
COSTA RICA, 2004-2015

| | 2004 | Scenarios in 2015 | |
|---------------------------------|-------------|---------------------------|--------------------|
| | | Prevalence unchanged | Eradication (2.5%) |
| Health | 11.1 | 11.1 | 2.2 |
| Education | 0.6 | 0.6 | 0.2 |
| Productivity | | | |
| <i>Loss due to mortality</i> | 1.2 | 1.2 | 0.8 |
| <i>Fewer years of schooling</i> | 35.1 | 35.2 | 11.6 |
| Total | 48.0 | 48.1^(*) | 14.8 |

Source: Authors' compilation.

(*) The slight increase in cost can be explained by demographic projections showing an increase in the size of the cohort aged 0 to 4 years, the direct effect of which is a rise in the absolute number of children suffering from undernutrition even though the prevalence remains the same.

Based on the cost trends shown, it is possible to estimate potential savings that would be generated as soon as actions aimed at achieving the target are initiated.

The distances between the trend lines in figure 8 – scenario 2 compared to scenario 1 – illustrate the savings that would be generated from year to year through 2015 as undernutrition is gradually eradicated. These savings, expressed in 2004 present values, amount to US\$ 48.7 million,⁴² of which 50% would be produced by 2010.

This implies that not only could costs be significantly lower in 2015, but major savings could be achieved throughout the process of attaining the proposed target. In turn, if appropriate policies remain in place, the projected benefits could continue to accumulate beyond 2015.

TABLE III.13
ESTIMATED SAVINGS (PV, IN MILLIONS OF US\$)
COSTA RICA, 2015

| | Eradication (2.5%) |
|---------------------------------|--------------------|
| Health | 38.7 |
| Education | 0.3 |
| Productivity | |
| <i>Loss due to mortality</i> | 0.9 |
| <i>Fewer years of schooling</i> | 8.8 |
| Total | 48.7 |

Source: Authors' compilation.

⁴² Value updated to 2004, with an annual discount rate of 8%.

The foregoing is a reflection of the economic benefits that could be derived from progress towards eradicating undernutrition. Any programme that is effective in this regard would have impacts on individuals' quality of life and would also yield major savings for society.

IV. Results of the study in Guatemala

A. Background

Guatemala has the highest prevalences of undernutrition in the entire region of Latin America and the Caribbean, with a weight deficit affecting nearly 1 in 4 boys and girls under the age of 5 and stunting affecting nearly half that population.

In addition, it is one of the three countries in the region that have seen undernourishment rise between 1990/1992 and 2000/2002, and it has one of the highest indices of poverty and indigence (ECLAC, 2005).

According to the most recent national estimate available (WHO/DHS, 2002), about 22.7% of boys and girls aged 1 to 59 months suffer from “moderate” to “severe” undernutrition on the basis of low weight for their age. Although Guatemala has made significant progress from previous measurements, its population is still vulnerable.

In the case of newborns, just over 12 in 100 have low birth weight and 7 in 100 have intrauterine growth restriction. These percentages mean that Guatemala has one of the highest incidences of all the countries belonging to the Central American Integration System (SICA).

Although there is insufficient representative information to perform an in-depth analysis of the nutritional status of pregnant women, just as in other Central American countries, unofficial data suggest that this group as well suffers from serious undernutrition problems, indicating a cycle of undernutrition which begins in the womb.

With respect to the evolving risk of undernutrition in the first years of life, various studies conducted in the region reveal that there is a tendency in Guatemala for the problem to become significantly worse in the first 24 months of life (reaching as much as 30% in 2002), followed by improvement and stabilization during the rest of the pre-school stage.

It should be noted, in turn, that the most vulnerable population is comprised of indigenous children living in rural areas. However, this increased risk should not obscure the fact that large numbers of people living in urban areas also suffer from undernutrition.

TABLE IV.1
POPULATION AND UNDERWEIGHT IN GUATEMALA

| Age | Population size (2004) | Population affected (2004) ^b | Prevalences | | | |
|------------------------------|------------------------|---|-------------------|---------|---------|-----------|
| | | | 2002 | 1995 | 1987 | 1965 / 67 |
| Newborn (IUGR) | 419 334 ^a | 30 448 | 7.3% ^c | no data | no data | no data |
| 0 to 11 months | 419 334 | 52 349 | 12.5% | 10.9% | 11.8% | 23.0% |
| 12 to 23 months | 408 821 | 121 940 | 29.8% | 35.2% | 44.2% | 53.4% |
| 24 to 59 months ^d | 1 176 055 | 269 327 | 22.9% | 29.0% | no data | 38.0% |
| TOTAL | 2 004 210 | 474 065 | | | | |

Source: Authors' compilation, based on National Demographic and Health Surveys, UNICEF, and WHO and CELADE estimates.

^a In a given year, the population of newborns is the same as that of babies aged 0 to 11 months.

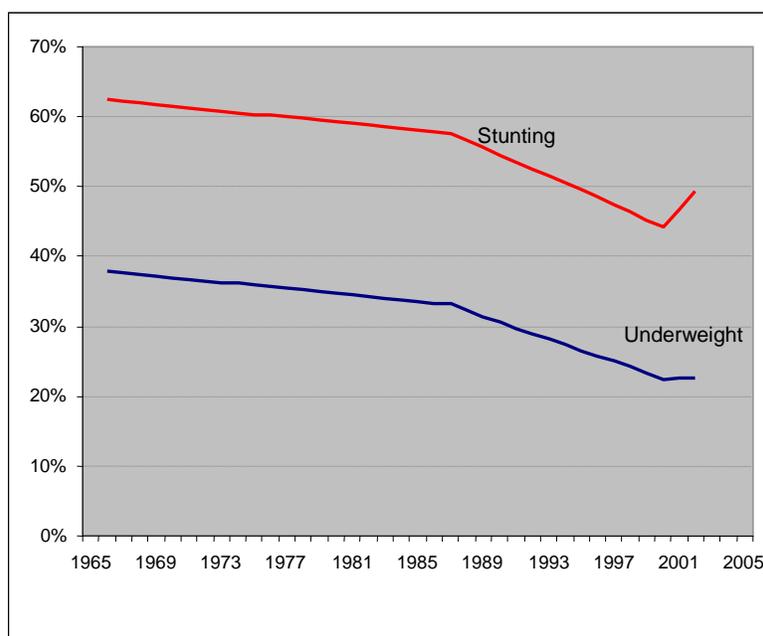
^b Estimated based on the latest available prevalence figure.

^c Estimated using the De Onis equation, with official data from UNICEF for low birth weight (1998-2003).

^d The prevalence of undernutrition for 1965/67 corresponds to 24-47 months.

As the following figure indicates, Guatemala has seen a steady decline in underweight in the last 40 years. The rate experienced a sharp downturn beginning in 1985, but has remained relatively stable since 1998 (above 20%).

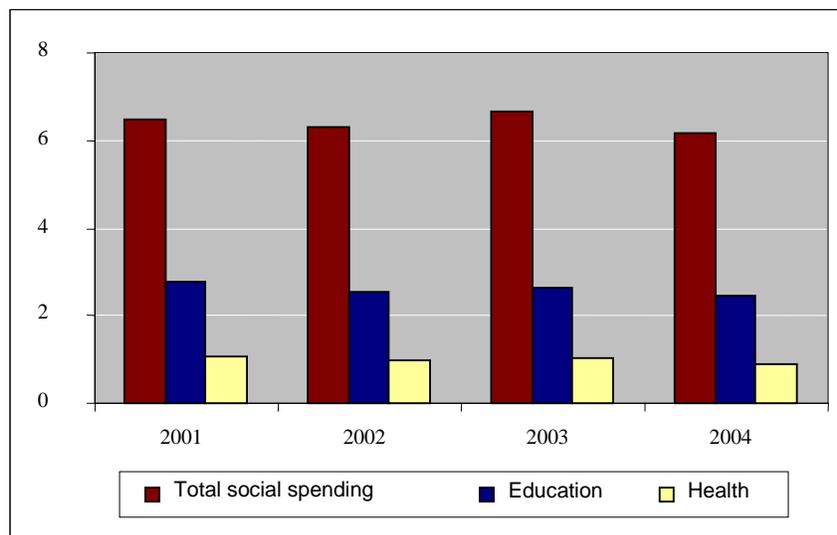
FIGURE IV.1
ESTIMATE OF UNDERWEIGHT TRENDS IN CHILDREN UNDER FIVE, GUATEMALA



Source: Authors' compilation, based on DHS (1965/67, 1987, 1995, 1998/99, 2000 and 2002).

In response to the problems of undernutrition, between 2000 and 2004 Guatemala devoted approximately 6.3% of its GDP to public social spending, with an average of 2.6% on education and 1% on health. The latter two categories account for 57% of total public social spending. As a percentage of GDP each year, since 1990 total public social spending has increased by 80% (55% on education and 10% on health).

FIGURE IV.2
PUBLIC SOCIAL SPENDING AS A PERCENTAGE OF GDP BY SECTOR
GUATEMALA, 2001-2004



Source: Authors' compilation, based on social spending data.

Guatemala has made noteworthy advances in the institutionalization of food policy during this decade. In 2001, the Nutritional Food Security (SAN) law created the National Nutritional Food Security Council (CONSAN) for the purpose of coordinating national policy in this area. Later, in 2003, this responsibility came under the purview of the Vice Ministry of Food Security of the Agriculture and Livestock Ministry (MAGA).

In 2005 the National Food and Nutrition Security System (SINASAN) law⁴³ was passed, which defines SAN as a civil right. This law incorporates the notion of food sovereignty, the principle of viewing genetically modified products with caution, the coordination and decentralization of measures, and SAN data systems and early alert. To implement the law, the National SAN Council (CONASAN) was created to oversee the SINASAN system, and the Secretariat of Food and Nutritional Security (SESAN) was established for the purpose of coordinating activities among the ministries, preparing the SAN Strategic Plan and Policy, supervising the SAN National Information System, raising awareness in national, private and civil society institutions, documenting and regulating monetary and in-kind donations related to SAN, and promoting dialog among the various actors so that the battle against hunger will become a true matter of State.

⁴³ Decree 32 of the Congress of the Republic of Guatemala.

B. Effects and costs of underweight in 2004 (Analysis of the incidental retrospective dimension)

This part describes the results of the estimates of health, education and productivity consequences of underweight in Guatemala as of 2004,⁴⁴ based on the incidental retrospective dimension. That is, the health effects and costs for pre-school boys and girls (0 to 59 months old) who suffer from undernutrition in that year; the education effects and costs derived from the undernutrition suffered in the first 5 years of life by those who are of school age (7 to 18 years) during the year of analysis; and the economic costs derived from the loss of productivity in persons of working age (15 to 64 years) who were exposed to undernutrition in the first 5 years of life.

As indicated in the methodology developed for these studies, this dimension makes it possible to estimate and analyse the education, health and productivity effects and costs generated by undernutrition in a specific year, in this case 2004.

1. Health

1.1. Effects on health

Undernutrition at an early age predisposes people to a higher risk for morbidities as well as mortality, which can be analysed through probability differentials.

To estimate these effects, we have consulted data from epidemiological follow-up studies and official health statistics for the country, complemented by information gathered through interviews with national specialists. We have also analysed the results of a longitudinal study carried out by the Institute for Nutrition of Central America and Panama (INCAP) to evaluate food supplements.

1.1.1 Morbidity

In Guatemala, the effects of undernutrition on morbidity rates among the various associated pathologies amounted to close to 85,000 additional cases in 2004. Of these, the most noteworthy are acute diarrheal disease (ADD), with 49,000 cases; acute respiratory infections (ARI) with 21,000; and iron deficiency anemia with 15,000 cases.⁴⁵ This situation arises from the differences in prevalence (DP)⁴⁶ that are shown in table IV.2.

In addition, the pathologies specific to critical nutritional deficiencies in calories and proteins, such as marasmus and kwashiorkor, must be considered. In 2004 there were 1,091 cases of these pathologies, ranking Guatemala among the countries with the highest number of reported cases in the region.⁴⁷

⁴⁴ The baseline information used in this study comes from data available as of September 2005.

⁴⁵ The estimates of effects and costs presented in this report are averages, and are subject to the original sources' margins of error.

⁴⁶ DP refers to the higher probability that those suffering from undernutrition will have a pathology (i) as a "consequence" of their undernutrition.

⁴⁷ The direct effects of deficiencies in micronutrients are not considered, only those associated with underweight.

TABLE IV.2
HEALTH EFFECTS OF UNDERWEIGHT
GUATEMALA, 2004

| Age | Pathology | Differences in prevalences |
|-----------------|-----------|----------------------------|
| 0 to 11 months | Anemia | 5.0% |
| | ADD | 16.4% |
| | ARI | 15.0% |
| 12 to 23 months | Anemia | 0.5% |
| | ADD | 7.5% |
| | ARI | 1.5% |
| 24 to 59 months | Anemia | 4.4% |
| | ADD | 11.6% |
| | ARI | 4.3% |

Source: Authors' compilation, based on information from the Health Ministry, relative risks from specialized studies on Central America, and 2002 DHS.

1.1.2 Mortality

There are several pathologies through which undernutrition affects mortality, most notably diarrhea, pneumonia, malaria and measles. In order to reduce the errors derived from the poor quality of official records on causes of death, the situation in each country is assessed by using the estimates made by Fishman et al (2004), which define differential relative risks for all causes of death in children under five, and the mortality rates estimated by the Latin American and Caribbean Demographic Centre (CELADE-Population Division).

Based on the foregoing, it is estimated that between 1940 and 2004, just over 1 million children under 5 died from causes associated with undernutrition. Considering the survival rates of the different cohorts throughout the entire period, a little over 77% would still be alive in 2004 if they had not suffered from underweight. Moreover, it is estimated that of the total number of deaths in the population under 5 years of age in 2004, NEARLY 39,000 (40%), were associated with underweight.

In addition, as demonstrated in table IV.3, between 1940 and 1989 undernutrition was responsible for the deaths of 641,000 children under 5 who would be between 15 and 64 years of age in 2004, and therefore would be part of the working-age population (WAP).⁴⁸ As indicated in section 3 of this chapter, this has a major impact on productivity in the country.

⁴⁸ For purposes of comparing the cost estimates, in this study the WAP is defined as the population between 15 and 64 years of age.

TABLE IV.3
MORTALITY OF CHILDREN UNDER FIVE ASSOCIATED WITH
UNDERWEIGHT, ADJUSTED FOR SURVIVAL RATE
GUATEMALA, 1940-2004

| Period | No. of deceased children |
|--------------|--------------------------|
| 1940s | 86 197 |
| 1950s | 115 231 |
| 1960s | 148 370 |
| 1970s | 154 096 |
| 1980s | 137 509 |
| 1990s | 91 103 |
| 2000-2004 | 38 984 |
| TOTAL | 771 491 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al, and DHS 1965/67, 1987, 1995, 1998/99, 2000 and 2002.

1.2. Health costs

The institutional costs (paid by the public health care system) and private health costs, incurred as a result of more care required for pathologies associated with undernutrition⁴⁹ in children under 5 are concentrated in the group aged 24 to 59 months: 58% of the population affected and 53% of the total health costs for the cohort in the year in question. However, the highest unit costs are found among newborns with low birth weight due to intrauterine growth restriction (LBW_{IUGR}) because the treatment protocols for this age group are more expensive.

Public and private health costs for Guatemala are estimated at US\$ 285 million, which represents 1.04% of GDP for that year and is 1.17 times public spending on health for that year.

When these costs are broken down, it can be seen that 94% are paid by the public sector and 6% by the private sector. The highest private cost corresponds to the time and transportation required to seek health care, which is equivalent to nine times the cost of medical inputs not covered by the public health system.

The 560,000 cases requiring health care for diseases associated with undernutrition, shown in table IV.4, include 474,000 boys and girls needing direct care just because they are underweight.

⁴⁹ In the case of public costs, indicators were estimated based on information reported by various agencies of the Health Ministry. Private costs were estimated using the official minimum wage and urban public transportation fares.

TABLE IV.4
HEALTH COSTS OF UNDERWEIGHT
GUATEMALA, 2004

| Age | Number of cases | Millions of Q | Millions of US\$ |
|-----------------|-----------------|----------------|------------------|
| Newborn (IUGR) | 30 448 | 281.9 | 35.5 |
| 0 to 11 months | 71 691 | 275.7 | 34.7 |
| 12 to 23 months | 133 726 | 515.2 | 64.8 |
| 24 to 59 months | 324 595 | 1 194.1 | 150.3 |
| TOTAL | 560 459 | 2 267.0 | 285.3 |

Source: Authors' compilation.

2. Education

2.1. Effects on education

The education coverage figures reported in official Guatemalan statistics are high for primary school (87%) and low for secondary school (30%).

According to the 2003 household survey, the average level of education of the adult population (20 to 64 years of age) is 4.5 years of schooling, reflecting a progressive increase in school attendance. Thus, among those aged 55 to 64 years, the average level of education is 3.6 years less than those aged 20 to 24 years. However, scholastic achievement is low, and the large coverage shortfall means that only 17% of the latter have completed secondary school.

In primary and secondary school, the Guatemalan population suffering from undernutrition averages two years less schooling than those who have normal nutrition. This is probably due in part to the fact that of those who suffered from undernutrition in their pre-school years, a larger share do not even complete the first grade of primary school.

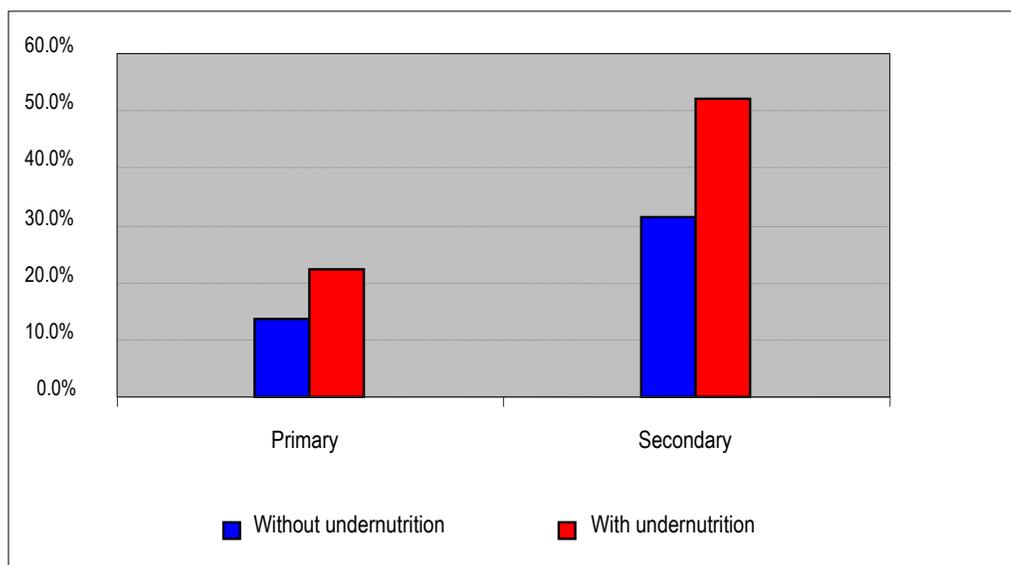
The population that has suffered from child undernutrition has a lower proportion of students who complete secondary school (2%) than the population that has not had undernutrition (19%). Considering only those who have had some schooling, 88% of those suffering from undernutrition attain only a primary school education, compared to a figure of 44% for those who did not suffer from undernutrition. The correlation gradually reverses in secondary education, with 3% of those with undernutrition completing 12 years of schooling, compared to 29% of those with normal nutrition. These differences are very important indicators of the job-opportunity and income gaps between the two groups during their working life.

Furthermore, underweight in Guatemala is responsible for 82,247 additional repeated grades in 2004, which boosts costs accordingly. Of this total, 66% is in primary school.⁵⁰

⁵⁰ The estimate of educational gaps caused by undernutrition is based on an adaptation of the estimates made in a longitudinal study conducted in Chile between 1987 and 1998 (Ivanovic, 2005). According to these estimates, in socioeconomically similar populations, persons who have suffered from undernutrition in their pre-school years run a risk of repeating (a grade in school) equivalent to 1.65 times the risk run by those with normal nutrition. In the absence of estimators for Central America, and in view of the characteristics of the educational systems, comparative estimates among the Central American countries were arrived at by using this relative risk for repeated grades and an attrition differential during the years of schooling of approximately 1.2.

It is worth noting that children who have suffered from undernutrition are more likely to repeat the early grades of primary school than “normal” children. However, as shown in the figure below, in both groups the rates are higher at the secondary level, though there is always a gap that primarily affects those who have suffered from undernutrition.

FIGURE IV.3
EFFECTS OF UNDERWEIGHT ON GRADE REPETITION
GUATEMALA, 2004



Source: Authors' compilation, based on official Education Ministry data (2003), DHS (2002) and CELADE population estimates (2004).

2.2. Education costs

The additional cost of operating the school system as a result of more grades being repeated by students who suffered from undernutrition is a critical factor in education costs. The 82,000-plus extra students accommodated in 2004, given the differential probability of repeating grades, cost US\$ 16.5 million. This figure represents 2.45% of social spending on education and 0.06% of GDP for that year.

TABLE IV.5
COSTS RESULTING FROM GRADE REPETITION DIFFERENTIAL
DUE TO UNDERWEIGHT
GUATEMALA, 2004

| | Level of education | |
|--|--------------------|------------|
| | Primary | Secondary |
| Annual cost per student (2004 quetzales) | 1 669 | 1 450 |
| Additional annual cost (2004 quetzales) | 90 652 024 | 40 500 465 |
| Additional annual cost (2004 US\$) | 11 407 793 | 5 096 642 |
| | 16 504 435 | |
| % Social spending on education | 2.45% | |
| % GDP | 0.06% | |

Source: Authors' compilation, based on official Education Ministry data (2003) and DHS (2002).

3. Productivity

3.1. Effects on productivity

As shown previously, undernutrition has a negative impact on a country's production capacity as a result of a higher prevalence of mortality among children under five, caused by pathologies associated with undernutrition, as well as a lower level of education attained by the population suffering from undernutrition.

Table IV.6 depicts the magnitude of the productivity losses resulting from the aforementioned 641,000 deaths of children under 5 years of age. Considering the country's employment rates by cohort, the resultant cost is equivalent to 983 million work hours, a little more than 10% of the hours worked by the economically active population (EAP).

TABLE IV.6
PRODUCTIVITY EFFECTS OF MORTALITY DUE TO UNDERWEIGHT
IN GUATEMALA

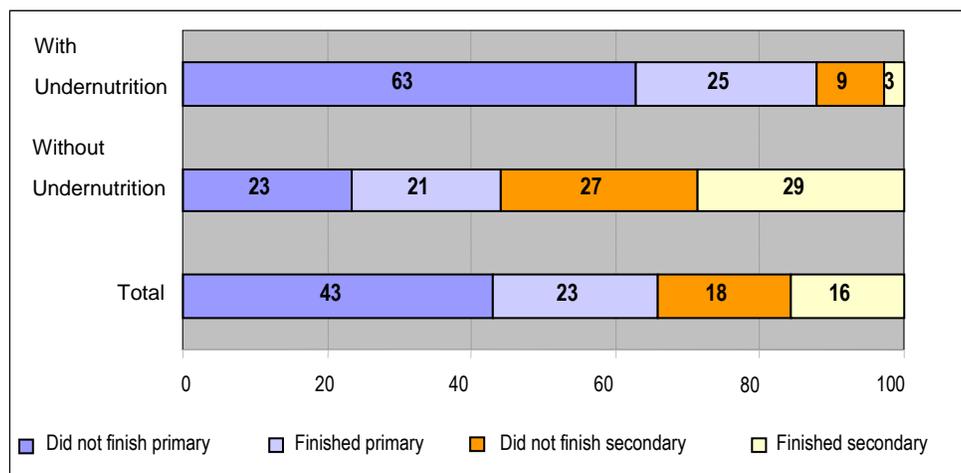
| Age group | Mortality due to undernutrition (No. of cases, 1940-1989) | Lost work hours (2004) |
|---------------------------------|---|------------------------|
| 15 to 24 years | 137 509 | 153 877 370 |
| 25 to 34 years | 154 096 | 252 731 814 |
| 35 to 44 years | 148 370 | 268 002 111 |
| 45 to 54 years | 115 231 | 183 737 219 |
| 55 to 64 years | 86 197 | 124 955 092 |
| TOTAL | 641 403 | 983 303 605 |
| Hours lost as a function of EAP | | 10.5% |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al, and DHS 2002..

If labour potential is considered to be 2,400 hours of work per year, these deaths associated with undernutrition mean an estimated loss of 1.539 million hours, equivalent to 16% of EAP hours worked.

The lower productivity resulting from the education gap corresponds to the differences in the distribution of the population by years of primary and secondary schooling among those who have suffered from underweight and those who have not. The figure below reflects the levels attained by those who had access to school.

FIGURE IV.4
EFFECTS OF UNDERWEIGHT ON EDUCATION-LEVEL DISTRIBUTION
GUATEMALA, 2004 (POPULATION AGED 25 TO 64)
(In percentages)



Source: ECLAC, based on Household Surveys (2004), DHS (2002) and CELADE population estimate (2004).

3.2. Productivity costs

The higher productivity costs reflect the economic value into which the aforementioned effects translate. For 2004, it is estimated that lower levels of education caused losses amounting to US\$ 1.668 million, which is equivalent to all social spending for the year, 2.5 times the amount of public spending on education and about 6% of GDP.

In addition, the loss of productivity due to deaths assumed to be caused by undernutrition in the population that would have been of working age in 2004 is estimated at US\$ 1.158 million, or approximately 4% of GDP. Thus, if the country had not suffered any undernutrition in recent decades, productivity in 2004 would have been 10% higher.

4. Summary of costs

In summation, the underweight to which the population in the different cohorts was exposed during early childhood generated a cost of approximately 24.853 million quetzales, or US\$ 3.128 billion, in 2004. These values amount to 11.4% of GDP and just under twice the total amount of social spending in the country for that year.

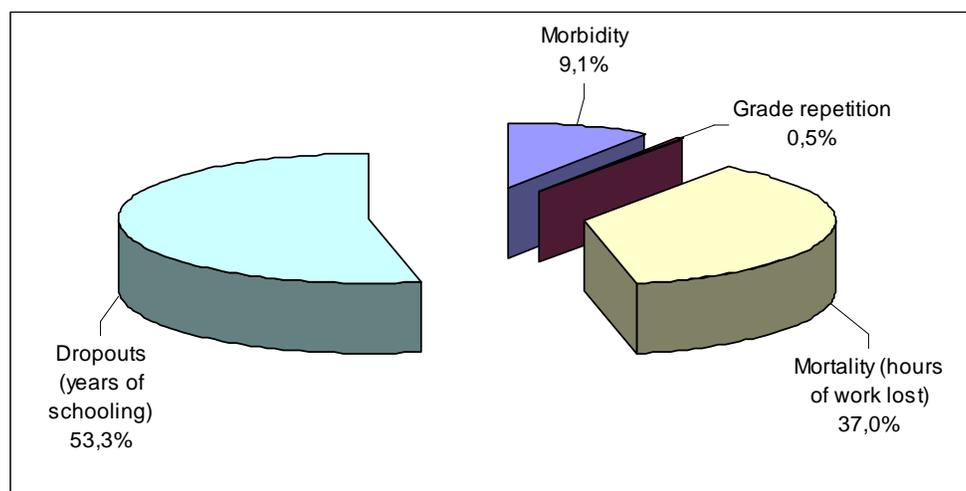
TABLE IV.7
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERNUTRITION
GUATEMALA, 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)

| | Units | Millions of Q | Millions of US\$ |
|--|-------------|---------------|------------------|
| Health | | | |
| <i>Additional cases of morbidity</i> | 560 459 | 2 267 | 285 |
| <i>Number of additional deaths</i> | 771 491 | | |
| Education | | | |
| <i>Additional repeated grades</i> | 82 247 | 131 | 17 |
| <i>Differential number of dropouts</i> | 627 643 | | |
| Productivity | | | |
| <i>Hours lost due to mortality</i> | 983 303 605 | 9 199 | 1 158 |
| <i>Fewer years of schooling</i> | 2,4 | 13 256 | 1 668 |
| TOTAL | | 24 853 | 3 128.39 |
| Social spending | | | 185.4% |
| % OF GDP | | | 11.4% |

Source: Authors' compilation.

As shown in the figure below, the costs of lost productivity due to mortality and years of schooling amount to 90% of total costs, whereas those associated with morbidity due to undernutrition represent 9.1%.

FIGURE IV.5
COST DISTRIBUTION OF UNDERWEIGHT BY FACTOR
GUATEMALA, 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)



Source: Authors' compilation.

C. Effects and costs in the cohort aged 0-59 months in 2004 (analysis of the prospective dimension)

This dimension makes it possible to estimate present and future losses (and potential savings) due to medical treatments, repeated grades and lower productivity stemming from the prevalence of underweight in Guatemala among children under five in 2004.

1. Health effects and costs

As demonstrated in the preceding chapter, undernutrition at an early age increases the risk of dying and of suffering from certain diseases.

Based on projections made from census data, it is estimated that the cohort aged 0 to 59 months in 2004 will have 30,396 deaths before the age of 5 years. Of these, 12,000 (39%) will be associated with the prevalence of undernutrition, with 8,000 cases in 2004.⁵¹ Therefore, whereas undernutrition affects 23% of children, this figure rises to 39% of the resulting mortality, because of the greater risk of mortality incurred by those who are underweight.

As table IV.8 shows, the highest incidence of deaths occurs within the first year of life, during which the probability of dying is 4 times greater than in the remaining years of the cohort. However, more than 5,000 children could also die of causes associated with underweight between 1 and 4 years of age.

TABLE IV.8
MORTALITY ASSOCIATED WITH UNDERWEIGHT IN CHILDREN UNDER FIVE,
GUATEMALA, 2004-2008

| Age | 2004 | 2005 | 2006 | 2007 | 2008 | % |
|-----------------|-------|-------|-------|------|------|--------|
| 0 to 11 months | 6 490 | | | | | 6 490 |
| 12 to 59 months | 1 526 | 1 552 | 1 173 | 788 | 397 | 5 436 |
| Total | 8 016 | 1 552 | 1 173 | 788 | 397 | 11 926 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks reported by Fishman et al, and DHS 2002.

With respect to morbidity, it is estimated that the cohort aged 0 to 59 months in 2004 in Guatemala will suffer from 125,000 additional cases of diseases associated with underweight before they turn 5 years old. The main diseases are anemia, ADD and ARI. Of these, 68% will be in the group aged 24 to 59 months.

⁵¹ All estimates for the cohort aged 0-4 years in 2004 will gradually decrease through 2008 as a result of the members moving up into higher age groups.

TABLE IV.9
MORBIDITY ASSOCIATED WITH UNDERWEIGHT IN CHILDREN UNDER FIVE
GUATEMALA, 2004-2008

| Age | Estimated total cases of disease | | | | | |
|-----------------|----------------------------------|--------|-------|-------|------|---------|
| | 2004 | 2005 | 2006 | 2007 | 2008 | % |
| 0 to 11 months | 19 342 | | | | | 16% |
| 12 to 23 months | 11 785 | 9 217 | | | | 17% |
| 24 to 59 months | 55 267 | 18 692 | 8 407 | 1 754 | 320 | 68% |
| TOTAL | 86 394 | 27 909 | 8 407 | 1 754 | 320 | 124 785 |

Source: Authors' compilation, based on CELADE population and mortality statistics, differences in prevalences, and DHS 2002.

In addition to the cases of morbidity shown in table IV.9, the direct treatment required by underweight boys and girls is also taken into consideration. The 2004 total is 474,000 cases, and the figure for 2005 to 2008 is 200,000 cases. Of these, 30,000 correspond to children who suffered from low birth weight caused by intrauterine growth restriction (LBW_{-IUGR}).

The additional health cost resulting from the increased cases of disease caused by undernutrition amounts to US\$ 285 million in 2004 alone, with a present value⁵² of US\$ 385 million for the 2004-2008 period.

TABLE IV.10
COSTS OF MORBIDITY ASSOCIATED WITH UNDERWEIGHT
GUATEMALA, 2004-2008 (MILLIONS OF 2004 US\$)

| Age | 2004 | 2005 | 2006 | 2007 | 2008 |
|-----------------|-------|------|------|------|------|
| Newborn | 35.5 | | | | |
| 1 to 11 months | 34.7 | | | | |
| 12 to 23 months | 64.8 | 44.0 | | | |
| 24 to 59 months | 150.3 | 42.1 | 18.9 | 3.9 | 0.7 |
| TOTAL | 285.3 | 86.0 | 18.9 | 3.9 | 0.7 |
| PNV | 384.8 | | | | |

Source: Authors' compilation.

The values indicated in table IV.10 translate into an equivalent annual cost (EAC)⁵³ of US\$ 95 million for that period, which represents about 38.7% of public spending on health and 0.35% of GDP.

2. Education effects and costs

When the education process is projected for those under the age of 5 in 2004,⁵⁴ the differential probability of scholastic achievement can be estimated, along with the additional costs generated by the approximately 605,000 future students who are now suffering from undernutrition in Guatemala.

⁵² With an annual discount rate of 8%.

⁵³ Ibid.

⁵⁴ This projection is based on education coverages of the school-age population and educational levels achieved by the cohort aged 20 to 24 as of the latest household survey (2003).

Based on official data, it is possible to estimate that between 2006 and 2021 there will be 68,264 additional grades repeated. Of these, 66% will be in primary school and 34% in secondary school, which is explained by the greater coverage in primary education.

As a result of the additional repeated grades, education costs expressed in present value (at a discount rate of 8%) are estimated at 61 million quetzales, equivalent to US\$ 7.6 million.

