Nutritional status of urban schoolchildren of high and low socioeconomic status in Quetzaltenango, Guatemala

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ABSTRACT

Objective.   *The prevalence of overweight and obesity is growing in children in many developing countries, increasing chronic disease risk. Our objective was to assess the prevalence of stunting, underweight, overweight, and obesity in schoolchildren 8 to 10 years old who were of high or low socioeconomic status (SES) in Quetzaltenango, which is the second largest city in Guatemala.*

Methods.   *Between April and June 2005 we conducted a cross-sectional survey among 583 children in private and public elementary schools, in which we measured height and weight. The Centers for Disease Control and Prevention (CDC) 2000 height-for-age z-scores, weight-for-age z-scores, and body mass index-for-age centiles were used to define stunting, underweight, overweight, and obesity.*

Results.   *Mean height, weight, and body mass index were significantly higher in the 327 children of high SES than in the 256 children of low SES, across sexes and age groups. The prevalence of stunting was significantly higher in low-SES children than in high-SES ones (27.0% vs. 7.3%, P < 0.01) , and this was also true for underweight (14.1% versus 4.6%, P < 0.01). In contrast, the prevalence of overweight (17.7% versus 10.5%, P < 0.01) was higher in high-SES children than in low-SES ones; the same was true for obesity (14.4% versus 2.3%, P < 0.01). The prevalence of stunting among children of low SES, and the prevalence of overweight and obesity among children of high SES far exceeded the CDC 2000 reference ranges.*

Conclusions.   *A high prevalence of both stunting and excess body weight was found in this urban Guatemalan population, with notable contrasts between social classes. The obesity among high-income children indicates that the city is undergoing the nutrition transition, with further implications for future risks related to chronic disease. Nutrition and health interventions are needed to reduce these risks.*

Key words   Child, child nutrition disorders, anthropometry, body mass index, overweight, social class, Guatemala.

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In recent years, due to globalization and growing economic growth, many countries have been rapidly developing and undergoing important demographic, epidemiological, and nutrition transitions. Urbanization and increasing income have a great impact on health and well-being (1–3), due in part to a change in dietary and physical activity patterns (1, 4). Traditional di-

etary patterns rich in grains, legumes, fruits, and vegetables seems to be changing into a "Western" dietary pattern. The "new" diet is typically lower in dietary fiber, higher in fat and animal products, and includes more refined sugars and more prepared and processed food (5). A highly active lifestyle changes into a sedentary lifestyle. These changes are the main causes of the enormous rise in the prevalence of overweight and obesity. According to the World Health Organization (WHO), obesity has become a "global epidemic" (6). As a consequence of the nutrition and epidemiologic transition, the high prevalence of chronic diseases, such as cardiovascular diseases and diabetes mellitus type 2, is an increasingly important public health concern. In recent decades, the main cause of death in most developing countries has shifted from communicable, infectious diseases to noncommunicable, chronic ones (1, 7). Chronic diseases increasingly affect not only adults but also children worldwide. In the United States of America (USA), the National Health and Nutrition Examination Surveys (NHANES) of children aged 6–17 years showed that between 1963 and 1994 the prevalence of obesity increased from around 4% to some 11% (8).

Several studies in Latin American countries have also shown an increase in overweight and obesity (9–13). Obesity prevalence rose in countries with a relatively high gross national product, such as Argentina, Brazil, and Costa Rica, and mainly in urban areas. In most Latin American countries, risk of overweight in children was related to urban residency and high socioeconomic status (SES) (14). Over the past two decades, the prevalence of overweight in Brazil increased most rapidly among children of high SES, and it was higher in urban areas than in rural ones (15). In a cross-sectional survey among Brazilian children, overweight and obesity prevalence was highest in preschool children (14.5% and 8.3%, respectively) and decreased with age (10.8% and 4.9%, respectively in adolescents). Overweight

and obesity were mostly observed among high-income families (16). The influence of SES on overweight and obesity changes over time, depending on the country's degree of economic development. The correlation is mainly positive in relatively poor countries. This correlation may become reversed, reflecting the pattern observed in higher-income countries, in which low SES is associated with the greatest risk of obesity (17, 18).

In spite of increasing overweight and obesity prevalence, undernutrition is still observed in developing countries. In Guatemala in 1995, the levels of child stunting (low height-for-age) were still relatively high (56%) (14). Stunting may be a consequence of malnutrition in the first years of life (19). Malnutrition of young children may be due to insufficient breast milk in undernourished women (20). Stunting in childhood has emerged as one of the causal factors for overweight and obesity in later life (3, 4, 21, 22). The concept of the prevalence of undernutrition and overweight in the same population has been defined as the "double burden" of disease (23).

