USAID
FROM THE AMERICAN PEOPLE

HEALTH CARE IMPROVEMENT PROJECT

TECHNICAL REPORT

Status and Trends in Chronic Malnutrition in Guatemala

OCTOBER 2010

This technical report was prepared University Research Co., LLC (URC) for review by the United States Agency for International Development (USAID) and authored by Dr. Hernan L. Delgado of URC. The study was carried out under the USAID Health Care Improvement Project, which is managed by URC and made possible by the generous support of the American people through USAID.

TECHNICAL REPORT

Status and Trends in Chronic Malnutrition in Guatemala

OCTOBER 2010

Hernan L. Delgado, University Research Co., LLC

Acknowledgements: The author wishes to acknowledge Humberto Méndez and Aura Estela Leiva from the Institute of Nutrition of Central America and Panama (INCAP) for assistance with databases and analyses. Special thanks to Tisna Veldhuijzen van Zanten, Rodrigo Bustamante, and Elena Hurtado of University Research Co., LLC (URC) for the opportunity and motivation to prepare this report and for their comments and subsequent revisions.

This study was supported by the American people through the United States Agency for International Development (USAID) and its Health Care Improvement Project (HCI). HCI is managed by URC under the terms of Contract Numbers GHN-I-01-07-00003-00 and GHN-I-03-07-00003-00. URC's subcontractors for HCI include EnCompass LLC, Family Health International, Health Research, Inc., Initiatives Inc., Institute for Healthcare Improvement, Johns Hopkins University Center for Communication Programs, and Management Systems International. For more information on HCI's work, please visit www.hciproject.org or write hci-info@urc-chs.com.

Recommended citation: Delgado HL. 2010. Status and Trends in Chronic Malnutrition in Guatemala. *Technical Report*. Published by the USAID Health Care Improvement Project. Bethesda, MD: University Research Co., LLC (URC).

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

ACRONYMS

Cm	Centimeter
ENCOVI	National Living Standards Survey *(Encuesta Nacional de Condiciones de Vida)*
ENSMI	National Maternal and Infant Health Survey (*Encuesta Nacional de Salud Materno Infantil*)
HCI	USAID Health Care Improvement Project
INCAP	Institute of Nutrition of Central America and Panama (*Instituto de Nutrición de Centro América y Panamá*)
LSMS	Living Standards Measurement Study
MUAC	Mid-upper arm circumference
MSPAS	Ministry of Public Health and Social Assistance (*Ministerio de Salud Pública y Asistencia Social*)
NCHS	National Center for Health Statistics
SAM	Severe Acute Malnutrition
SEGEPLAN	General Secretariat of the National Council for Economic Planning (*Secretaría General de Programación y Planificación*)
SESAN	Secretariat for Food Security and Nutrition (*Secretaría de Seguridad Alimentaria y Nutricional*)
URC	University Research Co., LLC
USAID	United States Agency for International Development
WHO	World Health Organization

EXECUTIVE SUMMARY

Malnutrition in Guatemala is evidenced by linear growth or height retardation in preschool and school children and adults, iron-deficiency anemia in both reproductive-age women and children and overweight and obesity in women of reproductive age, as found in numerous health and nutrition surveys conducted over the past fifty years. There is a minor downward trend in chronic malnutrition while overweight and obesity are on the rise. These trends place the country in a phase of a polarizing nutritional epidemiological transition, in which manifestations of deficiencies in energy and macro and micronutrients coexist with imbalances and feeding and nutritional excesses.

National averages, however, hide the contrasts found between the metropolitan region, which exhibits the best indicators and more favorable trends, and departments and municipalities with the highest percentage of the indigenous populations where malnutrition prevalences are higher and improvements have been slight. Moreover, there are municipalities which have consistently experienced a deterioration of their nutritional status over the past twenty years. This considerable heterogeneity between communities and population groups was the basis for a proposal made for designing and implementing differentiated intervention packages specific to community groups and depending on the nature, magnitude and duration of the nutritional problems, made in the companion document "Basis for Addressing the Situation of Chronic Malnutrition in Guatemala."

Both at the departmental and municipal levels, statistically significant associations were found in the expected direction between the prevalence of height retardation in preschool and school children in 2008 and variables related to:

- access and use of health services (use of family planning methods, attendance to prenatal care, qualified childbirth and postpartum care, and infant mortality rate)
- households living in poverty and extreme poverty
- possession of and access to goods and services in homes and basic sanitation
- agricultural work, regardless of land ownership
- density of micro farms
- level of parental education
- indigenous population
- size of the family and dependency ratio

The adverse nutritional situation in Guatemala contrasts with the rich nutritional information existing in the country and the valuable contributions made to the nutritional sciences worldwide. Moreover, Guatemala—like the rest of the countries in the Central American region—has, since the 1990s, promoted a Food and Nutrition Security Initiative, which currently has a legal basis and a specific law which established the National System of Food and Nutrition Security in 2005. Only by strengthening the authority of the Secretariat of Food and Nutrition Security, as well the effective provision of human, material, and financial resources during a sustained period of time and in the amount and quality corresponding to the magnitude of the country's food and nutritional problems will allow improvement in this dire situation.

Programmatic models that integrate assistance with preventive and promotional actions in the context of the holistic strategy of food and nutrition security are recommended. Also, emphasis should be placed on the planning of sustained actions of proven efficacy in the medium and long run that are focused in the most-at-risk groups: children in the first 24 to 36 months of life, girls, reproductive-age women, and indigenous populations traditionally excluded from development. Technical contents in the short and medium term have been proven by the health sector, but other sectors—directly related with the food

and nutrition field—must participate in a multi-sector solution. Finally, implementing multiple actions, both integrated and sector-specific, within a food and nutrition security framework and with optimal social, productive, environmental and human resource investments, should be given the highest priority.

I. INTRODUCTION

Guatemala is the country in the Americas region with the highest prevalence of chronic malnutrition among preschool children and is also among the five countries with the highest prevalence worldwide – a situation evidenced by height and linear growth retardation. Considering the efforts made at the national level, and their apparent low impact in reducing the magnitude of the problem, it is relevant and appropriate to analyze the situation and trends more thoroughly in search of information that will enlighten the proposed solutions for scenarios based on future projections of this problem.

As is true for the other countries in Central America, the recorded history of public nutrition began with the first food and nutrition survey in 1965 (1). This survey, based on a probability sample representative of the Guatemalan population, provided an overview of the nature, extent, distribution, and potential causes of the most prevalent problems, both nationwide and in urban and rural areas. This survey also provided a baseline with which to compare the findings of numerous anthropometric surveys conducted on preschool children between 1965 and the most recent survey in 2008/9 (2–7).

As identified in the baseline survey and confirmed in surveys that followed, the most prevalent problems of childhood malnutrition include linear growth retardation (indicating chronic malnutrition) and iron deficiency or anemia. Other problems identified in the baseline survey, such as other micronutrient deficiencies, have been reduced, whereas overweight and obesity, the expression of excess and imbalances in malnutrition, have grown.

All information derived from these maternal and child health-care and living-conditions surveys has been analyzed and disseminated in numerous publications. Worthy of special mention are an analysis of anthropometric nutritional information of Guatemala in the period 1987–2002 (8) and a recent compilation containing secondary analyses of information from each Central American country and the Dominican Republic. The latter examines the trends in malnutrition among preschool children between 1965 and 2002 and their relationship to differences in geography, economy, ethnicity, and gender, among other factors (9).

Guatemala, like the other countries of the region, conducts periodic height censuses of school children, consisting of measuring the height of all children attending first grade in public education institutions. Three height censuses of school children have been taken to date: in 1986, 2001, and 2008 (10–12).

Other special studies carried out in the country have provided information useful for examining the magnitude and distribution of malnutrition, as well as the changing trends in various manifestations of protein energy malnutrition. These projects include the study of Guatemala Functional Classification (13), sentinel surveillance in communities and health facilities (14), and recent specific surveys aimed at detecting cases of acute severe malnutrition resulting from economic and environmental crises that affect the nutritional situation of the population, especially the poorest and most marginalized (15–16).

While information on weight and height of preschool children is available for representative samples at a national level and for some specific population groups, the aforementioned information on food consumption of the population is limited. The only direct information is from dietary surveys in the baseline survey, while indirect information is based on estimates of food expenditure from household surveys. The most recent survey, conducted in 2008/9, collected data on food consumption but is not yet available for secondary analysis and inclusion in this report.

The purpose of this document is to integrate the existing information from various reports and to present results of new secondary analyses. The goal is to review the situation of chronic malnutrition in preschool and school children in Guatemala and to present information on trends to date, projected ahead to possible future scenarios.

II. RELEVANCE OF THE STUDY

In simple terms, nutrition is defined as the balance between intake of food (and hence of energy and nutrients) and the requirements of an organism. Good nutrition is an essential element of good health.

As shown in several studies, both in Guatemala and at an international level, when nutrition is deficient during infancy and childhood due to limited consumption or increased requirements, physical growth slows or stops in order to conserve essential nutrients and energy for vital functions (17); in extreme situations, emaciation develops as a result of the catabolism of fat and lean mass to increase the availability of energy and essential nutrients (18).

As mentioned, chronic nutritional deficiencies constitute a serious problem for public health, nutrition, and social development in Guatemala and affect a large proportion of the population. A valid and reliable indicator of chronic malnutrition is the delay in growth in preschool children and school children. As confirmed by numerous investigations, this growth is determined by environmental factors such as inadequate nutrition and increased disease burden which, both independently and in combination, limit the genetic potential for growth in height. According to current evidence, this potential for growth should be quite comparable among all ethnic groups (19).

The delay in growth, recognized today as a manifestation of chronic food insecurity and nutrition (20), is a growing concern among national decision makers for several reasons. First, low height is a valid and reliable manifestation of chronic malnutrition. The most rapid growth in length occurs in the first 18 weeks of intrauterine life so, in that period, environmental factors such as nutrition and diseases have their greatest impact on growth. Once established *in utero* and the first 24–36 months of age, growth delay is usually irreversible and is directly and significantly associated with a reduced immune response, and premature illness and death. Secondly, there is a close relationship between physical growth and mental development: The delay in growth is directly associated, to various degrees depending on the populations studied, with diminished mental development and reduced learning ability. Additionally, the work capacity and productivity of chronically undernourished adults are less than those of a well-nourished population. Furthermore, the existence of a direct relationship between poor nutrition early in life and the risk of non-transmissible chronic diseases during adulthood has been postulated. And finally, related to the foregoing considerations, income generation by chronically malnourished population is less than that of better-nourished populations, which adversely influences national economic growth and poverty levels.

Not all of these associations with growth retardation are necessarily causal, but it is reasonable to expect that nutritional deficiencies manifested in reduced physical growth affect other morphological and functional aspects as well.