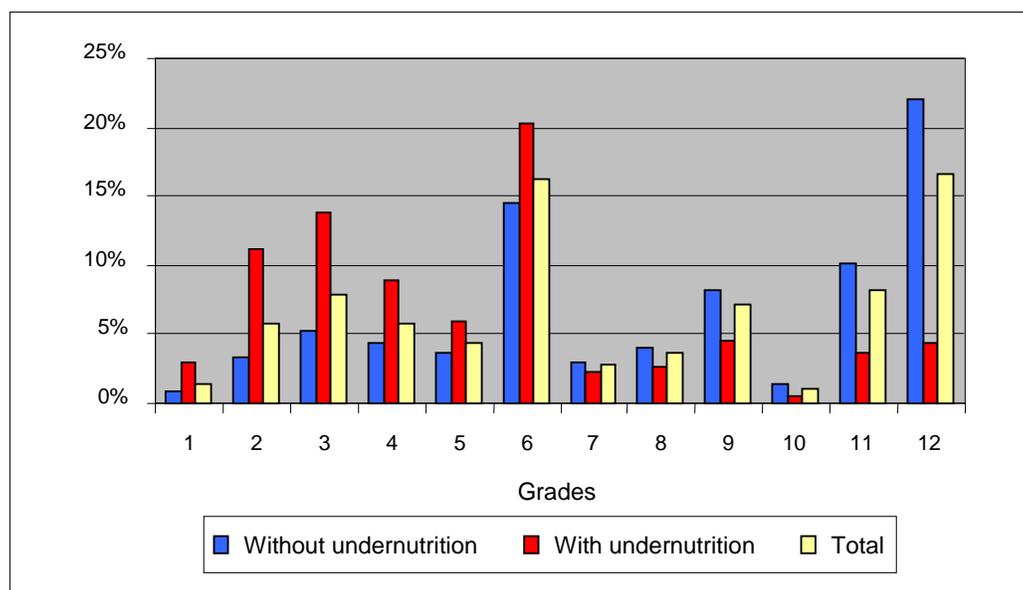
Estimating these values as an equivalent annual cost for the 16-year period during which the cohort in question would be of school age (2006-2021) results in a figure of 7.1 million quetzales, or US\$ 890,000 in 2004 dollars. This represents 0.13% of social spending on education and 0.04% of GDP for that year.

Of these costs, 17.6% are assumed to be paid by the children's families and 82.4% by the school system itself.

Moreover, the greater risk of school attrition by children suffering from undernutrition will mean that 118,230 students will terminate their education early as a result of undernutrition.

As a result, it is estimated that the education differential between those who have suffered undernutrition and those who have not is 2.4 years of schooling, with the former group receiving an average of 4 years of education.

FIGURE IV.6
ESTIMATED DISTRIBUTION OF GRADE COMPLETION FOR THE COHORT AGED 0-59 MONTHS IN 2004, WITH AND WITHOUT UNDERWEIGHT. GUATEMALA



Source: Authors' compilation, based on Household Surveys (2003), DHS (2002) and CELADE population estimates.

Finally, for the cohort as a whole, it is estimated that 4 of every 100 children who have suffered from undernutrition will complete 12 years of school, in contrast to the 22 per 100 of those with normal nutrition who will complete their full education.

3. Productivity effects and costs

The schooling differential discussed in the previous section translates into less human capital accumulated by persons suffering from undernutrition, and has a direct negative impact on their productivity.

Consideration must also be given to the 11,926 additional deaths estimated to be caused by undernutrition in the cohort aged 0 to 59 months during the 2004-2008 period. They represent a potential productivity loss of 1 billion work hours during this cohort's working life (between 2014 and 2068).

Against this backdrop, economic losses in productivity associated with underweight in the population under the age of 5 in Guatemala are estimated at 9.652 billion quetzales in 2004, equivalent to US\$ 1.215 billion in 2004 dollars.⁵⁵ Of this total, US\$ 1.150 billion can be attributed to the lower level of education and US\$ 64 million to differential mortality.

Considering the entire period in which these values would be produced (2014-2068), the equivalent annual cost is 785 million quetzales, or US\$ 99 million. Of this figure, a little over US\$ 93 million corresponds to losses due to lower education levels and US\$ 5 million represents mortality costs.

The equivalent annual cost of these productivity costs represents 0.36% of Guatemala's GDP.

4. Summary of effects and costs

When all sources of costs related to undernutrition are grouped together for the cohort of boys and girls under 5 who suffer from undernutrition in 2004, they yield a present value of 12.721 billion quetzales, or US\$ 1.601 billion.

TABLE IV.11
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERWEIGHT FOR THE COHORT
AGED 0 TO 59 MONTHS IN 2004 IN GUATEMALA

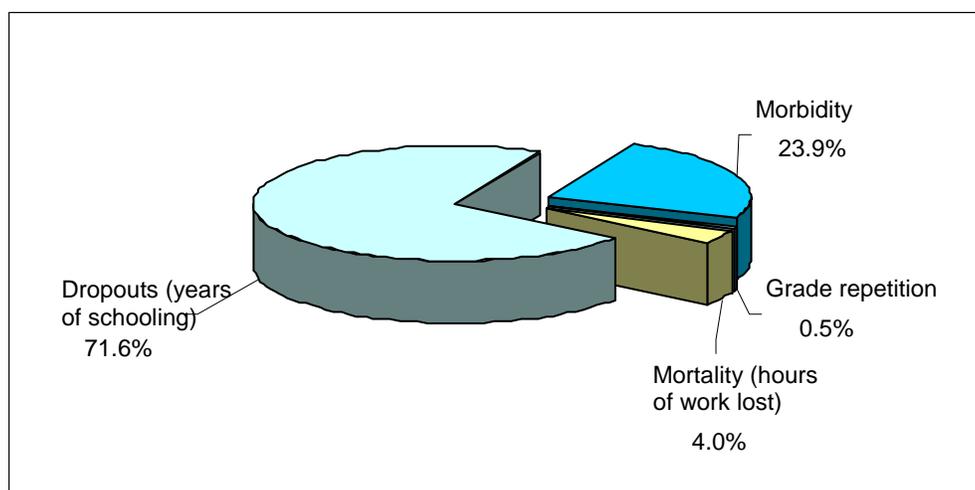
| | Units | Costs (Present value) | |
|--|---------------|--------------------------|------------------|
| | | Millions of Q | Millions of US\$ |
| HEALTH | | | |
| <i>Additional cases of morbidity</i> | 674 383 | 3 058 | 384.8 |
| <i>Number of additional deaths</i> | 11 926 | | |
| EDUCATION | | | |
| <i>Additional repeated grades</i> | 68 254 | 61 | 7.6 |
| <i>Differential number of dropouts</i> | 118 230 | | |
| PRODUCTIVITY | | | |
| <i>Hours lost due to mortality</i> | 1 005 713 786 | 511 | 64.3 |
| <i>Fewer years of schooling</i> | 2.4 | 9 141 | 1 150.4 |
| TOTAL | | 12 771 | 1 607 |

Source: Authors' compilation.

This means that the loss of human resources due to lower education levels and higher health costs attributable to morbidity account for the lion's share of estimated undernutrition costs, 72% and 24%, respectively.

⁵⁵ Considering an annual discount rate of 8%.

FIGURE IV.7
ESTIMATED COST DISTRIBUTION OF UNDERWEIGHT BY FACTOR, GUATEMALA
(PROSPECTIVE DIMENSION, 2004)



Source: Authors' compilation.

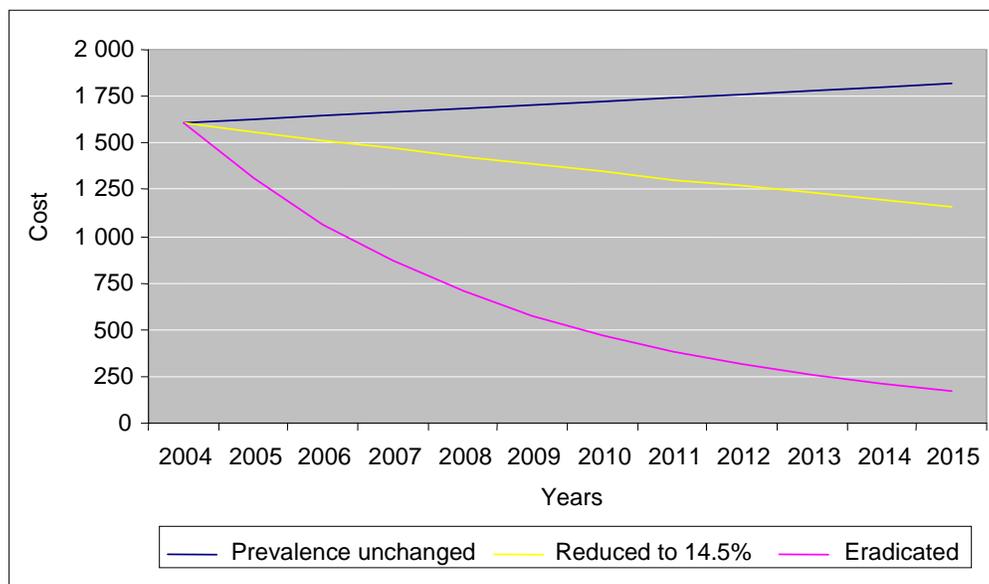
D. Analysis of scenarios: costs and savings

Based on the estimated costs incurred by Guatemala as a result of the prevalence of underweight in the population under five in 2004, it is possible to project different scenarios. Below are the results of the simulations corresponding to three undernutrition scenarios and their effects on costs for 2015:

The scenarios considered are the following:

1. The latest figures available on the prevalence of underweight used in this study remain the same in 2015 (see table IV.1).
2. The Millennium Development Goal (MDG) target of reducing underweight to half the figure prevalent in 1990 is achieved. This would mean bringing it down gradually to a rate of 14.5% among children under 5, meaning an average decrease of about 0.6 percentage points per year.
3. Underweight is eradicated in the country by 2015, which for purposes of this analysis means achieving a prevalence of 2.5%, the "normal" proportion of cases according to the measurement parameters published by the National Center of Health Statistics (NCHS). To achieve this figure, a decline of just over 1.5 percentage points per year will be required.

FIGURE IV.8
TREND IN ESTIMATED UNDERWEIGHT COSTS IN THREE SCENARIOS
(MILLIONS OF US\$)
GUATEMALA, 2004-2015



Source: Authors' compilation.

Figure IV.8 shows how a progressive reduction in the prevalence of underweight also leads to a progressive reduction in associated costs. If the prevalence remains constant (scenario 1), since Guatemala has a tendency to increase the size of the cohort aged 0 to 4 years, the costs will increase by 13% in 2015. If the MDG target is reached (scenario no. 2), the costs of underweight in 2015 will fall to US\$ 1,160,700,000.⁵⁶ If the eradication scenario is achieved, costs will fall further, to a present value of US\$ 170 million⁵⁷ in 2015.

Table IV.12 depicts a comparison of estimated costs for 2004 with those projected for 2015 for each scenario. It can be seen that the highest variation in costs occurs in health and productivity.

⁵⁶ Value updated to 2015, with an annual discount rate of 8%.

⁵⁷ Value updated to 2015, with an annual discount rate of 8%.

TABLE IV.12
ESTIMATED TOTAL COST OF UNDERWEIGHT
FOR THE BASE YEAR AND THREE SCENARIOS (MILLIONS OF US\$)
GUATEMALA, 2004-2015

| | 2004 (PV) | Scenarios for 2015 | | |
|---------------------------------|----------------|------------------------------|---------------------|-----------------------|
| | | Prevalence unchanged | Reduced to 14.5% | Eradication (2.5%) |
| HEALTH | 384.8 | 432.4 | 279.7 | 53.8 |
| EDUCATION | 7.6 | 8.6 | 5.9 | 0.8 |
| PRODUCTIVITY | | | | |
| <i>Loss due to mortality</i> | 64.3 | 74.4 | 36.4 | 7.7 |
| <i>Fewer years of schooling</i> | 1 150.4 | 1 301.1 | 838.7 | 107.7 |
| TOTAL | 1 607.1 | 1 816.6^(*) | 1 160.7 | 170.0 |

Source: Authors' compilation.

(*) The increase in cost can be explained by demographic projections showing an increase in the size of the cohort aged 0 to 4 years, the direct effect of which is a rise in the absolute number of children suffering from undernutrition even though the prevalence remains the same.

Based on the cost trends shown, it is possible to estimate potential savings that would be generated as soon as actions aimed at achieving the targets are initiated.

The distances between the trend lines in figure VI.8 – scenario 2 compared to scenario 1 and scenario 3 compared to scenario 1 – illustrate the savings that would be generated from year to year through 2015 as undernutrition is gradually reduced or eradicated. These savings, expressed in 2004 present value,⁵⁸ amount to nearly US\$ 525 million and US\$ 1.534 billion for scenarios 2 and 3, respectively. Of these totals, 43% and 50% would be derived in each case from the impact generated in the first half of the process (2005-2010).

TABLE IV.13
ESTIMATED SAVINGS ACCORDING TO SCENARIOS (MILLIONS OF US\$)
GUATEMALA, 2015

| | Reduced to 14.5% | Eradication (2.5%) |
|---------------------------------|------------------|--------------------|
| Health | 131.0 | 369.8 |
| Education | 1.7 | 6.2 |
| Productivity | | |
| <i>Loss due to mortality</i> | 107.1 | 195.8 |
| <i>Fewer years of schooling</i> | 285.1 | 961.9 |
| TOTAL | 524.9 | 1 533.7 |

Source: Authors' compilation.

This implies that not only could costs be significantly lower in 2015, but major savings could be achieved throughout the process of attaining the proposed target for each scenario. In turn, if appropriate policies are kept in place, the projected benefits will continue to accrue beyond 2015. Thus, any programme that is effective in this regard will affect individuals' quality of life and will also yield major savings for society.

⁵⁸ Value updated to 2004, with an annual discount rate of 8%.

V. Results of the study in El Salvador

A. Background

El Salvador is one of the countries with a high prevalence of undernutrition in the region of Latin America and the Caribbean. One in every ten children under the age of five suffers from a weight deficit in El Salvador and stunted growth affects nearly a quarter of this population, with both indicators showing figures that are 1.5 times the regional average.

This situation exists in a country which has one of the lowest undernourishment rates in Central America, and which, while having made progress towards achieving the Millennium Development Goals during the 2000/2002 period, has only been moving towards such goals at a third of the rate necessary, with indigence affecting one in five people (ECLAC, 2005).

According to the most recent official reports available (WHO/DHS, 2002/03), 10.3% of children aged 1 to 59 months suffer from undernutrition in the categories “moderate” and “severe,” on the basis of low weight for age. While El Salvador has shown significant improvement from previous measurements, part of its population remains vulnerable.

Regarding newborns, nearly 7 of every 100 infants have low birth weight and almost 3 of every 100 suffer from intrauterine growth restriction. This a rate places El Salvador below the average range among member countries of the Central American Integration System (SICA).

Although there is insufficient representative information to perform an in-depth analysis of the nutritional status of pregnant women, unofficial data suggest that this group as well suffers from serious undernutrition problems, indicating a cycle of undernutrition which begins in the womb.

With respect to the evolving risk of undernutrition during the first years of life, the problem in El Salvador—as noted in various studies in the region—has a tendency to become worse in the first 24 months of life (reaching nearly 13% in 2002/03), followed by improvement and stabilization during the rest of the pre-school stage.

TABLE V.1
POPULATION AND UNDERWEIGHT IN EL SALVADOR

| Age | Size of Population (2004) | Population Affected (2004) ^b | Prevalences | | | |
|------------------------------|---------------------------|---|---------------------|---------|---------|-----------|
| | | | 2002/2003 | 1998 | 1988 | 1965/1967 |
| Newborn (IUGR) | 162 235 ^a | 4 544 | 2.8% ^(c) | No data | No data | No data |
| 0 to 11 months | 162 235 | 8 323 | 5.1% | 6.1% | 8.6% | 18.0% |
| 12 to 23 months | 161 125 | 20 398 | 12.7% | 13.3% | 23.1% | 50.0% |
| 24 to 59 months ^d | 480 627 | 51 667 | 10.8% | 12.9% | 15.2% | 30.4% |
| Total | 803 987 | 84 932 | | | | |

Source: Authors' compilation, based on National Demographic and Health Surveys, the Ministry of Health and estimates from WHO and CELADE.

^a In a given year, the population of newborns is the same as that of infants aged 0 to 11 months.

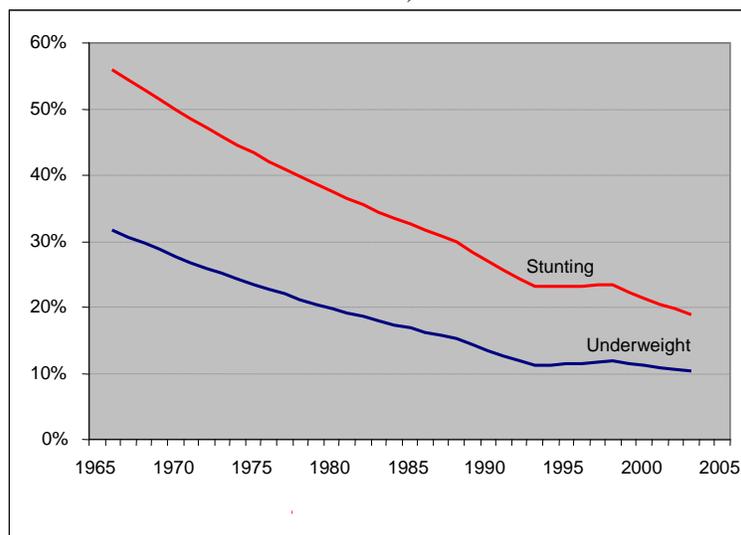
^b Estimated based on the most recent prevalence figure available.

^c Estimated using the De Onis equation, with official data from the Ministry of Health for low birth weight in 2004.

^d The prevalence of undernutrition for 1965/67 corresponds to 24 – 47 months.

As shown in the following figure, the rate of underweight in El Salvador has been steadily declining over a 40-year period, though the rate of reduction slows considerably from 1993 onward. While the 1966 – 1993 period shows, on average, an annual reduction of 0.7 percentage points, the rate stabilizes from that point forward, despite the decline of approximately 0.3 percentage points per year during the 1998 – 2003 period. The trend for the latter period may be insufficient to achieve the goal of halving the undernutrition figures for 1990 to 2015.

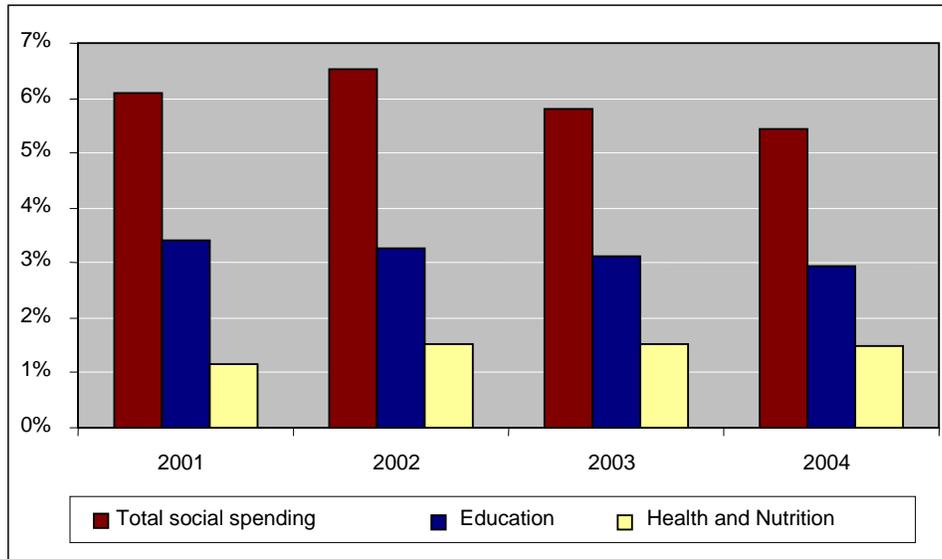
FIGURE V.1
ESTIMATED UNDERNUTRITION RATES FOR CHILDREN UNDER FIVE
EL SALVADOR, 1966 – 2003



Source: Authors' compilation, based on Demographic and Health Surveys (1965/67, 1988, 1993, 1998 and 2002/03)

In response to undernutrition problems, El Salvador dedicated 5.7% of its GDP to public social spending between the years 2000 and 2004,⁵⁹ earmarking an average of 3.1% for education and 1.4% for health, which, combined, make up 80% of the total. As a function of GDP for each year, total public social spending increased by 38% on 1993 (65% for education and 21% for health).

FIGURE V.2
PUBLIC SOCIAL SPENDING AS A PERCENTAGE OF GDP BY SECTOR
EL SALVADOR, 2001 – 2004



Source: Authors' compilation, social spending database

Additionally, as of 2003, El Salvador has a Food and Nutrition Security (SAN) Policy. The Social Committee of Ministers is responsible for implementing the policy through the Technical Committee for Food and Nutrition Security (COTSAN), which receives support from the Ministries of Public Health and Social Welfare (MSPAS), Agriculture and Livestock (MAG) and Education (MINED); the National Secretariat of the Family (SNF), the Solidarity Network programme and the Technical Secretariat of the Presidency, which is responsible for coordinating the committee. Complementing COTSAN are a series of programmes implemented in various sectors, which receive a great deal of support from international cooperation and United Nations agencies.

⁵⁹ According to the methodology for classifying public social spending (PSS) used by ECLAC in order to compare countries in the region, this figure corresponds to Central Government spending by branch and administrative area published by the Macroeconomic and Fiscal Advisory Unit of the Ministry of the Treasury, based on the General Directorate of the Treasury of the same Ministry. The estimates do not include information from autonomous budget entities, such as Family Welfare, the Salvadoran Social Security Institute, Military Health or FOSALUD, which, according to information provided by the Technical Secretariat of the Presidency of the Republic of El Salvador, would raise PSS to 6.4% of GDP.

B. Effects and costs of underweight in 2004 (Analysis of the incidental retrospective dimension)

This section describes the estimated consequences of underweight in El Salvador in the year 2004⁶⁰ in terms of health, education and productivity, based on the incidental retrospective dimension. That is, the health effects and costs for pre-school children (0 to 59 months of age) suffering from undernutrition that year; the educational effects and costs resulting from undernutrition suffered during the first five years of life by those who were of school age (7 to 18 years) during the year of study; and the economic costs resulting from the loss of productivity among those of working age (15 to 64 years) who suffered from undernutrition prior to age 5.

As indicated in the methodology prepared for these studies, the above parameters are used to estimate and analyse the effects and costs for education, health and productivity resulting from undernutrition in a given year, in this case 2004.

1. Health

1.1. Effects on health

Those who suffer from undernutrition at an early age are more vulnerable to disease and death, a fact which can be determined by analysing probability rates.

To estimate these effects, the authors have consulted data from epidemiological studies and the country's official health statistics, as well as information obtained through interviews with Salvadoran specialists.

1.1.1 Morbidity

The effects of undernutrition on morbidity rates in El Salvador for the various associated diseases are estimated at 13,000 additional cases in 2004. This figure can be broken down into Acute Diarrheal Disease (ADD) with 6,700 cases, Acute Respiratory Infections (ARI) with 3,800 cases and iron-deficiency anemia with nearly 2,500⁶¹ cases, a situation resulting from the differences in prevalence⁶² shown in table V.2.

Also relevant are diseases peculiar to critical calorie and protein deficiencies, such as wasting and kwashiorkor, of which there were some 25 cases⁶³ in 2004, according to official records.

⁶⁰ The base information used in this study corresponds to data available as of November 2005.

⁶¹ The estimated effects and costs presented in this report correspond to averages and are subject to the margins of error inherent in the original sources.

⁶² Differences in prevalence (DP) refer to the increased probability for those suffering from undernutrition of contracting a disease (i) as a "consequence" of their condition.

⁶³ The direct effects of micronutrient deficiencies are not considered, only the effects associated with underweight.

TABLE V.2
HEALTH EFFECTS OF UNDERWEIGHT
EL SALVADOR, 2004

| Age | Disease | Differences in Prevalence |
|-----------------|---------|---------------------------|
| 0 to 11 months | Anemia | 4.9% |
| | ADD | 13.8% |
| | ARI | 15.5% |
| 12 to 23 months | Anemia | 0.5% |
| | ADD | 5.9% |
| | ARI | 1.5% |
| 24 to 59 months | Anemia | 3.7% |
| | ADD | 8.4% |
| | ARI | 4.3% |

Source: Authors' compilation, based on official health statistics, relative risks from specialized studies of Central America and DHS 2002/03.⁶⁴

1.1.2 Mortality

Undernutrition affects mortality through a number of diseases, the most common of which are diarrhea, pneumonia, malaria and measles. In order to limit errors resulting from the poor quality of official records for causes of death, the situation in each country was assessed using estimates made by Fishman et al (2004), which define differential relative risks for each cause of death for children under 5 years of age, as well as mortality rates estimated by the Latin American and Caribbean Demographic Centre (CELADE).

Based on the above, it is estimated that some 417,000 children under the age of 5 died from causes related to undernutrition between the years 1940 and 2004. Considering the survival rates of the various cohorts throughout the period, slightly over 75% would still have been alive in 2004 had they not suffered from underweight. It is also estimated that of the total deaths that occurred in 2004 among the population of children under 5, 6,730 (23%) were related to underweight.

Moreover, as shown in table V.3, between 1940 and 1989 underweight is believed to have been responsible for the deaths of 289,000 children under 5 who would have been between the ages of 15 and 64 in 2004 and, therefore, part of the working-age population (WAP).⁶⁵ As mentioned in section 3 of the current chapter, this has a substantial effect on the country's productivity.

⁶⁴ For the purpose of making comparisons between countries, the term "Demographic and Health Surveys (DHS)" is used generically. In the case of El Salvador, this refers to the National Family Health Survey (FESAL).

⁶⁵ For the purpose of comparing estimated costs, WAP is defined in this study as the population between 15 and 64 years of age.

TABLE V.3
MORTALITY OF CHILDREN UNDER FIVE ASSOCIATED WITH
UNDERWEIGHT, ADJUSTED TO SURVIVAL RATE
EL SALVADOR, 1940 – 2004

| Period | No. of child deaths |
|--------------|---------------------|
| 1940s | 39 111 |
| 1950s | 57 781 |
| 1960s | 78 027 |
| 1970s | 72 629 |
| 1980s | 42 015 |
| 1990s | 17 017 |
| 2000-2004 | 6 730 |
| Total | 313 309 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al and DHS 1965/67, 1988, 1993, 1998 and 2002/03.

1.2. Costs to the health system

Institutional (publicly funded) and private health costs incurred to treat diseases associated with undernutrition⁶⁶ that affect children under 5 years of age are concentrated among newborns, which account for 5% of the affected population yet 69% of total health costs for the cohort for the year.

Public and private health costs related to undernutrition in El Salvador are estimated at US\$ 24 million a year, which represents 0.15% of GDP and 10.4% of public spending on health.

A breakdown of these costs reveals that 95% correspond to the public sector.

The nearly 98,000 cases requiring health care due to illnesses associated with undernutrition (see table V.4) include 85,000 children who need medical attention for no other reason than that they are underweight.

⁶⁶ Costs to the public system were estimated based on information reported by various authorities from the Ministry of Health. Private costs were estimated using the official minimum wage and the fare for urban public transport.

TABLE V.4
HEALTH COSTS OF UNDERWEIGHT
EL SALVADOR, 2004

| Age | Number of cases | Millions of US\$ |
|-----------------|-----------------|------------------|
| Newborn (IUGR) | 4 544 | 16.9 |
| 0 to 11 months | 11 178 | 1.1 |
| 12 to 23 months | 22 010 | 1.6 |
| 24 to 59 months | 60 148 | 4.8 |
| Total | 97 880 | 24.4 |

Source: Authors' compilation.

2. Education

2.1. Effects on education

According to the 2004 household survey, the average education level among the adult population (ages 20 to 64) is 6.6 years of schooling, which reflects a progressive increase in school attendance. While the average education level of age group 55-64 is 4.3 years below that of age group 20-24, scholastic achievement remains low and because of the coverage deficit, which remains high, only 37% of the latter group have completed secondary education.

For primary and secondary education, the average education level of Salvadorans who suffer from undernutrition is 2.2 years lower than that of Salvadorans who do not. This may be due in part to the fact that those who suffered from undernutrition at the pre-school stage are more likely never to have reached even the first primary grade.

The percentage of those having suffered from undernutrition during childhood who complete secondary education (13%) is smaller than for those who have not suffered from undernutrition (34%). Considering only those with some level of schooling, 66% of the population suffering from undernutrition attended only primary school, whereas the figure for those not suffering from undernutrition is 35%. This correlation gradually reverses in secondary education, with fewer than 16% of those who suffer from undernutrition completing 12 years of school, while 41% of those who do not suffer from undernutrition reach this level. These differences are important indicators of the job-opportunity and income gaps that exist among Salvadorans of working age.

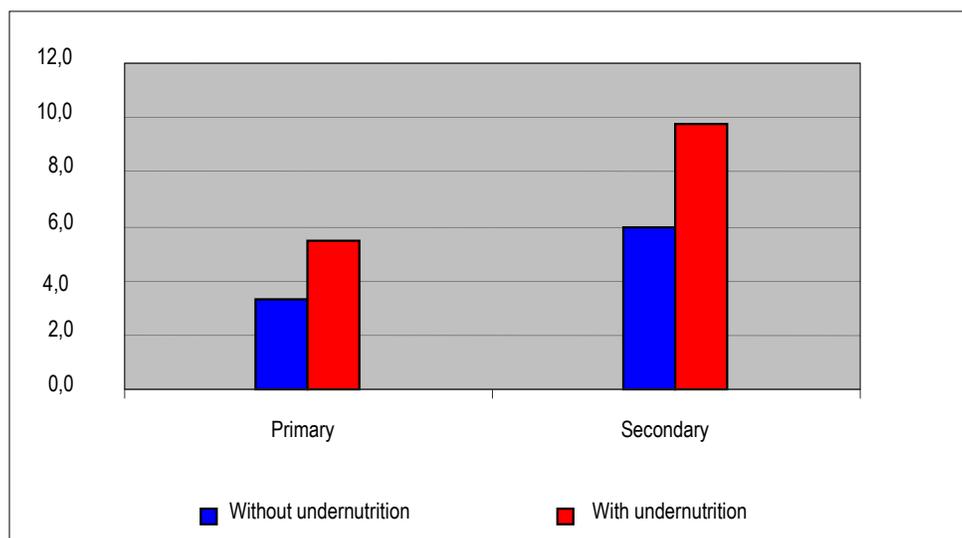
Underweight in El Salvador is likely to have caused nearly 4,000 additional grade repetitions, which translate into corresponding incremental costs. Eighty-five percent of these repetitions occur in primary school.⁶⁷

It is worth noting that children who have suffered from undernutrition account for a larger percentage of repetitions in the early primary grades than do “normal” children. However,

⁶⁷ The educational gaps resulting from undernutrition were calculated by adapting estimates from a longitudinal study conducted in Chile between 1987 and 1998 (Ivanovic 2005). According to these estimates, among socioeconomically similar populations, the risk of grade repetition for students having suffered from undernutrition at the pre-school stage is 1.65 times the risk for students who have not. In the absence of estimators for Central America and considering the characteristics of the education systems, comparable estimates between the Central American countries were obtained using the aforementioned relative risk for grade repetition and an attrition differential of roughly 1.2.

as shown in the following figure, the rates for both groups are higher at the secondary level, though there is always a gap affecting mainly those who have suffered from undernutrition.

FIGURE V.3
EFFECTS OF UNDERWEIGHT ON GRADE REPETITION
EL SALVADOR, 2004
(Expressed in percentages)



Source: Authors' compilation, based on official education statistics (2003), DHS (2002/03) and CELADE population estimates (2004).

2.2. Education Costs

Additional operating costs for the education system resulting from the increased grade repetition rate among those who have suffered from undernutrition account for a substantial portion of education costs. The nearly 4,000 additional students estimated to have been present in 2004 due to the differential probability of repetition translate into US\$ 991,000, which represents 0.21% of public spending on education and 0.006% of GDP.

TABLE V.5
COSTS RESULTING FROM THE GRADE-REPETITION DIFFERENTIAL FOR
UNDERWEIGHT
EL SALVADOR, 2004

| | Education Level | |
|--------------------------------------|-----------------|-----------|
| | Primary | Secondary |
| Annual cost per student (2004 US\$) | 240 | 322 |
| Additional cost per year (2004 US\$) | 801 120 | 190 013 |
| | 991 133 | |
| % Social spending on education | 0.21% | |
| % GDP | 0.006% | |

Source: Authors' compilation, based on official education statistics (2003) and DHS (2002/03).

3. Productivity

3.1. Effects on productivity

As mentioned before, undernutrition has a negative impact on a country's production capacity as a result of increased mortality among children under the age of 5 due to diseases associated with undernutrition, as well as lower levels of education attained by those suffering from the affliction.

Table V.6 shows the magnitude of the lost productivity resulting from the aforementioned 289,000 deaths of children under the age of 5. Considering the country's employment rates by cohort, the consequent cost amounts to 404 million work hours, roughly 7.7% of the hours worked by the economically active population (EAP).

TABLE V.6
PRODUCTIVITY EFFECTS OF MORTALITY DUE TO UNDERWEIGHT IN EL SALVADOR

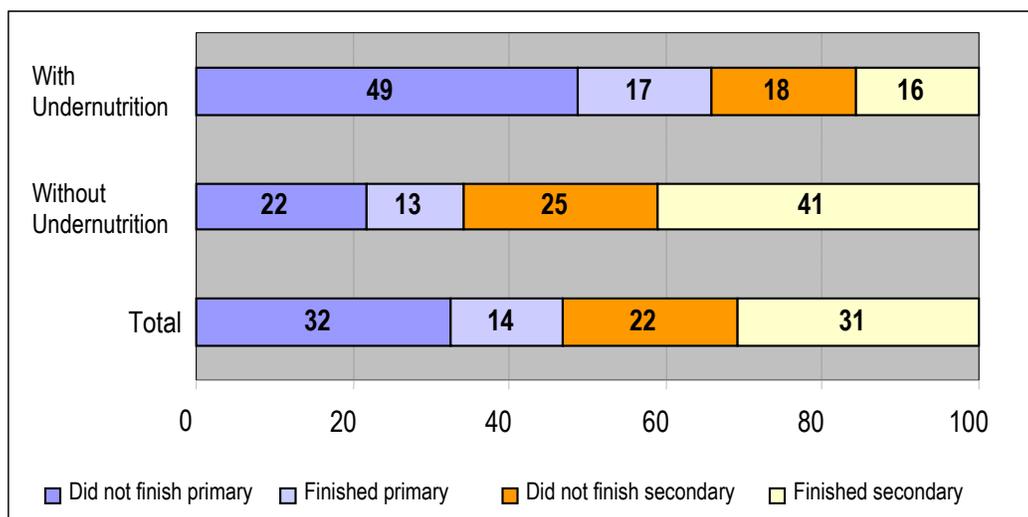
| Age Group | Mortality due to undernutrition (No. of cases, 1940 – 1989) | Lost work hours (2004) |
|------------------------------|---|------------------------|
| 15-24 | 42 015 | 33 903 151 |
| 25-34 | 72 629 | 110 648 069 |
| 35-44 | 78 027 | 128 036 985 |
| 45-54 | 57 781 | 86 480 043 |
| 55-64 | 39 111 | 45 396 632 |
| Total | 289 562 | 404 464 880 |
| % lost hours relative to EAP | | 7.7% |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al and DHS on undernutrition 2002/04.