Earlier studies on nutritional status in the Guatemalan population have mainly been performed in preschool children (13, 14), adolescents and adults (14, 24), and children in rural populations (25). Only limited findings[4] have been published on the nutritional status in a population of urban school-age children in Guatemala.

Quetzaltenango is the second largest city in Guatemala, with some 106 000 inhabitants at the time of our study there. In Quetzaltenango, rapid urban and economic development has taken place in recent years. As in other urban areas in Guatemala, cars and mobile phones are common goods for mestizos (persons who are a mixture of Spanish and indigenous Mayan ancestry). Food stalls selling Western-type foods (cookies, chips, sodas) can be found everywhere in Quetzalte-

nango. An increase in prevalence of childhood overweight and obesity in this urban area was suspected. In the rural area surrounding Quetzaltenango, most people are of indigenous origin. Poverty and illiteracy is relatively common among the indigenous,[5] for whom tortillas (made from maize) and black beans are staple foods. Some children of indigenous origin who live in the villages in the vicinity of Quetzaltenango may attend public schools in the city. Therefore, we also suspected stunting and/or underweight in our study population in Quetzaltenango.

The aims of this study were to assess stunting, underweight, overweight, and obesity in schoolchildren aged 8.00–10.99 years old of two different social classes in Quetzaltenango, and to determine the differences in nutritional status between children of high and low SES.

The age range of the study population was carefully selected. From the onset of puberty, height and fat mass distribution changes, with differences between boys and girls (26). Puberty in girls rarely starts before the age of 10.5 years (27). So as to minimize any confounding by puberty, we chose a population with a maximum age of 10.99 years. Our biological target was included within a specific age range, but our sampling framework was based on particular school grades.

Since accurate and individual data on SES are hard to obtain, we made a rough division between high and low SES by defining two strata on the basis of school type: respectively, private schools and public schools.

For practical, ethical, and financial reasons, we made use of anthropometric measurements. The measures are relatively easy to apply and reproduce (28), not invasive, and children do not have to undress. Therefore, data can be collected in different locations. The measurements are inexpensive since only a scale and a tape measure are

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4 Sandin M. Curvas de crecimiento de niños urbanos de Guatemala de 6 a 16 años [thesis]. Guatemala City: Universidad de San Carlos; 1997.

5 Nuestra diversidad es nuestra fuerza [campaign brochure]. Centro de Investigaciones Regionales de Mesoamérica, Guatemala City, 2005.

needed. We analyzed body mass index (BMI) since it has been recommended for use in defining overweight and obesity in many studies concerning nutritional status (29–31). BMI has been shown to indirectly measure body fatness, and it has a strong association with health risks (32).

MATERIALS AND METHODS

Study population

This cross-sectional survey, in which we explored nutritional status in schoolchildren 8 to 10 years old, took place between April and June 2005. A list of all the urban elementary schools in the area of Quetzaltenango was provided by the local education authorities. From all public schools in the urban area, we selected the eight largest schools. A selection of 12 highest-class private schools was made based on size of enrollment, prestige, and tuition fees. Because of time constraints, we did not select more than 20 schools.

We visited the selected schools after the study was authorized by the Director of the Education Department in the department of Quetzaltenango. To be able to include the private schools, we had to ask for the headmaster's permission. In the schools that agreed to participate, we invited all boys and girls in all third and fourth grade classes.

The objectives and methods of the study were explained, and all the third and fourth grade children were given a consent form for a parent or guardian to sign. After one week we collected the signed consent forms.

Those who had forgotten to return their form were given the opportunity to bring it on the day of the measurements. The protocol was approved by both the Human Studies Committee of the Center for Studies of Sensory Impairment, Aging, and Metabolism.

Data collection

Before data collection, a local expert in Guatemala city trained the first au-

thor (IG) to take all anthropometric measures in a standardized manner. The training was concluded with checks for intra-observer agreement, and agreement between the expert and the first author. The first author then trained and standardized three students of University Rafael Landívar, Department of Nutrition, in Quetzaltenango for intra- and interobserver agreement.