Physical growth in the children of Guatemala is primarily a result of low food intake compared to nutritional needs and a high burden of disease. Thus, the high prevalence of growth retardation is an expression of the exclusion (limited access to goods, services, and other opportunities) affecting a significant proportion of the population, especially indigenous groups. Inadequate intake and high morbidity also have underlying and fundamental causes such as food and nutrition insecurity and environmental insecurity which, in turn, relate to the country's development model as well as to the adverse and the positive effects of global, national, and local conditions.

For the above reasons, height retardation – in itself an indicator of past nutritional status – also constitutes a valid and reliable proxy for the inequity and economic and social underdevelopment of Guatemala.

Considering that height retardation, with its contributing social, biological, and environmental factors, is also a valid indicator of human underdevelopment, its study is, in turn, an analysis of human underdevelopment. Both have common determinants that tend to establish a vicious cycle that

perpetuates itself for generations. In addition to contributing to the measurement of living conditions of a population, height retardation is a valid indicator for the planning, monitoring, and evaluation of policies and programs aimed at reducing inequities, combating poverty, and relieving food and nutritional insecurity.

III. MATERIALS AND METHODS

The data in this report were obtained through national health surveys, height censuses of school children, and special surveys, as shown in Table 1. The table also presents information on the general characteristics of these studies, including the public sector entity responsible for the study, cooperating agencies involved, the population studied, the sample size, and level of representation by population groups and geographical areas. To facilitate further research by interested readers, each listing also indicates the reference source that contains a description of the methodology and data collection procedures. From the standpoint of survey comparability, two series – the Maternal and Child Health Care National Surveys of 1987, 1995, 1998/9, 2002, and 2008/9 and the School Children Height Censuses conducted in 1987, 2001, and 2008 – applied common sampling frames, had similar coverage, and used standardized methods of data collection and processing.

Table 1: National surveys with nutritional information for Guatemalan children, 1965–2008/9

	Name	Year	Sample	Size	Observations	Reference
--	Nutritional Evaluation of the Central America Population and Panama, Guatemala	1965	Random sample	4,113 individuals, 867 less than 5 years old	Petén is excluded and populations over 25,000 inhabitants	1
I	Maternal and Child Health Care National Survey	1987	Multistage probability sample	5,459 households surveyed	Petén is excluded; includes children 3–36 months old	2
II	Maternal and Child Health Care National Survey	1995	Multistage probability sample	11,297 households surveyed	Petén is excluded; includes anthropometry of women of childbearing age (up to 49 years) children up to 60 months	3
III	Maternal and Child Health Care National Survey	1998/9	Stratified multistage probability sample	5,587 households surveyed	Petén is included	4
--	Living Conditions National Survey	2000	Two-stage stratified sample	7,940 households surveyed	Based on the LSMS methodology developed by the World Bank	5
IV	Maternal and Child Health Care National Survey	2002	Two-stage stratified sample	11,489 households surveyed	Final report under preparation	6
V	Maternal and Child Health Care National Survey	2008/9	Two-stage stratified sample	21,990 households surveyed	Representative of the country's 22 departments	7

The databases were given to the Institute of Nutrition in Central America and Panama (INCAP) by Guatemala, where the data were cleaned and processed by skilled personnel using standardized criteria recommended by the World Health Organization (WHO) (21), and were analyzed in a timely manner at the Computer Center of the Institute[1].

The basic variables of this analysis, contained in all databases, are age by months, sex, and anthropometric measurements of height and weight. These measures form the basis for estimating indices and indicators and were used to calculate the indicators traditionally used to classify child malnutrition: weight-for-age, height-for-age, and weight-for-height. These indicators are presented in this report as z-scores – the result of normalizing the distributions by comparing individual measurements obtained in the surveys with the median of the measurements (specific to gender and age) found in universally recommended growth reference standards proposed at that time by the University of Iowa, University of Denver, and Harvard University, and adopted by the Ministry of Public Health (22). The reference populations of the National Center for Health Statistics (NCHS)/WHO (23) have been used during the past three decades and more recently, since 2005, the Child Growth Standards of WHO (24–25) were used. The three indices are categorized, so that children's nutritional deficiencies are identified in the category with z-scores more than two standard deviations below the median (< –2.0 standard deviations). In most of the analyses, properly cleaned and processed anthropometric data are presented as indicators, with low height-for-age (stunting, or stunted linear growth) as a manifestation of chronic malnutrition; low weight-for-height indicating acute malnutrition or emaciation; and low weight-for-age as an expression of global malnutrition (26).

As shown in Table 1, all national surveys included in this report are representative at the national level, with disaggregation by urban and rural residence, and by sex and age groups. Since 1987, the surveys also obtained representative information on the ethnicity of the children measured, as well as household characteristics such as parental education, socioeconomic indicators, and information on the mothers' reproductive history. Representative information was available for seven out of eight political-administrative regions in the country, in 1987, and for all eight regions in the surveys that followed. In addition, in the most recent demography and health survey, conducted in 2008/9, representative information was obtained at the level of the 22 departments in the country.

During the same period, in 1986, Guatemala carried out the first National Height Census in first-grade children in primary public schools. The height censuses, described in Table 2, have been conducted by adequately trained elementary school teachers in all countries of the Central American region since 1979, when Costa Rica carried out the first national census in the region (27). Guatemala conducted a later census in 2001, and the last one in 2008. Considering that measurement is performed on all first-grade students, this information can be compiled at the levels of school, village, municipality, department, and political-administrative region, and consolidated nationwide.

Table 2: National height censuses of first-grade children in public schools, Guatemala, 1986–2008

Name	Year	Sampling	Size	Observations	Reference
First National Height Census	1986	Universe	202,997	Measurement of all children enrolled in first grade at each school	10
Second National Height Census	2001	Universe	380,579	Same as above	11
Third National Height Census	2008	Universe	459,808	Same as above	12

[1]We would like to thank the INCAP Computer Center, and especially to Mr. Humberto Méndez and Lic. Aura Estela Leiva, for their valuable cooperation in the preparation of this report.

As was the case for surveys, databases were provided to INCAP by the Ministries of Health and Education and the Secretariat for Food Security and Nutrition (SESAN), who took part in the third census, in all cases relying upon the valuable technical and financial collaboration of international and bilateral cooperation agencies, foundations, and private sector institutions.

The basic information was entered, cleaned, and processed following standard procedures. For analytic purposes, as with preschool children, the basic measures of children's age, sex, and height were used to determine indices and indicators, classifying children with heights more than two standard deviations below the median height of children of the same age and sex as low height-for-age or with height retardation, based on the Child Growth Standards of the WHO. As previously explained, height retardation is an expression of past or chronic malnutrition, with effects accumulating from conception until the age of measurement.

Finally, this report includes results from four special studies implemented at a national level or in specific regions of the country (see Table 3). Two of these, at the national level, were carried out in the 1980s: a) A study of Regionalization of Nutritional Problems in Guatemala (13), following the proposed methodology of the Functional Classification of Malnutrition (28), was implemented as a joint effort of the General Secretariat of the National Council for Economic Planning (SEGEPLAN) and INCAP, with the support of the United States Agency for International Development (USAID); and b) the Sentinel Surveillance System (14) was implemented by the Ministry of Public Health and Social Assistance (MSPAS) and INCAP, also with the cooperation of USAID.

The other two special studies are more current and reflect the need for information on the adverse effects of recent crises, such as the increase in food prices, financial stress, and drought associated with the "El Niño" (14–15) climatic phenomenon. These surveys, conducted in late 2009 and early 2010, placed particular emphasis on the population living in the "Dry Corridor of eastern Guatemala," a semi-arid strip of land affected by recurrent droughts during the rainy season, with degraded soils and low agricultural yield, which extends through the departments of Alta and Baja Verapaz, El Progreso, Zacapa, Chiquimula, Jutiapa, Santa Rosa, Jalapa, and El Quiché.

Results of the analyses of these databases are presented in the country's geographical context, by region, department, or municipalities, as well as by urban/rural groups, and ethnicity.

Finally, with the purpose of presenting a comprehensive vision of chronic malnutrition in Guatemala in different population groups, as well as details of preschool and schoolchildren's growth, this report includes information on women's height. The inclusion of this information acknowledges that the environment, especially the food supply and disease burden, is the most important determinant of height attained by the population of different ages in developing countries. Therefore it is important, in Guatemalan surveys, to analyze women's attained height at childbearing age as evidence of the effects of past inadequate food supply and diseases on their nutritional status. The sample of women studied consisted of mothers of preschool children measured in the National Maternal and Infant Health Surveys (ENSMI) conducted in 1995, 1998, and 2002. As in the case of children, measurements were carried out by trained personnel using standardized, comparable, internationally recommended techniques in the three surveys.

Table 3: Special surveys with nutritional information on Guatemalan children, 1980–2010

Name	Year	Sample	Size	Observations	Reference
Regionalization of nutritional problems in Guatemala	1980	Random selection in nine departments and two metropolitan areas	114 municipalities 355 populated places 3.317 families	Departments and municipalities were selected for their higher percentage of agricultural workers. Only damaged and marginalized areas were included in the department of Guatemala.	13
Simplified National Survey of Maternal and Child Health Care and Nutrition: Final Report	1985	Sentinel Census in 119 communities in 24 health areas, with re-visits between 1985 and 1987	119 communities 16.273 houses 18.691 families 92.665 people	Includes communities of 1,000 inhabitants ± 250, children under 36 months of age	14
Food and Nutrition Situation in the Central American Dry Corridor and Guatemala: Preliminary Report	2009	Random selection of 20 households in 80 communities in 10 municipalities recommended by key informants in five departments of the dry corridor	1600 households	Measurement of mid-upper arm circumference and presence of edema used for the evaluation of children's nutritional status from 6 to 59 months of age	15
Valuation of food and nutritional insecurity in departments of the dry corridor of eastern Guatemala, Quiché and Izabal	2009	Random stratified systematic selection of settlements of each one of the studied municipalities (54 of the prioritized dry corridor by SESAN and 10 of Quiché and Izabal).	A total of 1455 homes in 190 selected communities were studied	Determination of the nutritional status by measurement of the brachial circumference and the presence of edema	16

IV. RESULTS

This section summarizes information on the magnitude, distribution, and trends of chronic undernutrition at national, regional, departmental, and municipal levels, between 1965 and 2009.

A. National and Regional Level

The first national survey of food supply and nutrition, conducted in 1965, concluded that "during the first three months of life, the height and weight of Guatemalan children are normal compared to appropriate standards. However, after that age, growth rates decelerate: at six months of age height and weight are already below the standards, at two years of age they are a year behind, and at five years of age the delay is nearly two years. There was no recovery from this delay during the remaining period of growth."

As shown in Table 4, these findings were also applicable to subsequent surveys, which show that height retardation in preschool children has been prevalent nationwide and is currently the main nutritional problem in Guatemala. Using the most current information regarding growth of normal preschool

children in the reference population of NCHS/WHO, the prevalence of stunting, underweight-for-age, and low weight-for-height are 43.4%, 19.3%, and 0.9%, respectively[2].