Assuming a work potential of 2,400 hours a year, these deaths associated with undernutrition translate into an estimated loss of 694 million work hours, equivalent to 11% of those worked by the EAP.

Reduced productivity due to the educational gap corresponds to the differences in distribution of the population according to years of primary and secondary education between those who have suffered from undernutrition and those who have not. This phenomenon can be observed in the following figure, which depicts the grade levels reached by those who were able to attend school.

FIGURE V.4
EFFECTS OF UNDERWEIGHT ON EDUCATION-LEVEL DISTRIBUTION
EL SALVADOR, 2004 (POPULATION AGED 25 TO 64)



Source: Authors' compilation, based on the household survey (2004), DHS (2002/03) and the CELADE population estimate (2004).

3.2. Productivity costs

The increased productivity costs reflect the economic value of the aforementioned effects. For the year 2004, decreased education levels are estimated to have produced losses totaling US\$ 552 million, which represents nearly 65% of social spending, 1.2 times the public spending on education and roughly 3.5% of GDP.

Moreover, lost productivity as a result of deaths from undernutrition among the population that would have been of working age in 2004 is estimated at US\$ 598 million, approximately 3.8% of GDP. Thus, were it not for the undernutrition levels suffered in the country over the last few decades, productivity in 2004 would have been nearly 7.3% higher.

4. Summary of costs

In summation, it is estimated that in 2004 the underweight suffered by the various cohorts had a cost of US\$ 1.175 billion. This sum is equivalent to 7.4% of GDP and approximately 137% of the country's total social spending.

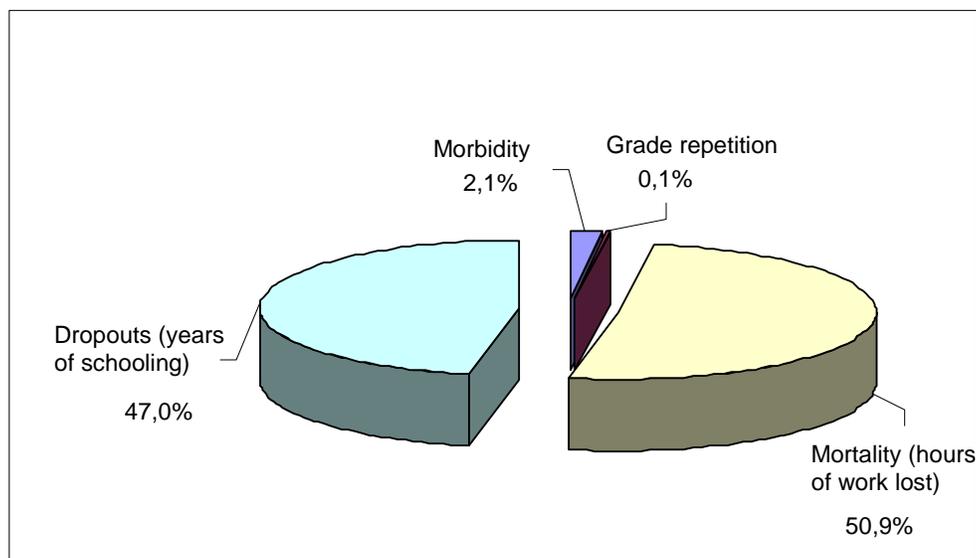
TABLE V.7
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERNUTRITION
EL SALVADOR 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)

| | Units | Millions of US\$ |
|--|-------------|------------------|
| HEALTH | | |
| <i>Additional cases of morbidity</i> | 97 880 | 24.4 |
| <i>Number of additional deaths</i> | 313 309 | |
| EDUCATION | | |
| <i>Additional repeated grades</i> | 3 931 | 1.0 |
| <i>Differential number of dropouts</i> | 202 531 | |
| PRODUCTIVITY | | |
| <i>Hours lost due to mortality</i> | 404 464 880 | 597.7 |
| <i>Fewer years of schooling</i> | 2.2 | 552.3 |
| Total | | 1.175 |
| Social Spending | | 137% |
| GDP % | | 7.4% |

Source: Authors' compilation.

As shown in the following figure, the costs corresponding to lost productivity as a result of mortality and fewer years of schooling account for 98% of the total, while costs associated with morbidity from undernutrition account for 2%.

FIGURE V.5
DISTRIBUTION OF THE COST OF UNDERWEIGHT BY FACTOR
EL SALVADOR 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)



Source: Authors' compilation.

C. Effects and costs for the cohort aged 0-59 months in 2004 (Analysis of the prospective dimension)

This model serves to estimate present and future losses (and potential savings) associated with health care, grade repetition and decreased productivity due to the current prevalence of underweight in El Salvador for the year 2004 among children under the age of five.

1. Health effects and costs

As noted in the previous chapter, undernutrition suffered at an early age increases the risk of dying and contracting certain diseases.

According to projections based on census data, it is estimated that of the children belonging to the cohort aged 0-59 months in 2004, slightly over 9,000 will die before reaching 5 years of age. Of these deaths, some 2,000 (23%) will be related to undernutrition, with 1,317 such cases in 2004.⁶⁸ Thus, while undernutrition affects nearly 11% of children under 5, the proportion of deaths resulting from this affliction climbs to 23%, reflecting the increased risk of mortality for those who suffer from underweight.

TABLE V.8
MORTALITY ASSOCIATED WITH UNDERWEIGHT AMONG CHILDREN UNDER FIVE
EL SALVADOR, 2004-2008

| Age Group | Total Estimated Deaths | | | | | |
|-----------------|------------------------|------------|------------|------------|-----------|--------------|
| | 2004 | 2005 | 2006 | 2007 | 2008 | % |
| 0 to 11 months | 999 | | | | | 47% |
| 12 to 59 months | 318 | 318 | 238 | 159 | 79 | 53% |
| Total | 1 317 | 318 | 238 | 159 | 79 | 2 111 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks reported by Fishman et al and DHS 2002/03.

The majority of the deaths are expected to occur before reaching age 1, during which period the probability of death is 4 times that of the rest of the cohort. Nevertheless, over 1,000 children may die from causes associated with underweight between 1 and 4 years of age.

Regarding morbidity, it is estimated that among the cohort aged 0-59 months in 2004 in El Salvador, nearly 19,000 additional cases of illness associated with underweight will arise prior to age 5, primarily due to anemia, ADD and ARI. Of these cases, 69% will occur between 24 and 59 months of life.

⁶⁸ All the estimates for the cohort aged 0-4 years in 2004 decline progressively until 2008 as a result of its members passing into older age groups.

TABLE V.9
MORBIDITY ASSOCIATED WITH UNDERWEIGHT AMONG CHILDREN UNDER FIVE
EL SALVADOR, 2004 – 2008

| Age | Total Estimated Cases of Disease | | | | | |
|-----------------|----------------------------------|-------|-------|------|------|--------|
| | 2004 | 2005 | 2006 | 2007 | 2008 | % |
| 0 to 11 months | 2 855 | | | | | 15% |
| 12 to 23 months | 1 611 | 1 330 | | | | 16% |
| 24 to 59 months | 8 481 | 2 834 | 1 217 | 249 | 46 | 69% |
| Total | 12 947 | 4 164 | 1 217 | 249 | 46 | 18 623 |

Source: Authors' compilation, based on CELADE population and mortality statistics, differences in prevalence and DHS 2002/03.

In addition to the cases of morbidity indicated in table V.9, it is important to consider treatment specifically for underweight required by children suffering from the condition, which amounts to 85,000 cases in 2004 and approximately 35,000 more between 2005 and 2008. Of these, 4,544 correspond to low birth weight due to intrauterine growth retardation (LBW_{IUGR}).

The additional health cost resulting from the additional cases of disease estimated to have been caused by undernutrition totals US\$ 24.4 million in 2004 alone, with a present value⁶⁹ of US\$ 27.1 million if the entire 2004-2008 period is considered.

TABLE V.10
COSTS OF MORBIDITY ASSOCIATED WITH UNDERWEIGHT
EL SALVADOR, 2004-2008 (MILLIONS OF US\$ 2004)

| Age | 2004 | 2005 | 2006 | 2007 | 2008 |
|-----------------|------|------|------|------|------|
| Newborn | 16.9 | | | | |
| 1 to 11 months | 1.1 | | | | |
| 12 to 23 months | 1.6 | 1.1 | | | |
| 24 to 59 months | 4.8 | 1.3 | 0.5 | 0.1 | 0.02 |
| Total | 24.4 | 2.4 | 0.5 | 0.1 | 0.02 |
| PNV | 27.1 | | | | |

Source: Authors' compilation.

The values indicated in table V.10 translate into an equivalent annual cost (EAC)⁷⁰ of US\$ 6.8 million for the period indicated, representing approximately 2.9% of public spending on health and 0.04% of GDP.

⁶⁹ With a discount rate of 8% per year.

⁷⁰ Ibid.

2. Education effects and costs

A projection for the education of the children under 5 years of age in 2004⁷¹ is made by estimating the differential probability of scholastic achievement as well as the additional costs that will be generated by the approximately 87,000 future students that currently suffer from undernutrition in El Salvador.

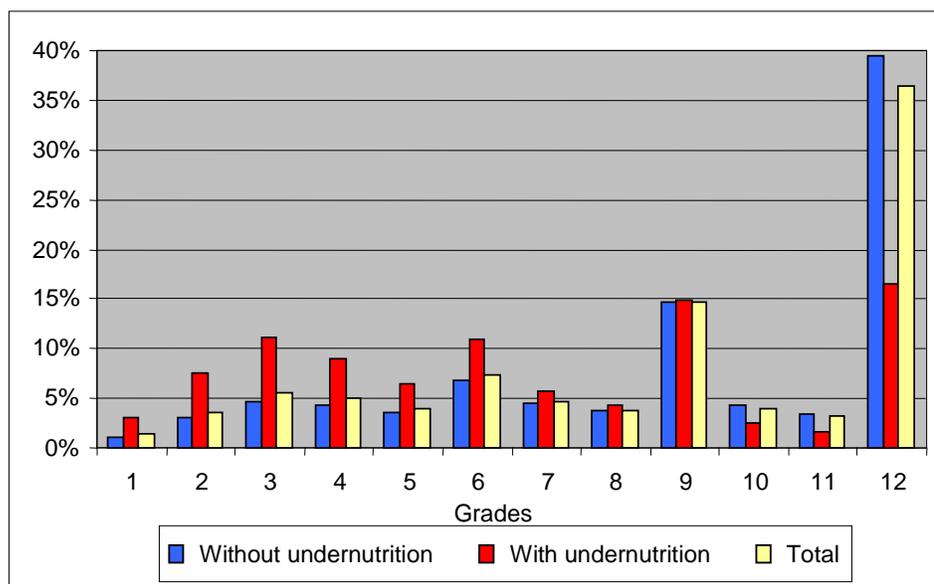
According to official data, it is reasonable to estimate that between the years 2006 and 2021 some 2,330 additional cases of grade repetition will occur. Of these cases, 85% will occur in the primary grades and 15% in the secondary grades.

As a result of the additional repetitions, education costs, expressed in present value (at a discount rate of 8%), would total US\$ 308,000.

This amount, over the 15-year period during which the cohort being studied would be of school age (2006-2021), translates into an equivalent annual cost of US\$ 36,000 in 2004 dollars, representing 0.01% of public spending on education.

Of these costs, 33% would be borne by the children's families and 63% by the education system itself.

FIGURE V.6
ESTIMATED DISTRIBUTION OF GRADE COMPLETION FOR THE COHORT AGED 0-59
MONTHS IN 2004, WITH AND WITHOUT UNDERWEIGHT
EL SALVADOR



Source: Authors' compilation, based on the household survey (2003), DHS (2002/03) and CELADE population estimates.

Moreover, the higher drop-out risk for those suffering from undernutrition will cause some 13,116 students to leave school prematurely as a result of this condition.

⁷¹ The projection is based on education coverage for the school-age population and education levels reached by the cohort aged 20 to 24 years according to the most recent household survey (2003).

Consequently, the estimated difference in grade completion between those who suffer from undernutrition and those who do not is 2.1 years, with students suffering from the condition completing 6.3 years of study on average.

Lastly, for the cohort as a whole it is estimated that 16 of every 100 children suffering from undernutrition complete 12 years of school, while 39 of every 100 students not suffering from the condition attain this level of education.

3. Productivity effects and costs

The grade-completion differentials discussed in the previous section have a direct impact on the productivity of individuals suffering from undernutrition, due to the diminished human capital they possess.

Also, the 2,111 additional deaths that are estimated to have occurred between 2004 and 2008 as a result of undernutrition among the cohort aged 0-59 months represent a potential productivity loss of nearly 198 million work hours during their productive lives (2014 to 2068).

Based on these figures, the economic losses in terms of productivity associated with underweight among the population under 5 years of age in El Salvador are estimated at just over US\$ 119 million, 108 million as a result of lower education levels and 12 million as a result of the mortality differential.

Considering the entire period during which these losses are expected to occur (2014-2068), the equivalent annual cost is US\$ 10 million. Of this amount, US\$ 1 million corresponds to costs due to mortality and US\$ 9 million are losses due to lower education levels.

The equivalent annual cost of these losses in productivity represents 0.06% of GDP in El Salvador.

4. Summary of effects and costs

Combining all the sources of estimated costs stemming from undernutrition among the cohort of children under the age of 5 in 2004 produces a total present value of US\$ 147 million.

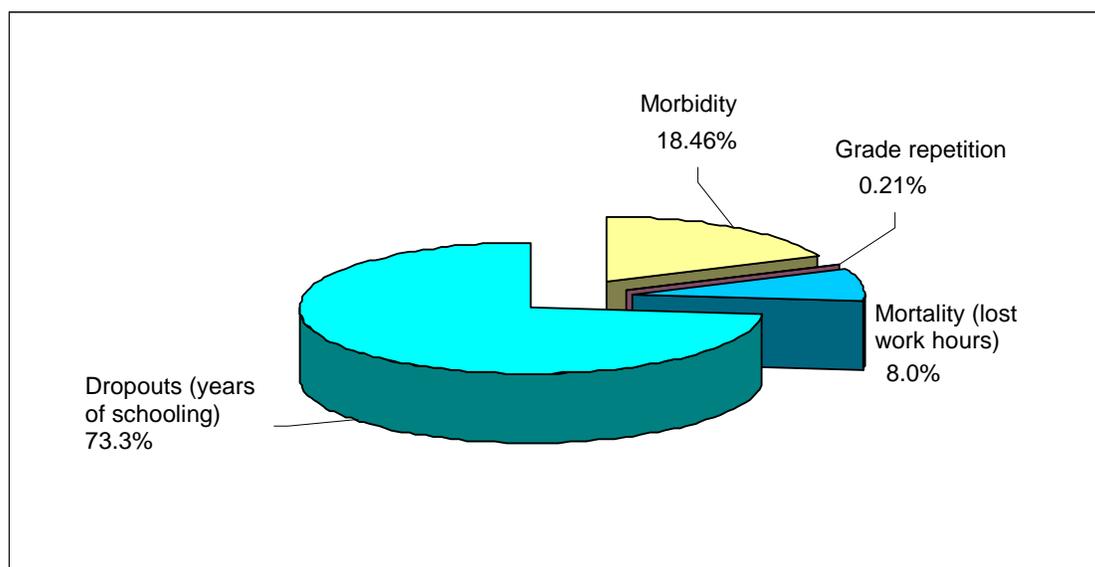
These figures indicate that the human resources lost as a result of reduced academic achievement and higher health costs due to morbidity account for most of the estimated costs of undernutrition (73.3% and 18.5%, respectively).

TABLE V.11
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERWEIGHT FOR THE COHORT
AGED 0-59 MONTHS IN 2004 IN EL SALVADOR

| | Units | Costs (Present Value) |
|--|-------------|-----------------------|
| | | Millions of US\$ |
| HEALTH | | |
| <i>Additional cases of morbidity</i> | 120 115 | 27.1 |
| <i>Number of additional deaths</i> | 2 111 | |
| EDUCATION | | |
| <i>Additional repeated grades</i> | 2 330 | 0.3 |
| <i>Differential number of dropouts</i> | 13 166 | |
| PRODUCTIVITY | | |
| <i>Hours lost due to mortality</i> | 197 846 095 | 11.8 |
| <i>Fewer years of schooling</i> | 2.1 | 107.7 |
| Total | | 146.9 |

Source: Authors' compilation.

FIGURE V.7
DISTRIBUTION OF THE ESTIMATED COST OF UNDERNUTRITION IN EL SALVADOR BY
FACTOR (PROSPECTIVE DIMENSION 2004)



Source: Authors' compilation.

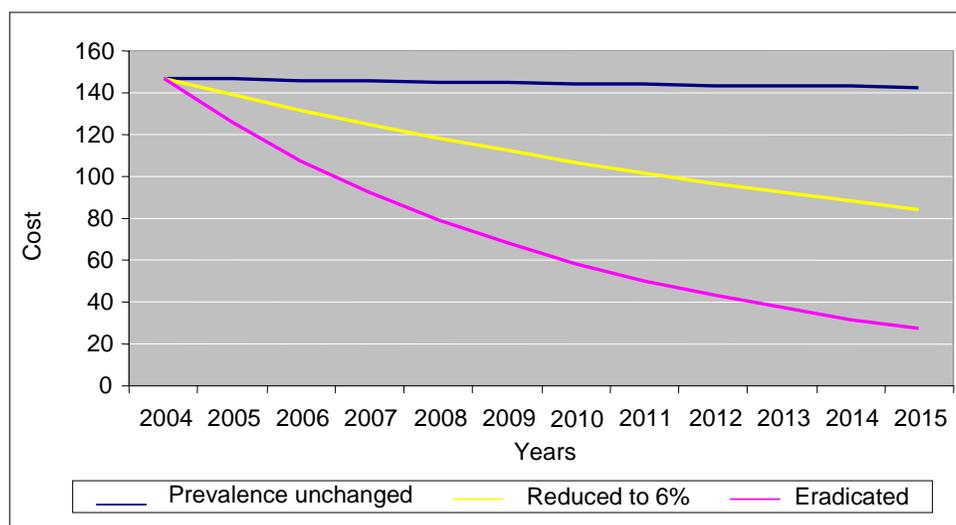
D. Analysis of scenarios: costs and savings

Based on the estimated costs for El Salvador resulting from the prevalence of underweight among the population under 5 years of age in 2004, various possible scenarios can be constructed. Below are the results of simulations corresponding to three scenarios for undernutrition trends and their effects on costs for the year 2015.

The scenarios considered are the following:

1. The most recent figures available on the prevalence of underweight, used for this study, are maintained through 2015 (see table V.1).
2. The target set in the Millennium Development Goals (MDG) of reducing underweight to half 1990 levels is achieved by 2015. This would entail progressively lowering levels until reaching a rate of 6% for children under five, a reduction of approximately 0.36 percentage points per year on average, 20% more than the trend from 1998 to 2003.
3. By 2015, the country has eradicated underweight, which for purposes of analysis means reducing prevalence to 2.5%, representing the “normal” rate as defined by NCHS measuring parameters. Achieving this objective requires a reduction of slightly over 0.65 percentage points per year, more than double the trend from 1998 to 2003.

FIGURE V.8
TREND OF ESTIMATED COSTS OF UNDERWEIGHT FOR THREE SCENARIOS
(MILLIONS OF US\$)
EL SALVADOR, 2004 – 2015



Source: Authors' compilation.

Figure V.8 demonstrates how progressively reducing the prevalence of underweight creates a progressive reduction in the costs associated with it. Given the decreasing size of the cohort of children ages 0-4 in El Salvador, if the prevalence remains constant (scenario 1), the costs will decrease slowly. If the MDG target is achieved (scenario 2), the costs of underweight are reduced to US\$ 84.1 million by 2015.⁷² And if the scenario of eradication is realized, the costs are reduced even further to a present value of US\$ 27.6 million⁷³ by 2015.

Table V.12 compares the costs in 2004 with those projected for each scenario by 2015. As shown, the greatest variation in costs occurs in health and productivity.

⁷² Value updated to 2015, with a discount rate of 8% per year.

⁷³ Value updated to 2015, with a discount rate of 8% per year.

TABLE V.12
ESTIMATED OF TOTAL UNDERWEIGHT COSTS
FOR THE BASE YEAR AND THREE SCENARIOS (MILLIONS OF US\$)
EL SALVADOR, 2004 AND 2015

| | Scenarios for the year 2015 | | | |
|---------------------------------|-----------------------------|-----------------------------|---------------|-------------------|
| | 2004 | Prevalence remains constant | Reduced to 6% | Eradicated (2.5%) |
| Health | 27.1 | 26.9 | 6.8 | 2.6 |
| Education | 0.3 | 0.3 | 0.2 | 0.1 |
| Productivity | | | | |
| <i>Losses due to mortality</i> | 11.8 | 8.2 | 5.2 | 2.4 |
| <i>Fewer years of schooling</i> | 107.7 | 107.2 | 71.9 | 22.6 |
| Total | 146.9 | 142.6^(*) | 84.1 | 27.6 |

Source: Authors' compilation.

(*) The reduced cost is due to demographic projections which suggest a shrinking cohort of children aged 0 to 4 years, the direct effect of which is a reduction in the absolute number of children suffering from undernutrition even if prevalence remains constant.

Based on the cost trends shown, it is possible to estimate the potential savings that may be produced as soon as steps are taken to achieve the proposed goals.

The distances between the trend lines in figure V.8 (between scenario 2 and scenario 1 and between scenario 3 and scenario 1) illustrate the savings which would occur from year to year, accumulating through 2015 as steps are taken to reduce or eradicate undernutrition. These savings, expressed in 2004 present value,⁷⁴ equal US\$ 133 million and 202.9 million for scenarios 2 and 3, respectively, of which nearly 55% would be obtained from the impact produced during the first half of the period (2005 – 2010).

This means that not only would costs in 2015 be significantly lower, but substantial savings would also be produced throughout the process of achieving the goal set for each scenario. Moreover, if the appropriate policies were maintained, the projected benefits would continue to accumulate in the years following 2015.

TABLE V.13
ESTIMATED SAVINGS FOR EACH SCENARIO (MILLIONS OF US\$)
EL SALVADOR, 2015

| | Reduced to 6% | Eradicated (2.5%) |
|---------------------------------|---------------|-------------------|
| HEALTH | 94.3 | 115.3 |
| EDUCATION | 0.1 | 0.18 |
| PRODUCTIVITY | | |
| <i>Losses due to mortality</i> | 16.5 | 24.9 |
| <i>Fewer years of schooling</i> | 22.1 | 62.9 |
| Total | 133.0 | 202.9 |

Source: Authors' compilation.

The above reflects the economic benefits of making progress towards the eradication of undernutrition. Any programme that produces results in this area will improve people's quality of life while creating substantial savings for society.

⁷⁴ Value updated to 2004, with a discount rate of 8% per year.

VI. Results of the study in Honduras

A. Background

Honduras is one of the countries with the highest prevalence of undernutrition in all of Latin America and the Caribbean, with weight deficits affecting almost 1 in every 6 children under the age of 5 and nearly a third of this group suffering from stunted growth.

This situation is part of a backdrop in which the country's progress in the area of undernourishment, as of 2000/2002, has taken place at a third of the rate necessary to meet the target set in the Millennium Development Goals for the year 2015, while over half the population lives in conditions of extreme poverty (ECLAC, 2005).

According to the most recent official publication available (WHO/DHS, 2001), 16.6% of children aged 1 to 59 months suffer from undernutrition in the categories "moderate" and "severe" on the basis of low weight for age. While Honduras shows significant improvement upon previous measurements, it has still not achieved levels sufficient to free the country from its condition of vulnerability.

Concerning newborns, nearly 9 in every 100 infants have low birth weight and 3 of every 100 suffer from intrauterine growth restriction, percentages which place Honduras within the group of high-incidence countries among the member states of the Central American Integration System (SICA).

Although there is insufficient representative information to perform an in-depth analysis of the nutritional status of pregnant women, as in other Central American countries, certain unofficial data suggest that this group as well suffers from serious undernutrition problems, indicating a cycle of undernutrition which begins in the womb.

TABLE VI.1
POPULATION AND UNDERWEIGHT IN HONDURAS

| Age | Size of Population (2004) | Population Affected (2004) ^b | Prevalences | | | |
|------------------------------|---------------------------|---|-------------------|-----------|---------|-----------|
| | | | 2001 | 1993/1994 | 1987 | 1965/1967 |
| Newborn (IUGR) | 202 841 ^a | 6 944 | 3.4% ^c | No data | No data | No data |
| 0 to 11 months | 202 841 | 17 321 | 8.5% | 7.7% | 9.2% | 22.1% |
| 12 to 23 months | 199 643 | 36 776 | 18.4% | 18.8% | 29.4% | 38.3% |
| 24 to 59 months ^d | 590 889 | 108 173 | 18.3% | 21.9% | 21.5% | 34.3% |
| Total | 993 373 | 169 214 | | | | |

Source: Authors' compilation, based on National Demographic and Health Surveys, the Dept. of Statistics of the Ministry of Health and estimates from WHO and CELADE.

^a In a given year, the population of newborns is the same as that of infants aged 0 to 11 months.

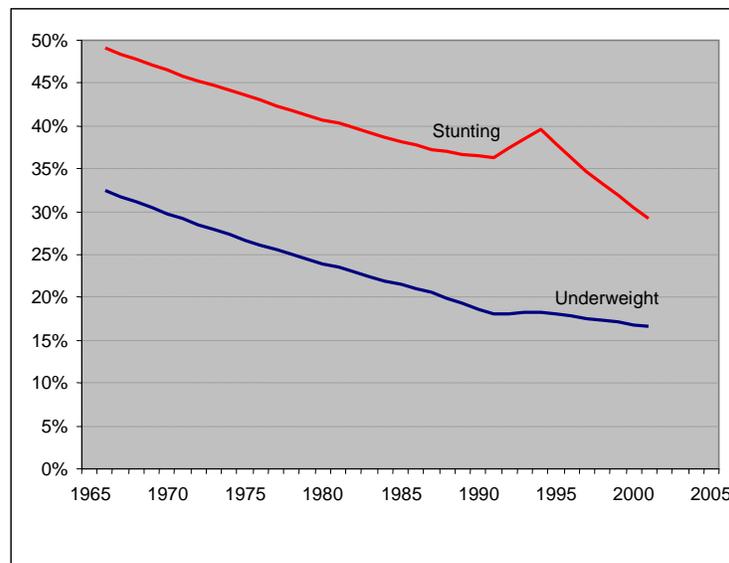
^b Estimated based on the most recent prevalence figure available.

^c Estimated using the De Onis equation, with official data from the Dept. of Statistics of the Ministry of Health for low birth weight in 2004.

^d The prevalence of undernutrition for 1965/67 corresponds to 24 – 47 months.

With respect to the evolving risk of undernutrition during the first years of life, the problem in Honduras—as noted in various studies in the region—has a tendency to become worse in the first 24 months of life (reaching nearly 19% in 2001), followed by improvement and stabilization during the rest of the pre-school stage.

FIGURE VI.1
ESTIMATED UNDERNUTRITION LEVELS FOR CHILDREN UNDER FIVE
HONDURAS, 1966 – 2001

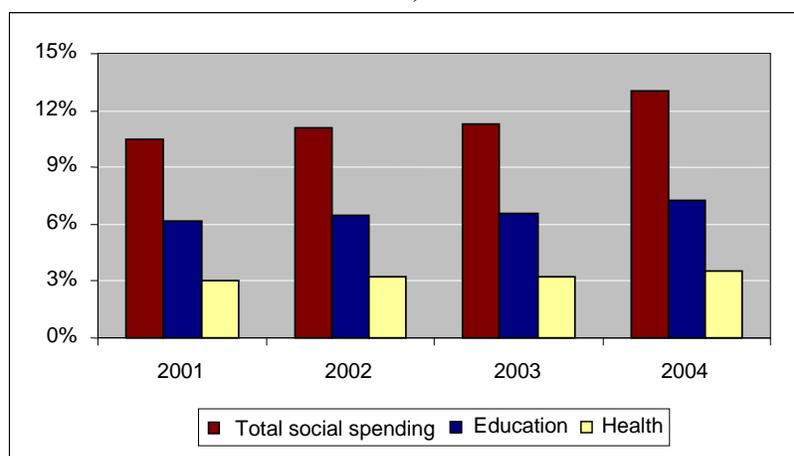


Source: Authors' compilation, based on DHS (1965/67, 1987, 1991, 1994 and 2001).

As shown in figure VI.1, the rate of underweight in Honduras has declined steadily over 40 years; however, its reduction has slowed considerably. While during the 1966 – 1987 period the rate declines, on average, by approximately 0.6 percentage points per year, after 1987 it declines by only 0.3 percentage points and from 1994 onward, 0.2. The latter rate makes it difficult to achieve the goal of halving undernutrition by 2015 with respect to 1990 levels.

In response to undernutrition problems, Honduras dedicated 10% of its GDP to public social spending between the years 2000 and 2004, earmarking an average of 6.2% for education and 3.2% for health, which, combined, make up slightly over 85% of the total. As a function of GDP for each year, total public social spending increased by 40% on 1990 (50% for education and 30% for health).

FIGURE VI.2
PUBLIC SOCIAL SPENDING AS A PERCENTAGE OF GDP BY SECTOR
HONDURAS, 2001 – 2004



Source: ECLAC, social spending data base.

With respect to food policy in Honduras, most prominent among the relevant steps taken during the present decade is the work begun by the office of the presidential appointee in 2003. This effort is aimed at establishing a “frame of reference for the creation of nutritional food-safety policies,” with the participation of all the related sectors, as well as the programmes developed in line with the Poverty Reduction Strategy (PRS).

Various sectoral efforts have been made as well, such as the policies and programmes aimed at rural development implemented by the Secretariat of Agriculture and Livestock (SAG); the progress made by the Ministries of Health and Education in the implementation and development of nutrition surveys, healthy schools and school snack programmes; and food-support initiatives adopted as part of the Family Allowance Programme (PRAF). These processes probably could not have been implemented without the support of international financing and cooperation organizations.

B. Effects and costs of underweight in 2004 (Analysis of the incidental retrospective dimension)

This section describes the estimated consequences of underweight in Honduras in terms of health, education and productivity in the year 2004,⁷⁵ based on the incidental retrospective dimension. That is, the health effects and costs for pre-school children (0 to 59 months of age) suffering from undernutrition that year; the education effects and costs resulting from undernutrition suffered during the first 5 years of life by those who are of school age (7 to 18 years) during the year being studied; and the economic costs resulting from lost productivity among those of working age (15 to 64 years) who suffered from undernutrition before reaching age 5.

As indicated in the methodology prepared for these studies, the above parameters are used to estimate and analyse the effects and costs for education, health and productivity resulting from undernutrition in a given year, in this case 2004.

1. Health

1.1. Effects on health

Those who suffer from undernutrition at an early age are more vulnerable to disease and death, a fact which can be determined by analysing probability differentials.

To estimate these effects, the authors have consulted data from epidemiological studies and the country's official health statistics, as well as information obtained through interviews with Honduran specialists.

1.1.1 Morbidity

In Honduras, the effect of underweight on the morbidity rates of various associated diseases is likely to have amounted to 31,000 additional cases in 2004. This figure can be broken down into acute diarrheal diseases (ADD) with 18,000 cases, acute respiratory infections (ARI) with 7,000 cases and iron-deficiency anemia with 6,000 cases,⁷⁶ a situation resulting from the differences in prevalence⁷⁷ shown in table VI.2.

Also relevant are diseases peculiar to critical calorie and protein deficiencies, such as wasting and kwashiorkor, of which there were 351 cases in 2004, according to official records.⁷⁸

⁷⁵ The base information used in this study corresponds to data available as of the month of October, 2005.

⁷⁶ The estimated effects and costs presented in this report correspond to averages and are subject to the margins of error inherent in the original sources.

⁷⁷ Differences in prevalence (DP) refer to the increased probability for those suffering from undernutrition of contracting a disease (i) as a "consequence" of their condition.

⁷⁸ The direct effects of micronutrient deficiencies are not considered, only the effects associated with underweight.

TABLE VI.2
EFFECTS OF UNDERWEIGHT ON HEALTH
HONDURAS, 2004

| Age | Disease | Differences in Prevalence |
|-----------------|---------|---------------------------|
| 0 to 11 months | Anemia | 1.7% |
| | ADD | 16.1% |
| | ARI | 15.2% |
| 12 to 23 months | Anemia | 0.5% |
| | ADD | 7.0% |
| | ARI | 1.0% |
| 24 to 59 months | Anemia | 5.2% |
| | ADD | 11.8% |
| | ARI | 4.3% |

Source: Authors' compilation, based on data from the Ministry of Health, relative risks from specialized studies of Central America and DHS 2001.

1.1.2 Mortality

Undernutrition affects mortality through a number of diseases, the most common of which are diarrhea, pneumonia, malaria and measles. In order to limit errors resulting from the poor quality of official records for causes of death, the situation in each country was assessed using estimates made by Fishman et al (2004), which define differential relative risks for each cause of death for children under 5 years of age, as well as mortality rates estimated by the Latin American and Caribbean Demographic Centre (CELADE).

Based on the above, it is estimated that some 438,000 children under the age of 5 died from causes related to undernutrition between the years 1940 and 2004. Considering the survival rates of the various cohorts throughout the period, slightly over 73% would still have been alive in 2004 had they not suffered from underweight. It is also estimated that of the total deaths that occurred in 2004 among the population of children under 5, 16,370 (33%) were related to underweight.

Moreover, as shown in table VI.3, between 1940 and 1989 underweight is believed to have been responsible for the deaths of 267,000 children under five who would have been between the ages of 15 and 64 in 2004 and, therefore, part of the working-age population (WAP).⁷⁹ As indicated in section 3 of the present chapter, this has a substantial effect on the country's productivity.

⁷⁹ For the purpose of comparing estimated costs, WAP is defined in this study as the population between 15 and 64 years of age.

TABLE VI.3
MORTALITY ASSOCIATED WITH
UNDERWEIGHT AMONG CHILDREN UNDER FIVE, ADJUSTED TO THE SURVIVAL RATE
HONDURAS, 1940 – 2004

| Period | No. of child deaths |
|--------------|---------------------|
| 1940s | 32 915 |
| 1950s | 49 563 |
| 1960s | 70 158 |
| 1970s | 65 241 |
| 1980s | 48 902 |
| 1990s | 36 301 |
| 2000-2004 | 16 370 |
| Total | 319 451 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al and DHS 1965/67, 1987, 1991, 1994 and 2001.

1.2. Costs to the health system

Institutional (publicly funded) and private health costs incurred to treat diseases associated with undernutrition⁸⁰ affecting children under 5 years of age are concentrated within the age range of 24 to 59 months: 86% of the affected population and 78% of the total health costs for the cohort for the year. However, the highest costs occur among infants aged 0 to 11 months.