In each group of children, one trained researcher took the measurements, and another recorded the results. Afterwards, the data were checked for inconsistencies or implausible values; if found, the child was measured a second time. Children were weighed on a bathroom scale (Trends mechanical scale, Guatemala) in their school uniform without shoes and sweater, and after removal of heavy objects from their pockets. Weight was recorded to the nearest pound (0.45 kg). The scale was calibrated each morning before starting the measurements. Standing height was obtained by measuring the child without shoes, using a centimeter tape vertically affixed to the wall. Subjects stood on a flat surface, with their heels, buttocks, scapulae, and head against the wall and their arms hanging freely. Their head was positioned in the Frankfort horizontal plane. A wooden headpiece was lowered until it touched the head of the child. Height was recorded to the nearest 0.5 cm. Children who were unable to stand straight due to a malformation were not measured.

We did not collect data on past health issues, such as infections, that may have influenced growth. The dates of birth were obtained from the schools' registration records. Because onset of puberty was an important potential confounder that could not be controlled, we chose to exclude children above the age of 10 from the reported results. However, in order to avoid the feeling of exclusion and to encourage participation, all students were allowed to participate in the study, regardless of age. Children of all ages, even those excluded from the analysis reported here, were given information and feedback about their

measurement results and recommendations for a healthy diet.

Data analysis

All data were entered into the SPSS for Windows, Version 12.0.1, 2003, (SPSS Inc., Chicago, USA) and Epi Info™ version 3.3.2, 2005 (United States Centers of Disease Control and Prevention, Atlanta, Georgia, USA). Median height, weight, and BMI were calculated for all three age groups and for each stratum. Mean, median minimum and maximum height-for-age z-scores (HAZ), weight-for-age z-scores (WAZ), and BMI-for-age centiles were determined for each stratum. The HAZ and WAZ have been widely used as measures of nutritional status for children (10, 33, 34), and in 1995, a WHO expert committee recommended them as measures of nutritional status for persons 2–20 years of age (35). Stunting was determined based on WHO definitions as a height-for-age < -2 z-scores from the median of the National Center for Health Statistics (NCHS) reference population. A weight-for-age < -2 z-scores from the median of the NCHS reference was defined as underweight. Overweight was classified as a BMI-for-age between the 85th and 95th percentiles of the United States Centers for Disease Control and Prevention (CDC) growth charts references, made for the United States boys and girls aged 2 to 20 years (36, 37). Obesity was classified as a BMI-for-age above the 95th percentile of the CDC reference population. Differences in means between low and high SES, both for girls and for boys, were calculated by Student's t test, with a significance level of 0.01. Percentages of stunting, underweight, overweight, and obesity were calculated for each stratum. To determine the influence of SES on stunting and overweight and to determine the influence of stunting on overweight, Mantel Haenszel common odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. To simplify the presentation of results, the categories of overweight and obesity were combined.

RESULTS

Population characteristics

The approval of the Director of the Education Department permitted us to include all of the selected public schools. In the 12 private schools we visited, we were able to personally invite each headmaster for enrollment of his or her school in our study. Participation was denied in three private schools. A total of nine private schools (75%) agreed to participate. In total, 1 626 children were invited, of whom 46% agreed to participate (public schools: 43%, private schools 49%). Of the remaining 54%, some may have forgotten their consent form, and some may not have been present on the days of our visits. A total of 735 children in third and fourth grade were measured. From the initial sample, 152 children were excluded from analyses because they fell outside of the age range of 8 to 10 years. Table 1 shows the numbers of subjects divided by age, sex, and SES. Mean age per grade was higher in the public schools than in the private schools; therefore, the number of 8-year-old children was relatively low in the public school group.

Descriptive statistics for height, weight, and BMI

Medians for height, weight, and BMI in all age groups stratified by SES and sex are presented in Table 2. As expected, height, weight, and BMI of the subjects increased with age. In both sexes, trends in age difference between age 8 and 10 years for all three variables was larger in the high SES group than in the low SES group. When we compared low and high SES with all age groups combined, we found that the mean height, weight, and BMI were all significantly lower in the low SES group than in the high SES group, for both boys and girls ($P < 0.01$, data not shown). We also assessed differences in these three variables between sexes. In all age groups combined, high SES boys had a significantly higher height ($P = 0.002$), and slightly higher weight ($P = 0.052$), and BMI ($P = 0.336$) than high

TABLE 1. Population in study of nutritional status of schoolchildren divided by age, sex, and socioeconomic status (SES), Quetzaltenango, Guatemala, 2005