Table 4: Prevalence of anthropometric indicators of malnutrition in preschool – Guatemala, 1965–2008/9

Indicator	1965	1987 ENSMI	1995 ENSMI	1998/9 ENSMI	2000 ENCOVI	2002 ENCOVI	2008/9 ENSMI
Weight/Age	33.6	33.7	27.3	24.3	20.7	22.9	19.3
Height/Age	58.2	55.4	49.8	46.7	45.6	49.2	43.4
Weight/Height	2.4	1.6	3.3	2.5	2.6	1.7	0.9

Additionally, this table shows a steady decline in the prevalence of weight retardation, height retardation, and weight-for-height malnutrition. This decline in prevalence should, however, be interpreted with caution because the sample populations studied are not necessarily comparable across surveys, as indicated previously in Table 1. The exception to the downward trend in height retardation was the 2002 survey, which shows an increased prevalence compared to the previous two surveys; the same is true in 1995 in relation to weight-for-height. Analyzing the extent of change in the national prevalence of height retardation between 1965 and 2008/9 reveals a reduction of 14.8 percentage points, i.e., 0.34 percentage points per year. When analysis was limited to the period from 1995 to 2008/9, with comparable samples and methodologies as in the case of maternal and child health care surveys, the average annual reduction in height retardation was 0.49 percentage points; between 2002 and 2008/9 the reduction was 0.82 to 0.97 percentage points per year.

Analysis at the level of political-administrative regions, as shown in Figures 1–3, shows variability between the average regional prevalence, with a lower prevalence of height retardation and low weight-for-age in the metropolitan region and the highest prevalence in the northwestern region; low weight-for-height is significantly less prevalent, with the northeastern region most affected. Noting the trends in each region between 1965 and 2008/9, one sees very little reduction in height retardation in the northern, northwestern, and northeastern regions, while the greatest improvement was in the metropolitan area. On the other hand, the prevalence of height retardation was reduced significantly more between 2002 and 2008/9 than between 1965 and 2002; the exception to this observation is the northeastern region, where the prevalence of height retardation has actually increased since 2000.

The downward trend in the prevalence of underweight is quite apparent in all regions with the exception of the northwestern region, as is the downward trend in prevalence of low weight-for-height. It is important to be cautious in interpreting these figures because, as mentioned, the national surveys of preschool children are not necessarily comparable, except for the ENSMI series of surveys, which had comparable sampling frames and standardized methodologies.

[2] In the case of preschool children in this report, the reference population of NCHS/WHO is used, not the growth pattern of normal children recommended by WHO in 2005, due to the fact that in the Preliminary Report of the V Survey of Maternal and Child Health Care 2008–2009 this standard growth was the only one used.

Figure 1: Changes in the prevalence of low height-for-age in children under five years of age in Guatemala, Total and by region, NCHS standards, 1966–2008

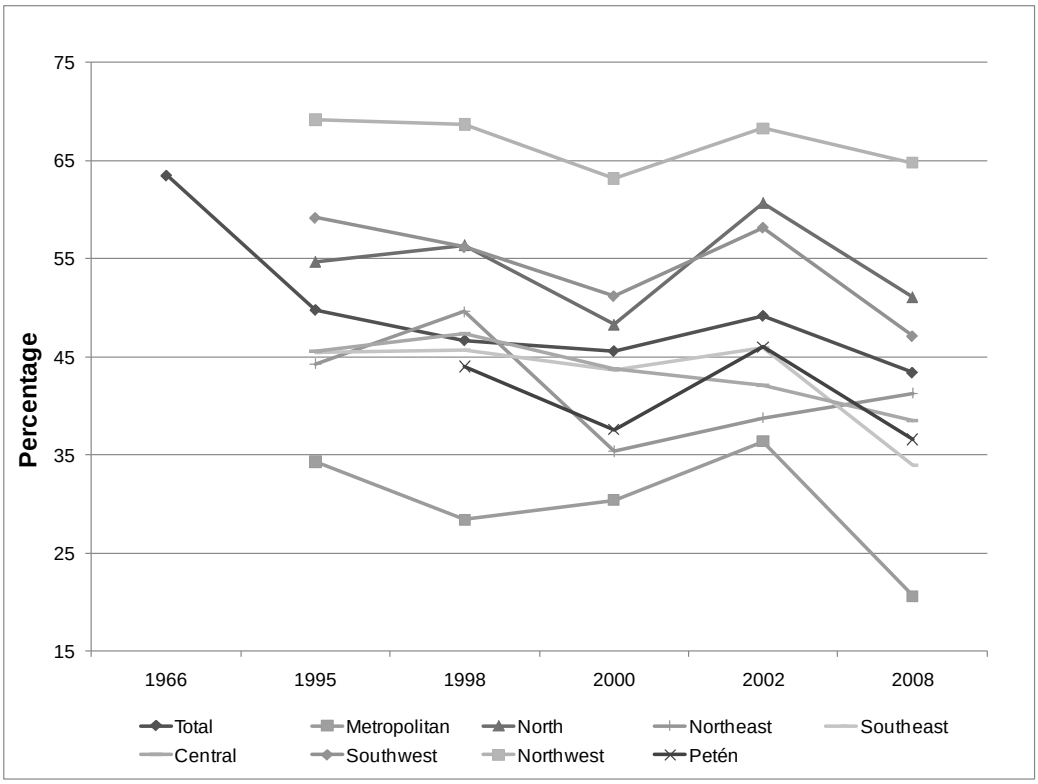


Figure 2: Changes in the prevalence of low weight-for-age in children under five years of age in Guatemala, Total and by region, NCHS standards, 1966–2008

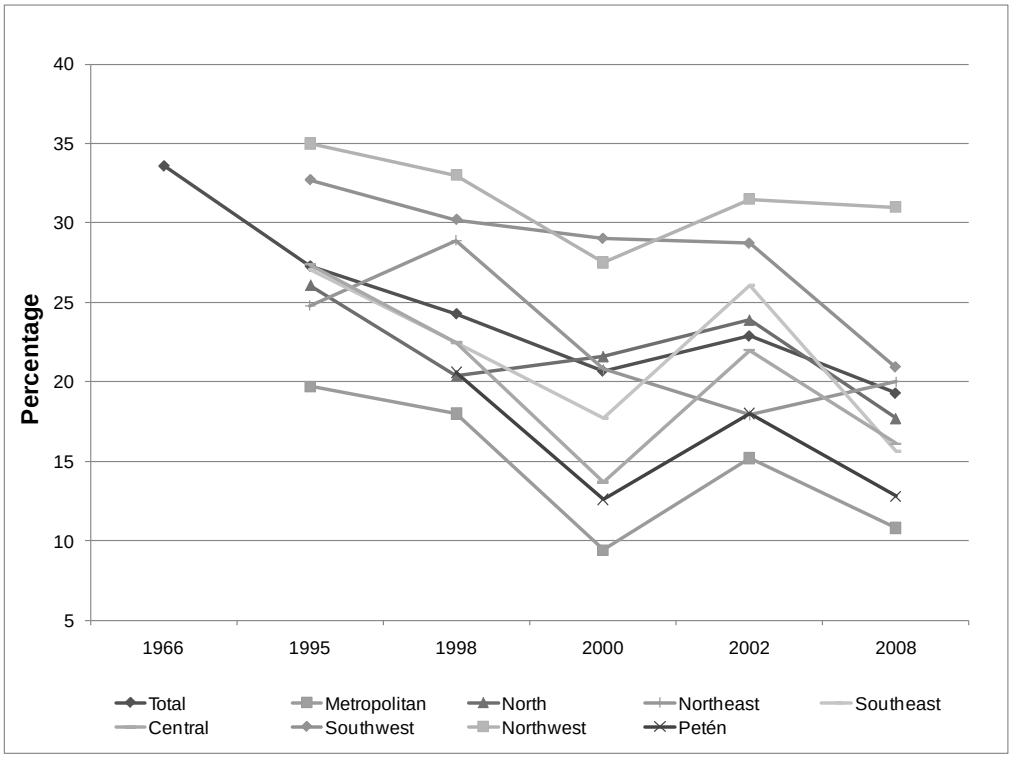
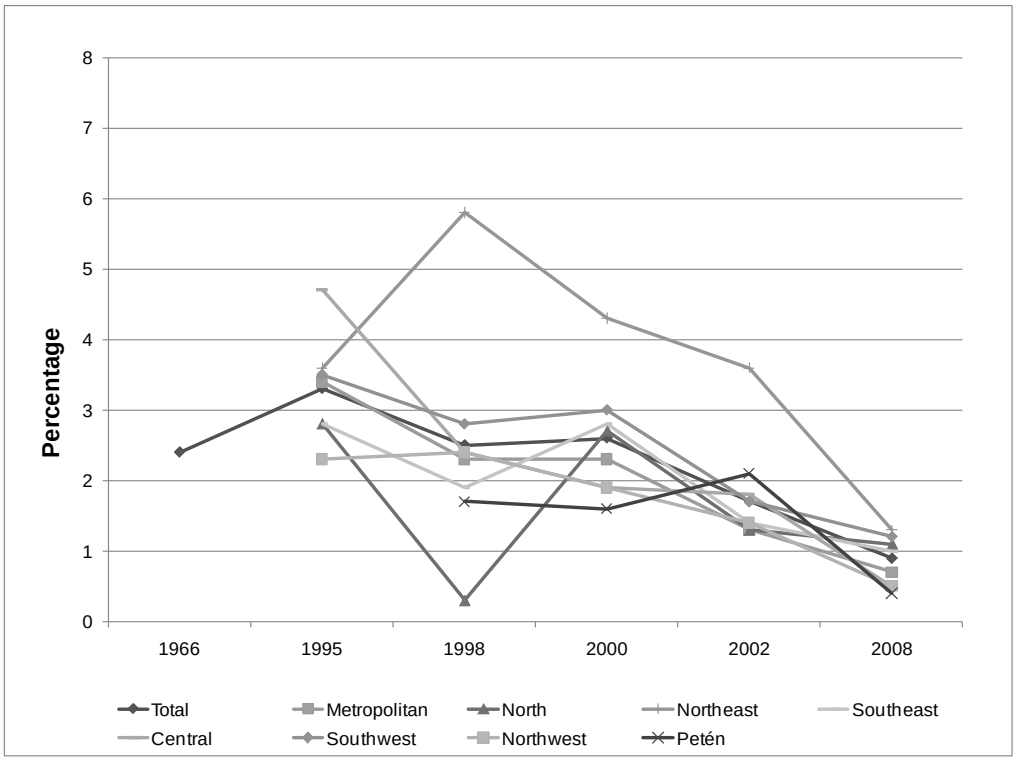


Figure 3: Changes in the prevalence of low weight-for-height in children under five years of age in Guatemala, Total and by region, NCHS standards, 1966–2008



The analysis of the information on height retardation based on the height censuses (Table 5) shows that the average national reduction in height retardation in school children between 1986 and 2008 was equal to 5.5 percentage points, or 0.25 percentage points per year. This annual reduction in height retardation was less than that recorded for preschool children; however, when the analysis is limited to the most recent two census periods (2001-2008) , when the change was 0.59 percentage points per year, the improvement in growth retardation is more than six times that occurring between 1986 and 2001.