The estimated public and private health costs for Honduras are equivalent to US\$ 48 million in 2004 dollars, representing 0.64% of GDP and 18% of public spending on health for that year.

A breakdown of these costs reveals that 92% correspond to the public sector and 8% to the private sector.

The 201,000 cases requiring health care due to illnesses associated with undernutrition (see table VI.4) include 169,000 cases corresponding to children who need direct medical attention for no other reason than that they are underweight.

⁸⁰ Costs to the public system were estimated based on information reported by various authorities from the Ministry of Health. Private costs were estimated using the official minimum wage and the fare for urban public transport.

TABLE VI.4
COST OF UNDERWEIGHT IN TERMS OF HEALTH
HONDURAS, 2004

| Age | Number of Cases | Millions of L | Millions of US\$ |
|-----------------|-----------------|---------------|------------------|
| Newborn (IUGR) | 6 944 | 39.0 | 2.1 |
| 0 to 11 months | 23 129 | 150.5 | 8.3 |
| 12 to 23 months | 39 991 | 254.6 | 14.0 |
| 24 to 59 months | 131 367 | 421.5 | 23.2 |
| Total | 201 431 | 865.6 | 47.6 |

Source: Authors' compilation.

2. Education

2.1. Effects on education

According to the 2001 household survey, the average level of education of the adult population (20 to 64 years of age) is 5.4 years of study, reflecting a progressive increase in school attendance. While the average education level of age group 55-64 is 3.2 years below that of age group 20-24, scholastic achievement remains low and because of the coverage deficit, which remains high, only 18% of the latter group have completed secondary education.

For primary and secondary education, the average education level of Hondurans who suffer from undernutrition is more than two years lower than that of Hondurans who do not. This may be due in part to the fact that those who suffered from undernutrition at the pre-school stage are more likely never to have reached even the first primary grade.

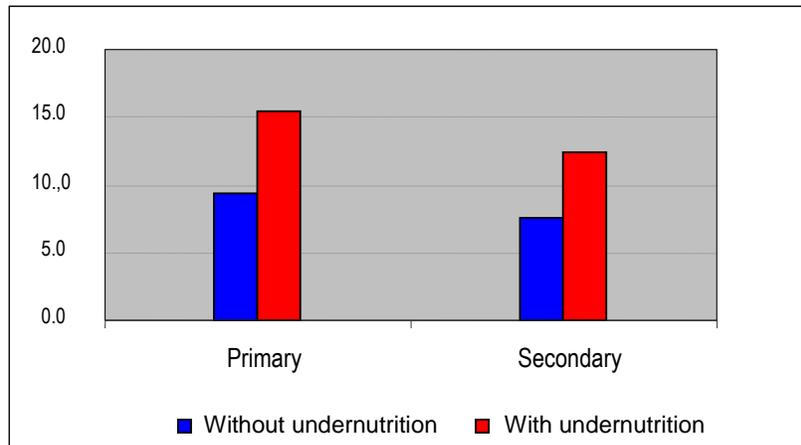
The percentage of those having suffered from undernutrition during childhood who complete secondary education (2%) is smaller than for those who have not suffered from the condition (21%). Considering only those with some level of schooling, 92% of the population suffering from undernutrition attended only primary school, whereas the figure for those not suffering from undernutrition is 58%. This correlation gradually reverses in secondary education, with fewer than 3% of those who suffer from undernutrition completing 12 years of school, while 26% of those who do not suffer from the condition reach this level. These differences are important indicators of the job-opportunity and income gaps that exist among Hondurans of working age.

Underweight in Honduras is likely to have caused 18,486 additional grade repetitions in 2004, which translate into corresponding incremental costs. Ninety-six percent of these repetitions occur at the primary level.⁸¹

⁸¹ The educational gaps resulting from undernutrition were calculated by adapting estimates from a longitudinal study conducted in Chile between 1987 and 1998 (Ivanovic 2005). According to these estimates, among socioeconomically similar populations, the risk of grade repetition for students having suffered from undernutrition at the pre-school stage is 1.65 times the risk for students who have not. In the absence of estimators for Central America and considering the characteristics of the education systems, comparable estimates between the Central American countries were obtained using the aforementioned relative risk for grade repetition and an attrition differential of roughly 1.2.

It is worth noting that children who have suffered from undernutrition account for a larger percentage of repetitions in the early primary grades than do “normal” children. However, as shown in the following figure, the rates for both groups are higher at the secondary level, though there is always a gap mainly affecting those who have suffered from undernutrition.

FIGURE VI.3
EFFECTS OF UNDERWEIGHT ON GRADE REPETITION
HONDURAS, 2004
(In percentages)



Source: Authors' compilation, based on data from the Ministry of Education (2003), DHS (2001) and CELADE population estimates (2004).

2.2. Education costs

Additional operating costs for the education system resulting from the increased grade repetition rate among those who have suffered from undernutrition account for a substantial portion of education costs. The slightly over 18,000 additional students estimated to have been present in 2004 due to the differential probability of repetition translate into US\$ 5 million, which represents 0.93% of public spending on education and 0.07% of GDP for that year.

TABLE VI.5
COSTS RESULTING FROM DIFFERENTIAL GRADE REPETITION DUE TO UNDERWEIGHT
HONDURAS, 2004

| | Education Level | |
|------------------------------------|-----------------|-----------|
| | Primary | Secondary |
| Annual cost per student (L 2004) | 4 778 | 7 156 |
| Additional annual cost (L 2004) | 84 535 506 | 5 689 311 |
| Additional annual cost (2004 US\$) | 4 643 226 | 312 493 |
| | 4 955 719 | |
| % Social spending on education | 0.93% | |
| % GDP | 0.07% | |

Source: Authors' compilation, based on data from the Ministry of Education (2003) and DHS (2001).

3. Productivity

3.1. Effects on productivity

As mentioned before, undernutrition has a negative impact on a country's production capacity as a result of increased mortality among children under the age of 5 from diseases associated with undernutrition, as well as lower levels of education attained by those suffering from the affliction.

Table VI.6 shows the magnitude of the lost productivity resulting from the aforementioned 267,000 deaths of children under the age of 5. Considering the country's employment rates by cohort, the consequent cost amounts to 386 million work hours, roughly 7.1% of the hours worked by the economically active population (EAP).

TABLE VI.6
PRODUCTIVITY EFFECTS OF MORTALITY DUE TO UNDERWEIGHT IN HONDURAS

| Age Group | Mortality due to undernutrition (No. of cases, 1940 – 1989) | Lost work hours (2004) |
|-------------------------------------|---|------------------------|
| 15-24 | 48 902 | 46 304 738 |
| 25-34 | 65 241 | 101 623 379 |
| 35-44 | 70 158 | 116 675 282 |
| 45-54 | 49 563 | 78 242 082 |
| 55-64 | 32 915 | 43 542 644 |
| Total | 266 779 | 386 388 125 |
| % hours lost relative to EAP | | 7.1% |

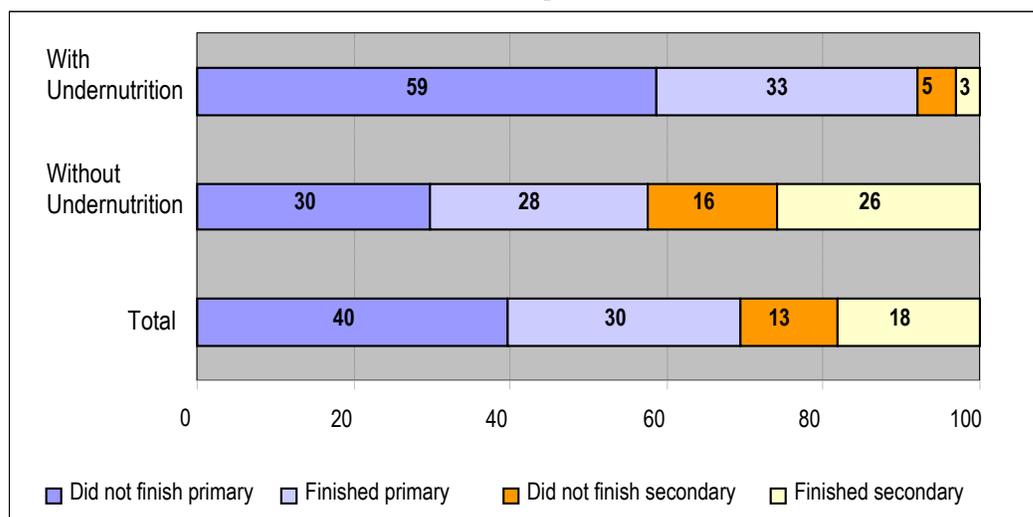
Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al and DHS 2001.

Assuming a work potential of 2,400 hours a year, these deaths associated with undernutrition translate into an estimated loss of 640 million work hours, equivalent to 10% of those worked by the EAP.

Reduced productivity due to the educational gap corresponds to the differences in distribution of the population according to years of primary and secondary education between

those who have suffered from undernutrition and those who have not. This phenomenon can be observed in the following figure, which depicts the grade levels reached by those who were able to attend school.

FIGURE VI.4
EFFECTS OF UNDERWEIGHT ON EDUCATION-LEVEL DISTRIBUTION
HONDURAS, 2004 (POPULATION AGED 25 TO 64)
(In percent)



Source: Authors' compilation, based on the Household Survey (2003), DHS (2001) and the CELADE population estimate (2004).

3.2. Productivity costs

The increased productivity costs reflect the economic value of the aforementioned effects. For the year 2004, losses due to decreased education levels are estimated at US\$ 413 million, which represents 78% of public spending on education and roughly 5.6% of GDP.

Moreover, lost productivity as a result of deaths from undernutrition among the population that would have been of working age in 2004 is estimated at US\$ 314 million, approximately 4.3% of GDP. Thus, were it not for the undernutrition levels suffered in the country over the last few decades, productivity in 2004 would have been nearly 10% higher.

4. Summary of costs

In summation, it is estimated that in 2004 the underweight suffered by the various cohorts had a cost of 13.933 billion lempiras, equaling US\$ 780 million. This amount represents 10.6% of GDP and roughly 81% of total social spending for the country that year.

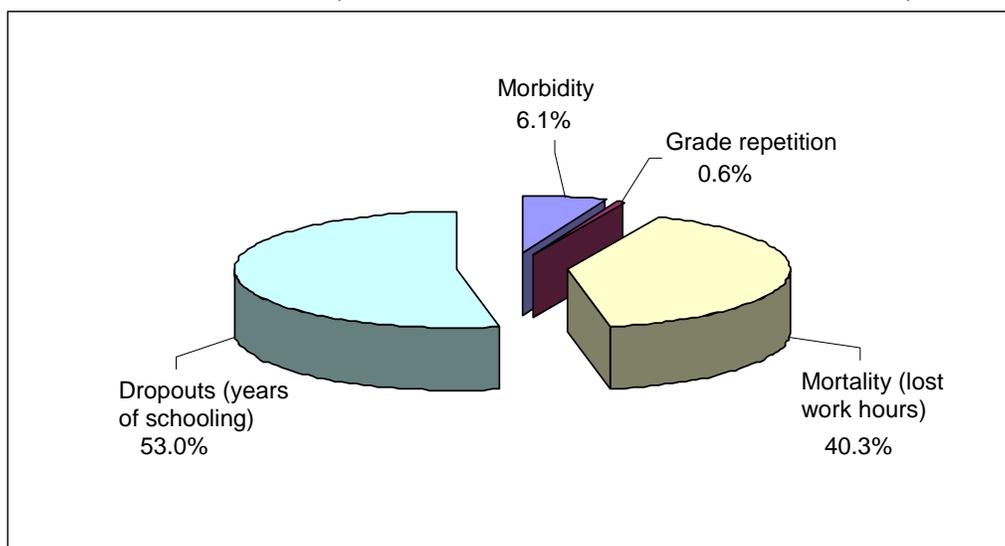
TABLE VI.7
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERNUTRITION
HONDURAS 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)

| | Units | Millions of L | Millions of US\$ |
|--|-------------|---------------|------------------|
| HEALTH | | | |
| <i>Additional cases of morbidity</i> | 201 431 | 866 | 47.5 |
| <i>Number of additional deaths</i> | 319 451 | | |
| EDUCATION | | | |
| <i>Additional repeated grades</i> | 18 486 | 90 | 5.0 |
| <i>Differential number of dropouts</i> | 304 516 | | |
| PRODUCTIVITY | | | |
| <i>Hours lost due to mortality</i> | 386 388 125 | 5 448 | 314.1 |
| <i>Fewer years of schooling</i> | 2.2 | 7 530 | 413.6 |
| Total | | 13 934 | 780 |
| Social Spending | | | 80.9% |
| % GDP | | | 10.6% |

Source: Authors' compilation.

As shown in the following figure, the costs corresponding to lost productivity as a result of mortality and fewer years of schooling account for 93% of the total, while costs associated with morbidity from undernutrition account for 6% and grade repetition represents just under 1%.

FIGURE VI.5
DISTRIBUTION OF THE COST OF UNDERWEIGHT BY FACTOR
HONDURAS 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)



Source: Authors' compilation.

C. Effects and costs for the cohort aged 0-59 months in 2004 (Analysis of the prospective dimension)

This model serves to estimate present and future losses (and potential savings) associated with health care, grade repetition and decreased productivity due to the current level of underweight in Honduras for the year 2004 among children under the age of five.

1. Health effects and costs

As noted in the previous chapter, undernutrition suffered at an early age increases the risk of dying and contracting certain diseases.

According to projections based on census data, it is estimated that of the children belonging to the cohort aged 0-59 months in 2004, slightly over 15,739 will die before reaching 5 years of age. Of these deaths, just over 5,000 (32%) will be related to undernutrition, with nearly 3,000 such cases in 2004.⁸² Thus, while undernutrition affects nearly 17% of children under 5, the proportion of deaths resulting from this affliction climbs to 32%, reflecting the increased risk of mortality for those who suffer from underweight.

TABLE VI.8
MORTALITY ASSOCIATED WITH UNDERWEIGHT AMONG CHILDREN UNDER FIVE
HONDURAS, 2004 – 2008

| Age | 2004 | 2005 | 2006 | 2007 | 2008 | % |
|-----------------|-------|------|------|------|------|-------|
| 0 to 11 months | 2 079 | | | | | 41 |
| 12 to 59 months | 856 | 860 | 646 | 431 | 215 | 59 |
| Total | 2 936 | 860 | 646 | 431 | 215 | 5 088 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks reported by Fishman et al and DHS 2001.

As shown in table VI.8, the majority of the deaths are expected to occur before reaching age 1, during which period the probability of death is 2.5 times that of the rest of the cohort. Nevertheless, over 2,000 children may die from causes associated with underweight between the ages of 1 and 4.

Regarding morbidity, it is estimated that among the cohort aged 0-59 months in 2004 in Honduras, nearly 45,000 additional cases of illness associated with underweight will arise prior to age 5, primarily due to anemia, ADD and ARI. Of these cases, 75% will occur among children aged 24 to 59 months.

⁸² All the estimates for the cohort aged 0-4 years in 2004 decline progressively until 2008 as a result of its members passing into older age groups.

TABLE VI.9
MORBIDITY ASSOCIATED WITH UNDERWEIGHT AMONG CHILDREN UNDER FIVE
HONDURAS, 2004 – 2008

| Age | Total Estimated Cases of Disease | | | | | |
|-----------------|----------------------------------|-------|-------|------|------|--------|
| | 2004 | 2005 | 2006 | 2007 | 2008 | % |
| 0 to 11 months | 5 808 | | | | | 13 |
| 12 to 23 months | 3 215 | 2 309 | | | | 12 |
| 24 to 59 months | 23 194 | 7 013 | 2 705 | 531 | 96 | 75 |
| Total | 32 217 | 9 322 | 2 705 | 531 | 96 | 44 870 |

Source: Authors' compilation, based on CELADE population and mortality statistics, differences in prevalence and DHS 2001.

In addition to the cases of morbidity indicated in table VI.9, it is important to consider treatment specifically for underweight required by children suffering from the condition, which amounts to 169,000 cases in 2004 and 64,000 more between 2005 and 2008. Of these, nearly 7,000 correspond to low birth weight due to intrauterine growth retardation (LBW_{IUGR}).

The additional cost in health resulting from the additional cases of disease estimated to have been caused by undernutrition totals US\$ 48 million in 2004 alone, with a present value⁸³ of US\$ 64 million for the 2004-2008 period.

TABLE VI.10
COSTS OF MORBIDITY ASSOCIATED WITH UNDERWEIGHT
HONDURAS, 2004-2008 (MILLIONS OF 2004 US\$)

| Age | 2004 | 2005 | 2006 | 2007 | 2008 |
|-----------------|------|------|------|------|------|
| Newborn | 2.1 | | | | |
| 1 to 11 months | 8.2 | | | | |
| 12 to 23 months | 14.0 | 9.1 | | | |
| 24 to 59 months | 23.2 | 5.8 | 2.2 | 0.4 | 0.1 |
| Total | 47.5 | 14.9 | 2.2 | 0.4 | 0.1 |
| PNV | 63.6 | | | | |

Source: Authors' compilation.

The amounts indicated in table VI.10 translate into an equivalent annual cost (EAC)⁸⁴ of US\$ 16 million for the period shown, which represents roughly 6.1% of public spending on health and 0.22% of GDP.

⁸³ With a discount rate of 8% per year.

⁸⁴ Ibid.

2. Education effects and costs

A projection for the education of the children under 5 years of age in 2004⁸⁵ is created by estimating the differential probability of scholastic achievement as well as the additional costs that will be generated by the approximately 202,000 future students that currently suffer from undernutrition in Honduras.

According to official data, it is reasonable to estimate that between the years 2006 and 2021 some 11,000 additional cases of grade repetition will occur. Of these cases, 40% will occur in the primary grades and 60% during secondary education.

As a result of the additional repetitions, education costs expressed in present value (at a discount rate of 8%), would total 34 million lempiras or US\$ 2 million in 2004 dollars.

This amount, over the 16-year period during which the cohort being studied would be of school age (2006-2021), translates into an equivalent annual cost of 4 million lempiras or US\$ 217,000 in 2004 dollars, representing 0.06% of public spending on education and 0.003% of GDP for that year.

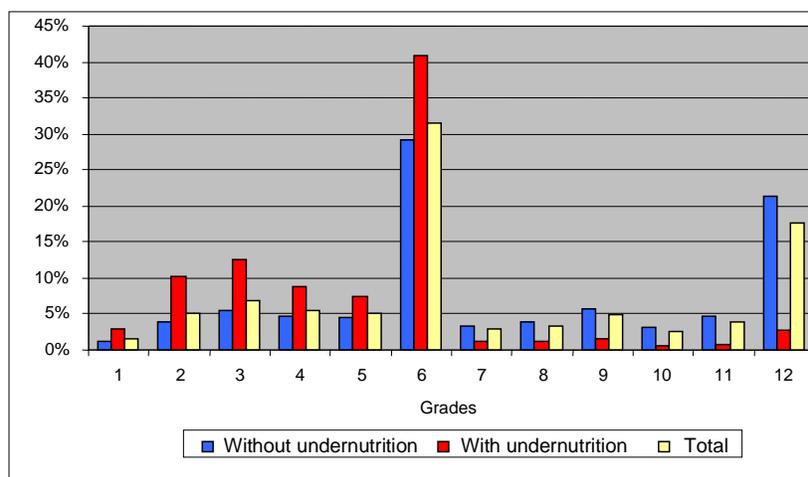
Of these costs, 21.6% would be borne by the children's families and 78.4% would be covered by the education system itself.

Moreover, the higher drop-out risk for those suffering from undernutrition will account for some 67,741 students' leaving school prematurely as a result of this condition.

Consequently, the estimated difference in grade completion between those who suffer from undernutrition and those who do not is 2.3 years, with students suffering from the condition completing 4.5 years of study on average.

Lastly, for the cohort as a whole it is estimated that 3 of every 100 children suffering from undernutrition complete 12 years of school, while 21 of every 100 students not suffering from the condition attain this level of education.

FIGURE VI.6
ESTIMATED DISTRIBUTION OF GRADE COMPLETION FOR THE COHORT AGED 0-59 MONTHS IN 2004, WITH AND WITHOUT UNDERWEIGHT HONDURAS



Source: Authors' compilation, based on the Household Survey (2003), DHS (2001) and CELADE population estimates.

⁸⁵ The projection is based on education coverage for the school-age population and education levels reached by the cohort aged 20 to 24 years according to the most recent household survey (2003).

3. Productivity effects and costs

The grade-completion differentials discussed in the previous section translate into less human capital acquired by those who suffer from undernutrition, producing a direct negative effect on their productivity. Also, the estimated 5,088 additional deaths that are expected to have occurred between 2004 and 2008 as a result of undernutrition among the cohort aged 0-59 months represent a potential productivity loss of nearly 500 million work hours during their productive lives (2014 to 2068).

Based on these figures, the economic losses in terms of productivity associated with underweight among the population under 5 years of age in Honduras are estimated at 4.106 billion lempiras in 2004, equivalent to US\$ 226 million.⁸⁶ Of this sum, 209 million is the result of lower education levels and 16 million is due to differential mortality.

Considering the entire period during which these losses are expected to occur (2014-2068), the equivalent annual cost is 333 million lempiras or US\$ 18.3 million. Of this amount, US\$ 17 million corresponds to losses due to lower education levels and US\$ 1.3 million represents the costs due to mortality.

The equivalent annual cost of these losses in productivity represents 0.25% of Honduras's GDP.

4. Summary of effects and costs

Combining all the sources of estimated costs stemming from undernutrition among the cohort of children under the age of 5 in 2004 produces a total present value of 5.299 billion lempiras or US\$ 291 million.

These figures indicate that the human resources lost as a result of reduced academic achievement and higher health costs due to morbidity account for most of the estimated costs of undernutrition (72% and 22%, respectively).

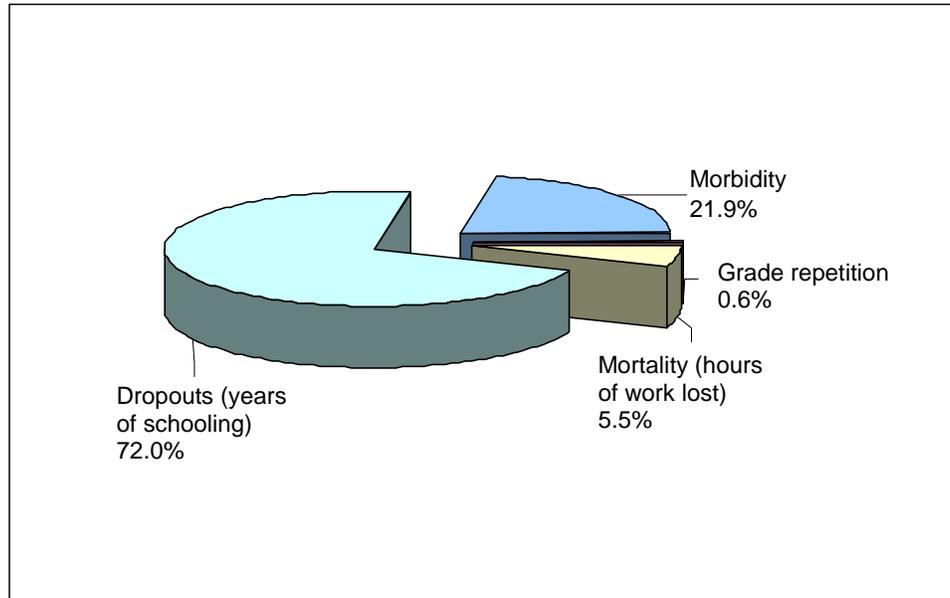
TABLE VI.11
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERWEIGHT FOR THE COHORT
AGED 0-59 MONTHS IN 2004 IN HONDURAS

| | Units | Costs (Present Value) | |
|--|-------------|-----------------------|------------------|
| | | Millions of L | Millions of US\$ |
| HEALTH | | | |
| <i>Additional cases of morbidity</i> | 233 154 | 1 158 | 63.6 |
| <i>Number of additional deaths</i> | 5 088 | | |
| EDUCATION | | | |
| <i>Additional repeated grades</i> | 11 363 | 34 | 1.9 |
| <i>Differential number of dropouts</i> | 67 741 | | |
| PRODUCTIVITY | | | |
| <i>Hours lost due to mortality</i> | 491 888 143 | 293 | 16.1 |
| <i>Fewer years of schooling</i> | 2.3 | 3 814 | 209.5 |
| Total | | 5 299 | 291 |

Source: Authors' compilation.

⁸⁶ With a discount rate of 8% per year.

FIGURE VI.7
DISTRIBUTION OF THE ESTIMATED COST OF UNDERWEIGHT IN HONDURAS BY
FACTOR (PROSPECTIVE DIMENSION 2004)



Source: Authors' compilation.

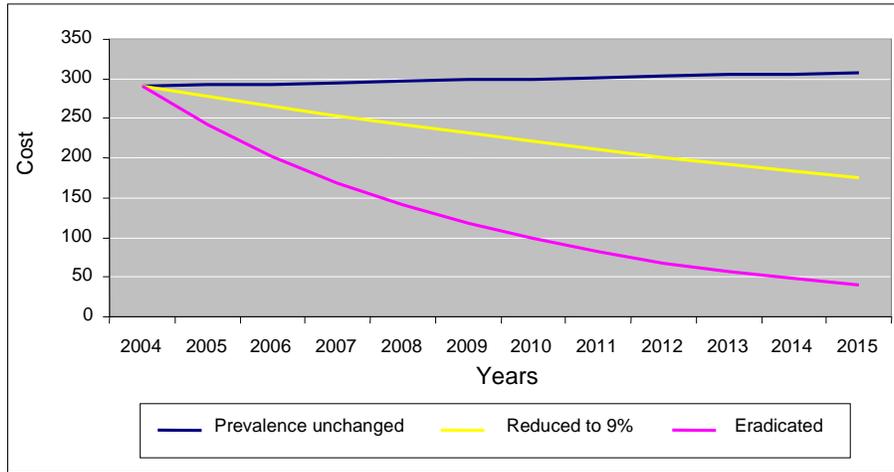
D. Analysis of scenarios: costs and savings

Based on the estimated costs for Honduras resulting from the prevalence of underweight among the population under 5 years of age in 2004, various possible scenarios can be constructed. Below are the results of simulations corresponding to three scenarios for undernutrition trends and their effects on costs for the year 2015.

The scenarios considered are the following:

1. The most recent figures available on the prevalence of underweight, used for this study, are maintained through 2015 (see table 1).
2. The target set in the Millennium Development Goals (MDG) of reducing underweight to half 1990 levels is achieved by 2015. This would entail progressively lowering levels until reaching a rate of 9% for children under 5, a reduction of approximately 0.6 percentage points per year on average.
3. By 2015, the country has eradicated underweight, which for purposes of analysis means reducing prevalence to 2.5%, representing the "normal" rate as defined by NCHS measuring parameters. Achieving this goal entails a reduction of just over 1 percentage point per year.

FIGURE VI.8
TREND OF ESTIMATED COSTS OF UNDERWEIGHT FOR THREE SCENARIOS
(MILLIONS OF US\$)
HONDURAS, 2004 – 2015



Source: Authors' compilation.

Figure VI.8 demonstrates how progressively reducing the prevalence of underweight creates a progressive reduction in the costs associated with it. Given the increasing size of the cohort of children ages 0-4 in Honduras, if the prevalence remains constant (scenario 1), the costs in 2015 will rise by nearly 6%. If the MDG target is achieved (scenario 2), the costs of underweight for the year 2015 are reduced to US\$ 175.2 million.⁸⁷ And if the scenario of eradication is realized, the costs are reduced even further to a present value of US\$ 39.9 million⁸⁸ by 2015.

Table VI.12 compares the estimated costs in 2004 with those projected for each scenario by 2015. As shown, the greatest variation in costs occurs in health and productivity.

TABLE VI.12
ESTIMATED TOTAL COST OF UNDERWEIGHT FOR THE BASE YEAR AND THREE
SCENARIOS (MILLIONS OF US\$) HONDURAS, 2004 AND 2015

| | 2004 | Scenarios for the year 2015 | | |
|---------------------------------|--------------|-----------------------------|---------------|-------------------|
| | | Prevalence remains constant | Reduced to 9% | Eradicated (2.5%) |
| HEALTH | 63.6 | 67.3 | 36.4 | 10.4 |
| EDUCATION | 1.9 | 2.0 | 1.3 | 0.3 |
| PRODUCTIVITY | | | | |
| <i>Losses due to mortality</i> | 16.1 | 17.0 | 8.1 | 2.6 |
| <i>Fewer years of schooling</i> | 209.5 | 222.0 | 129.4 | 26.6 |
| TOTAL | 291.1 | 308.3^(*) | 175.2 | 39.9 |

Source: Authors' compilation.

(*) The increased cost is due to demographic projections which suggest a growing cohort of children aged 0 to 4 years, the direct effect of which is an increase in the absolute number of children suffering from undernutrition even if prevalence remains constant.

⁸⁷ Value updated to 2015, with a discount rate of 8% per year.

⁸⁸ Value updated to 2015, with a discount rate of 8% per year.

Based on the cost trends shown, it is possible to estimate the potential savings that may be achieved as soon as steps are taken to attain the proposed goals.

The distances between the trend lines in figure VI.8 (between scenario 2 and scenario 1 and between scenario 3 and scenario 1) illustrate the savings which would occur from year to year, accumulating through 2015 as steps are taken to reduce or eradicate undernutrition. These savings, expressed in 2004 present value,⁸⁹ equal US\$ 117.8 million and 243 million for scenarios 2 and 3, respectively. Of these amounts, 46% and 51%, respectively, would occur with the impact produced during the first half of the period (2005 – 2010).

This means that not only would costs in 2015 be significantly lower, but substantial savings would also be produced throughout the process of achieving the goal set for each scenario. Moreover, if the appropriate policies were maintained, the projected benefits would continue to accumulate in the years following 2015.

TABLE VI.13
ESTIMATED SAVINGS FOR EACH SCENARIO (MILLIONS OF US\$)
HONDURAS, 2015

| | Reduced to 9% | Eradicated (2.5%) |
|---------------------------------|---------------|-------------------|
| HEALTH | 48.8 | 62.6 |
| EDUCATION | 0.5 | 1.3 |
| PRODUCTIVITY | | |
| <i>Losses due to mortality</i> | 10.1 | 26.0 |
| <i>Fewer years of schooling</i> | 58.4 | 153.1 |
| TOTAL | 117.8 | 243.0 |

Source: Authors' compilation.

The above reflects the economic benefits of making progress towards the eradication of undernutrition. Any programme that achieves results in this area will improve people's quality of life while producing substantial savings for society.

⁸⁹ Value updated to 2004, with a discount rate of 8% per year.

VII. Results of the study in Nicaragua

1. Background

Nicaragua is among the countries in which the prevalence of undernutrition is above average for Latin America and the Caribbean. It occupies fourth place in Central America, with 1 in 10 children under the age of 5 suffering from a weight deficit and stunted growth affecting a fifth of the population.

This situation has arisen in a country that has the second highest undernourishment rate in Latin America and the Caribbean (surpassed only by Haiti). And while progress has been made between 1990/1992 and 2000/2002, it has been less than half of what is required to achieve the target set in the Millennium Development Goals. Moreover, 42% of the population lives in conditions of extreme poverty and 27% are non-indigent poor (ECLAC, 2005).

According to the most recent official publication available (WHO/DHS, 2001), 9.6% of Nicaraguan children under 5 years of age suffer from undernutrition in the categories “moderate” and “severe” on the basis of low weight for age.

Concerning newborns, nearly 8 in every 100 infants have low birth weight and 4 of every 100 suffer from intrauterine growth restriction, percentages which place Nicaragua within the group of high-incidence countries among the member states of the Central American Integration System (SICA).

Although there is insufficient representative information to perform an in-depth analysis of the nutritional status of pregnant women, as in other Central American countries, some unofficial data suggest that this group as well suffers from undernutrition problems, indicating a cycle of undernutrition which begins in the womb.

With respect to the evolving risk of undernutrition during the first years of life, the problem in Nicaragua—as noted in various studies in the region—has a tendency to become worse in the first 24 months of life (reaching nearly 12% in 2001), followed by improvement and stabilization during the rest of the pre-school stage.

TABLE VII.1
POPULATION AND UNDERWEIGHT IN NICARAGUA

| Age | Size of population (2004) | Population Affected (2004) ^a | Prevalences | | | |
|------------------------------|---------------------------|---|-------------------|---------|-----------|-----------|
| | | | 2001 | 1993 | 1980/1982 | 1965/1967 |
| Newborn (IUGR) | 148 120 ^b | 5 702 | 3.8% ^c | No data | No data | No data |
| 0 to 11 months | 148 120 | 10 770 | 7.3% | 6.0% | 9.1% | 9.0% |
| 12 to 23 months | 146 362 | 20 311 | 13.9% | 12.1% | 9.9% | 27.1% |
| 24 to 59 months ^d | 438 518 | 48 868 | 11.1% | 12.3% | 11.1% | 20.4% |
| Total | 733 000 | 85 651 | | | | |

Source: Authors' compilation, based on National Demographic and Health Surveys, the Ministry of Health and estimates from WHO and CELADE.

^a Estimated based on the most recent prevalence figure available.

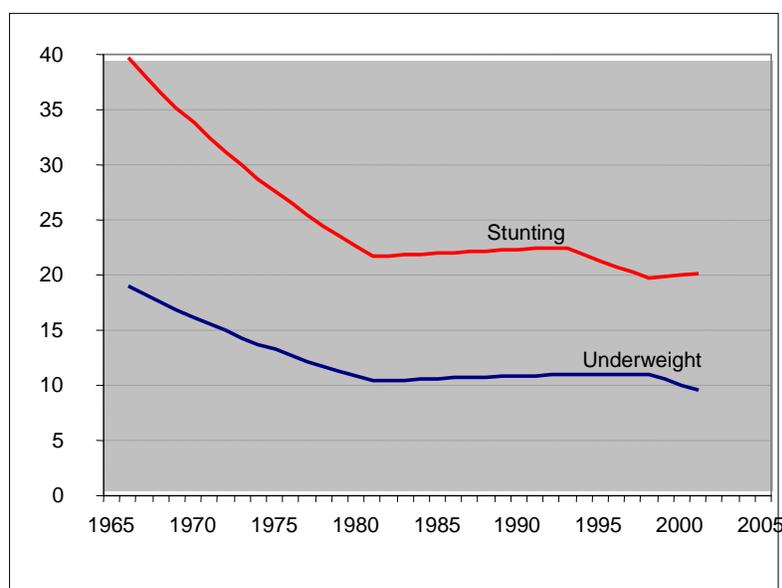
^b For a given year, the population of newborns is the same as that of infants aged 0 to 11 months.

^c Estimated using the De Onis equation, with official data from the Ministry of Health on low birth weight in 2004.

^d The prevalence of undernutrition for 1965/67 corresponds to 24 – 47 months.

As shown in the following figure, the rate of underweight in Nicaragua has declined significantly since 1960, however there is substantial variation in the rate of reduction. While prevalence declines between the years 1966 and 1980 by approximately 0.6 percentage points per year on average, from 1981 to 1998 it remains relatively constant (showing a slight increase) and from then until 2001 it falls by an average of just under 0.5 percentage points per year. If Nicaragua can maintain this annual rate of reduction, it may be able to eradicate underweight by 2015.

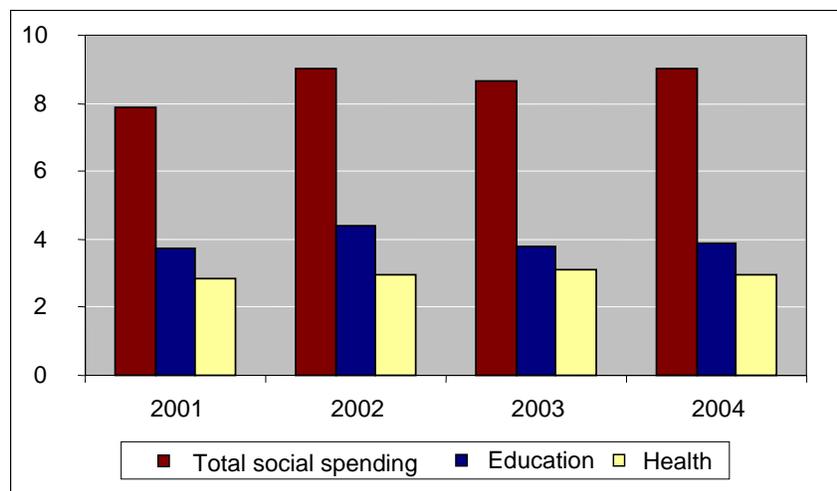
FIGURE VII.1
ESTIMATED UNDERNUTRITION LEVELS FOR CHILDREN UNDER FIVE
NICARAGUA, 1966 - 2001
(In percentages)



Source: Authors' compilation, based on DHS (1965/67, 1980/81, 1993, 1998 and 2001).

In response to undernutrition problems, Nicaragua dedicated 8.6% of its GDP to public social spending between the years 2000 and 2004, earmarking an average of 3.9% for education and 3.0% for health, which, combined, make up slightly over 80% of the total. As a function of GDP for each year, total public social spending increased by 23% since 1990 (rising 25% for education and falling 0.03% for health).

FIGURE VII.2
PUBLIC SOCIAL SPENDING AS A PERCENTAGE OF GDP BY SECTOR
NICARAGUA, 2001 - 2004
(In percentages)



Source: ECLAC, social spending data base.

Additionally, in the year 2000 Nicaragua adopted a new Food and Nutrition Security Policy, whose implementation is in the charge of the National Commission for Food and Nutrition Security (CONASAN), comprised of various ministries and state institutions. The Commission has developed a plan of action for the 2001-2006 period based on well-defined objectives, goals and responsible parties.

B. Effects and costs of underweight in 2004 (Analysis of the incidental retrospective dimension)

This section describes the estimated consequences of underweight in Nicaragua for health, education and productivity in the year 2004,⁹⁰ based on the incidental retrospective dimension. That is, the health effects and costs for pre-school children (0 to 59 months of age) suffering from undernutrition that year; the education effects and costs resulting from undernutrition suffered during the first five years of life by those who are of school age (7 to 18 years) during the year being studied; and the economic costs resulting from lost productivity among those of working age (15 to 64 years) who suffered from undernutrition before reaching age 5.

⁹⁰ The base information used in this study corresponds to data available as of December 2005.

As indicated in the methodology prepared for these studies, this model is used to estimate and analyse the effects and costs for education, health and productivity resulting from undernutrition in a given year, in this case 2004.

1. Health

1.1. Effects on health

Those who suffer from undernutrition at an early age are more vulnerable to disease and death, which can be determined by analysing probability differentials.

To estimate these effects, the authors have consulted data from epidemiological studies and the country's official health statistics, as well as information obtained through interviews with Nicaraguan specialists.

1.1.1 Morbidity

In Nicaragua, the effect of underweight on the morbidity rates of various associated diseases is likely to have amounted to 12,000 additional cases in 2004. The illnesses accounting for the majority of these cases are acute diarrheal diseases (ADD) with 6,000 cases, acute respiratory infections (ARI) with just over 2,500 cases and iron-deficiency anemia with slightly over 3,000 cases,⁹¹ a situation resulting from the differences in prevalence⁹² shown in table VII.2.

TABLE VII.2
EFFECTS OF UNDERWEIGHT ON HEALTH
NICARAGUA, 2004

| Age | Disease | Differences in Prevalence |
|-----------------|---------|---------------------------|
| 0 to 11 months | Anemia | 4.7% |
| | ADD | 12.0% |
| | ARI | 8.0% |
| 12 to 23 months | Anemia | 0.5% |
| | ADD | 5.5% |
| | ARI | 1.0% |
| 24 to 59 months | Anemia | 5.6% |
| | ADD | 7.3% |
| | ARI | 3.1% |

Source: Authors' compilation, based on official health statistics, relative risks from specialized studies of Central America and DHS 2001.

In addition to the aforementioned figures, 25 cases of diseases peculiar to critical calorie and protein deficiencies, such as wasting and kwashiorkor, were recorded in 2004.⁹³

⁹¹ The estimated effects and costs presented in this report are based on averages and are subject to the margins of error inherent in the original sources.

⁹² Differences in prevalence (DP) refers to the higher probability for those suffering from undernutrition of contracting a disease (i) as a "consequence" of their condition.

⁹³ This figure does not consider the direct effects of the micronutrient deficiencies; only the effects associated with underweight.

1.1.2 Mortality

Undernutrition affects mortality through a number of diseases, the most common of which are diarrhea, pneumonia, malaria and measles. In order to limit errors resulting from the poor quality of official records for causes of death, the situation in each country was assessed using estimates made by Fishman et al (2004), which define differential relative risks for each cause of death for children under 5 years of age, as well as mortality rates estimated by the Latin American and Caribbean Demographic Centre (CELADE).

Based on the above, it is estimated that some 236,000 children under the age of 5 died from causes related to undernutrition between the years 1940 and 2004. Considering the survival rates of the various cohorts throughout the period, slightly over 69% would still have been alive in 2004 had they not suffered from underweight. It is also estimated that of the total deaths that occurred in 2004 among the population of children under 5, 6,774 (22%) were related to underweight.

Moreover, as shown in table VII.3, between 1940 and 1989 underweight is believed to have been responsible for the deaths of 140,000 children under 5 who would have been between the ages of 15 and 64 in 2004 and, therefore, part of the working-age population (WAP).⁹⁴ As indicated in section 3 of the present chapter, this has a substantial effect on the country's productivity.

TABLE VII.3
MORTALITY ASSOCIATED WITH
UNDERWEIGHT AMONG CHILDREN UNDER FIVE, ADJUSTED TO THE SURVIVAL RATE
NICARAGUA, 1940 - 2004

| Period | No. of child deaths |
|--------------|---------------------|
| 1940s | 16 043 |
| 1950s | 26 768 |
| 1960s | 36 116 |
| 1970s | 31 987 |
| 1980s | 29 141 |
| 1990s | 17 678 |
| 2000-2004 | 6 754 |
| Total | 164 488 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al and DHS 1965/67, 1980/81, 1993, 1998 and 2001.

1.2. Costs to the health system

The majority of the institutional (publicly funded) and private health-care costs⁹⁵ which have arisen from the greater incidence of undernutrition-related diseases affecting children under 5

⁹⁴ For the purposes of comparing estimated costs, WAP is defined in this study as the population between 15 and 64 years of age.

⁹⁵ The costs to the public system were estimated based on information reported by various authorities from the Ministry of Health. The private costs were estimated using the official minimum wage and the fares for urban public transport.

years of age are concentrated within the age range of 24 to 59 months. This group accounts for 58% of the costs and the same percentage of the population affected.

The estimated public and private health costs of undernutrition in Nicaragua for 2004 equal US\$ 27 million, representing 0.6% of GDP and 20% of public spending on health for that year.

A breakdown of these costs reveals that 72% correspond to the public sector and 28% to the private sector.

The 97,000 cases requiring health care due to illnesses associated with undernutrition (see table VII.4) include 86,000 cases corresponding to children who need direct medical attention for no other reason than that they are underweight.

TABLE VII.4
COST OF UNDERWEIGHT IN TERMS OF HEALTH
NICARAGUA, 2004

| Age | Population Affected | Millions of C\$ | Millions of US\$ |
|-----------------|---------------------|-----------------|------------------|
| Newborn (IUGR) | 5 702 | 14.4 | 0.9 |
| 0 to 11 months | 13 437 | 43.0 | 2.7 |
| 12 to 23 months | 21 747 | 120.3 | 7.5 |
| 24 to 59 months | 56 669 | 251.1 | 15.8 |
| Total | 97 555 | 428.8 | 26.9 |

Source: Authors' compilation.

2. Education

2.1. Effects on education

Statistics from the Nicaraguan government indicate that education coverage is high in primary education (86%) and low in secondary education (39%).

According to the 2001 Household Survey, the average level of education of the adult population (20 to 64 years of age) is 5.5 years of study, reflecting a progressive increase in school attendance. While the average education level of age group 55-64 is 3 years below that of age group 20-24, scholastic achievement remains low and because of the coverage deficit, which remains high, only 25% of the latter group have completed secondary education.

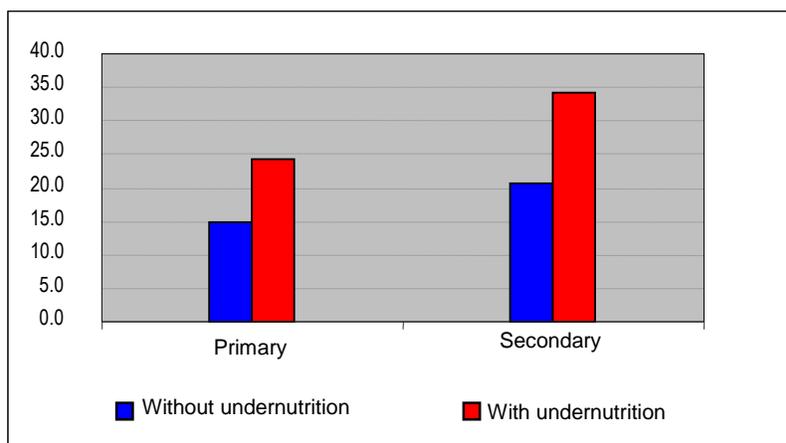
For primary and secondary education, the average education level of Nicaraguans who suffer from undernutrition is 1.9 years lower than that of Nicaraguans who do not. This may be due in part to the fact that those who suffered from undernutrition at the pre-school stage are more likely never to have reached even the first primary grade.

The percentage of those having suffered from undernutrition during childhood who complete secondary education (3%) is smaller than for those who have not suffered from undernutrition (20%). Considering only those with some level of schooling, 80% of the population suffering from undernutrition attended only primary school, whereas the figure for those not suffering from undernutrition is 48%. This correlation gradually reverses in secondary education, with fewer than 4% of those who suffer from undernutrition completing 11 years of school, while 25% of those who do not suffer from undernutrition reach this level. These differences are important indicators of the job-opportunity and income gaps that exist among Nicaraguans of working age.

Underweight in Nicaragua is likely to have caused 9,487 additional grade repetitions in 2004, with the corresponding incremental costs. Eighty percent of these repetitions occur at the primary level.⁹⁶

It is worth noting that children who have suffered from undernutrition account for a larger percentage of repetitions in the early primary grades than do “normal” children. However, as shown in the following figure, the rates for both groups are higher at the secondary level, though there is always a gap mainly affecting those who have suffered from undernutrition.

FIGURE VII.3
EFFECTS OF UNDERWEIGHT ON GRADE REPETITION
NICARAGUA, 2004
(In percentages)



Source: Authors' compilation, based on official education statistics (2003), DHS (2001) and CELADE population estimates (2004).

2.2. Education costs

Additional operating costs for the education system resulting from the increased grade repetition rate among those who have suffered from undernutrition account for a substantial portion of education costs. The slightly over 9,000 additional students estimated to have been present in 2004 due to the differential probability of repetition translate into US\$ 1.7 million, which represents 0.95% of public spending on education and 0.04% of GDP for that year.

⁹⁶ The educational gaps resulting from undernutrition were estimated by adapting the estimates from a longitudinal study conducted in Chile between 1987 and 1998 (Ivanovic 2005). According to these estimates, among socioeconomically similar populations, the risk of grade repetition for students having suffered from undernutrition at the pre-school stage is 1.65 times that of students who have not. In the absence of estimators for Central America and considering the characteristics of the education systems, comparable estimates between the Central American countries were made based on the aforementioned relative risk for grade repetition and an attrition differential of approximately 1.2.

TABLE VII.5
COSTS RESULTING FROM DIFFERENTIAL GRADE REPETITION DUE TO UNDERWEIGHT
NICARAGUA, 2004

| | Education Level | |
|------------------------------------|-----------------|-----------|
| | Primary | Secondary |
| Annual cost (per student C\$ 2004) | 2 708 | 3 153 |
| Additional annual cost (C\$ 2004) | 20 538 389 | 5 999 912 |
| Additional annual cost (2004 US\$) | 1 288 707 | 376 472 |
| | 1 665,180 | |
| % Social spending on education | 0.95% | |
| % GDP | 0.04% | |

Source: Authors' compilation, based on official education statistics (2003) and DHS (2001).

3. Productivity

3.1. Effects on productivity

As mentioned before, undernutrition has a negative impact on a country's production capacity as a result of increased mortality among children under the age of 5 from diseases associated with undernutrition, as well as lower levels of education attained by those suffering from the affliction.

Table VII.6 shows the magnitude of the lost productivity resulting from the aforementioned 140,000 deaths of children under the age of 5. Considering the country's employment rates by cohort, the consequent cost amounts to 203 million work hours, roughly 4.8% of the hours worked by the economically active population (EAP).

TABLE VII.6
PRODUCTIVITY EFFECTS OF MORTALITY DUE TO UNDERWEIGHT IN NICARAGUA

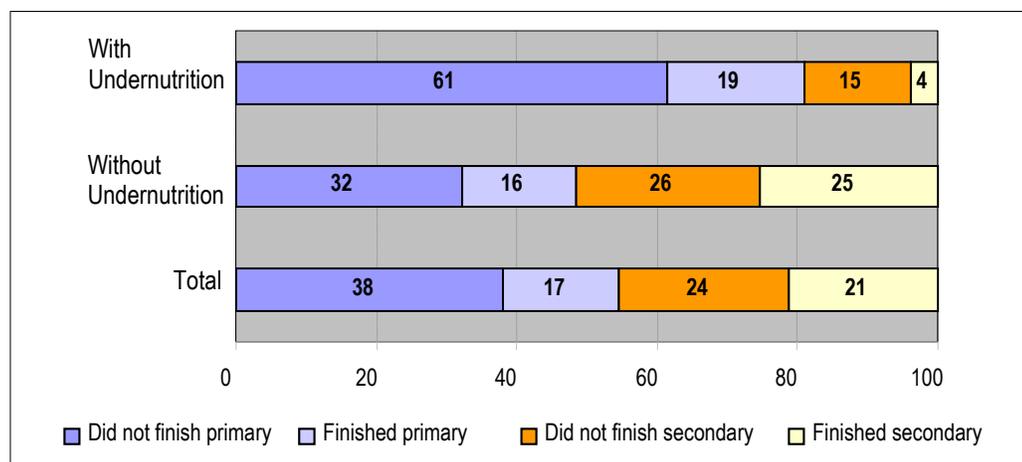
| Age Group (years) | Mortality due to undernutrition (No. of cases, 1940 – 1989) | Lost work hours (2004) |
|-------------------------------------|---|------------------------|
| 15-24 | 29 141 | 40 433 098 |
| 25-34 | 31 987 | 28 817 987 |
| 35-44 | 36 116 | 59 982 265 |
| 45-54 | 26 768 | 47 664 563 |
| 55-64 | 16 043 | 26 821 443 |
| Total | 140 056 | 203 719 356 |
| % hours lost relative to EAP | | 4.8% |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al and DHS 2001.

Assuming a work potential of 2,400 hours a year, these deaths associated with undernutrition translate into an estimated loss of 336 million work hours, equivalent to 6% of those worked by the EAP.

Reduced productivity due to the educational gap corresponds to the differences in distribution of the population according to years of primary and secondary education between those who have suffered from undernutrition and those who have not. This phenomenon can be observed in the following figure, which reflects the grade levels reached by those who were able to attend school.

FIGURE VII.4
EFFECTS OF UNDERWEIGHT ON EDUCATION-LEVEL DISTRIBUTION
NICARAGUA, 2004 (POPULATION 25 TO 64 YEARS OF AGE)
(In percentages)



Source: Authors' compilation, based on the Household Survey (2001), DHS (2001) and the CELADE population estimate (2004).

3.2. Productivity costs

The increased productivity costs reflect the economic value of the aforementioned effects. For the year 2004, losses due to lower education levels are estimated at US\$ 84 million, which represents 20% of public spending on education and roughly 1.8% of GDP.

Moreover, lost productivity as a result of deaths from undernutrition among the population that would have been of working age in 2004 is estimated at US\$ 152 million, approximately 3.3% of GDP. Thus, were it not for the levels of undernutrition suffered in the country over the last few decades, productivity in 2004 would have been 5% higher.

4. Summary of costs

In summation, it is estimated that in 2004 the underweight suffered by the various cohorts had a cost of 4.086 billion córdobas, equaling US\$ 264 million. This amount represents 5.8% of GDP and roughly 64% of total public social spending for the country that year.

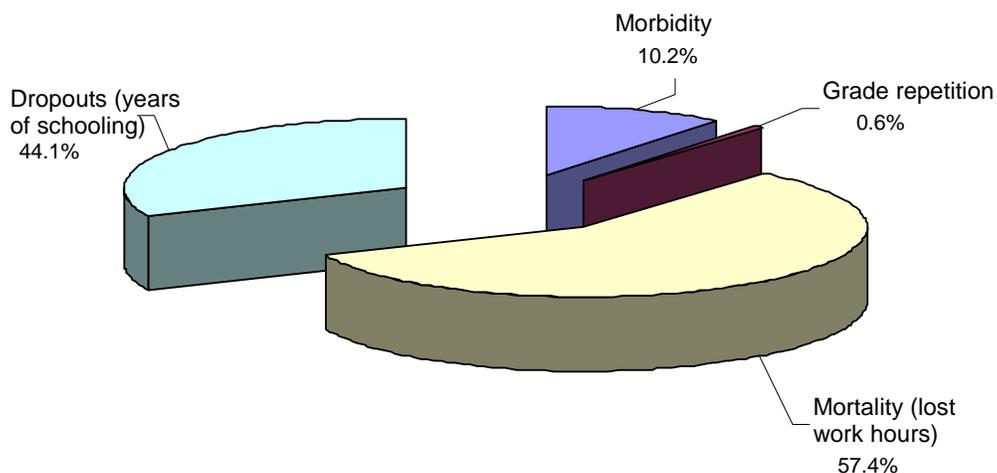
TABLE VII.7
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERNUTRITION
NICARAGUA 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)

| | Units | Millions of C\$ | Millions of US\$ |
|--|-------------|-----------------|------------------|
| HEALTH | | | |
| <i>Additional cases of morbidity</i> | 97 555 | 429 | 26.9 |
| <i>Number of additional deaths</i> | 164 488 | | |
| EDUCATION | | | |
| <i>Additional repeated grades</i> | 9 487 | 27 | 1.7 |
| <i>Differential number of dropouts</i> | 72 256 | | |
| PRODUCTIVITY | | | |
| <i>Hours lost due to mortality</i> | 203 719 356 | 2 293 | 151.8 |
| | 1.9 | 1 338 | 83.9 |
| Total | | 4 086 | 264 |
| Social Spending | | | 64.3% |
| % GDP | | | 5.8% |

Source: Authors' compilation.

As shown in the following figure, the costs corresponding to lost productivity as a result of mortality and fewer years of schooling account for nearly 90% of the total, while costs associated with morbidity from undernutrition account for 10% and grade repetition represents less than 1%.

FIGURE VII.5
DISTRIBUTION OF THE COST OF UNDERWEIGHT BY FACTOR
NICARAGUA 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)



Source: Authors' compilation.

C. Effects and costs for the cohort aged 0-59 months in 2004 (Analysis of the prospective dimension)

This model serves to estimate present and future losses (and potential savings) associated with health care, grade repetition and diminished productivity due to the current level of underweight in Nicaragua for the year 2004 among children under the age of five.

1. Health effects and costs

As noted in the previous chapter, undernutrition suffered at an early age increases the risk of dying and contracting certain diseases.

According to projections based on census data, it is estimated that of the children belonging to the cohort aged 0-59 months in 2004, slightly over 9,834 will die before reaching 5 years of age. Of these deaths, over 2,000 will be related to undernutrition, with nearly 1,313 such cases in 2004.⁹⁷ Thus, while undernutrition affects nearly 15% of children under 5, the proportion of deaths resulting from this affliction is 22%, reflecting the increased risk of mortality for those who suffer from underweight.

TABLE VII.8
MORTALITY ASSOCIATED WITH UNDERWEIGHT AMONG CHILDREN UNDER FIVE IN NICARAGUA, 2004 - 2008

| Age | 2004 | 2005 | 2006 | 2007 | 2008 | % |
|-----------------|-------|------|------|------|------|-------|
| 0 to 11 months | 983 | | | | | 46% |
| 12 to 59 months | 330 | 330 | 247 | 164 | 82 | 54% |
| Total | 1 313 | 330 | 247 | 164 | 82 | 2 136 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks reported by Fishman et al and DHS 2001.

As shown in table VII.8, the majority of the deaths are expected to occur before reaching age 1, during which period the probability of death is 3 times that of the rest of the cohort. Nevertheless, slightly over half the deaths from causes associated with undernutrition occur between the ages of 1 and 4.

Regarding morbidity, it is estimated that among the cohort aged 0-59 months in 2004 in Nicaragua, nearly 17,000 additional cases of illness associated with underweight will arise prior to age 5, primarily due to anemia, ADD and ARI. Of these cases, 70% will occur among children aged 24 to 59 months.

TABLE VII.9
MORBIDITY ASSOCIATED WITH UNDERWEIGHT AMONG CHILDREN UNDER FIVE NICARAGUA, 2004 - 2008

| Age | Total Estimated Cases of Disease | | | | | % |
|-----------------|----------------------------------|-------|-------|------|------|--------|
| | 2004 | 2005 | 2006 | 2007 | 2008 | |
| 0 to 11 months | 2 667 | | | | | 16 |
| 12 to 23 months | 1 435 | 979 | | | | 14 |
| 24 to 59 months | 7 801 | 2 522 | 1 020 | 206 | 36 | 70 |
| Total | 11 904 | 3 501 | 1 020 | 206 | 36 | 16 667 |

Source: Authors' compilation.

⁹⁷ All the estimates for the cohort aged 0-4 years in 2004 decline progressively through 2008 as a result of members passing into older age groups.

In addition to the cases of morbidity indicated in table VII.9, it is important to consider treatment specifically for underweight required for children who suffer from the condition, which amounts to 80,000 cases in 2004 and 37,000 more between 2005 and 2008. Of these, nearly 6,000 correspond to low birth weight due to intrauterine growth retardation (LBWIUGR).

The additional cost in health resulting from the additional cases of disease estimated to have been caused by undernutrition totals US\$ 27 million in 2004 alone, with a present value⁹⁸ of US\$ 37 million for the 2004-2008 period.

TABLE VII.10
COSTS OF MORBIDITY ASSOCIATED WITH UNDERWEIGHT
NICARAGUA, 2004-2008 (MILLIONS OF 2004 US\$)

| Age | 2004 | 2005 | 2006 | 2007 | 2008 |
|-----------------|------|------|------|------|------|
| Newborn | 0.9 | | | | |
| 1 to 11 months | 2.7 | | | | |
| 12 to 23 months | 7.5 | 4.5 | | | |
| 24 to 59 months | 15.8 | 4.3 | 1.7 | 0.3 | 0.1 |
| Total | 26.9 | 8.8 | 1.7 | 0.3 | 0.1 |
| PNV | 36.8 | | | | |

Source: Authors' compilation.

The amounts indicated in table VII.10 translate into an equivalent annual cost (EAC)⁹⁹ of US\$ 9 million for the period shown, which represents roughly 6.7% of public spending on health and 0.2% of GDP.

2. Education effects and costs

A projection for the education of the children under 5 years of age in 2004¹⁰⁰ is created by estimating the differential probability of scholastic achievement as well as the additional costs that will be produced by the approximately 84,000 future students that currently suffer from undernutrition in Nicaragua.

According to official data, it is reasonable to estimate that between the years 2006 and 2020 some 7,000 additional cases of grade repetition will occur. Of these cases, 80% will occur in the primary grades and 20% during secondary education.

The education costs of the additional repetitions, expressed in present value (at a discount rate of 8%), would total 12 million córdobas or US\$ 800,000 in 2004 dollars.

This amount, over the 15-year period during which the cohort being studied would be of school age (2006-2020), translates into an equivalent annual cost of 1.4 million córdobas or US\$ 88,000 in 2004 dollars, representing 0.05% of public spending on education and 0.002% of GDP for that year.

Of these costs, 43% would be borne by the children's families and 57% would be covered by the education system itself.

⁹⁸ With a discount rate of 8% per year.

⁹⁹ Ibid.

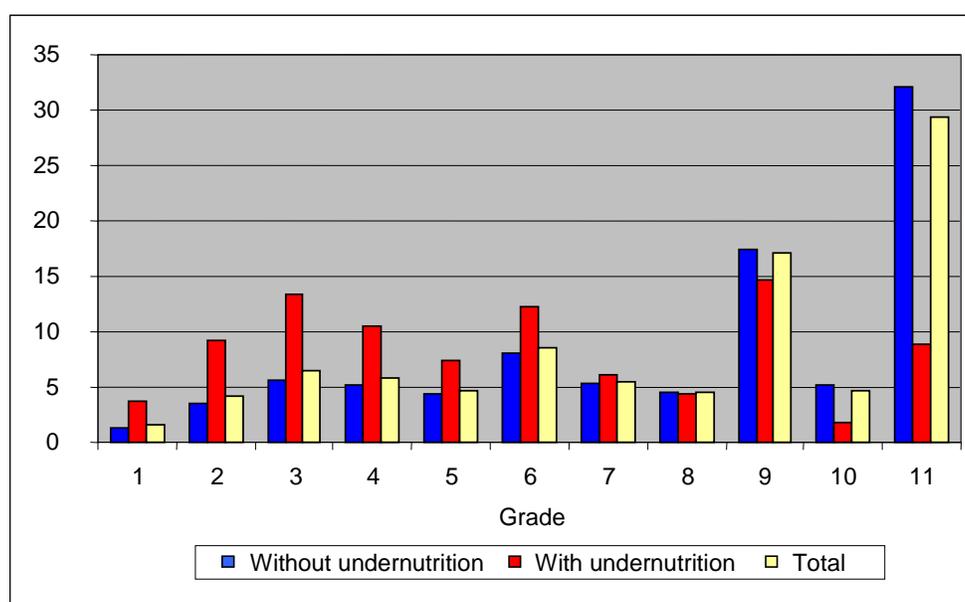
¹⁰⁰ The projection is based on education coverage for the school-age population and education levels reached by the cohort aged 20 to 24 years according to the most recent household survey (2001).

Moreover, the higher drop-out risk for those suffering from undernutrition will account for some 15,000 students' leaving school prematurely as a result of this condition.

Consequently, the estimated difference in grade completion between those who suffer from undernutrition and those who do not is 2.1 years, with students suffering from the condition completing 3.7 years of study on average.

Lastly, for the cohort as a whole it is estimated that 3 of every 100 children suffering from undernutrition complete 12 years of school, while 20 of every 100 students not suffering from the condition attain this level of education.

FIGURE VII.6
ESTIMATED DISTRIBUTION OF GRADE COMPLETION FOR THE COHORT AGED 0-59
MONTHS IN 2004, WITH AND WITHOUT UNDERWEIGHT. NICARAGUA
(In percentages)



Source: CELADE population estimates.

3. Productivity effects and costs

The grade-completion differentials discussed in the previous section translate into less human capital acquired by those who suffer from undernutrition, producing a direct negative effect on their productivity.

Also, the estimated 2,136 additional deaths that are expected to have occurred between 2004 and 2008 as a result of undernutrition among the cohort aged 0-59 months represent a potential productivity loss of nearly 200 million work hours during their productive lives (2014 to 2068).

Based on these figures, the economic losses in terms of productivity associated with underweight among the population under 5 years of age in Nicaragua are estimated at 648 million córdobas in 2004, equivalent to US\$ 41 million in 2004 dollars.¹⁰¹ Of this sum, US\$ 34 million is the result of lower education levels and 7 million is due to differential mortality.

¹⁰¹ With a discount rate of 8% per year.

Considering the entire period during which these losses are expected to occur (2014-2068), the equivalent annual cost is 53 million córdobas or US\$ 3.3 million. Of this amount, US\$ 500,000 corresponds to losses due to mortality and US\$ 2.8 million represents the costs due to lower education levels.

The equivalent annual cost of these losses in productivity represents 0.07% of Nicaragua's GDP.

4. Summary of effects and costs

Combining all the sources of estimated costs stemming from undernutrition among the cohort of children under the age of 5 in 2004 produces a total present value of 1.248 billion córdobas or US\$ 78 million.

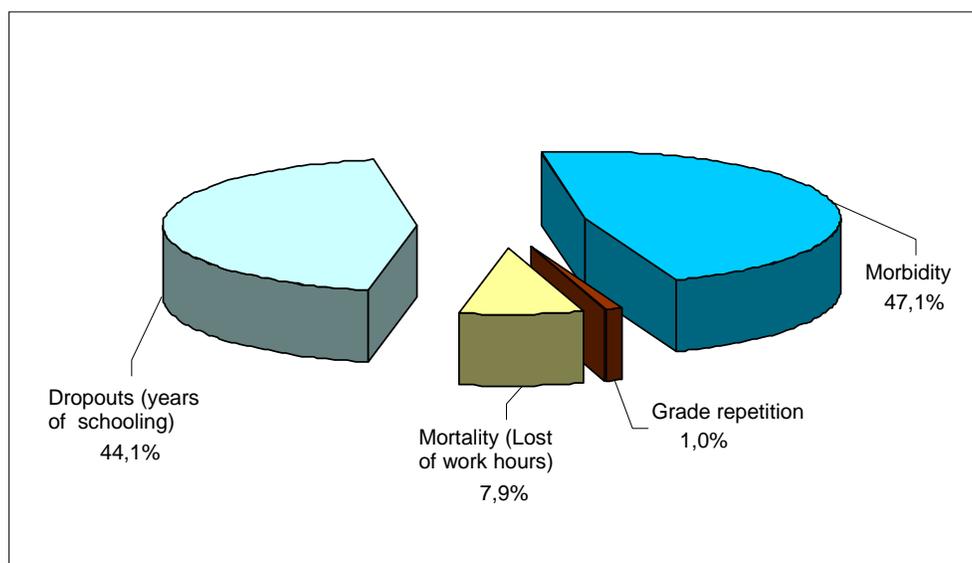
These figures indicate that the human resources lost as a result of reduced academic achievement and higher health costs due to morbidity account for most of the estimated costs of undernutrition (44% and 47%, respectively).

TABLE VII.11
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERWEIGHT FOR THE COHORT
AGED 0-59 MONTHS IN 2004 IN NICARAGUA

| | Units | Costs (Present Value) | |
|--|-------------|--------------------------|------------------|
| | | Millions of C\$ | Millions of US\$ |
| HEALTH | | | |
| <i>Additional cases of morbidity</i> | 117 727 | 587 | 36.8 |
| <i>Number of additional deaths</i> | 2 136 | | |
| EDUCATION | | | |
| <i>Additional repeated grades</i> | 7 823 | 12.5 | 0.8 |
| <i>Differential number of dropouts</i> | 14 705 | | |
| PRODUCTIVITY | | | |
| <i>Hours lost due to mortality</i> | 197 406 463 | 97.95 | 6.1 |
| <i>Fewer years of schooling</i> | 2.1 | 550 | 34.5 |
| Total | | 1 248 | 78 |

Source: Authors' compilation.

FIGURE VII.7
DISTRIBUTION OF THE ESTIMATED COST OF UNDERNUTRITION IN NICARAGUA BY FACTOR
(PROSPECTIVE DIMENSION 2004)



Source: Authors' compilation.

D. Analysis of scenarios: Costs and savings

Based on the estimated costs for Nicaragua resulting from the prevalence of underweight among the population under 5 years of age in 2004, various possible scenarios can be constructed. Below are the results of simulations corresponding to three scenarios for undernutrition trends and their effects on costs for the year 2015.

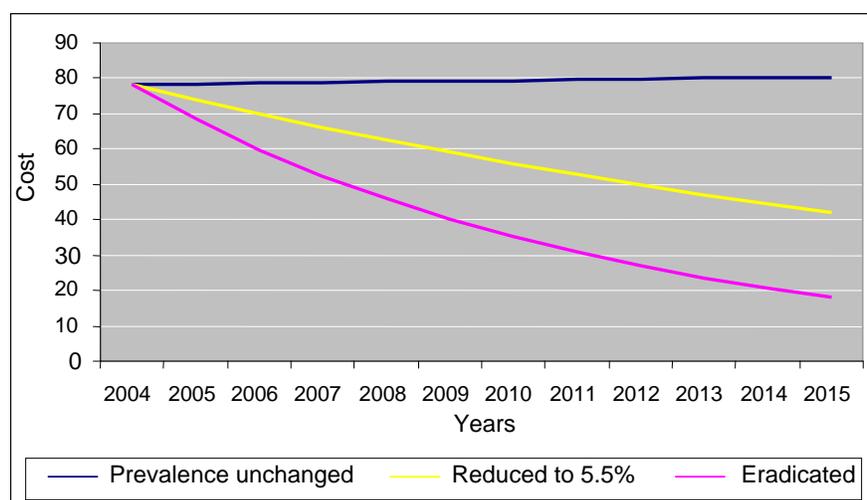
The scenarios considered are the following:

1. The most recent figures available on the prevalence of underweight, used for this study, are maintained through 2015 (see table VII.1).
2. The target set in the Millennium Development Goals (MDG) of reducing underweight to half 1990 levels is achieved by 2015. This would entail progressively lowering levels until reaching a rate of 5.5% for children under 5, a reduction of approximately 0.3 percentage points per year on average.
3. By 2015, the country has eradicated underweight, which for purposes of analysis means reducing prevalence to 2.5%, representing the "normal" rate as defined by NCHS measuring parameters. Achieving this goal entails a reduction of just over 0.5 percentage points per year, which would mean maintaining the trend shown between 1998 and 2001.