Table 5: Prevalence of height retardation in first-grade students by age, Guatemala, 1986–2008

Census Year	Age				
	6	7	8	9	Total
1986	33.5	44.4	58.2	69.1	51.1
2001	39.3	43.4	55.0	63.3	49.7
2008	34.8	39.6	51.7	60.0	45.6

Table 6 shows that the prevalence of height retardation in students is lowest in the metropolitan region and highest in the northwestern region. With this table, it is also possible to compare changes in each of the eight regions of the country over 22 years, analyzing the 1986, 2001, and 2008 censuses. Noteworthy in this analysis are the improvements in the metropolitan and central regions, with a reduction of approximately 12 percentage points; this contrasts with the reduction of only 3.2–3.4 percentage points in the northwestern, northeastern, and northern regions during the same period.

Table 6: Prevalence of height retardation in students (six–nine years) during the first cycle of primary education, by region in Guatemala

Region	Year		
	1986	2001	2008
Metropolitan	37.7	30.7	25.7
North	53.8	51.0	50.4
Northeastern	40.7	38.2	37.5
Southeastern	41.3	39.2	33.8
Central	50.9	45.5	38.8
Southwestern	61.4	60.2	52.7
Northwestern	66.5	66.7	63.3
Petén	42.2	40.7	34.2

The trend in the average height of girls, as measured in the 1986, 2001, and 2008 censuses, was also analyzed. The total change in average height was 0.41 cm in the 22 years elapsing between censuses, with the largest change occurring between 2001 and 2008.

Surveys from 1995 to the present have included measurements of women of childbearing age, sampling mothers of children under five years of age. Table 7 shows the average values for female height from all three surveys, with information for each of the eight political-administrative regions of the country. As was the case in preschool and schoolchildren, women's height in the metropolitan area is greater than in other regions, while the northwestern, northern, and southwestern regions have lower average maternal heights. Moreover, as in the case of preschool and schoolchildren, the height of the indigenous female population is significantly less, by about 5.5 centimeters (cm), than that of the non-indigenous population. The height difference between mothers with no education and those with secondary education or higher is about 7 cm, with the more educated mothers being taller.

Table 7: Height (cm) of women of reproductive age in Guatemala

Regions (Departments)	Surveys		
	1995	1998/9	2002
Metropolitan (Guatemala)	150.2	150.3	151.3
North (Alta Verapaz and Baja Verapaz)	145.9	146.8	146.6
Northeastern (El Progreso, Izabal, Zacapa, and Chiquimula)	148.9	148.2	149.0
Southeastern (Santa Rosa, Jutiapa, and Jalapa)	149.3	149.4	149.6
Central (Chimaltenango, Sacatepéquez, and Escuintla)	148.0	148.3	148.9
Southwestern (Sololá, Totonicapán, Quetzaltenango, Suchitepéquez, Retalhueleu, and San Marcos)	146.1	146.7	147.0
Northwestern (Huehuetenango and El Quiché)	145.0	144.7	145.9
Petén (Petén)	---	148.4	149.5
Total	147.1	147.6	148.0
Ethnic Group			
Indigenous	144.7	144.8	145.3
Ladino	150.1	150.0	151.1
Schooling			
None	145.7	145.1	145.8
Primary	148.2	148.5	148.7
Secondary and higher	153.2	152.8	152.8

The change in the average height of women between 1995 and 2002 was +1.0 cm; the change was greater among younger women (< 25) in comparison with those over 25 years of age. It is important to note that only in the metropolitan, southeastern, Petén, and northeastern areas does the height of

women exceed 149 cm – a value often used as a criterion of maternal and peri-neonatal risk. The average height of women determined in previous maternal and child health care surveys confirms that the value has consistently been low; in fact, the national average was found to be less than 149 cm in the 1965 survey and 149.4 cm in the sentinel communities studied in 1986. These studies also show the close association between the average height of mothers and the prevalence of height retardation in preschool and school children in all the country's regions: values of the correlation coefficient $r = -0.96$ and -0.97, for preschool and school children, respectively (8 cases; $p < 0.0001$ for both).

Regional information was also obtained in the study on Regionalization of the Nutritional Problems of Guatemala. Although the regions are not necessarily comparable to those established in 1987, it was found that those regions most affected by chronic malnutrition – expressed in this particular study as height-for-age of less than 90% compared to a standard population – were also the western highlands, composed of Sololá and Huehuetenango, and the northern region of Alta Verapaz; the lowest prevalences were found in the marginal and deteriorated areas in the capital city of Guatemala.

B. Departmental Level

As noted, the 5th Maternal and Child Health Care Survey, conducted in 2008/9, is the only one that contains information representative of preschool children at the departmental level. The prevalences of low weight-for-age, weight-for-height, and height-for-age among preschool children are presented in Table 8 and constitute a basis for estimating retardation using the NCHS/WHO reference population. Moreover, height data from the three censuses of schoolchildren conducted between 1986 and 2008 can be added at the departmental level.

Four departments have more than 60% prevalence of stunting in preschool children, four others are between 50% and 60%, four between 40% and 50%, four have prevalences between 30% and 40%, and the remaining six have growth retardation prevalences between 20% and 30%. The prevalence in Totonicapán is 3.6 times greater than that found in the department of Guatemala.

The prevalence of low weight-for-age is less variable than that for height, with 12 departments having prevalences between 0% and 20%, seven between 20% and 30%, and three greater than 30%. Again, the prevalence in Totonicapán is the highest: 3.2 times higher than that found in El Progreso, the department with the lowest prevalence of low weight-for-age. Regarding low weight-for-height, which is found to a much lesser extent, the departments with prevalence greater than 2% are Izabal and Retalhuleu, while levels in San Marcos and Suchitepéquez are between 1.5% and 2%.

Table 8 also presents the latest information on the height of school children, based on the 2008 census. As shown, there is a high association between the magnitude of stunting in preschool and in school children at the departmental level: the four departments with more than 60% prevalence of height retardation among preschool children are the same ones that have height retardation prevalences above 60% in school children.

The information from the 2008 School Height Census shows that the departments with chronic malnutrition among more than 50% of school children (20 times more than expected in a population of healthy and well-nourished children, according to WHO growth standards) are Chimaltenango, Sololá, Totonicapán, San Marcos, Huehuetenango, Quiché, Alta Verapaz, and Chiquimula.

Table 9 presents the information at the departmental level for each of the height censuses. As shown in this table, the departments in which chronic malnutrition in school children was above the national average in each of the censuses are Chimaltenango, Sololá, Totonicapán, Quetzaltenango, San Marcos, Huehuetenango, Quiché, and Alta Verapaz. Baja Verapaz, Sacatepéquez, and Suchitepéquez had prevalences above the national average in the first two censuses, which decreased in the last census, while Jalapa is among those most affected according to the last two censuses.

Table 8: Low weight-for-age, weight-for-height, and height-for-age in preschool and school children by department in Guatemala, 2008–2009

Department	Retardation			
	Preschool Children			School Children
	Weight/Age	Weight/Height	Height/Age	Height (2008)
Totonicapán	32.7	0.0	74.2	69.4
Quiché	31.6	0.8	64.8	63.9
Huehuetenango	30.4	0.3	64.7	62.8
Sololá	25.0	0.1	64.0	65.2
Chiquimula	23.1	0.9	55.7	50.5
Chimaltenango	20.8	0.4	53.3	53.9
Baja Verapaz	24.1	1.2	53.3	45.6
Alta Verapaz	16.2	1.0	50.6	51.7
San Marcos	20.6	1.7	46.8	55.5
Jalapa	20.2	0.7	46.0	47.7
Sacatepéquez	15.3	0.0	43.9	37.9
Zacapa	22.8	0.4	41.0	30.8
Quetzaltenango	15.2	1.2	37.0	46.0
Petén	12.8	0.4	36.6	34.2
Suchitepéquez	18.4	1.5	35.4	41.5
Izabal	18.4	2.4	33.9	33.2
Retalhuleu	16.3	2.1	29.9	35.8
Jutiapa	13.9	1.3	29.4	28.1
Escuintla	13.3	0.8	27.2	25.3
Santa Rosa	12.0	1.1	24.4	28.3
El Progreso	10.1	1.2	21.2	25.5
Guatemala	10.8	0.7	20.6	
Total	**19.3**	**0.9**	**43.4**	**45.6**

Table 9: Height retardation in school children (six–nine years) in the first grade of elementary school, by department in Guatemala

Departments	Years		
	1986	2001	2008
Chimaltenango	66.2	61.3	53.9
Sololá	76.9	74.0	65.2
Totonicapán	76.2	74.4	69.4
Quetzaltenango	60.0	55.9	46.0
San Marcos	61.1	62.3	55.5
Huehuetenango	65.9	67.4	62.8
Quiché	67.2	65.8	63.9
Alta Verapaz	53.9	50.4	51.7
Baja Verapaz	53.8	52.6	45.6
Sacatepéquez	55.2	46.0	37.9
Suchitepéquez	56.1	49.9	41.5
Jalapa	50.9	53.2	47.7
El Progreso	39.1	31.6	25.5
Escuintla	39.0	31.4	25.3
Santa Rosa	39.8	35.8	28.3
Retalhuleu	47.9	42.8	35.8
Petén	42.2	40.7	34.2
Izabal	38.7	34.5	33.2
Zacapa	37.0	33.8	30.8
Chiquimula	47.1	48.3	50.5
Jutiapa	37.4	33.1	28.1
National Total	**51.1**	**49.7**	**45.6**

The magnitude of height retardation in school children is directly linked to the age of the children, and changes in the age composition of those attending the first grade – as would result from actions aimed at increasing school enrollment – might constitute a confounding factor in the analysis to target the populations most at risk and to estimate trends. Thus, changes in the prevalence of height retardation were analyzed only for the children seven years of age, the largest group in all censuses. As shown in Table 10, based on information limited to height retardation at seven years of age, the previous findings are consistent, and Chiquimula is included as one of the departments with higher than average prevalence in the 2008 census.