Figure VII.8 demonstrates how progressively reducing the prevalence of underweight creates a progressive reduction in the costs associated with it. Given that the cohort of children aged 0-4 years is expanding in Nicaragua, if the prevalence remains constant (scenario 1), costs in 2015 will increase by nearly 3%. If the MDG target is achieved (scenario 2), the costs of

underweight for the year 2015 will fall to US\$ 42.2 million.¹⁰² And if the scenario of eradication is realized, the costs will be reduced even further to a present value of US\$ 18.9 million¹⁰³ by 2015.

FIGURE VII.8
TREND OF ESTIMATED COSTS OF UNDERWEIGHT FOR THREE SCENARIOS
(MILLIONS OF US\$)
NICARAGUA, 2004 - 2015



Source: Authors' compilation.

Table VII.12 compares the estimated costs in 2004 with those projected for each scenario by 2015. As shown, the greatest variation in costs occurs in health and productivity.

TABLE VII.12
ESTIMATED TOTAL COSTS OF UNDERWEIGHT FOR THE BASE YEAR AND THREE
SCENARIOS (MILLIONS OF US\$) NICARAGUA, 2004 AND 2015

| | 2004 | Scenarios for the year 2015 | | |
|---------------------------------|-------------|-----------------------------|-----------------|-------------------|
| | | Prevalence remains constant | Reduced to 5.5% | Eradicated (2.5%) |
| HEALTH | 36.8 | 37.9 | 18.7 | 8.2 |
| EDUCATION | 0.8 | 0.8 | 0.5 | 0.2 |
| PRODUCTIVITY | | | | |
| <i>Losses due to mortality</i> | 6.1 | 6.2 | 2.7 | 1.3 |
| <i>Fewer years of schooling</i> | 34.5 | 35.6 | 20.4 | 8.2 |
| Total | 78.3 | 80.4^(*) | 42.2 | 18.9 |

Source: Authors' compilation.

(*) The increased cost is due to demographic projections which suggest a growing cohort of children aged 0 to 4 years, the direct effect of which is an increase in the absolute number of children suffering from undernutrition even if prevalence remains constant.

¹⁰² Value updated to 2015, with a discount rate of 8% per year.

¹⁰³ Ibid.

Based on the cost trends shown, it is possible to estimate the potential savings that may be produced as soon as steps are taken to achieve the proposed goals.

The distances between the trend lines in figure VII.8 (between scenario 2 and scenario 1 and between scenario 3 and scenario 1) illustrate the savings which would occur from year to year, accumulating through 2015 as steps are taken to reduce or eradicate undernutrition. These savings, expressed in 2004 present value,¹⁰⁴ equal US\$ 25.2 million and 45.9 million for scenarios 2 and 3, respectively. Of these amounts, 45% and 48%, respectively, would be saved with the impact produced during the first half of the period (2005 – 2010).

TABLE VII.13
ESTIMATED SAVINGS FOR EACH SCENARIO (MILLIONS OF US\$)
NICARAGUA, 2015

| | Reduced to 5.5% | Eradicated (2.5%) |
|---------------------------------|------------------------|--------------------------|
| HEALTH | 11.1 | 17.2 |
| EDUCATION | 0.2 | 0.5 |
| PRODUCTIVITY | | |
| <i>Losses due to mortality</i> | 4.2 | 8.3 |
| <i>Fewer years of schooling</i> | 9.7 | 19.9 |
| Total | 25.2 | 45.9 |

Source: Authors' compilation.

These results indicate that not only would costs in 2015 be significantly lower, but substantial savings would also be produced throughout the process of achieving the goal set for each scenario. Moreover, if the appropriate policies were maintained, the projected benefits would continue to accumulate in the years following 2015.

The above reflects the economic benefits of making progress towards the eradication of undernutrition. Any programme that achieves results in this area will improve people's quality of life while producing substantial savings for society.

¹⁰⁴ Value updated to 2004, with a discount rate of 8% per year.

VIII. Results of the study in Panama

A. Background

Panama has one of the lowest prevalences of undernutrition in Central America, with rates below the average for Latin America and the Caribbean. The results of the most recent nutrition surveys show that weight deficits affect 1 in every 15 children under the age of 5 and roughly a fifth of this group suffers from stunted growth.

This situation has arisen in a country that has the second highest undernourishment rate in Central America and has shown a negative trend over the last decade, with a retreat of 48%, making it difficult to reach the target set in the Millennium Development Goals. On the other hand, Panama has one of the lowest levels of poverty and extreme poverty in the Central American subregion (ECLAC, 2005).

According to the most recent official publication available (ENCOVI, 2003), 6.8% of children aged 1 to 59 months suffer from undernutrition in the categories “moderate” and “severe” on the basis of low weight for their age. Thus, while significant progress has been made, it is necessary to continue working towards the eradication of undernutrition.

Concerning newborns, nearly 13 in every 100 infants have low birth weight and 8 of every 100 suffer from intrauterine growth restriction, making Panama one of the countries with the highest incidence among the member nations of the Central American Integration System (SICA), along with Guatemala.

With respect to the evolving risk of undernutrition during the first years of life, the problem in Panama—as noted in various studies in the region—has a tendency to become worse in the first 24 months of life (reaching nearly 9% in 2003), followed by improvement and stabilization during the rest of the pre-school stage.

TABLE VIII.1
POPULATION AND UNDERWEIGHT IN PANAMA

| Age | Size of Population (2004) | Population Affected | Prevalences | | | |
|------------------------------|---------------------------|---------------------|-------------------|---------|---------|-----------|
| | | | 2003 | 1997 | 1980 | 1965/1967 |
| Newborn (IUGR) | 69 326 ^b | 5 377 | 7.8% ^c | No data | No data | No data |
| 0 to 11 months | 69 326 | 3 288 | 4.7% | 3.6% | 7.8% | 12.0% |
| 12 to 23 months | 68 696 | 6 125 | 8.9% | 11.5% | 17.1% | 24.0% |
| 24 to 59 months ^d | 203 376 | 13 975 | 6.9% | 8.3% | 17.6% | 12.9% |
| Total | 341 398 | 28 765 | | | | |

Source: Authors' compilation, based on National Demographic and Health Surveys, the Survey of Living Conditions, the Statistics Division of the Ministry of Health and estimates from WHO and CELADE.

^a Estimated based on the most recent prevalence figure available.

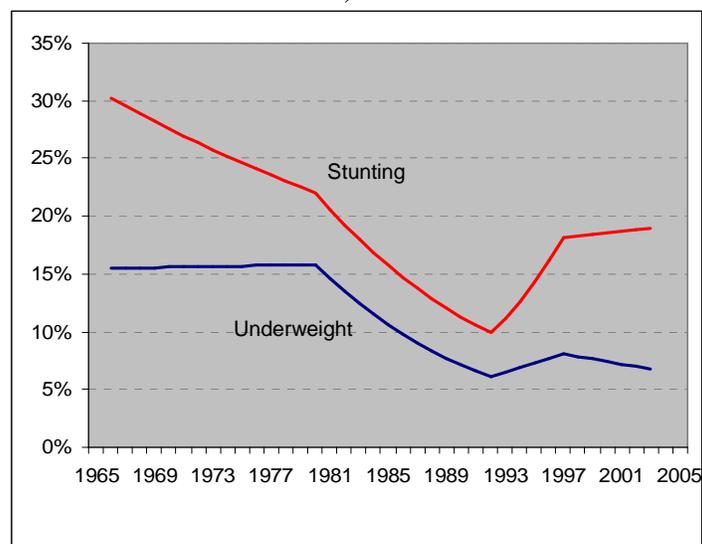
^b For a given year, the population of newborns is the same as that of infants aged 0 to 11 months.

^c Estimated using the De Onis equation, with official data from the Statistics Division of the Ministry of Health on low birth weight in 2004.

^d The prevalence of undernutrition for 1965/67 corresponds to 24 – 47 months.

As the following figure indicates, while underweight has shown a general downward trend in Panama over the last 40 years, there is a stark contrast between periods. Whereas the rate remains more or less constant between 1966 and 1980, from 1980 to 1992 it falls by an average of 0.4 percentage points per year. From this point forward there is a period of increase, followed by another period of decline (0.09 and 0.06 percentage points per year, respectively). As a result of these changing trends, the undernutrition rate in 2003 is in fact slightly higher than in 1992.

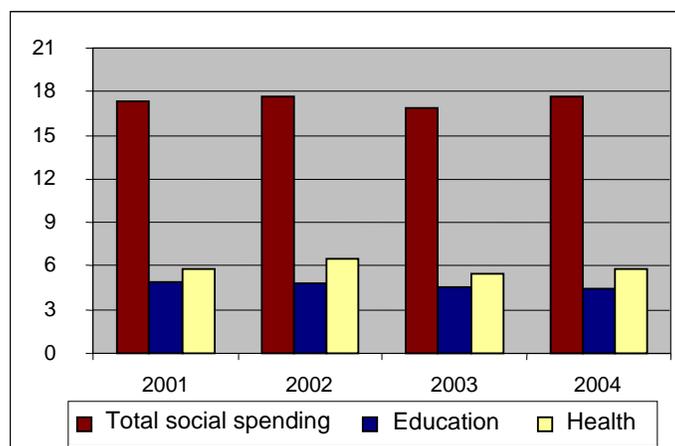
FIGURE VIII.1
ESTIMATED UNDERNUTRITION LEVELS FOR CHILDREN UNDER FIVE
PANAMA, 1966 – 2001



Source: Authors' compilation, based on DHS (1965/67, 1980, 1992, 1997) and ENCOVI 2003.

In response to undernutrition problems, Panama dedicated 17.4% of its GDP to public social spending between the years 2000 and 2004, earmarking an average of 4.7% for education and 5.9% for health, which, combined, make up slightly over 61% of total public spending. As a function of GDP for each year, total public social spending increased by 14% since 1990 (16% for education and 13% for health).

FIGURE VIII.2
PUBLIC SOCIAL SPENDING AS A PERCENTAGE OF GDP BY SECTOR
PANAMA, 2001 – 2004
(In percentages)



Source: ECLAC, social spending data base.

Concerning food policy, Panama's Executive Decree No. 171 of October 18, 2004 establishes the National Secretariat for the Food and Nutrition Plan (SENEPAN) "as the body in charge of proposing, coordinating, overseeing and evaluating promotional, prevention, reduction and training efforts related to the country's food and nutrition problem" (SENEPAN 2006).

B. Effects and costs of underweight in 2004 (Analysis of the incidental retrospective dimension)

This section describes the estimated consequences of underweight in Panama for health, education and productivity in the year 2004,¹⁰⁵ based on the incidental retrospective dimension. That is, the health effects and costs for preschool children (0 to 59 months of age) suffering from undernutrition that year; the education effects and costs resulting from undernutrition suffered during the first 5 years of life by those who are of school age (7 to 18 years) during the year being studied; and the economic costs resulting from lost productivity among those of working age (15 to 64 years) who suffered from undernutrition before reaching age 5.

As indicated in the methodology prepared for these studies, this model is used to estimate and analyse the effects and costs for education, health and productivity resulting from undernutrition in a given year, in this case 2004.

¹⁰⁵ The base information used in this study corresponds to data available as of January 2006.

1. Health

1.1. Effects on health

Those who suffer from undernutrition at an early age are more vulnerable to disease and death, a fact which can be determined by analysing probability differentials.

To estimate these effects, the authors have consulted data from epidemiological studies and the country's official health statistics, as well as information obtained through interviews with Panamanian specialists.

1.1.1 Morbidity

In Panama, the effects of underweight on the morbidity rates of various associated diseases is likely to have equaled 4,000 additional cases in 2004. Of these cases, half correspond to acute diarrheal diseases (ADD) and the other half are distributed evenly between acute respiratory infections (ARI) and iron-deficiency anemia,¹⁰⁶ a situation arising from the differences in prevalence¹⁰⁷ shown in table VIII.2.

TABLE VIII.2
EFFECTS OF UNDERWEIGHT ON HEALTH
PANAMA, 2004
(In percentages)

| Age | Disease | Differences in Prevalence |
|-----------------|---------|---------------------------|
| 0 to 11 months | Anemia | 4.8 |
| | ADD | 14.4 |
| | ARI | 15.5 |
| 12 to 23 months | Anemia | 0.5 |
| | ADD | 7.6 |
| | ARI | 1.5 |
| 24 to 59 months | Anemia | 7.0 |
| | ADD | 11.5 |
| | ARI | 4.3 |

Source: Authors' compilation, based on official health statistics, relative risks from specialized studies of Central America and ENCOVI 2003.

In addition to the aforementioned figures, three cases of diseases peculiar to critical calorie and protein deficiencies, such as wasting and kwashiorkor, were recorded in 2004.¹⁰⁸

¹⁰⁶ The estimated effects and costs presented in this report correspond to averages and are subject to the margins of error inherent in the original sources.

¹⁰⁷ Differences in prevalence (DP) refer to the increased probability for those suffering from undernutrition of contracting a disease (i) as a "consequence" of their condition.

¹⁰⁸ The direct effects of micronutrient deficiencies are not considered, only the effects associated with underweight.

1.1.2 Mortality

Undernutrition affects mortality through a number of diseases, the most common of which are diarrhea, pneumonia, malaria and measles. In order to limit errors resulting from the poor quality of official records for causes of death, the situation in each country was assessed using estimates made by Fishman et al (2004), which define differential relative risks for each cause of death for children under five years of age, as well as mortality rates estimated by the Latin American and Caribbean Demographic Centre (CELADE).

Based on the above, it is estimated that nearly 57,000 children under the age of 5 died from causes related to undernutrition between the years 1940 and 2004. Considering the survival rates of the various cohorts throughout the period, slightly over 77% would still have been alive in 2004 had they not suffered from underweight. It is also estimated that of the total deaths that occurred among the population of children under 5 in 2004, some 1,546 (17%) were related to underweight.

Moreover, as shown in table VIII.3, between 1940 and 1989 underweight is believed to have been responsible for the deaths of 40,000 children under 5 who would have been between the ages of 15 and 64 in 2004 and, therefore, part of the working-age population (WAP).¹⁰⁹ As indicated in section 3 of the present chapter, this has a substantial effect on the country's productivity.

TABLE VIII.3
MORTALITY ASSOCIATED WITH
UNDERWEIGHT AMONG CHILDREN UNDER FIVE, ADJUSTED TO THE SURVIVAL RATE
PANAMA, 1940 – 2004

| Period | No. of child deaths |
|--------------|---------------------|
| 1940s | 6 376 |
| 1950s | 9 103 |
| 1960s | 11 033 |
| 1970s | 9 690 |
| 1980s | 4 745 |
| 1990s | 3 437 |
| 2000-2004 | 1 546 |
| Total | 44 385 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks reported by Fishman et al and DHS 1965/67, 1980, 1992, 1997 and ENCOVI 2003.

1.2. Costs to the health system

The majority of the institutional (publicly funded) and private health-care costs which have arisen from the greater incidence of undernutrition-related diseases¹¹⁰ affecting children under 5 years of

¹⁰⁹ For the purpose of comparing estimated costs, WAP is defined in this study as the population between 15 and 64 years of age.

¹¹⁰ Costs to the public system were estimated based on information reported by various authorities from the Ministry of Health. Private costs were estimated using the official minimum wage and the fare for urban public transport.

age are concentrated among newborns, who represent 16% of the affected population and 75% of the total health costs for the cohort. This is due to the fact that the highest unit costs occur in this group.

The estimated public and private health costs for Panama are equivalent to US\$ 26 million in 2004 dollars, representing 0.2% of GDP and 3.3% of public spending on health for that year.

TABLE VIII.4
HEALTH COST OF UNDERWEIGHT
PANAMA, 2004

| Age | Number of Cases | Millions of US\$ |
|-----------------|-----------------|------------------|
| Newborn (IUGR) | 5 377 | 19.9 |
| 0 to 11 months | 4 428 | 0.9 |
| 12 to 23 months | 6 712 | 1.6 |
| 24 to 59 months | 17 169 | 3.9 |
| Total | 33 686 | 26.4 |

Source: Authors' compilation.

The nearly 34,000 cases requiring health care due to illnesses associated with undernutrition (see table VIII.4) include 28,000 cases corresponding to children who need direct medical attention for no other reason than that they are underweight.

2. Education

2.1. Effects on education

According to the 2002 household survey, the average level of education of the adult population (20 to 64 years of age) is 6.8 years of study, reflecting a progressive increase in school attendance. The average education level of Panamanians aged 55 to 64 years is 2.9 years lower than for those aged 20 to 24 years. However, only half of the latter group have completed secondary education.

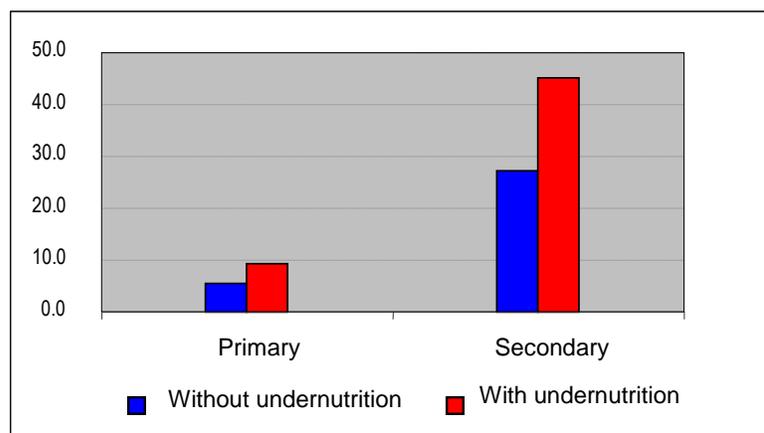
For primary and secondary grades, the average education level of Panamanians who suffer from undernutrition is 1.8 years lower than that of Panamanians who do not. This may be due in part to the fact that those who suffered from undernutrition at the pre-school stage are more likely never to have reached even the first primary grade.

The percentage of students having suffered from undernutrition during childhood who complete secondary education (22%) is smaller than for those who have not suffered from undernutrition (46%). Considering only those with some level of schooling, 54% of the population suffering from undernutrition attended only primary school, whereas the figure for those not suffering from the condition is 27%. This correlation gradually reverses in secondary education, with fewer than 23% of those who suffer from undernutrition completing 12 years of school, while 48% of those who do not suffer from undernutrition reach this level. These differences are important indicators of the job-opportunity and income gaps that exist among Panamanians of working age.

Underweight in Panama is likely to have caused 5,092 additional grade repetitions in 2004, which translate into corresponding incremental costs. Seventy-three percent of these repetitions occur at the secondary level.¹¹¹

It is worth noting that children who have suffered from undernutrition account for a larger percentage of repetitions in the early primary grades than do “normal” children. However, as shown in the following figure, the rates for both groups are higher at the secondary level, though there is always a gap mainly affecting those who have suffered from undernutrition.

FIGURE VIII.3
EFFECTS OF UNDERWEIGHT ON GRADE REPETITION
PANAMA, 2004
(In percentages)



Source: Authors' compilation, based on official education statistics (2004), ENCOVI (2003) and CELADE population estimates (2004).

2.2. Education costs

Additional operating costs for the education system resulting from the increased grade repetition rate among those who have suffered from undernutrition account for a substantial portion of education costs. The nearly 5,000 additional students estimated to have been present in 2004 due to the differential probability of repetition translate into US\$ 3.7 million, which represents 0.6% of public spending on education and 0.03% of GDP for that year.

¹¹¹ The educational gaps resulting from undernutrition were calculated by adapting estimates from a longitudinal study conducted in Chile between 1987 and 1998 (Ivanovic 2005). According to these estimates, among socioeconomically similar populations, the risk of grade repetition for students having suffered from undernutrition at the preschool stage is 1.65 times the risk for students who have not. In the absence of estimators for Central America and considering the characteristics of the education systems, comparable estimates between the Central American countries were obtained using the aforementioned relative risk for grade repetition and an attrition differential of roughly 1.2.

TABLE VIII.5
COSTS RESULTING FROM DIFFERENTIAL GRADE REPETITION DUE TO UNDERWEIGHT
PANAMA, 2004

| | Education Level | |
|-------------------------------------|-----------------|-----------|
| | Primary | Secondary |
| Annual cost per student (2004 US\$) | 553 | 800 |
| Additional annual cost (2004 US\$) | 765 696 | 2 968 142 |
| | 3 733 839 | |
| % Social spending on education | 0.61% | |
| % GDP | 0.03% | |

Source: Authors' compilation, based on official education statistics (2004) and ENCOVI (2003).

3. Productivity

3.1. Effects on productivity

As mentioned before, undernutrition has a negative impact on a country's production capacity as a result of increased mortality among children under the age of five due to diseases associated with undernutrition, as well as lower levels of education attained by those suffering from the affliction.

Table VIII.6 shows the magnitude of the lost productivity resulting from the aforementioned 41,000 deaths of children under the age of 5. Considering the country's employment rates by cohort, the consequent cost amounts to 55 million work hours, roughly 2.2% of the hours worked by the economically active population (EAP).

TABLE VIII.6
PRODUCTIVITY EFFECTS OF MORTALITY DUE TO UNDERWEIGHT IN PANAMA

| Age Group (Years) | Mortality due to undernutrition (No. of cases, 1940 – 1989) | Lost work hours (2004) |
|-------------------------------------|---|------------------------|
| 15-24 | 4 745 | 3 202 182 |
| 25-34 | 9 690 | 14 411 580 |
| 35-44 | 11 033 | 17 682 971 |
| 45-54 | 9 103 | 13 703 371 |
| 55-64 | 6 376 | 6 721 233 |
| Total | 40 948 | 55 721 336 |
| % hours lost relative to EAP | | 2.2% |

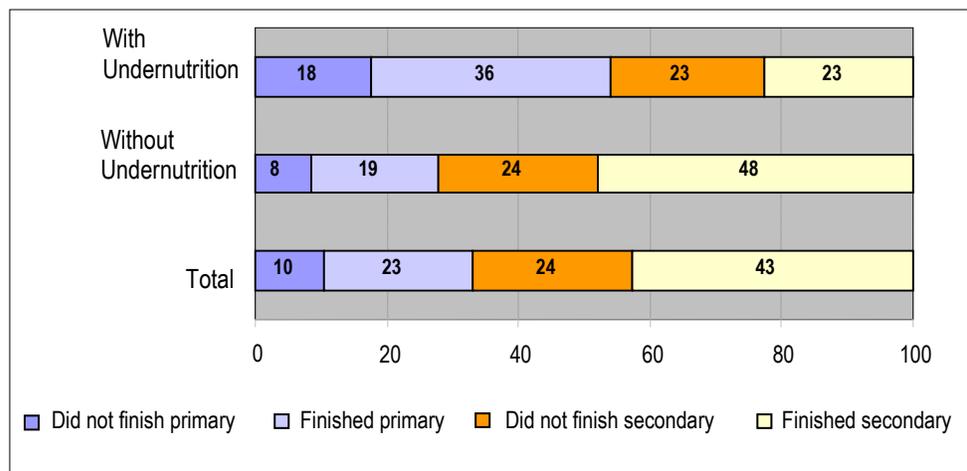
Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al and ENCOVI 2003.

Assuming a work potential of 2,400 hours a year, these deaths associated with undernutrition translate into an estimated loss of 98 million work hours, equivalent to 3.1% of those worked by the EAP.

Reduced productivity due to the educational gap corresponds to the differences in distribution of the population according to years of primary and secondary education between those who have suffered from undernutrition and those who have not. This phenomenon can be

observed in the following figure, which reflects the grade levels reached by those who were able to attend school.

FIGURE VIII.4
EFFECTS OF UNDERWEIGHT ON EDUCATION-LEVEL DISTRIBUTION
PANAMA, 2004 (POPULATION AGED 25 TO 64 YEARS)
(In percentages)



Source: Authors' compilation, based on the Household Survey (2002), ENCOVI (2003) and the CELADE population estimate (2004).

3.2. Productivity costs

The increased productivity costs reflect the economic value of the aforementioned effects. For the year 2004, losses due to lower education levels are estimated at US\$ 190 million, which represents 31% of public spending on education and roughly 1.4% of GDP.

Moreover, lost productivity as a result of deaths from undernutrition among the population that would have been of working age in 2004 is estimated at US\$ 101 million, approximately 0.7% of GDP. Thus, were it not for the levels of undernutrition suffered in the country over the last few decades, productivity in 2004 would have been just over 2% higher.

4. Summary of effects and costs

In summation, it is estimated that in 2004 the underweight suffered by the various cohorts had a cost of US\$ 322 million. This amount represents 2.3% of GDP and roughly 13.2% of total public social spending for the country that year.

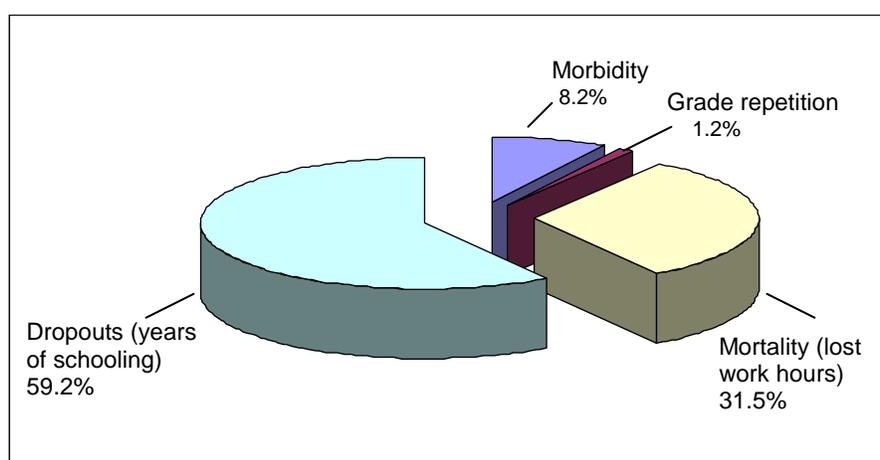
TABLE VIII.7
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERNUTRITION
PANAMA 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)

| | Units | Millions of US\$ |
|--|------------|------------------|
| HEALTH | | |
| <i>Additional cases of morbidity</i> | 33 686 | 26.4 |
| <i>Number of additional deaths</i> | 44 385 | |
| EDUCATION | | |
| <i>Additional repeated grades</i> | 5 092 | 3.7 |
| <i>Differential number of dropouts</i> | 63 200 | |
| PRODUCTIVITY | | |
| <i>Hours lost due to mortality</i> | 55 721 336 | 101.2 |
| <i>Fewer years of schooling</i> | 1.8 | 190.2 |
| Total | | 322 |
| Social Spending | | 13.2% |
| % GDP | | 2.3% |

Source: Authors' compilation.

As shown in the following figure, the costs corresponding to lost productivity as a result of mortality and fewer years of schooling account for nearly 91% of the total, while costs associated with morbidity and grade repetition due to undernutrition account for approximately 8% and 1%, respectively.

FIGURE VIII.5
DISTRIBUTION OF THE COST OF UNDERWEIGHT BY FACTOR
PANAMA 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)



Source: Authors' compilation.

C. Effects and costs for the cohort aged 0-59 months in 2004 (Analysis of the prospective dimension)

This model serves to estimate present and future losses (and potential savings) associated with health care, grade repetition and diminished productivity due to the current prevalence of underweight in Panama for the year 2004 among children under the age of five.

1. Health effects and costs

As noted in the previous chapter, undernutrition suffered at an early age increases the risk of dying and contracting certain diseases.

According to projections based on census data, it is estimated that of the children belonging to the cohort aged 0-59 months in 2004, slightly over 3,000 will die before reaching 5 years of age. Of these deaths, nearly 500 will be related to undernutrition, with nearly 309 such cases in 2004.¹¹² Thus, while undernutrition affects nearly 8% of children under 5, the proportion of deaths resulting from this affliction is 16.5%, reflecting the increased risk of mortality for those who suffer from underweight.

TABLE VIII.8
MORTALITY ASSOCIATED WITH UNDERWEIGHT AMONG CHILDREN UNDER FIVE
PANAMA, 2004 – 2008

| Age | 2004 | 2005 | 2006 | 2007 | 2008 | % |
|-----------------|------------|-----------|-----------|-----------|-----------|------------|
| 0 to 11 months | 239 | | | | | 49% |
| 12 to 59 months | 70 | 71 | 53 | 35 | 18 | 51% |
| Total | 309 | 71 | 53 | 35 | 18 | 486 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks reported by Fishman et al and ENCOVI 2003.

As shown in table VIII.8, the majority of the deaths are expected to occur before reaching age 1, during which period the probability of death is 3.5 times that of the rest of the cohort. Nevertheless, 247 children may die from causes associated with underweight between the ages of 1 and 4.

Regarding morbidity, it is estimated that among the cohort aged 0-59 months in 2004 in Panama, nearly 7,000 additional cases of illness associated with underweight will arise prior to age 5, primarily anemia, ADD and ARI. Of these cases, 69% will occur among children aged 24 to 59 months.

In addition to the cases of morbidity indicated in table VIII.9, it is important to consider treatment specifically for underweight required by children who suffer from the affliction, which amounts to 28,000 cases in 2004 and 9,490 more between 2005 and 2008. Of these cases, 5,377 correspond to children with low birth weight due to intrauterine growth retardation (LBWIUGR).

¹¹² All the estimates for the cohort aged 0-4 years in 2004 decline progressively until 2008 as a result of its members passing into older age groups.

The increased health cost resulting from the additional cases of disease estimated to have been caused by undernutrition totals US\$ 26 million in 2004 alone, with a present value¹¹³ of US\$ 29 million for the 2004-2008 period.

TABLE VIII.9
MORBIDITY ASSOCIATED WITH UNDERWEIGHT AMONG CHILDREN UNDER FIVE
PANAMA, 2004 – 2008

| Age | Total estimated cases of disease | | | | | |
|-----------------|----------------------------------|--------------|------------|-----------|-----------|--------------|
| | 2004 | 2005 | 2006 | 2007 | 2008 | % |
| 0 to 11 months | 1 141 | | | | | 17% |
| 12 to 23 months | 587 | 405 | | | | 14% |
| 24 to 59 months | 3 193 | 1 049 | 432 | 88 | 16 | 69% |
| Total | 4 921 | 1 453 | 432 | 88 | 16 | 6 910 |

Source: Authors' compilation, based on CELADE population and mortality statistics, differences in prevalence and ENCOVI 2003.

The amounts indicated in table VIII.10 translate into an equivalent annual cost (EAC)¹¹⁴ of US\$ 6.7 million for the period shown, which represents roughly 0.8% of public spending on health and 0.05% of GDP.

TABLE VIII.10
COSTS OF MORBIDITY ASSOCIATED WITH UNDERWEIGHT
PANAMA, 2004-2008 (MILLIONS OF 2004 US\$)

| Age | 2004 | 2005 | 2006 | 2007 | 2008 |
|-----------------|-------------|------------|------------|------------|-------------|
| Newborn | 19.9 | | | | |
| 1 to 11 months | 0.9 | | | | |
| 12 to 23 months | 1.6 | 1.0 | | | |
| 24 to 59 months | 3.9 | 1.1 | 0.4 | 0.1 | 0.02 |
| Total | 26.3 | 2.0 | 0.4 | 0.1 | 0.02 |
| PNV | 28.7 | | | | |

Source: Authors' compilation.

2. Education effects and costs

A projection for the education of the children under 5 years of age in 2004¹¹⁵ is created by estimating the differential probability of scholastic achievement as well as the additional costs that will be produced by the approximately 29,000 future students that currently suffer from undernutrition in Panama.

¹¹³ With a discount rate of 8% per year.

¹¹⁴ Ibid.

¹¹⁵ The projection is based on education coverage for the school-age population and education levels reached by the cohort aged 20 to 24 years according to the most recent household survey (2002).

According to official data, it is reasonable to estimate that between the years 2006 and 2021 some 2,000 additional cases of grade repetition will occur. Of these cases, 27% will occur in the primary grades and 73% during secondary education.

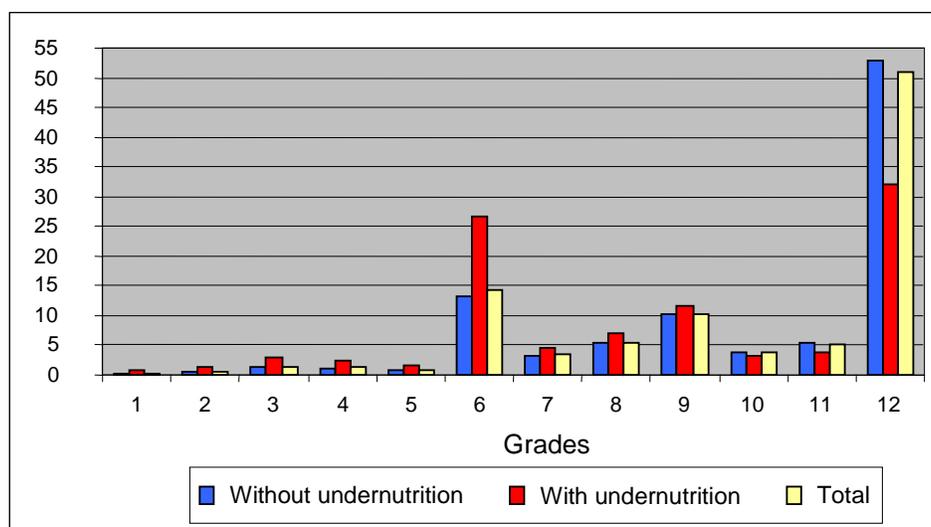
The education costs of the additional repetitions, expressed in present value (at a discount rate of 8%), would total US\$ 1 million in 2004 dollars.

This amount, over the 16-year period during which the cohort being studied would be of school age (2006-2021), translates into an equivalent annual cost of US\$ 90,000 in 2004 dollars, representing 0.02% of social spending on education and 0.001% of GDP for that year.

Of these costs, 22% would be borne by the children's families and 78% would be covered by the education system itself.

Moreover, the higher drop-out risk for those suffering from undernutrition will account for some 3,500 students' leaving school prematurely as a result of this condition.

FIGURE VIII.6
ESTIMATED DISTRIBUTION OF GRADE COMPLETION FOR THE COHORT AGED 0-59
MONTHS IN 2004, WITH AND WITHOUT UNDERWEIGHT
PANAMA
(In percentages)



Source: Authors' compilation, based on the Household Survey (2002), ENCOVI (2003) and CELADE population estimates.

Consequently, the estimated difference in grade completion between those who suffer from undernutrition and those who do not is 1.4 years, with students suffering from the condition completing 8.4 years of study on average.

Lastly, for the cohort as a whole it is estimated that 32 of every 100 children suffering from undernutrition complete 12 years of school, while 53 of every 100 students not suffering from the condition attain this level of education.

3. Productivity effects and costs

The grade-completion differentials discussed in the previous section translate into less human capital acquired by those who suffer from undernutrition, producing a direct negative effect on their productivity.

Also, the estimated 500 additional deaths that are expected to have occurred between 2004 and 2008 as a result of undernutrition among the cohort aged 0-59 months represent a potential productivity loss of nearly 72 million work hours during their productive lives (2014 to 2068).

Based on these figures, the economic losses in terms of productivity associated with underweight among the population under 5 years of age in Panama are estimated at US\$ 36 million in 2004 dollars.¹¹⁶ Of this sum, US\$ 33 million is the result of lower education levels and US\$ 3 million is due to differential mortality.

Considering the entire period during which these losses are expected to occur, the equivalent annual cost is US\$ 3 million. Of this amount, US\$ 256,000 corresponds to losses due to lower education levels and US\$ 2.7 million represents the costs due to mortality.

The equivalent annual cost of these losses in productivity represents 0.02% of Panama's GDP.

4. Summary of effects and costs

Combining all the sources of estimated costs stemming from undernutrition among the cohort of children under the age of 5 in 2004 produces a present value of US\$ 65 million.

TABLE VIII.11
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERWEIGHT FOR THE COHORT
AGED 0-59 MONTHS IN 2004 IN PANAMA

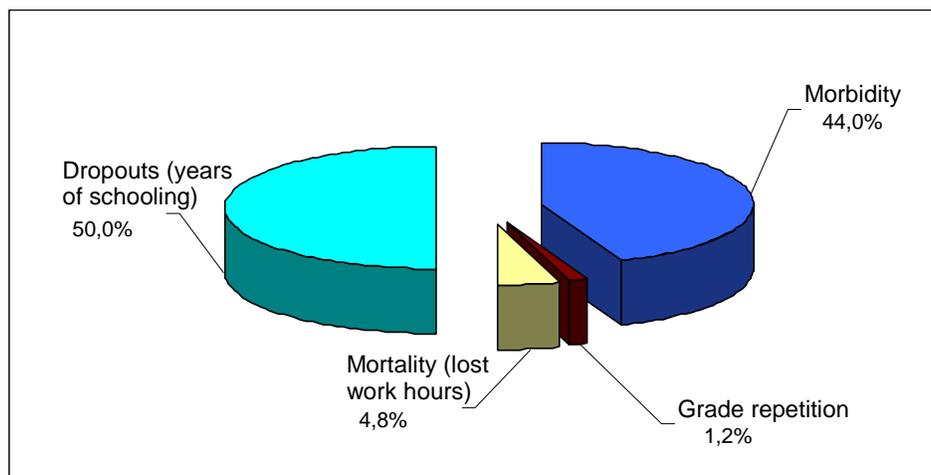
| | Units | Costs (Present Value) |
|--|------------|-----------------------|
| | | Millions of US\$ |
| HEALTH | | |
| <i>Additional cases of morbidity</i> | 38 255 | 28.7 |
| <i>Number of additional deaths</i> | 486 | |
| EDUCATION | | |
| <i>Additional repeated grades</i> | 2 543 | 0.8 |
| <i>Differential number of dropouts</i> | 3 533 | |
| PRODUCTIVITY | | |
| <i>Hours lost due to mortality</i> | 71 711 942 | 3.2 |
| <i>Fewer years of schooling</i> | 1.4 | 32.6 |
| Total | | 65 |

Source: Authors' compilation.

¹¹⁶ With a discount rate of 8% per year.

These figures indicate that the human resources lost as a result of reduced academic achievement and higher health costs due to morbidity account for most of the estimated costs of undernutrition (50% and 44%, respectively).

FIGURE VIII.7
DISTRIBUTION OF THE ESTIMATED COST OF UNDERNUTRITION IN PANAMA BY FACTOR (PROSPECTIVE DIMENSION 2004)



Source: Authors' compilation.

D. Analysis of scenarios: Costs and savings

Based on the estimated costs for Panama resulting from the prevalence of underweight among the population under five years of age in 2004, various possible scenarios can be constructed. Below are the results of simulations corresponding to three scenarios for undernutrition trends and their effects on costs for the year 2015.

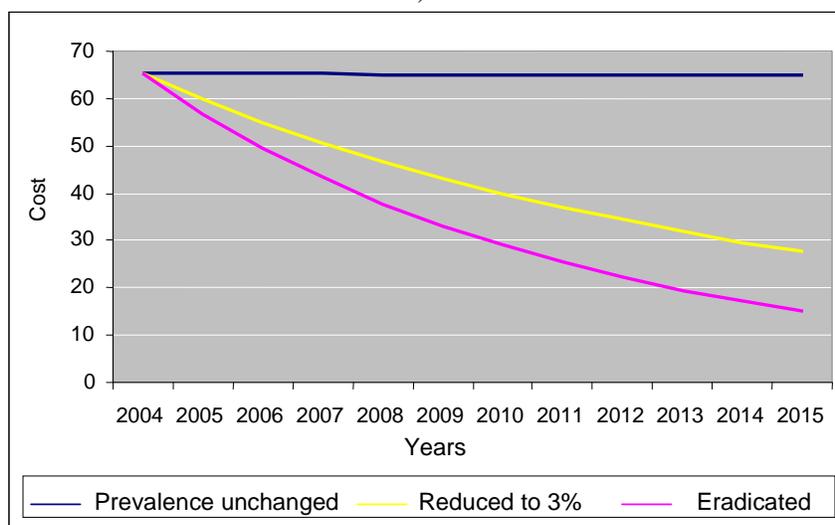
The scenarios considered are the following:

1. The most recent figures available on the prevalence of underweight, used for this study, are maintained through 2015 (see table VIII.1).
2. The target set in the Millennium Development Goals (MDG) of reducing underweight to half 1990 levels is achieved by 2015. This would entail progressively lowering levels until reaching a rate of 3% for children under 5, a reduction of approximately 0.3 percentage points per year on average.
3. By 2015, the country has eradicated underweight, which for purposes of analysis means reducing prevalence to 2.5%, representing the “normal” rate as defined by NCHS measuring parameters. Achieving this goal entails a reduction of just over 0.35 percentage points per year.

Figure VIII.8 demonstrates how progressively reducing the prevalence of underweight creates a progressive reduction in the costs associated with it. Given that the cohort of children ages 0-4 is shrinking in Panama, if the prevalence remains constant (scenario 1), the costs will decrease slowly. If the MDG target is achieved (scenario 2), the costs of underweight for the year 2015 will fall to US\$

27.5 million.¹¹⁷ And if the scenario of eradication is realized, the costs will be reduced even further to a present value of US\$ 15.1 million¹¹⁸ by 2015.

FIGURE VIII.8
ESTIMATED COSTS OF UNDERWEIGHT FOR THREE SCENARIOS (MILLIONS OF US\$)
PANAMA, 2004 - 2015



Source: Authors' compilation.

Table VIII.12 compares the estimated costs in 2004 with those projected for each scenario by 2015. As shown, the greatest variation in costs occurs in health and productivity.

TABLE VIII.12
ESTIMATED TOTAL COSTS OF UNDERWEIGHT
FOR THE BASE YEAR AND THREE SCENARIOS (MILLIONS OF US\$)
PANAMA, 2004 AND 2015
(In percentages)

| | 2004 | Scenarios for the year 2015 | | |
|---------------------------------|-------------|-----------------------------|---------------|-------------------|
| | | Prevalence remains constant | Reduced to 3% | Eradicated (2.5%) |
| HEALTH | 28.7 | 28.4 | 7.0 | 4.2 |
| EDUCATION | 0.8 | 0.8 | 0.5 | 0.2 |
| PRODUCTIVITY | | | | |
| <i>Losses due to mortality</i> | 3.2 | 3.1 | 1.1 | 0.9 |
| <i>Fewer years of schooling</i> | 32.6 | 32.6 | 19.0 | 9.7 |
| TOTAL | 65.3 | 64.9^(*) | 27.5 | 15.1 |

Source: Authors' compilation.

(*) The slight reduction in cost is due to demofigureic projections which suggest a shrinking cohort of children aged 0 to 4 years, the direct effect of which is a reduction in the absolute number of children suffering from undernutrition even if prevalence remains constant.

¹¹⁷ Value updated to 2015, with a discount rate of 8% per year.

¹¹⁸ Value updated to 2015, with a discount rate of 8% per year.

Based on the cost trends shown, it is possible to estimate the potential savings that may be produced as soon as steps are taken to achieve the proposed goals.

The distances between the trend lines in figure VIII.8 (between scenario 2 and scenario 1 and between scenario 3 and scenario 1) illustrate the savings which would occur from year to year, accumulating through 2015 as steps are taken to reduce or eradicate undernutrition. These savings, expressed in 2004 present value,¹¹⁹ equal US\$ 99 million and US\$ 125 million for scenarios 2 and 3, respectively, of which 55% is achieved by mid 2010.

This means that not only would costs in 2015 be significantly lower, but substantial savings would also be produced throughout the process of achieving the goal set for each scenario. Moreover, if the appropriate policies were maintained, the projected benefits would continue to accumulate in the years following 2015.

TABLE VIII.13
ESTIMATED SAVINGS FOR EACH SCENARIO (MILLIONS OF US\$)
PANAMA, 2015

| | Reduced to 3% | Eradicated (2.5%) |
|---------------------------------|----------------------|--------------------------|
| HEALTH | 86.6 | 109.0 |
| EDUCATION | 0.2 | 0.4 |
| PRODUCTIVITY | | |
| <i>Losses due to mortality</i> | 3.0 | 3.5 |
| <i>Fewer years of schooling</i> | 8.7 | 12.5 |
| Total | 98.5 | 125.4 |

Source: Authors' compilation.

The above reflects the economic benefits of making progress towards the eradication of undernutrition. Any programme that achieves results in this area will improve people's quality of life while producing substantial savings for society.

¹¹⁹ Value updated to 2004, with a discount rate of 8% per year.

IX. Results of the study in the Dominican Republic

A. Background

The Dominican Republic belongs to the group of countries with a low prevalence of undernutrition in the region of Latin America and the Caribbean, with weight deficits affecting 1 in every 19 children under the age of 5 and 1/11 of this group suffering from stunted growth.

This situation exists in a country that has one of the highest rates of undernourishment in the subregion, with one in every five people living in extreme poverty.

Moreover, the analysis of the degree of progress made between 1990/1992 and 2000/2002 towards achieving the nutritional target established in the Millennium Development Goals reveals a disparate situation: while the goal for underweight has already been achieved, undernourishment is declining at only a third of the rate necessary (ECLAC, 2005).

According to the most recent official publication available (WHO/DHS, 2002), 5.3% of children aged 1 to 59 months suffer from undernutrition in the categories “moderate” and “severe” on the basis of low weight for age and 8.9% on the basis of low stature for age.

In addition to the effects of undernutrition on the pre-school population, low birth weight is relevant as well, as evidenced by the chain of causality present in the life cycle during these early stages. Approximately 8 in every 100 newborns have low birth weight and slightly over 3 in every 100 suffer from intrauterine growth restriction, a rate which falls within the average range among the member countries of the Central American Integration System (SICA).

TABLE IX.1
POPULATION AND UNDERWEIGHT IN THE DOMINICAN REPUBLIC

| Age | Size of Population (2004) | Population Affected (2004) ^a | Prevalences (In percentages) | | | |
|-----------------------------|---------------------------|---|------------------------------|---------|---------|---------|
| | | | 2002 | 2000 | 1991 | 1986 |
| Newborn (IUGR) | 205 740 ^b | 7 078 | 3.4 ^c | No data | No data | No data |
| 0 to 11 months ^d | 205 740 | 6 352 | 3.1 | 2.9 | 6.0 | 6.9 |
| 12 to 23 months | 202 237 | 12 247 | 6.1 | 6.3 | 13.9 | 12.6 |
| 24 to 59 months | 594 913 | 32 164 | 5.4 | 4.7 | 10.1 | No data |
| Total | 1 002 890 | 57 841 | | | | |

Source: Authors' compilation, based on National Demographic and Health Surveys, SESPAS and estimates from WHO and CELADE.

^a Estimated based on the most recent prevalence figure available.

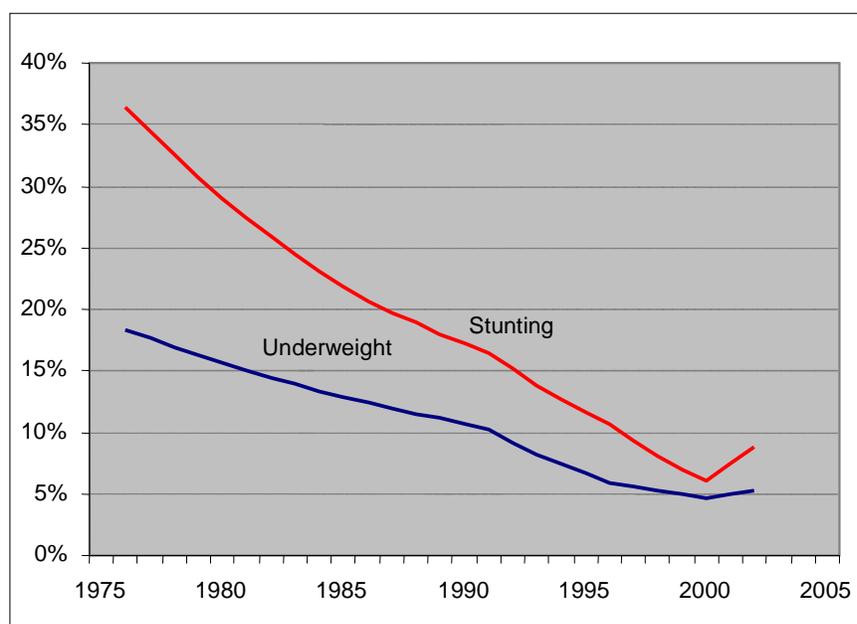
^b For a given year, the population of newborns is the same as that of infants aged 0 to 11 months.

^c Estimated using the De Onis equation, with official data from SESPAS on low birth weight in 2004.

^d The prevalence of undernutrition for 1986 corresponds to children aged 6 – 11 months.

With respect to the evolving risk of undernutrition during the first years of life, the problem in the Dominican Republic—as noted in various studies in the region—has a phase of significant expansion in the first 24 months of life (over 6% in 2002), followed by improvement and stabilization during the rest of the pre-school stage.

FIGURE IX.1
ESTIMATED UNDERNUTRITION LEVELS FOR CHILDREN UNDER FIVE
DOMINICAN REPUBLIC, 1976 – 2002

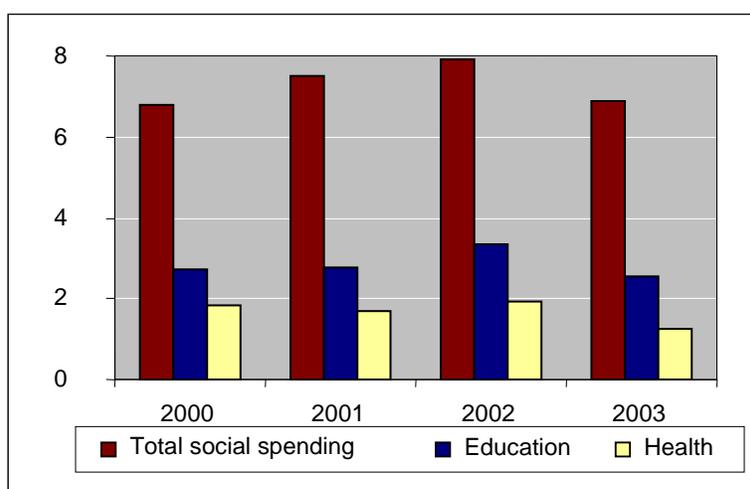


Source: Authors' compilation, based on DHS (1976, 1986, 1991, 1996, 2000 and 2002).

As shown in figure IX.1, the rate of underweight in the Dominican Republic has declined steadily over a 40-year period; however, its reduction has slowed considerably in recent years. While the rate declines between the years 1986 and 1996 by approximately 0.65 percentage points per year on average, from 1996 to 2002 it falls by only 0.1 percentage points per year. It is worth noting, however, that the prevalence of underweight in 2002 is 15% higher than in the year 2000 (5.3% compared to 4.6%). Nevertheless, the prevalence in 2002 is half that of 1990 in the country.

In response to undernutrition problems, the Dominican Republic dedicated 7.3% of its GDP to public social spending between the years 2000 and 2003, earmarking an average of 2.9% for education and 1.7% for health, which, combined, make up 62% of total public spending. As a function of GDP for each year, total public social spending increased by 55% on 1990 (121% for education and 48% for health).

FIGURE IX.2
PUBLIC SOCIAL SPENDING AS A PERCENTAGE OF GDP BY SECTOR
DOMINICAN REPUBLIC, 2000 - 2003
(In percentages)



Source: ECLAC, social spending data base.

B. Effects and costs of underweight in 2004 (Analysis of the incidental retrospective dimension)

This section describes the estimated consequences of underweight in the Dominican Republic for health, education and productivity in the year 2004,¹²⁰ based on the incidental retrospective dimension. That is, the health effects and costs for pre-school children (0 to 59 months of age) suffering from undernutrition that year; the education effects and costs resulting from undernutrition suffered during the first five years of life by those who are of school age (7 to 18 years) during the year being studied; and the economic costs resulting from lost productivity among those of working age (15 to 64 years) who suffered from undernutrition before reaching age 5.

¹²⁰ The base information used in this study corresponds to data available as of April 2006.

As indicated in the methodology prepared for these studies, this model is used to estimate and analyse the effects and costs for education, health and productivity resulting from undernutrition in a given year, in this case 2004.

1. Health

1.1. Effects on health

Those who suffer from undernutrition at an early age are more vulnerable to disease and death, a fact which can be determined by analysing probability differentials.

To estimate these effects, the authors have consulted data from epidemiological studies and the country's official health statistics, as well as information obtained through interviews with Dominican specialists.

1.1.1 Morbidity

In the Dominican Republic, the effects of underweight on the morbidity rates of various associated diseases is likely to have amounted to 7,200 additional cases in 2004. This figure is comprised of acute diarrheal diseases (ADD) with nearly 4,000 cases, acute respiratory infections (ARI) with roughly 1,800 cases and iron-deficiency anemia with approximately 1,400 cases,¹²¹ a situation resulting from the differences in prevalence¹²² shown in table IX.2.

TABLE IX.2
HEALTH EFFECTS OF UNDERWEIGHT
DOMINICAN REPUBLIC, 2004

| Age | Disease | Differences in prevalence (In percentages) |
|-----------------|---------|--|
| 0 to 11 months | Anemia | 0.5 |
| | ADD | 14.0 |
| | ARI | 15.3 |
| 12 to 23 months | Anemia | 0.3 |
| | ADD | 6.3 |
| | ARI | 1.4 |
| 24 to 59 months | Anemia | 4.3 |
| | ADD | 7.2 |
| | ARI | 3.8 |

Source: Authors' compilation, based on official health statistics, relative risks from specialized studies of Central America and DHS 2002.

¹²¹ The estimated effects and costs presented in this report correspond to averages and are subject to the margins of error inherent in the original sources.

¹²² Differences in prevalence (DP) refer to the increased probability for those suffering from undernutrition of contracting a disease (i) as a "consequence" of their condition.

Unlike the Central American countries with higher prevalences of undernutrition, the Dominican Republic does not report cases of wasting or kwashiorkor.¹²³

1.1.2 Mortality

Undernutrition affects mortality through a number of diseases, the most common of which are diarrhea, pneumonia, malaria and measles. In order to limit errors resulting from the poor quality of official records for causes of death, the situation in each country was assessed using estimates made by Fishman et al (2004), which define differential relative risks for each cause of death for children under 5 years of age, as well as mortality rates estimated by the Latin American and Caribbean Demographic Centre (CELADE).

Based on the above, it is estimated that some 393,000 children under the age of 5 died from causes related to undernutrition between the years 1940 and 2004. Considering the survival rates of the various cohorts throughout the period, slightly over 74% would still have been alive in 2004 had they not suffered from underweight. It is also estimated that of the total deaths that occurred among the population of children under five in 2004, nearly 7,000 (14%) were related to underweight.

Moreover, as shown in table IX.3, between 1940 and 1989 underweight is believed to have been responsible for the deaths of 265,000 children under 5 who would have been between the ages of 15 and 64 in 2004 and, therefore, part of the working-age population (WAP).¹²⁴ As indicated in section 3 of the present chapter, this has a substantial effect on the country's productivity.

TABLE IX.3
MORTALITY ASSOCIATED WITH
UNDERWEIGHT AMONG CHILDREN UNDER FIVE, ADJUSTED TO THE SURVIVAL RATE
DOMINICAN REPUBLIC, 1940 - 2004

| Period | No. of child deaths |
|--------------|---------------------|
| 1940s | 37 580 |
| 1950s | 55 795 |
| 1960s | 72 888 |
| 1970s | 61 434 |
| 1980s | 37 982 |
| 1990s | 17 669 |
| 2000-2004 | 6 691 |
| Total | 290 039 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al and DHS 1976, 1986, 1991, 1996, 2000 and 2000.

¹²³ The direct effects of micronutrient deficiencies are not considered, only the effects associated with underweight.

¹²⁴ For the purpose of comparing estimated costs, WAP is defined in this study as the population between 15 and 64 years of age.

1.2. Costs to the health system

The institutional (publicly funded) and private health costs of additional treatment for diseases associated with undernutrition,¹²⁵ affecting children under 5 years of age, are concentrated among newborns. This group, which represents 11% of the affected population, accounts for 78% of the total health costs, due to the greater unit cost of treating them.

In the Dominican Republic, the public and private costs arising from the effects on health amount to 549 million pesos or US\$ 13 million in 2004 dollars. This represents 0.07% of GDP for 2004 and 6.3% of public spending on health in 2003.¹²⁶

A breakdown of these costs reveals that 91% correspond to the public sector and 9% to the private sector.

TABLE IX.4
HEALTH COST OF UNDERWEIGHT
DOMINICAN REPUBLIC, 2004

| Age | Number of Cases | Millions of RD\$ | Millions of US\$ |
|-----------------|-----------------|------------------|------------------|
| Newborn (IUGR) | 7 078 | 426.1 | 10.1 |
| 0 to 11 months | 8 244 | 21.3 | 0.5 |
| 12 to 23 months | 13 230 | 29.5 | 0.7 |
| 24 to 59 months | 37 102 | 71.6 | 1.7 |
| Total | 65 654 | 548.6 | 13.0 |

Source: Authors' compilation.

The nearly 66,000 cases requiring health care due to illnesses associated with undernutrition (see table IX.4) include 58,000 cases corresponding to children who need direct medical attention for no other reason than that they are underweight.

2. Education

2.1. Effects on education

According to the 2002 household survey, the average level of education of the adult population (20 to 64 years of age) is 7.7 years of study, reflecting a progressive increase in school attendance. While the average education level of age group 55-64 is 4.1 years below that of age group 20-24, scholastic achievement remains low and because of the coverage deficit, which remains high, only 43% of the latter group have completed secondary education.

For primary and secondary grades, the average education level of Dominicans who suffer from undernutrition is 2.1 years lower than that of Dominicans who do not. This is probably due

¹²⁵ Costs to the public system were estimated based on information reported by various authorities from the Ministry of Health. Private costs were estimated using the official minimum wage and the fare for urban public transport.

¹²⁶ All the calculations for total social spending and social spending by sector were made using figures for 2003, which are the most recent data available on spending.

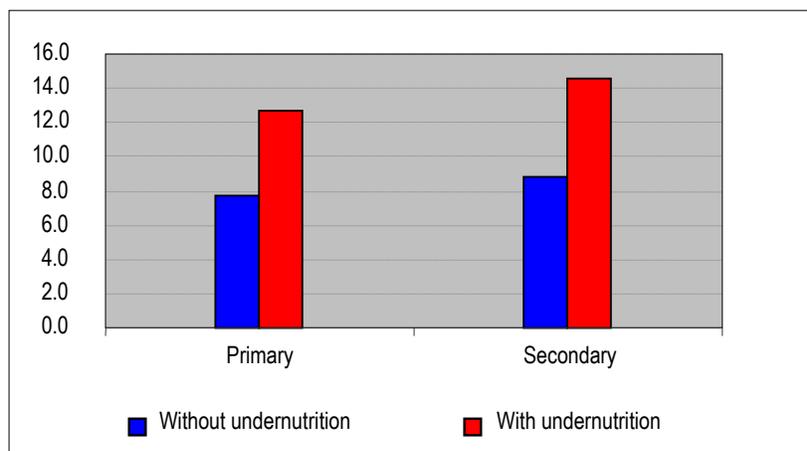
in part to the fact that those who suffered from undernutrition at the pre-school stage are more likely never to have reached even the first primary grade.

The percentage of those having suffered from undernutrition during childhood who complete secondary education (12%) is smaller than for those who have not suffered from the condition (34%). Considering only those with some level of schooling, 55% of the population suffering from undernutrition attended only primary school, whereas the figure for those not suffering from undernutrition is 28%. This correlation gradually reverses in secondary education, with fewer than 13% of those who suffer from undernutrition completing 12 years of school, while 38% of those who do not suffer from the condition reach this level. These differences are important indicators of the job-opportunity and income gaps that exist among Dominicans of working age.

Underweight in the Dominican Republic is likely to have caused 5,136 additional grade repetitions in 2004, which translate into corresponding incremental costs. Eighty-eight percent of these repetitions occur at the primary level.¹²⁷

It is worth noting that children who have suffered from undernutrition account for a larger percentage of repetitions in the early primary grades than do “normal” children. However, as shown in the following figure, the rates for both groups are higher at the secondary level, though there is always a gap mainly affecting those who have suffered from undernutrition.

FIGURE IX.3
EFFECTS OF UNDERWEIGHT ON GRADE REPETITION
DOMINICAN REPUBLIC, 2004
(In percentages)



Source: Authors' compilation, based on official education statistics (2003), DHS (2002) and CELADE population estimates (2004).

¹²⁷ The educational gaps resulting from undernutrition were calculated by adapting estimates from a longitudinal study conducted in Chile between 1987 and 1998 (Ivanovic 2005). According to these estimates, among socioeconomically similar populations, the risk of grade repetition for students having suffered from undernutrition at the pre-school stage is 1.65 times the risk for students who have not. In the absence of estimators for Central America and considering the characteristics of the education systems, comparable estimates between the Central American countries were obtained using the aforementioned relative risk for grade repetition and an attrition differential of roughly 1.2.

2.2. Education costs

Additional operating costs for the education system resulting from the increased grade repetition rate among those who have suffered from undernutrition account for a substantial portion of education costs. The slightly over 5,000 additional students present in 2004 due to the differential probability of repetition translate into US\$ 495,000, representing 0.1% of public spending on education and 0.003% of GDP.

TABLE IX.5
COSTS RESULTING FROM DIFFERENTIAL GRADE REPETITION
DUE TO UNDERWEIGHT
DOMINICAN REPUBLIC, 2004

| | Education level | |
|-------------------------------------|-----------------|-----------|
| | Primary | Secondary |
| Annual cost per student (RD\$ 2004) | 4 276 | 2 573 |
| Additional annual cost (RD\$ 2004) | 19 220 638 | 1 649 433 |
| Additional annual cost (2004 US\$) | 456 334 | 39 161 |
| | 495 494 | |
| % Social spending on education | 0.1% | |
| % GDP | 0.003% | |

Source: Authors' compilation, based on official education statistics (2003) and DHS (2002).

3. Productivity

3.1. Effects on productivity

As mentioned before, undernutrition has a negative impact on a country's production capacity as a result of increased mortality among children under the age of five from diseases associated with undernutrition, as well as lower levels of education attained by those suffering from the affliction.

Table IX.6 shows the magnitude of the lost productivity resulting from the aforementioned 266,000 deaths of children under the age of 5. Considering the country's employment rates by cohort, the consequent cost amounts to 342.5 million work hours, roughly 5% of the hours worked by the economically active population (EAP).

TABLE IX.6
PRODUCTIVITY EFFECTS OF MORTALITY DUE TO UNDERWEIGHT
IN THE DOMINICAN REPUBLIC

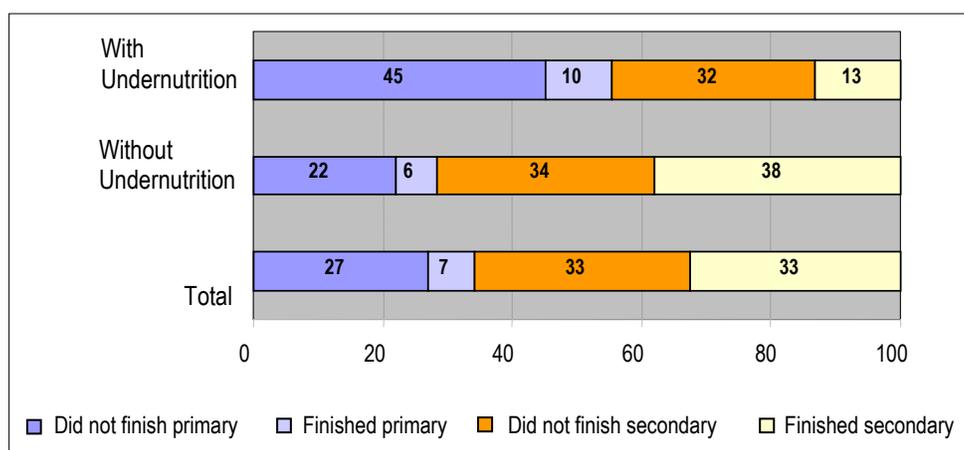
| Age Group (Years) | Mortality due to undernutrition (No. of cases, 1940 – 1989) | Lost work hours (2004) |
|-------------------------------------|---|------------------------|
| 15-24 | 37 982 | 45 825 587 |
| 25-34 | 61 434 | 48 927 468 |
| 35-44 | 72 888 | 109 930 030 |
| 45-54 | 55 795 | 87 286 099 |
| 55-64 | 37 580 | 50 569 686 |
| Total | 265 680 | 342 538 869 |
| % hours lost relative to EAP | | 5.0% |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks estimated by Fishman et al and DHS 2002.

Assuming a work potential of 2,400 hours a year, these deaths associated with undernutrition translate into an estimated loss of 637 million work hours, equivalent to 7% of those worked by the EAP.

Reduced productivity due to the educational gap corresponds to the differences in distribution of the population according to years of primary and secondary education between those who have suffered from undernutrition and those who have not. This phenomenon can be observed in the following figure, which reflects the grade levels reached by those who were able to attend school.

FIGURE IX.4
EFFECTS OF UNDERWEIGHT ON EDUCATION-LEVEL DISTRIBUTION
DOMINICAN REPUBLIC, 2004 (POPULATION AGED 25 TO 62 YEARS)
(In percentages)



Source: Authors' compilation, based on the Household Survey (2002), DHS (2002) and the CELADE population estimate (2004).

3.2. Productivity costs

The increased productivity costs reflect the economic value of the aforementioned effects. For the year 2004, losses due to lower education levels are estimated at US\$ 132 million, which represents 31% of public spending on education and roughly 0.7% of GDP.

Moreover, lost productivity as a result of deaths from undernutrition among the population that would have been of working age in 2004 is estimated at US\$ 526 million, approximately 2.8% of GDP. Thus, were it not for the levels of undernutrition suffered in the country over the last few decades, productivity in 2004 would have been roughly 3.5% higher.

4. Summary of effects and costs

In summation, it is estimated that in 2004 the underweight suffered by the various cohorts had a cost of 22.35 billion pesos, equaling US\$ 672 million. This amount represents 3.6% of GDP and roughly 59% of total social spending for the country.

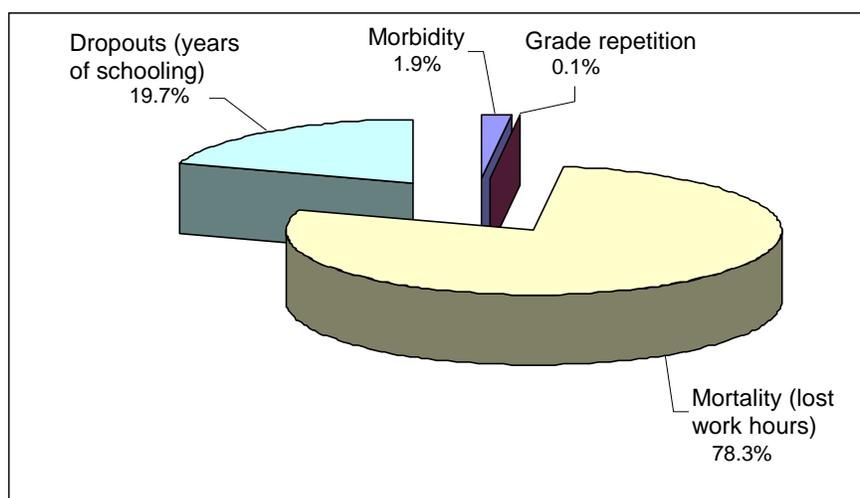
TABLE IX.7
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERNUTRITION
DOMINICAN REPUBLIC 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)

| | Units | Millions of RD\$ | Millions of US\$ |
|--|-------------|------------------|------------------|
| HEALTH | | | |
| <i>Additional cases of morbidity</i> | 65 654 | 549 | 13.0 |
| <i>Number of additional deaths</i> | 283 348 | | |
| EDUCATION | | | |
| <i>Additional repeated grades</i> | 5 136 | 21 | 0.5 |
| <i>Differential number of dropouts</i> | 2 691 | | |
| PRODUCTIVITY | | | |
| <i>Hours lost due to mortality</i> | 342 538 869 | 16 212 | 525.8 |
| <i>Fewer years of schooling</i> | 2.1 | 5 569 | 132.2 |
| Total | | 22 350 | 672 |
| Social Spending | | | 59.1% |
| % GDP | | | 3.6% |

Source: Authors' compilation.

As shown in the following figure, the costs corresponding to lost productivity as a result of mortality and fewer years of schooling account for 98% of the total, while costs associated with morbidity from undernutrition account for roughly 2% and grade repetition represents just under 0.1%.