Table 10: Height retardation in school children seven years old, by department in Guatemala

Departments	Years		
	1986	2001	2008
Chimaltenango	61.4	56.2	49.4
Sololá	72.4	70.0	62.6
Totonicapán	72.2	71.5	66.3
Quetzaltenango	56.0	58.8	41.7
San Marcos	55.1	56.8	49.8
Huehuetenango	56.8	61.4	56.0
Quiché	61.1	60.9	59.2
Alta Verapaz	45.9	45.7	46.7
Baja Verapaz	47.7	47.4	41.0
Sacatepéquez	50.2	39.8	31.2
Suchitepéquez	49.7	45.0	36.1
Jalapa	46.2	48.4	41.4
Chiquimula	41.9	42.3	46.0
Guatemala	34.3	26.0	20.8
El Progreso	35.4	26.3	20.8
Escuintla	34.5	26.6	21.1
Santa Rosa	35.7	32.2	24.2
Retalhuleu	43.1	37.7	31.1
Petén	35.3	36.3	30.0
Izabal	30.7	29.7	28.4
Zacapa	31.4	28.9	23.6
Jutiapa	33.5	28.0	23.6
Total	**44.4**	**43.4**	**39.6**

For purposes of this analysis of the status and trends of chronic malnutrition in Guatemala, information from special studies was also considered, such as the Regionalization of the Nutritional Problems of Guatemala, carried out in 1980, and data derived from the Sentinel Surveillance System between 1985 and 1987. The regionalization study found higher prevalence of height retardation (over 50% height retardation, based on the indicator <90% of adequate height-for-age) in Sololá, Huehuetenango, Alta Verapaz, Baja Verapaz, Suchitepéquez, and Jalapa. The aggregated information from the sentinel communities of the Sentinel Surveillance System confirms that the prevalence of height retardation in preschool children is greater than 50% in the same departments identified in the height census: the northern and southwestern regions, as well as Baja Verapaz and Jalapa, belonging to the so-called "dry corridor" of the country, and Sacatepéquez, Retalhuleu, and Suchitepéquez.

C. Municipal Level

The only information available on height retardation at the municipal level is the result of the aggregation of height census data obtained from those enrolled in first grade of public primary schools. In 2008, this amounted to 459,808 children between six and nine years old, at more than 15,000 establishments in 333 municipalities.

Analyzing the last census, it is possible to identify the municipalities with the highest and lowest prevalence of chronic malnutrition. The lowest prevalence of height retardation, 10.2%, corresponds to the municipality of Guastatoya, department of El Progreso; and the highest, having 91.4% of children with chronic malnutrition, corresponds to the municipality of San Juan Atitán, department of Huehuetenango. Based on the Child Growth Standards of WHO, it is expected that approximately 2.3% of children fall more than two standard deviations below the median of the distribution, so there is four times more height retardation than expected in Guastatoya, while in San Juan Atitán the prevalence is nearly 40 times greater than expected for a population of children with adequate growth.

Based on the aggregation of the 2008 census information, it was found that 127 of the 333 municipalities (38.1%) across Guatemala have a prevalence of height retardation of 50% or more, i.e., more than 20 times the prevalence expected in a healthy and well-nourished population. At the departmental level, shown in Table 11, the departments in which 50% or more of the municipalities have more than 50% of their schools with height retardation prevalences greater than 50% are, in order from highest to lowest: Totonicapán (100% of its municipalities), Quiché (86%), Huehuetenango (84%), Sololá (79%), Alta Verapaz (75%), San Marcos (55%), and Chimaltenango (50%). Only 23 other municipalities in the country have more than 50% of schools with greater than 50% prevalence of height retardation. Eleven of these are located in Quetzaltenango, four in Chiquimula, three in Jalapa, two in Suchitepéquez, and one each in Zacapa, Sacatepéquez, and Baja Verapaz.

Height Retardation

The prevalence of height retardation in young children in developing countries, like Guatemala, is a valid and accurate indicator of health and nutritional status. Stunting in preschool and school children, as well as in adulthood reflects inadequate nutrition from conception until 24 to 36 months; the highest length growth velocity occurs during the first 16 to 20 weeks of life. As shown in this report, height retardation in school children is highly prevalent in the highlands of Guatemala, predominantly in Mayan population, reflecting poor socioeconomic conditions and exclusion. Prevalence of height retardation of school children is also dependent of the coverage of the public education system (low enrollment is likely to underestimate the extent of stunting); given that coverage has significantly increased in Guatemala during the last 22 years and is high, the school height censuses constitute a reliable and valid tool for small-area targeting of nutritional interventions. Furthermore, the mean stature of women in Guatemala is 148 cm and about 145.6 cm in the highlands; small adult body size is detrimental to the health of women, and the health and nutrition of the fetus and infant, which, without well-targeted and determined interventions, can continue to perpetuate the vicious cycle of malnutrition.

Analysis at the schools level found that 6,919 schools nationwide, 47% of the total, had more than 50% prevalence of height retardation. When school data were added together for each department, the same seven departments (plus Chiquimula) contained more than 50% of the schools with height retardation prevalence greater than 50%. Excluding these eight departments, the remaining 14 departments have a total of 1,560 schools with prevalence of height retardation greater than 50%; thus, 23% of the schools in these departments have a prevalence of height retardation exceeding 50%, compared with 66% of the schools in the eight most-affected departments.

Table 11: Schools and municipalities, by department, having more than 50% of school children with height retardation, according to the 2008 census

Department	Municipalities with >50% schools with >50% prevalence of height retardation (total # municipalities)	# schools with >50% height retardation (total # schools)	Municipalities with >50% prevalence of height retardation – ordered from lowest to highest prevalence within each department
Guatemala	0 (18)	84 (907)	---
El Progreso	0 (8)	39 (209)	---
Sacatepéquez	1 (16)	25 (99)	Santa María de Jesús
Chimaltenango	8 (16)	294 (463)	Patzicia, Acatenango, San José Poaquil, Patzún, San Juan Comalapa, Santa Cruz Balanyá, Tecpán, Santa Apolonia
Escuintla	0 (13)	29 (421)	---
Santa Rosa	0 (14)	61 (472)	---
Sololá	15 (19)	342 (416)	Santa Catarina Palopó, San Lucas Tolimán, Santa Lucía Utatlán, San Andrés, Semetabaj, San Marcos La Laguna, Santa Clara La Laguna, San Antonio Paolopó, San José Chacayá, San Juan La Laguna, San Pablo La Laguna, Sololá. Santa Cruz La Laguna, Concepción, Nahualá, Santa Catarina Ixtahuacán
Totonicapán	8 (8)	405 (445)	San Cristóbal Totonicapán, Totonicapán, San Bartolo Aguas Calientes, San Francisco el Alto, Santa Lucía La Reforma, San Andrés Xecul, Momostenango, Santa María Chiquimula
Quetzaltenango	11 (24)	256 (564)	Zunil, San Francisco La Unión, Almolonga, San Juan Ostuncalco, Palestina de los Altos, Concepción Chiquirichapa, San Miguel Siguilá, San Martín Sacatepéquez, Cajolá, Cabricán, Huitán
Suchitepéquez	2 (20)	111 (380)	San Antonio Suchitepéquez, San Miguel Panán
Retalhuleu	0 (9)	59 (266)	---
San Marcos	16 (29)	850 (1,378)	San Pablo, Nuevo Progreso, Malacatán, San Lorenzo, Tejutla, La Reforma, San Antonio Sacatepéquez, San José Ojetenam, San Miguel Ixtahuacán, Sipacapa, Tacaná, Ixchiguán, Sibinal, Tajumulco, Comitancillo, Concepción Tutuapa
Huehuetenango	27 (32)	1,182 (1,621)	Unión Cantinil, Cuilco, Jacaltenango, La Libertad, Chiantla, Nentón, San Pedro Soloma, Aguacatán, San Idelfonso Ixtahuacán, San Pedro Necta, Todos Santos Cuchumatán, San Sebastián Coatán, Santa Bárbara, Concepción Huista, San Juan Ixcoy, Tectitán, San Sebastián Huehuetenango, San Rafael Petzal, Santa Cruz Barillas, Colotenango, Santa Eulalia, San Gaspar Ixchil, San Rafael la Independencia, San Mateo Ixtatán, San Miguel Acatán, Santiago Chimatenango, San

Department	Municipalities with >50% schools with >50% prevalence of height retardation (total # municipalities)	# schools with >50% height retardation (total # schools)	Municipalities with >50% prevalence of height retardation – ordered from lowest to highest prevalence within each department
			Juan Atitán
Quiché	18 (21)	955 (1,319)	San Andrés Sajcabajá, Joyabaj, Chinique, Zacualpa, Santa Cruz del Quiché, San Antonio Ilotenango, San Pedro Jocopilas, Sacapulas, San Miguel Uspantán, Chiché, Chicamán, San Bartolomé Jocotenango, Cunén, Santo Tomás Chichicastenango, San Juan Cotzal, Patzité, Chajul, Nebaj
Baja Verapaz	1 (8)	205 (487)	Purulhá
Alta Verapaz	12 (16)	962 (1,751)	Santa María Cahabón, Panzos, Santa Catalina La Tinta, Chahal, Santa Cruz Verapaz, San Miguel Tucurú, San Juan Chamelco, Senahú, Lanquin, Tactic, San Cristóbal Verapaz, Tamahú
Petén	0 (12)	177 (875)	---
Izabal	0 (5)	170 (600)	---
Zacapa	1 (10)	76 (295)	La Unión
Chiquimula	4 (11)	369 (675)	San Juan Ermita, Camotán, Olopa, Jocotán
Jalapa	3 (7)	170 (408)	Jalapa, San Carlos Alzatate, San Pedro Pinula
Jutiapa	0 (17)	98 (600)	---
TOTAL	**127 (333)**	**6,919 (14,651)**	**127 identified municipalities**

As shown in Table 11, in Sololá and Totonicapán over 80% of schools have height retardation prevalences exceeding 50%; height retardation in Huehuetenango and Quiché exceeds 70%, Chimaltenango and San Marcos show prevalences greater than 60%, and Alta Verapaz and Chiquimula have prevalences of more than 50%.

Information about municipalities in which more than 50% of schools have a prevalence of height retardation of over 50% is also included in Table 11.

V. TRENDS

Surveys of preschool children, height censuses in school children, and information on the height of women of childbearing age allow the assessment of trends in the changes that have occurred in Guatemala in recent decades with respect to chronic malnutrition.

As was shown in Table 4, considering the full range of surveys of preschool children from 1965 through 2008/9, there has been a reduction of about 0.34 percentage points per year in the prevalence of height retardation. On the other hand, if the trend is estimated from the ENSMI 1995 survey, the reduction is 0.49 percentage points per year. The reduction has been constant over the decades, with the exception of the increase in prevalence noted in the ENSMI 2002 survey. In the case of low weight-for-age, the decline in prevalence, expressed in percentage points per year, has been greater (i.e., faster) than for height retardation.

The downward trend in height retardation, estimated from the censuses of school children, indicates a

total change of 0.25 percentage points per year. Finally, when analyzing the average growth in women of childbearing age, the average height difference between the women measured in 1995 and in 2002 is +0.9 cm.

In all of these cases, the major reductions in prevalence of height retardation or the increased measure of women's height occurred in the metropolitan region, while minor changes occurred in the northwestern, northern, and northeastern regions.

In order to examine in greater detail the changes in prevalence of height retardation in preschool children, Table 12 presents the average prevalence in various population groups, classified by age, area of residence, ethnicity, interval between births, educational level, and socioeconomic index. Whether examining the full set of surveys from 1965 to 2008/9, or only the ENSMI, the greatest reductions in the prevalence of height retardation are found in preschool children who are between 24 and 35 months old, residents in urban areas, non-indigenous, with a birth interval of more than 36 months, and whose mothers have secondary education and are of higher socioeconomic status. It is noteworthy that almost no improvement was found between 1995 and 2002 in the indigenous population, in the population without education, at the low socioeconomic levels, and in those with a birth interval less than 36 months.