FIGURE IX.5
DISTRIBUTION OF THE COST OF UNDERWEIGHT BY FACTOR
DOMINICAN REPUBLIC 2004 (INCIDENTAL RETROSPECTIVE DIMENSION)



Source: Authors' compilation.

C. Effects and costs for the cohort aged 0-59 months in 2004 (Analysis of the prospective dimension)

This model serves to estimate present and future losses (and potential savings) associated with health care, grade repetition and diminished productivity due to the current prevalence of underweight in the Dominican Republic in the year 2004 among children under the age of five.

1. Health effects and costs

As noted in the previous chapter, undernutrition suffered at an early age increases the risk of dying and contracting certain diseases.

According to projections based on census data, it is estimated that of the children belonging to the cohort aged 0-59 months in 2004, slightly over 17,000 will die before reaching 5 years of age. Of these deaths, over 2,200 will be related to undernutrition, with 1,300 such cases in 2004.¹²⁸ Thus, while undernutrition affects nearly 5.3% of children under 5, the proportion of deaths resulting from this affliction is 13%, reflecting the increased risk of mortality for those who suffer from underweight.

As shown in table IX.8, the majority of the deaths are expected to occur before reaching age 1, during which period the probability of death is 3 times that of the rest of the cohort. However, 58% of the deaths from causes associated with underweight may occur between the ages of 1 and 4.

¹²⁸ All the estimates for the cohort aged 0-4 years in 2004 decline progressively until 2008 as a result of its members passing into older age groups.

TABLE IX.8
MORTALITY ASSOCIATED WITH UNDERWEIGHT AMONG CHILDREN UNDER FIVE
DOMINICAN REPUBLIC, 2004 - 2008

| Age | 2004 | 2005 | 2006 | 2007 | 2008 | % |
|-----------------|--------------|------------|------------|------------|-----------|--------------|
| 0 to 11 months | 955 | | | | | 42% |
| 12 to 59 months | 368 | 371 | 279 | 186 | 93 | 58% |
| Total | 1 323 | 371 | 279 | 186 | 93 | 2 252 |

Source: Authors' compilation, based on CELADE population and mortality statistics, relative risks reported by Fishman et al and DHS 2002.

Regarding morbidity, it is estimated that among the cohort aged 0-59 months in 2004 in the Dominican Republic, nearly 11,000 additional cases of illness associated with underweight will arise prior to age 5, primarily anemia, ADD and ARI. Of these cases, 67% will occur among children aged 24 to 59 months.

In addition to the cases of morbidity indicated in table IX.9, it is important to consider treatment specifically for underweight required by children who suffer from the condition, which amounts to 58,000 cases in 2004 and 20,000 more between 2005 and 2008. Of these, slightly over 7,000 correspond to low birth weight due to intrauterine growth retardation (LBWIUGR).

TABLE IX.9
MORBIDITY ASSOCIATED WITH UNDERWEIGHT AMONG CHILDREN UNDER FIVE
DOMINICAN REPUBLIC, 2004 - 2008

| Age | Total estimated cases of disease | | | | | |
|-----------------|----------------------------------|--------------|------------|------------|-----------|---------------|
| | 2004 | 2005 | 2006 | 2007 | 2008 | % |
| 0 to 11 months | 1 891 | | | | | 17% |
| 12 to 23 months | 983 | 708 | | | | 15% |
| 24 to 59 months | 4 938 | 1 616 | 634 | 126 | 22 | 67% |
| Total | 7 813 | 2 324 | 634 | 126 | 22 | 10 920 |

Source: Authors' compilation, based on CELADE population and mortality statistics, differences in prevalence and DHS 2002.

The additional cost in health resulting from the additional cases of disease estimated to have been caused by undernutrition totals US\$ 13 million in 2004 alone, with a present value¹²⁹ (PNV) of US\$ 14 million for the 2004-2008 period.

¹²⁹ With a discount rate of 8% per year.

TABLE IX.10
COSTS OF MORBIDITY ASSOCIATED WITH UNDERWEIGHT
DOMINICAN REPUBLIC, 2004-2008 (MILLIONS OF 2004 US\$)

| Age | 2004 | 2005 | 2006 | 2007 | 2008 |
|-----------------|-------------|------------|------------|-------------|-------------|
| Newborn | 10.1 | | | | |
| 1 to 11 months | 0.5 | | | | |
| 12 to 23 months | 0.7 | 0.4 | | | |
| 24 to 59 months | 1.7 | 0.4 | 0.2 | 0.03 | 0.01 |
| Total | 13.0 | 0.9 | 0.2 | 0.03 | 0.01 |
| PNV | 14.0 | | | | |

Source: Authors' compilation.

The amounts indicated in table IX.10 translate into an equivalent annual cost (EAC)¹³⁰ of US\$ 4 million for the period shown, which represents roughly 1.9% of public spending on health and 0.02% of GDP.

2. Education effects and costs

A projection for the education of the children under 5 years of age in 2004¹³¹ is created by estimating the differential probability of scholastic achievement as well as the additional costs that will be produced by the approximately 53,000 future students that currently suffer from undernutrition in the Dominican Republic.

According to official data, it is reasonable to estimate that between the years 2006 and 2021 some 3,000 additional cases of grade repetition will occur. Of these cases, 88% will occur in the primary grades and 12% during secondary education.

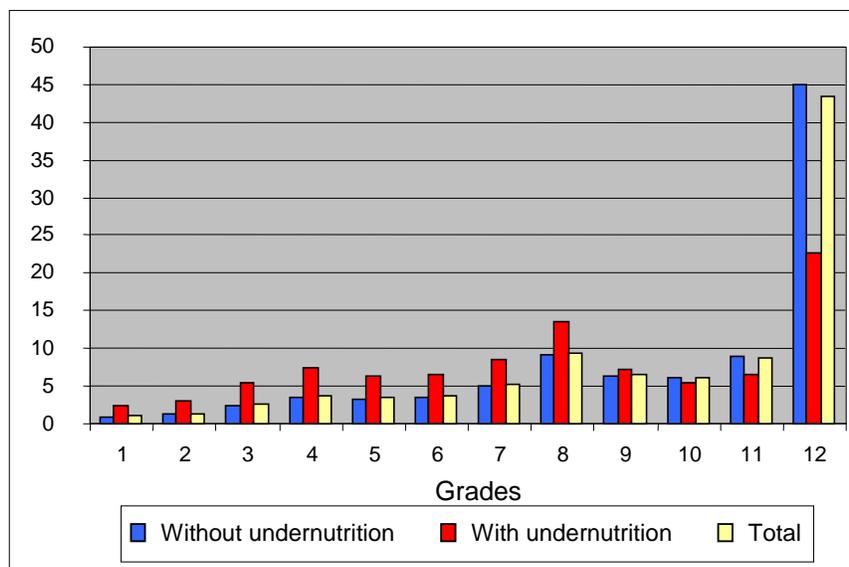
The education costs of these additional repetitions, expressed in present value (at a discount rate of 8%), would total 7.3 million pesos or US\$ 174,000 in 2004 dollars.

This amount, over the 16-year period during which the cohort being studied would be of school age (2006-2021), translates into an equivalent annual cost of 826,000 pesos or US\$ 20,000 in 2004 dollars.

¹³⁰ Ibid.

¹³¹ The projection is based on education coverage for the school-age population and education levels reached by the cohort aged 20 to 24 years according to the most recent household survey (2002).

FIGURE IX.6
ESTIMATED DISTRIBUTION OF GRADE COMPLETION FOR THE COHORT AGED 0-59
MONTHS IN 2004, WITH AND WITHOUT UNDERWEIGHT
DOMINICAN REPUBLIC
(In percentages)



Source: Authors' compilation, based on the Household Survey (2002), DHS (2002) and CELADE population estimates.

Moreover, the higher drop-out risk for those suffering from undernutrition will account for some 5,700 students' leaving school prematurely as a result of this condition.

Consequently, the estimated difference in grade completion between those who suffer from undernutrition and those who do not is 1.7 years, with Dominicans suffering from the condition completing 7.6 years of study on average.

Lastly, for the cohort as a whole it is estimated that 23 of every 100 children suffering from undernutrition complete 12 years of school, while 45 of every 100 students not suffering from the condition attain this level of education.

3. Productivity effects and costs

The grade-completion differentials discussed in the previous section translate into less human capital acquired by those who suffer from undernutrition, producing a direct negative effect on their productivity.

Also, the estimated 2,252 additional deaths that are expected to have occurred between 2004 and 2008 as a result of undernutrition among the cohort aged 0-59 months represent a potential productivity loss of nearly 217 million work hours during their productive lives (2014 to 2068).

Based on these figures, the economic losses in terms of productivity associated with underweight among the population under 5 years of age in the Dominican Republic are estimated at 870 million pesos in 2004, equivalent to US\$ 21 million in 2004 dollars.¹³² Of this sum, US\$

¹³² With a discount rate of 8% per year.

12 million is the result of lower education levels and US\$ 9 million is due to differential mortality.

Considering the entire period during which these losses are expected to occur (2014-2068), the equivalent annual cost is 71 million pesos or US\$ 1.7 million. Of this amount, US\$ 700,000 corresponds to costs due to mortality and US\$ 1 million represents the losses due to lower education levels.

The equivalent annual cost of these losses in productivity represents 0.01% of the Dominican Republic's GDP.

4. Summary of effects and costs

Combining all the sources of estimated costs stemming from undernutrition among the cohort of children under the age of 5 in 2004 produces a total present value of 1.468 billion pesos or US\$ 35 million.

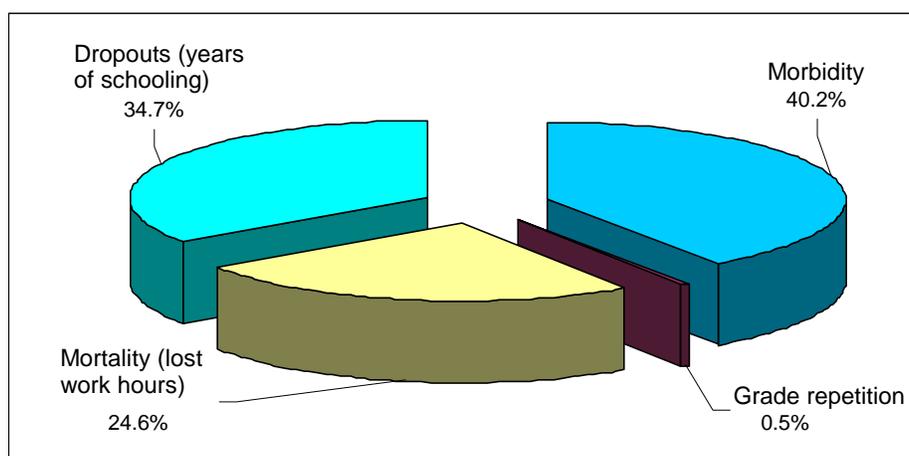
These figures indicate that the human resources lost as a result of reduced academic achievement and higher health costs due to morbidity account for most of the estimated costs of undernutrition (35% and 40%, respectively).

TABLE IX.11
SUMMARY OF RESULTS: EFFECTS AND COSTS OF UNDERWEIGHT FOR THE COHORT
AGED 0-59 MONTHS IN 2004 IN THE DOMINICAN REPUBLIC

| | Units | Costs (Present Value) | |
|--|-------------|--------------------------|---------------------|
| | | Millions of RD\$ | Millions of US\$ |
| HEALTH | | | |
| <i>Additional cases of morbidity</i> | 77 828 | 590.4 | 14.0 |
| <i>Number of additional deaths</i> | 2 252 | | |
| EDUCATION | | | |
| <i>Additional repeated grades</i> | 2 983 | 7.3 | 0.2 |
| <i>Differential number of dropouts</i> | 5 701 | | |
| PRODUCTIVITY | | | |
| <i>Hours lost due to mortality</i> | 216 698 585 | 360.9 | 8.6 |
| <i>Fewer years of schooling</i> | 1.7 | 509.3 | 12.1 |
| Total | | 1 468 | 35 |

Source: Authors' compilation.

FIGURE IX.7
DISTRIBUTION OF THE ESTIMATED COST OF UNDERNUTRITION IN THE DOMINICAN
REPUBLIC BY FACTOR (PROSPECTIVE DIMENSION 2004)



Source: Authors' compilation.

D. Analysis of scenarios: Costs and savings

Based on the estimated costs for the Dominican Republic resulting from the prevalence of underweight among the population under 5 years of age in 2004, various possible scenarios can be constructed. Below are the results of simulations corresponding to two scenarios for undernutrition trends and their effects on costs for the year 2015.¹³³

The scenarios considered are the following:

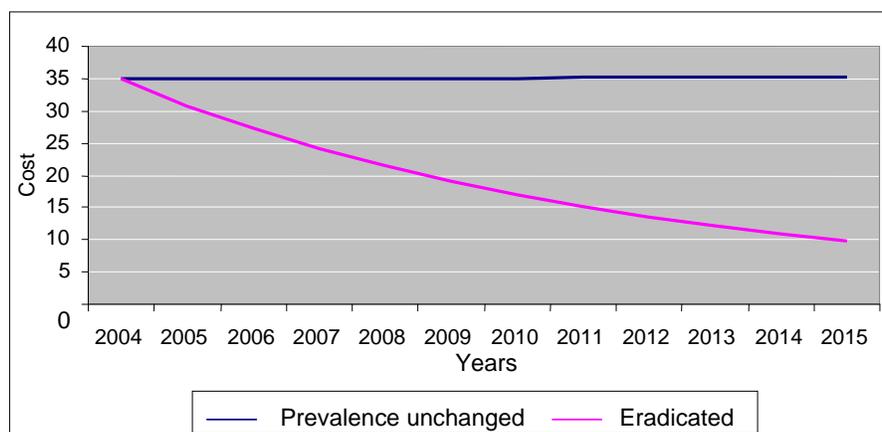
1. The most recent figures available on the prevalence of underweight, used for this study, are maintained through 2015 (see table 1).
2. By 2015, the country has eradicated underweight, which for purposes of analysis means reducing prevalence to 2.5%, representing the “normal” rate as defined by NCHS measuring parameters. Achieving this goal entails a reduction of just over 0.2 percentage points per year.

Figure IX.8 demonstrates how progressively reducing the prevalence of underweight creates a progressive reduction in the costs associated with it. Given that the cohort of children aged 0-4 years is growing in the Dominican Republic, if the prevalence remains constant (scenario 1), the costs will increase slightly. If eradication is achieved (scenario 2), the costs of underweight for the year 2015 will total US\$ 9.9 million.¹³⁴

¹³³ The current rate of underweight for the population under 5 years of age reflects a decline equivalent to achieving goal 1 of the Millennium Development Goals (MDG).

¹³⁴ Value updated to 2015, with a discount rate of 8% per year.

FIGURE IX.8
TREND OF ESTIMATED COSTS OF UNDERWEIGHT FOR TWO SCENARIOS
(MILLIONS OF US\$)
DOMINICAN REPUBLIC, 2004 - 2015



Source: Authors' compilation.

Table IX.12 compares the estimated costs in 2004 with those projected for each scenario by 2015. As shown, the greatest variation in costs occurs in health and productivity.

TABLE IX.12
ESTIMATED TOTAL COSTS OF UNDERWEIGHT
FOR THE BASE YEAR AND TWO SCENARIOS (MILLIONS OF US\$)
DOMINICAN REPUBLIC, 2004 AND 2015

| | 2004 | Scenarios for the year 2015 | |
|---------------------------------|-------------|-----------------------------|-------------------|
| | | Prevalence remains constant | Eradicated (2.5%) |
| HEALTH | 14.0 | 14.1 | 2.0 |
| EDUCATION | 0.2 | 0.2 | 0.1 |
| PRODUCTIVITY | | | |
| <i>Losses due to mortality</i> | 8.6 | 8.7 | 2.9 |
| <i>Fewer years of schooling</i> | 12.1 | 12.4 | 4.9 |
| TOTAL | 34.9 | 35.3 | 9.9 |

Source: Authors' compilation.

Based on the cost trends shown, it is possible to estimate the potential savings that may be produced as soon as steps are taken to achieve the proposed goals.

The distances between the trend lines in figure IX.8 (between scenario 2 and scenario 1) illustrate the savings which would occur from year to year, accumulating through 2015 as steps

are taken to eradicate undernutrition. These savings, expressed in 2004 present value,¹³⁵ equal nearly US\$ 71 million, of which 52% would result from the impact produced by 2010.

This means that not only would costs in 2015 be significantly lower, but substantial savings would also be produced throughout the process of achieving the proposed goal. Moreover, if the appropriate policies were maintained, the projected benefits would continue to accumulate in the years following 2015.

TABLE IX.13
ESTIMATED SAVINGS FOR THE SCENARIO OF ERADICATION
DOMINICAN REPUBLIC, 2015

| | Present Value (Millions of US\$) |
|---------------------------------|---|
| HEALTH | 52.6 |
| EDUCATION | 0.1 |
| PRODUCTIVITY | |
| <i>Losses due to mortality</i> | 12.9 |
| <i>Fewer years of schooling</i> | 5.1 |
| Total | 70.7 |

Source: Authors' compilation.

The above reflects the economic benefits of making progress towards the eradication of undernutrition. Any programme that achieves results in this area will improve people's quality of life while producing substantial savings for society.

¹³⁵ With a discount rate of 8% per year.

Annex: Sources of Information

Below are the sources from which the data for this study were compiled. Some are generic sources for all countries and others are country-specific.

A. Generic Sources

1. World Bank, World Development Indicators, 2005.
2. ECLAC, public social spending data base.
3. ECLAC, processing of the household survey 2001 / 2004.
4. ECLAC, exchange rate data base.
5. MACRO ORC, Demographic and Health Surveys (DHS) (all the surveys available for each country)
6. WHO, Statistical Information System (1979-2004)
7. WHO, Global Database on Child Growth and Malnutrition www.who.int/gdgm/p-child_pdf.
8. CELADE, Population Division of the Economic Commission for Latin America and the Caribbean ECLAC, Population and mortality projections 1940 – 2068.

B. Sources by Country

Costa Rica

1. 2004 Medical Services Yearbook, Costa Rican Social Security Fund, Directorate of Finance and Accounting. Costs Department, Hospital Costs Division
2. 2004 Statistical Yearbook, Costa Rican Social Security Fund.
3. Situational assessment of the operational programme, Centres of Nutrition and Child Development. Steering and Strengthening Project of the Ministry of Health. Technical and Administrative Analysis from the CEN-CINAI (1998).
4. Hospital Expenditures of the Costa Rican Social Security Fund, 2004.
5. 2005 Income and Expenditure Survey.
6. Interviews with specialists at third-level hospitals.

7. 2004 Goal Assessment of the National Development Plan 2002-2006. Ministry of National Planning and Economic Policy. National Evaluation System, Education as a priority for the development of human abilities.
8. Demographic indicators for 2004. National Statistical and Census Institute.
9. Education indicators for 2004. Statistics Department of the Ministry of Public Education.
10. Compliance Monitoring Report of the Costa Rican Action Plan for Education, 2003-2015. Ministry of Public Education – National Forum of Education for All.
11. Care manual for high-risk newborns. HNN, CCSS, MS. CCSS Statistics Department.
12. 2004 Annual Institutional Report of the Ministry of Public Health.
13. Budget appropriation. Ministry of Education 113-076 and 113-089. Ministry of the Treasury, Office of the Deputy Minister.
14. Minimum wage report for the Central American region, Economic Integration System (through 2005).
15. Health in Figures. National Report, Costa Rica 2005.
16. Interviews with Costa Rican specialists in the public and private sectors.

El Salvador

1. National Census of Stature in schoolchildren at the first-grade level (2000).
2. Cost estimated by the Planning Directorate of the Ministry of Health, for planning purposes. Construction based on edited costs from MIS, 2006 Promotion Needs and 2005 budget deficits.
3. Household and multi-purpose survey (2004).
4. Interviews with specialists at third-level hospitals.
5. Specific study on the Cost of Diarrhea, Pneumonia and Broncopneumonia. Epidemiological Unit of the Benjamín Bloom Hospital (San Salvador, 2005).
6. Guides on integrated care for prevalent childhood diseases. Ministry of Public Health and Social Assistance (2005).
7. Education Indicators, education costs and programmes, Ministry of Education (2004).
8. Education Indicators, education costs and programmes, Ministry of Education (2004).
9. Related indicators. Health Information Unit, Ministry of Public Health and Social Assistance (2004).
10. FESAL National Report 2002-2003.
11. Annual institutional report of the Ministry of Education (2004).
12. Standards for hospital management and care in pediatrics and obstetric gynecology.
13. Record of discharges, deaths and outpatient service in establishments of the Ministry of Health, El Salvador (2004).
14. Record of population estimates and projections, General Directorate of Statistics and Census of El Salvador (DIGESTYC).
15. Minimum wage report for the Central American region, Economic Integration System (through 2005).
16. Interviews with Salvadoran specialists in the public and private sectors.

Guatemala

1. National Census of Stature in schoolchildren at the first-grade level (2002).
2. Survey of living conditions (2000).
3. National Survey of Maternal and Child Health (DHS, 2002).
4. Departmental statistics for morbidity and costs of hospital care (2004 period of care).
5. National Education Act, Legislative Decree No. 12-91, effective since January 12, 1991.
6. Annual progress report of the Ministry of Education 2004.

7. Annual progress report of the Ministry of Public Health and Social Assistance for the year 2004.
8. Standards for hospital management and care in pediatrics.
9. Annual operating plan prepared by the hospitals of the National Health Services System for 2004.
10. General Budget of State Revenue and Expenditure for the Fiscal Year 2005.
11. Economic and social reactivation programme 2004-2005.
12. National Scholarship Programme (EDUBECAS).
13. Public education programmes. Notes from interviews with officials in charge.
14. Electronic data registry for Morbidity of the National Administrative Health Information System of the Ministry of Public Health and Social Assistance for the year 2004.
15. Electronic data registry for Mortality of the National Administrative Health Information System of the Ministry of Public Health and Social Assistance for the year 2004.
16. Statistical data registry of the Information Technology Unit of the Guatemalan Ministry of Education.
17. Minimum wage report for the Central American region, Economic Integration System (through 2005).
18. Interviews with Guatemalan specialists in the public and private sectors.

Honduras

1. Hospital activities for the first half of 2004. Secretariat of Health.
2. Hospital mortality data base for the year 2004.
3. Outpatient statistics report for the year 2004. Directorate of Management Planning and Evaluation, Statistics Department, Secretariat of Health.
4. Statistical Information Report (2004), Directorate of Management Planning and Evaluation, Statistics Department, Secretariat of Health.
5. Estimates based on the registration system for production, performance and costs of Hospital Escuela for 2004.
6. Specific Morbidity estimates from the Statistics Department (2004). Secretariat of Health.
7. Estimates from Hospital Escuela, registry of statistical data by service and room for the year 2004.
8. National Census of Stature in schoolchildren at the first-grade level (2001).
9. National Survey of Living Conditions (2004).
10. ENESF National Health Survey (2001).
11. Interviews with specialists at third-level hospitals.
12. Estimated cost of medicine according to the WINSIG system (Management Information System) of the PAHO and the reference estimated by the Accounting Department of Hospital Escuela.
13. Education Indicators for 2004 provided by officials from the Secretariat of Education.
14. Education Indicators and costs, Secretariat of Education (2004).
15. Demographic Indicators, Secretariat of Health (2004).
16. Budget and itemized spending report from the Secretariat of Finance. Republic of Honduras, Central Government, Fiscal Year 2005.
17. Salary and wage projections from UPEG of the Secretariat of Health 2005.
18. Minimum wage report for the Central American region, Economic Integration System (through 2005).
19. Results of the study on the Prevalence of Anemia in three municipalities in southern Honduras (UNICEF, 2004).

20. Health in Figures (2003), Directorate of Management Planning and Evaluation, Statistics Department, Secretariat of Health.
21. Interviews with Honduran specialists in the public and private sectors.

Nicaragua

1. Social Audit III of the Civil Coordinator, The General Budget of the Republic and its Relation to Health (2003).
2. National Census of Stature in schoolchildren at the first-grade level (2004).
3. Table of treatment procedures for diseases prevalent among children. Government of the Republic MINSA, PAHO/WHO.
4. Distribution of cases by SILAIS and by age group (includes only weeks 1 through 47 of 2005), Nicaraguan System of National Epidemiological Surveillance (SISNIVEN).
5. Survey of Apparent Consumption (2004).
6. Survey of diabetes, hypertension and risk factors. Republic of Nicaragua, Ministry of Health – Pan-American Health Organization (2004).
7. National Micronutrient Survey (ENM 2000), Ministry of Health.
8. National Health Survey (ENDESA 2001).
9. Interviews with specialists at third-level hospitals.
10. Nutritional Study of Schoolchildren (PIN 2005).
11. Coverage indicators for food supplementation and fortification in Nicaragua, Integrated System for the Monitoring of Nutritional Interventions (SIVIN 2003-2004).
12. Education Indicators. Ministry of Education, Culture and Sports. General Directorate for Policy and Planning.
13. Demographic Indicators (2004), National Statistical and Census Institute.
14. Information from the Statistics Unit of the Ministry of Health – General Directorate for Planning (2004).
15. Budget by programme (2005), Ministry of Education, Culture and Sports, General Directorate for Policy and Planning.
16. Prevalence of Diarrheal Disease and Respiratory Diseases. Rapid Nutritional Study in the dry zone and the zone of the coffee crisis. PRRO - WFP. 2004
17. Report provided by personnel in charge, with data from the source: "Informe de estimación de costos de 25 motivos de atención y egreso de empresas médicas previsionales." Managua, Nicaragua, March 2005.
18. Interviews with Nicaraguan specialists in the public and private sectors.

Panama

1. Registry of hospital discharges at the national level (2004), Statistics Unit of the Ministry of Health.
2. Statistical report from Hospital del Niño 2004, Patronato Hospital del Niño.
3. Specific estimate of the cost of care at Hospital del Niño. Hospital board. 2005.
4. National Health Survey DHS (2003).
5. Survey of Living Conditions (2003).
6. Interviews with specialists at third-level hospitals.
7. Assessment of the acceptability and impact of the complimentary food programme, 2001. Ministry of Health, Department of Nutrition (2004).
8. Education indicators for the year 2004. Report from the Statistics Unit of the Ministry of Education.
9. Information from the Ministry of Education. "Merienda Escolar" Complimentary Food Programme, population and budget assigned for 2004.

10. Presidency of the Republic, National Secretariat for the Food and Nutrition Plan. Poverty Reduction in Panama. Food and Nutrition Security in the Districts of Mirono and Santa Fe (CD).
11. Prevalence of Anemia in Schoolchildren, National Survey of Goiter and Anemia in Schoolchildren (1999).
12. Prevalence of anemia, Assessment Survey of the Iron Supplementation Programme at Health Centres in Priority Districts, Ministry of Health (2005).
13. Prevalence of anemia, National Survey of Vitamin A and Nutritional Anemia (1999).
14. Nutritional Recuperation Programme, report from the Nutrition Department of the Ministry of Health.
15. National School Nutrition Programme, Social Investment Fund.
16. Current public programmes (2004) Cost report of the Ministry of Education.
17. Records of outpatient care for Morbidity at the facilities of the Ministry of Public Health (2004).
18. Records of mortality by cause for the year 2004. Office of the Comptroller General of Panama, Directorate of Statistics and Census.
19. Nutritional Situation of Schoolchildren, comparing weight for stature to Body Mass Index, Ministry of Health (2000).
20. Interviews with Panamanian specialists in the public and private sectors.

Dominican Republic

1. Analysis of the cost and effectiveness of the school food programme, UNDP (2005).
2. Analysis of National Accounts of the Dominican Republic, Magdalena Rathe (2005).
3. Statistical yearbook 2003 – 2004.
4. Benefits catalogue of the Basic Health Plan, Health and Labour Risks Superintendence.
5. Stature Census 2002.
6. Electronic copy of the SESPAS annual report for the year 2004. Directorate of Planning, Technical Undersecretary of SESPAS.
7. Copy in DBF and EXCEL format of the data base for Mortality at the National Level in 2004, Statistics Unit of the Secretariat of Health.
8. Income and Expenditure Survey (2002).
9. Interviews with provincial doctors.
10. Interviews with specialists at third-level hospitals.
11. Statistics for planning purposes (on hospital care for all the admission and outpatient services in 2004).
12. Statistics for neonatal care (2004).
13. Study of costs by region, region 4 of the country, REDSALUD and USAID.
14. Focalización de la pobreza 2005 (general report and maps of poverty).
15. Strengthening and optimization of the programme for fortifying wheat flour and flour with iron, folic acid and B-complex vitamins.
16. Education Indicators, education costs and programmes, Secretary of State of Education DOR (2004).
17. Indicators for production and use of services, SESPAS (2003-2004).
18. Information from Department of Perinatology statistics presented as indicators for birth, neonatal and perinatal mortality and number of cases resulting from disease in 2004.
19. Annual report for 2004 and 2005 from Robert Read Hospital.
20. ONAPLAN Social Plan, schools under the School Food Programme system.
21. Performance budget.
22. Project, Strengthening and Implementation of the National Food-Fortification Programme of the Dominican Republic (procedure manual).

23. Record of discharges, deaths and outpatient services for establishments of the Secretary of State of Public Health and Social Assistance.
24. Record of population estimates and projections used by SESPAS for calculating indicators. SESPAS Statistics Unit.
25. Minimum wage report for the Dominican Republic from the current labour code.
26. Current Perinatology Situation (2003).
27. Health Situation (2003).
28. Nutritional situation in the Dominican Republic and food assistance programmes: An Approximation, November 2005.
29. Interviews with Dominican specialists in the public and private sectors.

Bibliography

- Alderman, H. and J. Behrman (2004), Estimated Economic Benefits of Reducing Low Birth Weight in Low Income Countries. World Bank, Washington
- Andraca, I., M. Castillo and T. Walter (1997), Desarrollo psicomotor y conducta en lactantes anémicos por deficiencia de hierro. En: Desnutrición Oculta en América Latina: Deficiencia de Hierro. CESNI document.
- Behrman, J., H. Alderman, and J. Hoddinott, (2004), Hunger and Malnutrition, Copenhagen Consensus – Challenges and Opportunities, Washington DC.
- CELADE (2004), *Boletín Demográfico* No. 73. América Latina y El Caribe: Estimaciones y proyecciones de población. 1950-2050, ECLAC.
- ECLAC (2004), *Anuario Estadístico de América Latina y el Caribe*, Santiago de Chile.
- _____ (2003), *Panorama Social de América Latina 2002 – 2003*. Santiago de Chile.
- _____ (2002), *Panorama Social de América Latina 2001/2002*, Santiago de Chile.
- León, Arturo, Rodrigo Martínez, Ernesto Espíndola and Alejandro Schejtman, ECLAC - WFP (2004), “Pobreza, hambre y seguridad alimentaria en Centroamérica y Panamá, *Serie Políticas Sociales* N° 88, LC/L2134. ISBN 92-1-322525-3. Santiago de Chile.
- Martínez, Rodrigo ECLAC - WFP (2005), Hambre y desnutrición en los países miembros de la Asociación de Estados del Caribe (AEC). *Serie Políticas Sociales* N° 111. LC/L.2374. ISBN 92-1-322755-8. Santiago de Chile.
- _____ ECLAC - WFP (2005), Hambre y desigualdad en los países andinos: la desnutrición y la vulnerabilidad alimentaria en Bolivia, Colombia, Ecuador y Perú, *Serie Políticas Sociales* N° 112, LC/L.2400. ISBN 92-1-322780-9. Santiago de Chile.
- Martínez Rodrigo and Andrés Fernández, ECLAC – WFP (2006), Modelo de análisis del impacto social y económico de la desnutrición infantil en América Latina. *Serie Manuales* N° 52, LC/L.2650, ISBN 978-92-1-323010-7 Santiago de Chile.
- De Onis, M. and M. Blössner (2003), The World Health Organization Global Database on Child Growth and Malnutrition: Methodology and Applications. *International Journal of Epidemiology* 2003; 32:518-526.
- Fishman, Steven M. et al. (2004), Childhood and Maternal Underweight, in World Health Organization: Comparative Quantification of Health Risks. Global and regional burden or disease attributable to selected mayor risk factors. Edited by M. Ezzati, A López, A Rodgers and C. Murray. Geneva.

- Ivanovic, Danitza (2005), Factores que inciden en la permanencia del educando en el sistema educacional, en el marco de un estudio de seguimiento. Región Metropolitana, Chile, 1987-1998. INTA, Universidad de Chile. Data base reprocessed by ECLAC.
- Ivanovic, Danitza et al. (2000), Long-term Effects of severe under nutrition during the first year of life on brain development and learning in Chilean high-school graduates. *Nutrition* 16: 1056-1063. WHO Global (2006) Database on Child Growth and Malnutrition www.who.int/gdgm/p-child_pdf.
- ORC Macro (2005), MeasureEDS <http://www.measureEDS.com> WFP (2002), VAM Standard Analytical Framework. www.wfp.org
- Pelletier, DL. et al. (1995), “Malnutrition and Child Mortality”. <http://www.basics.org/pdf>.
- Shailen Nandy, et al. (2005), Poverty, Child Under Nutrition and Morbidity: New Evidence from India *Bull World Health Organ.* Mar;83(3):210-6.
- Smith TA, et al. (1991), Relationships Between Growth and acute Lower-Respiratory Infections in Children Aged less than 5 y in a Highland Population of Papua New Guinea. *Am J Clin Nutr.* 963-70.
- UNICEF (2005), Child mortality statistics. <http://www.childinfo.org/cmr/revis/db2.htm>.
- Villar J and Balizan J.M. (1982), The Timing Factor in the Pathophysiology of the Intrauterine Growth Retardation Syndrome. *Obstetric Gynaecology Survey.* 37: 499-506 (1982).
- WHO / PAHO (2003), “Estadísticas de Salud para las Américas”, Washington.
- _____ (1995), “Clasificación Estadística Internacional de Enfermedades y Problemas Relacionados con la Salud”. Vol. 1 & 2. Tenth Edition, USA.
- Wierzba Thomas F, et al. (2001), The Interrelationship of Malnutrition and Diarrhoea in a Periurban Area Outside Alexandria, Egypt. *Journal of Paediatrics Gastroenterology and Nutrition* 32:189–196 .
- Williams R.L., R.K. Creasy, G.C. Cunningham, W.E. Hawes, F.D. Norris and M. Tashiro (1982), Fetal Growth And Perinatal Viability in California. *Obstetric Gynaecology.* 59: 624-632,.
- World Bank (2005), World Development Indicators. Washington, D.C. <http://worldbank.org/data/>.
- World Health Organization (2004), Comparative Quantification of Health Risks. Global and regional burden of disease attributable to selected major risk factors. Edited by M. Ezzati, A López, A Rodgers and C. Murray. Geneva.