Table 12: Differentials in height retardation prevalence in preschool children in Guatemala, 1965–2008/9

	1965	1987 ENSMI	1995 ENSMI	1998/9 ENSMI	2000 ENCOVI	2002 ENSMI	2008/9 ENSMI
Age (in months)							
0–5	12.3	20.1	17.1	20.9	15.9	15.4	---
6–11	34.7	38.6	31.9	27.1	27.0	31.6	38.4
12–23	70.6	69.4	57.0	53.2	52.8	56.7	---
24–35	57.8	60.7	56.8	49.4	51.1	49.2	42.6
Area or Residency							
Urban	23.2	43.7	35.1	32.5	31.9	36.5	28.8
Rural	62.0	59.9	56.7	54.9	52.3	55.3	51.8
Ethnic Group							
Indigenous	---	69.4	66.7	67.4	59.5	69.3	---
Ladino	---	45.5	37.4	34.4	33.5	35.6	---
Birth Intervals							
< 36 months	---	59.4	56.5	55.3	48.7	58.1	---
≥ 36 months	---	55.6	44.1	37.2	31.7	42.4	---
Maternal education level							
None	---	66.7	63.0	64.5	50.0	65.3	62.9
Primary level	---	48.7	48.3	44.6	32.1	46.4	43.3
Secondary and higher levels	---	22.4	15.9	14.2	12.2	18.9	15.8
Socioeconomic Index							
Low	---	65.8	63.2	62.0	56.5	64.4	---
Medium	---	58.5	56.0	52.6	46.2	56.9	---
High	---	31.5	24.8	22.0	20.8	22.1	---

Similarly, the height census information on school children at departmental and municipal levels allows the analysis of trends between 1986 and 2008. At the national level, reduction in the prevalence of height retardation was more than six times greater from 2001 to 2008 than during the previous period from 1986 to 2001. When analyzing changes at the departmental level, previously shown in Table 9, decreases lower than the national average decrement were found during the first period in San Marcos, Huehuetenango, Quiché, Baja Verapaz, Jalapa, and Chiquimula; for the second period, the departments showing the least improvement were Quiché, Alta Verapaz, Izabal, and Chiquimula.

For the entire period – from 1986 through 2008 – at the national level, the prevalence of chronic malnutrition in children seven years of age declined by 4.8 percentage points; lesser reductions occurred in Huehuetenango, Quiché, Alta Verapaz, Izabal, Jalapa, and Chiquimula. The latter department showed an increase in chronic malnutrition between 1986 and 2008.

Changes between height censuses can be analyzed by municipalities, considering changes in the prevalence of height retardation in the periods 1986–2001 and 2001–2008. As shown in Table 13, it is possible to identify four categories of municipalities: 1) those that have improved in both periods, 2) those that showed a sustained decline in both periods, 3) those with recovery in the second period but deterioration in the first period, and 4) those that show deterioration in the second period but improvement in the first period.

Table 13: Change in the prevalence of chronic malnutrition in schoolchildren in two time periods (1986–2001 and 2001–2008) in 323 municipalities at the national level

		2001-2008			
		Deterioration		**Improvement**	
		n	%	n	%
1986-2001	**Deterioration**	16	5.0	92	28.5
	Improvement	23	7.1	192	59.4

Overall, there has been an improvement in the nutritional status of children, especially during the second period. However, detailed analysis shows that the downward trend in the prevalence of height retardation over the past 22 years has been slower in the municipalities of the western departments (Totonicapán, Quiché, Huehuetenango, Sololá, Alta Verapaz, San Marcos, Chimaltenango, and Quetzaltenango) than in the country's municipalities overall. Of 16 municipalities with continued deterioration during these two time periods, 13 (81%) are in eight of the western departments. Also, of the 39 municipalities with deterioration in the most recent period, 28 (72%) are in the departments of the western region. Finally, 82% of the municipalities in the eight western departments showed an improvement in the second period compared with 88% at the national level.

Annex 1 lists the names of the municipalities, in all departments nationwide, with greater nutritional damage and vulnerability. The criteria for defining municipalities with minimal changes in the prevalence of chronic malnutrition considered the changes (in terms of percentage points per year) in moderately effective programs that have shown reductions of one-half to one percentage point annually.

VI. SPECIAL STUDIES

Not all national surveys contain comparable regional data, which limits the ability to estimate subnational trends. In reality, while low height-for-age (indicating chronic malnutrition) and low weight-for-age (indicating global malnutrition) are appropriately estimated in cross-sectional health and nutrition surveys due to the fact that they are measures of prevalence, low weight-for-height (indicating acute

malnutrition) is underestimated in cross-sectional studies and is more appropriately estimated by prospective studies that would report it as incidence. A prospective study of changes in the low weight-for-height indicator would be a valid tool for early warnings associated with crisis situations; however, the available information only permits us to identify the regions of the country where global and chronic malnutrition were more prevalent at the time of the survey and to geographically locate the people at risk, as well as those with nutritional damage.

Regarding the current situation, the population of Guatemala has been affected by various crises, both financial and environmental, such as the prices of food and energy. Specific nutritional surveys or censuses were carried out in 2009, especially in territories and for groups most at risk such as residents of the "Dry Corridor," historically identified among geographic areas at risk, in which agricultural production experienced higher losses. These studies were conducted by international and nongovernmental organizations, with participation of national official authorities.

Information about the current state of acute malnutrition in children was obtained in Guatemala last October, through a survey conducted in departments within the borders of the "Dry Corridor," which includes Alta Verapaz, Baja Verapaz, El Progreso, Zacapa, Chiquimula, Jutiapa, Santa Rosa, Jalapa, and Quiché. Nutritional assessment was carried out by measuring mid-upper arm circumference (MUAC), and led to estimates that 5% of the cases studied had severe acute malnutrition (SAM) – i.e., arm circumference less than 11.5 cm. There was a greater prevalence of cases in the southern region of Quiché, a second cluster in the southern region of Izabal, Zacapa, Chiquimula, and northeast of Jalapa, and a third cluster in the northern region of Santa Rosa (Humanitarian Network, 2009).

In late 2009, a survey was conducted in communities in the departments of Chiquimula, Jalapa, El Progreso, Zacapa, and Jutiapa, also using the MUAC measurement. Based on this survey, the average prevalence of SAM in the region studied was 2.7%, with significantly higher levels in Jalapa (9.3%) and San Luis Jilotepeque (6.6%). The loss of the corn crop was estimated to be 58% of the first planting, and about 70% of beans for the first and second season (Action Against Hunger, 2009).

VII. VARIATE AND MULTIVARIATE ANALYSES

Chronic malnutrition is the most prevalent nutritional problem in Guatemala, particularly in the highland departments. Therefore, information on factors associated with height retardation in children was analyzed for this report. In order to have aggregated data at departmental and municipal levels, the analysis included the prevalence of height retardation among preschool and school children – total and for seven-year-olds only – as a dependent variable; this was obtained from the last ENSMI (2008/9) and School Height Census (2008), respectively, for the 22 departments. For analysis at the level of 333 municipalities nationwide, the prevalence of height retardation in schoolchildren – total and for seven-year-olds – was used as a dependent variable. Independent variables included in the analysis were demographic indicators, socioeconomic status, education, ethnicity, and occupation, access to services, sanitation, and land access, with information obtained from various sources for departmental and municipal levels.

Tables 14 and 15 present the values of the correlation index and statistical significance of associations between dependent and independent variables for the 22 departments and 333 municipalities of Guatemala, respectively.

Table 14: Factors associated with the prevalence of height retardation in preschool children, and school children six–nine years and seven years of age in 22 departments of Guatemala

Variables	Growth Retardation		
	Preschool children	Children 6–9 years of age	Children 7 years of age
Access and use of health services			
Contraceptive use	-0.88***	-0.86***	-0.86***
Infant mortality	0.39	0.44*	0.46*
Prenatal care attendance	-0.86***	-0.82***	-0.82***
Births attended in health facilities	-0.91***	-0.90***	-0.91***
Types of delivery (Cesarean)	-0.75***	-0.72***	-0.75***
Births attended by medical doctor	-0.91***	-0.90***	-0.90***
Postnatal check-up attendance	-0.48*	-0.51*	-0.50*
Domestic violence			
Sexual violence	-0.44*	-0.50*	-0.49*
Verbal violence	-0.50*	NS	NS
Demographic information			
Female	0.44*	0.48*	0.47*
Indigenous	0.80***	0.85***	0.86***
Population living in poverty			
Poverty	0.66***	0.71***	0.71***
Extreme poverty	0.61***	0.67***	0.67***
Female-headed households	NS	NS	-0.42*
Access to basic household services			
Connected to a sewage system network	-0.50*	-0.51*	-0.52*
Connected to electricity	-0.44*	-0.46*	-0.46*
Overcrowding, means of cooking, and garbage disposal			
Overcrowding	0.60**	0.68***	0.68***
Means of cooking: wood	0.68**	0.71***	0.72***
Trash thrown anywhere	0.65**	0.64**	0.63**
Occupational category			
Unpaid family member	0.65**	0.67***	0.66***
Numbers of farms			
Micro farms	0.46*	0.58**	0.58**
Sub-family	-0.43*	-0.54**	-0.55**
Large multifamily	-0.44*	-0.49*	-0.48*
Illiteracy			
Illiteracy	0.76***	0.74***	0.74***
Rural illiteracy	0.75***	0.72***	0.73***
Illiteracy among women	0.80***	0.81***	0.81***
Primary not completed	0.64**	0.61**	0.61**
Socioeconomic status			
House with dirt floor	0.57**	0.55**	0.55**
Occupational precariousness index	-0.61**	-0.60**	-0.60**
Deprivation index	0.54*	0.53*	0.53*
Average live births	0.63**	0.68***	0.68***
Demographic dependency ratio	0.59**	0.60**	0.60**

* p <.05 **p <.001 ***p<.0001 NS No significant correlation

Table 15: Factors associated with the prevalence of height retardation in school children (six–nine years) and school children seven years old in 333 municipalities of Guatemala

Variables	Children 6–9 years of age	Children 7 years of age
Demographic Information		
Rural population	0.32***	0.31***
Indigenous population	0.75***	0.76***
Median age	-0.70***	-0.69***
Percentage of women	0.24***	0.25***
Percentage of indigenous women	0.79***	0.76***
Population in poverty conditions		
Total poverty	0.72***	0.71***
Extreme poverty	0.68***	0.67***
Index of human development	-0.64***	-0.63***
Access to basic household services		
Female-headed	-0.21***	-0.21***
No toilet	0.12*	0.11*
Connected to sewage system network	-0.34***	-0.34***
Connected to electricity	-0.35***	-0.34***
Connected to a water network	-0.30***	-0.29***
Overcrowding, means for cooking, and garbage disposal		
Overcrowding	0.70***	0.68***
Means for cooking: electricity	-0.17**	-0.17**
Means for cooking: wood	0.65***	0.65***
Municipal service for garbage disposal	-0.24***	-0.22***
Trash thrown anywhere	0.59***	0.58***
Economically active population		
Economically active men	-0.22***	-0.22***
Economically active women	-0.22***	-0.23***
Occupational category		
Unpaid family member	0.47***	0.48***
Agriculture	0.35***	0.34***
Numbers of farms		
Micro farms	0.42***	0.42***
Sub-family	-0.31***	-0.32***
Family	-0.32***	-0.31***
Medium multifamily	-0.30***	-0.30***
Large multifamily	-0.20***	-0.21***
Average area of farms (Ha)		
Micro farms	0.16**	0.16**
Sub-family	-0.26***	-0.27***
All farms	-0.52***	-0.55***
Illiteracy		
Illiteracy	0.70***	0.68***
Rural illiteracy	0.66***	0.66***
Female illiteracy	0.77***	0.76***
Index of precariousness	-0.59***	-0.58***
Average live births	0.68***	0.68***

* p <.05 **p <.001 ***p<.0001

The results of these bivariate analyses confirmed that a number of factors related to demographics, socioeconomic status, education, land tenure, access to health services, goods and services at the household level, demographic dependency and overcrowding, as well as human development indices, occupational insecurity, and marginalization, are linearly associated with the prevalence of chronic malnutrition at departmental and national municipal levels. At the departmental level, in Table 14, statistically significant associations were found, in the expected direction, between the prevalence of height retardation in preschool and school children in 2008 and variables related to:

- access and use of health services (prevalence of use of family planning methods, prenatal care, childbirth and postpartum care, and the infant mortality rate)
- percentage of poverty and extreme poverty
- possession of and access to goods and services at home (sanitation)
- occupation of father and mother (agricultural work, regardless of land ownership is associated with a higher prevalence of chronic malnutrition)
- density of micro farms (possibly because the availability of stable employment is lower in micro farms than in large plots)
- level of parental education (inversely associated with prevalence of height retardation, which could be interpreted as a greater ability of educated families to access public services, information, employment, and other available services)
- indigenous population (due to the adverse socioeconomic conditions in which the indigenous population has lived); a strong direct association between altitude and chronic malnutrition has also been reported in Guatemala, suggesting that those living in mountainous terrain, generally less productive and with fewer services and roads, have a higher prevalence of malnutrition (29); many of the indigenous population of Guatemala live in these highlands
- the size of the family and the dependency ratio (the ratio of dependents, under age 15 and seniors, to the economically active); these associations are indicative of the effect of number of people to feed on nutritional status when resources are limited.

Although the information available on the independent variables is not exactly the same for the municipal level (Table 15), the associations seen at the departmental level are also apparent at the municipal level.

Finally, Table 16 shows the results of multivariate analysis based on the data available for municipalities at national levels, for school children in general (six-nine years) and for school children seven years of age, to examine the dependence of chronic malnutrition on a variety of independent variables. In the multiple regression model, the independent variables included were those most strongly associated with chronic malnutrition in the previous analyses. The dependent variables, analyzed separately, were the two indicators of height retardation in school children, i.e., the prevalence of height retardation in all school children (six-nine years of age) and the prevalence in school children seven years of age. The regression results show that models including the independent variables listed explain about 80% of the variability of height retardation in all school children and in school children seven years of age. Height retardation in school children is associated with a high percentage of poverty, low human development index, lack of housing connection to the drainage network, a high rate of overcrowding, increased use of wood as cooking fuel, high density of micro farms in the area and unpaid family work, a high percentage of illiteracy among women, high rates of occupational insecurity, and a higher average number of live births. The prevalence of chronic malnutrition also appears directly related to the percentage of indigenous population in the municipalities; this relationship mainly reflects the degree of exclusion under which the indigenous population has lived.

Table 16: Multiple regression: Determinants of height retardation in school children in 333 municipalities of Guatemala

A. All Schoolchildren 6–9 years					
Source	**DF**	**Sum of squares**	**Mean square**	**F-ratio**	**Pr > F**
Model	13	87,012	6,693.20	119.54	< 0.0001
Error	316	17,693	55.99		
Corrected total	329	104,705			
R squared	**Coefficient of variation**		**Root MSE**	**Dependent mean**	
0.82	16.68		7.48	44.86	
Parameter	**Estimate**		**Standard error**	**t-value**	**Pr > t**
Intercept	-25.20		21.46	-1.17	0.24
Indigenous population	0.09		0.02	4.44	< 0.0001
Poverty	0.11		0.05	2.17	0.0308
Overcrowding	0.26		0.07	3.78	0.0002
Unpaid family member	0.18		0.04	4.66	< 0.0001
Micro farm	0.22		0.02	11.24	< 0.0001
Illiteracy among women	0.33		0.07	4.61	< 0.0001
Occupational instability index	43.23		14.38	3.01	0.0029
B. Schoolchildren 7 years of age					
Source	**DF**	**Sum of squares**	**Mean square**	**F-ratio**	**Pr > F**
Model	13	88,915	6,839.64	114.18	< 0.0001
Error	316	18,928	59.90		
Corrected total	329	107,844			
R squared	**Coefficient of variation**		**Root MSE**	**Dependent mean**	
0.82	18.98		7.74	40.77	
Parameter	**Estimate**		**Standard error**	**t-value**	**Pr > t**
Intercept	-43.91		22.19	-1.98	0.049
Indigenous population	0.11		0.02	5.39	< 0.0001
Poverty	0.24		0.71	3.34	0.0009
Overcrowding	0.21		0.04	5.32	< 0.0001
Micro farm	0.22		0.02	10.86	< 0.0001
Illiteracy among women	0.29		0.07	4.00	< 0.0001
Occupational instability index	43.69		14.87	2.94	0.0036
Average living children	4.71		2.14	2.20	0.0288

These findings confirm that the nutritional status of children is determined by many causes that operate at the *basic or structural* level as well as at *underlying or community* levels and *proximal or intermediate* levels. As defined in the conceptual framework of food and nutritional security (20), the immediate determinants of nutritional status are food intake and biological utilization of food, indicating that consumption and serious infections would be the *proximal* determinants or intermediaries through which the *underlying* (food availability, income, health behaviors and conditions) and *basic* (social, economic, political, and environmental) causes of chronic malnutrition operate.

Based on this and other studies in Guatemala, it can be stated that factors indicative of poor living conditions—poverty, low level of education (especially the mother's), lack of basic services, including health care services and unhealthy environmental conditions—are among the main determinants of chronic malnutrition. The other variables found to be significantly associated with height retardation in the analyses presented here are also part of the three level web of structural, underlying, and proximal causes of chronic malnutrition in Guatemala.

VIII. DISCUSSION

As indicated in this report, valid and reliable information exists on the status and trends related to chronic malnutrition and food insecurity in Guatemala; these data identify the departments and municipalities most affected and the most vulnerable population groups. Although one could question the comparability of the different surveys and the validity of using the height of school children in geographic areas with low coverage of the education system (prevalence of chronic malnutrition would be underestimated there, because children not attending school would be in marginalized groups and have the highest prevalence of height retardation), overall the information allows for identification of groups at higher risk for malnutrition and for targeting programs most effectively.

As noted previously, it is evident that the problem of malnutrition begins at conception, in women of short height, chronically malnourished, and without the resources or ability to break the vicious cycle of malnutrition, which is perpetuated from one generation to the next. Infants are born short in length; the problem becomes more evident as age increases, reaching its highest prevalence in the first 24–36 months of age. Growth retardation accumulated in the early years is also evident in the school years and into adulthood for women. As is well known, short height in women is associated with obstetric risks for mothers and with limited fetal growth and development; consequently, it increases the prevalence of infants with intrauterine retardation and infant morbidity and mortality.

The groups most traditionally affected by chronic malnutrition are evidenced by the high prevalence of height retardation in preschool children, school children, and adult women living in eight departments in which the indigenous population of Mayan descent is concentrated. In some of these departments, the population of all municipalities is highly affected; in others, it is possible, through the analysis of height in school children, to identify the most affected schools and villages, keeping in mind that they may be affected by the coverage of the educational system.

In analyzing the changes from 1965 to the present in preschool children, school children, and adult women, a trend towards improvement became evident. In the case of preschoolers, previous studies based on the ENSMI surveys conducted between 1987 and 1998/9 concluded that the change during this period in children under three years of age, estimated at 1.16 percentage points per year, was higher than the average found in developing countries; nevertheless, extending that analysis to 2008/9, based on the latest ENSMI survey, reveals a reduction of about 15 percentage points over the 22 years elapsed – equivalent to 0.68 percentage points per year. Considering the age group up to five years of age, and analyzing the trend between 1995 and 2008/9, the change during this period was 6.4 percentage points in the 14 years elapsed, i.e., 0.45 percentage points annually.

It is interesting, at this point, to analyze and compare two countries in the Americas region, Brazil and Mexico, which have shown declines in growth retardation in children less than five years of age in recent periods (30–31). While Brazil experienced a decline in the prevalence of chronic malnutrition at the national level from 13.5% in 1986 to 6.8% in 2006, Mexico showed a reduction from 27% in 1988 to 15.5% in 2006. In terms of percentage points per year, the reductions in chronic malnutrition are 0.67 and 0.64, respectively, i.e., 40% to 50% greater than the reductions noted in Guatemala for the same age group. The analyses in both Brazil and Mexico emphasize that the biggest declines occurred in the countries' poorest regions, where the reduction in prevalence of height retardation was equal to or greater than one percentage point per year.

In Guatemala, the sharpest decline in prevalence of height retardation has occurred in the metropolitan area, while areas with higher prevalence have experienced less change. It is the children of urban, Ladino, and more-educated families with greater resources and access to services who have benefited the most in recent times. Concurrently, the traditionally marginalized populations—the indigenous, poor, and uneducated, with limited access to resources and services—continue to experience the highest prevalence of malnutrition. Moreover, these families live on marginal land with low productivity, making them particularly vulnerable to the effects of climate variability and change. As these are the same populations that have higher fertility rates and population growth, it is reasonable to conclude that the magnitude of the problem of chronic malnutrition, expressed in absolute numbers, increases every year, which in turn increases the demand for health care and preventive actions.

The available information also allows us to explore the determinants of chronic malnutrition and their differentials. As demonstrated, short stature in the mother is directly linked to chronic malnutrition in childhood, which starts the vicious intergenerational cycle of malnutrition. Other factors associated with chronic malnutrition are poverty, lack of health services and education, and low productive capacity. Indigenous families appear most affected, with the least decrease in the prevalence of height retardation in the past few decades. Knowing that the potential growth in height of the indigenous population does not differ from the potential of the Ladino population, the differences are mainly a reflection of the poor living conditions and marginalization that affect Mayan populations.

Considering this, and knowing the efforts of the Government of Guatemala, civil society, the private sector, and international cooperation and nongovernmental organizations to minimize and eventually eliminate chronic malnutrition as a problem of public nutrition, these findings are hardly encouraging. Although some progress is detected, unfortunately it has been irregular and not sustained. Therefore, while acknowledging that more of the same will not produce different results, it is clear that much more must be done. Programmatic models that integrate care with preventive actions and promotional materials, framed in the new holistic approach of food and nutrition security, would be the most appropriate. In this regard, the need for sustained plans, with proven effectiveness in the medium to long term, should be emphasized.

The Government of Guatemala is fully aware of the problem and its impact on the economic growth and development of the country. Legislation in these matters, proposing a technically valid and integrated approach, is a high national priority (32). Institutions have been strengthening and mobilizing resources, both financial and nonfinancial, to ensure the development of national programs and targeted actions, giving priority to the groups most at risk: particularly girls, in the first 24–36 months of age, women of childbearing age, and marginalized indigenous populations. To achieve the sustained effects over the medium to long term, it is recommended that Guatemala continue to strengthen and support the leading role of the SESAN, as well as the specialized role of other sectors related to this agenda.

Facing the situation of prevalent chronic malnutrition, there is sufficient knowledge about the efficiency and effectiveness of interventions that could achieve significant improvement. Priority attention should be assigned to implementing multiple actions, both integrated and sector-specific, within a food and nutrition security framework and with optimal social, productive, environmental and human resource

investments. In this regard, the development of technical programs of proven effectiveness that can be implemented by the health sector and others is discussed in more depth in the companion document to this report, "Basis for Addressing the Situation of Chronic Malnutrition in Guatemala" (33–34).

IX. BIBLIOGRAPHY

1. Institute of Nutrition of Central America and Panama (INCAP), Office of International Research of the National Institutes of Health, and Ministry of Public Health and Social Assistance of Guatemala. Evaluación nutricional de la población de Centroamérica y Panamá. INCAP, Guatemala, Guatemala C.A. 1969.
2. Ministry of Public Health and Social Assistance, INCAP, et al. Encuesta Nacional de Salud Materno Infantil 1987. Guatemala, Guatemala C.A. 1989.
3. Ministry of Public Health and Social Assistance, Instituto Nacional de Estadística, et al. Encuesta Nacional de Salud Materno Infantil 1995. Guatemala, Guatemala C.A. 1996.
4. Ministry of Public Health and Social Assistance, Instituto Nacional de Estadística et al. Encuesta Nacional de Salud Materno Infantil 1998/9. Guatemala, Guatemala C.A. 1999.
5. Instituto Nacional de Estadística et al. Encuesta Nacional de Condiciones de Vida 2000. Guatemala, Guatemala C.A. 2000.
6. Ministry of Public Health and Social Assistance, Instituto Nacional de Estadística, et al. Encuesta Nacional de Salud Materno Infantil 2002. Guatemala, Guatemala C.A. 2003.
7. Ministry of Public Health and Social Assistance, Instituto Nacional de Estadística, et al. V Encuesta Nacional de Salud Materno Infantil 2008–2009. Informe Preliminar ENSMI 2008–2009. Guatemala, Guatemala C.A. 2009.
8. Martorell, R., Flores, R. and Hickey, M. Stunting in Guatemala: analyses of change over 15 years. Department of International Health, Rollins School of Public Health. Emory University, Atlanta, GA. 2002.
9. Palmieri, M. et al. Ha crecido Centroamérica? Análisis de la situación antropométrica nutricional en niños menores de 5 años de edad en Centroamérica y República Dominicana para el período 1965–2006. Monograph. PRESANCA. San Salvador, El Salvador 2009.
10. Ministry of Education, et al. Primer Censo Nacional de Talla en Escolares del Primer Grado de Educación Primaria de Guatemala. Guatemala C.A. 1986.
11. Ministry of Education, et al. Segundo Censo Nacional de Talla en Escolares del Primer Grado de Educación Primaria de Guatemala. Guatemala C.A. 2001.
12. Ministry of Education, Secretaria de Seguridad Alimentaria y Nutricional, et al. Tercer Censo Nacional de Talla en Escolares del Primer grado de Educación Primaria de Guatemala. Guatemala C.A. 2009.
13. INCAP, Secretaría General del Consejo Nacional de Planificación Económica. Informe Final del Estudio sobre "Regionalización de Problemas Nutricionales en Guatemala." Guatemala, Guatemala C.A. 1980.
14. Ministry of Public Health and Social Assistance and INCAP. Encuesta Nacional Simplificada de Salud y Nutrición Materno Infantil. Guatemala, Guatemala C.A. 1986.
15. Acción contra el Hambre. Situación Alimentaria y Nutricional en el Corredor Seco de Centroamérica. Análisis de casos en Guatemala, Honduras y Nicaragua. 2009. Evaluación rápida del impacto del fenómeno de El Niño en la seguridad alimentaria de comunidades vulnerables del corredor seco de Guatemala, Guatemala. 2009.

16. Red Humanitaria. Informe: Resultados de la valoración de Inseguridad Alimentaria y Nutricional en los departamentos del Corredor Seco del oriente de Guatemala, Quiché e Izabal. Guatemala; 2009.
17. Martorell, R. Child growth retardation: a discussion of its causes and its relationship to health. In: *Nutritional adaptation in man*, ed. K. Blaxter and J.C. Waterlow. London: John Libbey; 1985.
18. American Academy of Pediatrics. Committee on Nutrition. *Pediatrics Nutrition Handbook*. 6th edition, USA. 2008.
19. Habicht, J.P., Martorell, R., Yarbrough, Ch. et al. Height and weight standards for preschool children. How relevant are ethnic differences in growth potential? *Lancet* 6:611–614. 1974.
20. Delgado, H.L. La Seguridad Alimentaria y Nutricional: Un Enfoque Integral. Síntesis de los Desafíos y Experiencias en Centroamérica. Segunda Edición. INCAP. Guatemala C.A. 2005.
21. WHO. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. Geneva: World Health Organization. 1995.
22. Tanner, J.M. Use and abuse of growth standards. In: *Human growth: A comprehensive treatise*, ed. Frank Falkner and J.M.Tanner, Volume 3. New York: Plenum Press. 1986.
23. WHO child growth standards: length/height for age, weight for age, weight for length, weight for height, and body mass index for age: methods and development. Geneva: World Health Organization. 2006.
24. De Onis, M. Child undernutrition based on the new WHO growths standards and rate of reduction to 2015. *SCN News* 36:12–16. 2008.
25. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards based on length/height, weight and age. *Acta Paediatric* Supplement 450: 76–85. 2006.
26. Waterlow, J.C., Buzina, R., Keller, W. et al. The presentation and use of height and weight data for comparing the nutritional status of groups of children under the age of 10 years. *Bulletin of the World Health Organization* 55 (4):489–498. 1977.
27. Valverde, V., et al. The school data as a source for food and nutrition surveillance systems in Central America and Panama. *Food and Nutrition Bulletin* 7(4): 32–37. 1985.
28. Joy, L and Payne, P.R. Nutrition and national development planning. *Food and Nutrition* 1(4):2–17. 1975.
29. Pebley, A. and Goldman, N. Social inequality in children's growth in Guatemala. *Health Transition Review* 5:1–20. 1995.
30. Monteiro, C. A., Benecio, M. H., Conde, W.L., et al. Narrowing socioeconomic inequality in child stunting: the Brazilian experience, 1974–2007. *Bulletin of the World Health Organization* 88: 305–311. 2010.
31. Rivera, J.A., Irizarry, L.M. and Gonzalez de Cossio, T. Overview of the nutritional status of the Mexican population in the last two decades. *Salud Pública de México* 51 supplement 4: s645–s656. 2009.
32. Government of Guatemala. Política Nacional de Seguridad Alimentaria y Nutricional. Ley del Sistema Nacional de Seguridad Alimentaria y Nutricional. Reglamento de la Ley del Sistema Nacional de Seguridad Aalimentaria y Nutricional. SESAN. Guatemala, Guatemala C.A. 2008.
33. Delgado, H.L. Bases para el mejoramiento de la situación de desnutrición crónica en Guatemala. Proyecto de USAID de Mejoramiento de la Atención en Salud. Bethesda, MD: University Research Co., LLC (URC). 2010.
34. Delgado, H.L. Basis for Addressing the Situation of Chronic Malnutrition in Guatemala. USAID Health Care Improvement Project. Bethesda, MD: URC. 2010.

X. ANNEX

Table 17: Municipalities at greatest risk and vulnerability in Guatemala, by department, according to 1986, 2001, and 2008 censuses

Department	Chronic deterioration 1986–2008	Recent deterioration 2001–2008	Has not improved significantly
Alta Verapaz	• Tactic • San Miguel Tucurú • Panzós • Senahú • San Pedro Carchá • Chahal	• Santa Cruz Verapaz • Lanquín • Chisec	• San Cristóbal Verapaz • San Juan Chamelco • Fray Bartolomé de las Casas
Chimaltenango		• Santa Apolonia • Tecpán	• San José Poaquil • Patzún
Huehuetenango	• San Juan Atitán • Santa Eulalia • Santiago Chimaltenango	• San Sebastián • San Juan Ixcoy • San Rafael Petzal	• Todos los Santos Cuchumatán • Colotenango • Tectitán • San Sebastián Coatán • San Mateo Ixtatán • Santa Cruz Barillas • Aguacatán
Quetzaltenango		• Sibilia	• Cabricán • Concepción Chiquirichapa • Palestina de los Altos
Quiché	• Chiché • San Miguel Uspantán • Chicamán	• Santa Cruz del Quiché San Bartolomé Jocotenango • Chinique	• Chajul • Santo Tomás Chichicastenango • Cunen • San Juan Cotzal Sacapulas
San Marcos	• Concepción Tutuapa	• San Antonio Sacatepéquez • Comitancillo • Tacaná • Sibinal • La Reforma • Sipacapa	
Sololá		• Panajachel • Concepción	• San José Chacayá • Santa Cruz La Laguna
Totonicapán		• San Bartolo Aguas Calientes	• San Francisco El Alto • Santa María Chiquimula
Sacatepéquez			• San Juan Sacatepéquez

Department	Chronic deterioration 1986–2008	Recent deterioration 2001–2008	Has not improved significantly
Escuintla			• Guanagazapa
Suchitepéquez			• San Lorenzo
Baja Verapaz		• Purulhá	• Cubulco
Retalhuleu		• San Andrés Villa Seca	
Petén			• La Libertad • San Luis Sayaxché • Poptún
Izabal	• Livingston		• El Estor • Morales
Zacapa	• Huite	• La Unión	• Estanzuela • Cabañas
Chiquimula	• Chiquimula • Jocotán	• Olopa	• Camotán
Jalapa			• Jalapa • San Pedro
Jutiapa		• Agua Blanca	• Moyuta • Comapa • Jerez

USAID HEALTH CARE IMPROVEMENT PROJECT
University Research Co., LLC
7200 Wisconsin Avenue, Suite 600
Bethesda, MD 20814

Tel: (301) 654-8338
Fax: (301) 941-8427
www.hciproject.org