Age (mo)	Girls low SES No.	Girls low SES %	Girls high SES No.	Girls high SES %	Boys low SES No.	Boys low SES %	Boys high SES No.	Boys high SES %
96–107	19	13.9%	59	31.4%	28	23.5%	33	23.7%
108–119	61	44.5%	92	48.9%	48	40.3%	73	52.5%
120–131	57	41.6%	37	19.7%	43	36.1%	33	23.7%
Total	137	100%	188	100%	119	100%	139	100%

TABLE 2. Medians for height, weight, and body mass index (BMI) of schoolchildren stratified by age, sex, and socioeconomic status (SES), Quetzaltenango, Guatemala, 2005

Group/Age (mo)	No.	Height (m)	Weight (kg)	BMI (kg/m^2)
Girls low SES				
96–107	19	1.25	25.45	16.16
108–119	61	1.28	26.36	16.19
120–131	57	1.30	28.18	16.44
Total	137	1.28	27.27	16.39
Girls high SES				
96–107	59	1.26	26.36	16.61
108–119	92	1.31	30.91	18.32
120–131	37	1.37	33.18	17.17
Total	188	1.30	29.55	17.55
Boys low SES				
96–107	28	1.23	25.00	16.00
108–119	48	1.26	26.14	16.53
120–131	43	1.31	29.09	16.99
Total	119	1.28	26.82	16.55
Boys high SES				
96–107	33	1.30	30.00	17.61
108–119	73	1.33	30.00	16.85
120–131	33	1.38	36.36	18.96
Total	139	1.33	30.91	17.85

SES girls. For low SES boys and girls, no such trend was found.

Interclass means for BMI centiles and height-for-age z-scores

In Table 3, mean and median HAZ, WAZ, and BMI-for-age centiles are presented for all four strata. Children of high SES were on average taller than children of low SES (mean difference of +0.74 for girls and of + 1.01 HAZ for boys), although mean and median HAZ are below zero in all four strata. Children of low SES weighed on average less than their high SES peers of the same age group. Children

of high SES had a mean WAZ nearly equal to that of the reference population (–0.03 for girls and 0.24 for boys), whereas mean WAZ in the low SES group was almost 1 standard deviation below the reference population (–0.95 for girls and –0.80 for boys). The mean BMI-for-age centile was higher in the high SES group than in the low SES group (+16.5 for girls and +12.2 for boys). The variation is large; the minimum and maximum BMI centiles are 0.00 and 99.83, respectively. Comparisons of means between SES groups, in both boys and girls, show that the differences in HAZ, WAZ, and BMI-for-age are all statistically significant ($P < 0.01$).

TABLE 3. Mean height-for-age *z*-score (HAZ), weight-for-age *z*-score (WAZ), and body mass index (BMI)-for-age centile, with minimum (min) and maximum (max) values, for schoolchildren stratified by sex and socioeconomic status (SES),[a] Quetzaltenango, Guatemala, 2005

	Girls low SES (*n* = 137)		Girls high SES (*n* = 188)		Boys low SES (*n* = 119)		Boys high SES (*n* = 139)		Overall (*n* = 583)	
	Mean	(min, max)	Mean	(min, max)	Mean	(min, max)	Mean	(min, max)	Mean	(min, max)
HAZ	−1.39	(−4.08, 1.59)	−0.65	(−3.31, 2.06)	−1.46	(−3.83, 0.98)	−0.45	(−2.62, 2.15)	−0.94	(−4.08, 2.15)
WAZ	−0.95	(−3.42, 1.76)	−0.03	(−2.52, 3.24)	−0.80	(−4.01, 2.27)	0.24	(−2.48, 2.47)	−0.34	(−4.01, 3.24)
BMI-for-age centile	46.27	(1.75, 98.35)	62.67	(1.45, 99.83)	52.98	(0.00, 99.01)	65.13	(0.90, 99.37)	57.43	(0.00, 99.83)

[a] HAZ, WAZ, and BMI-for-age centile were compared between low and high SES in both girls and boys. For all comparisons, $P < 0.01$

Categorical analysis of classification of nutritional status

In order to assess the difference in nutritional status between children of low SES and high SES, we explored on the one side the prevalence of undernutrition as defined by stunting and underweight, and on the other side the prevalence of overweight and obesity. Figure 1 shows the prevalence of stunting, underweight, overweight, and obesity in the girls, and Figure 2 gives the same information for the boys. For both girls and boys, there are two clear patterns: (1) stunting and underweight in the low SES groups and (2) overweight and obesity in high SES groups. The prevalence of stunting in girls of low SES was 26.3 %, versus the 8.5% in girls of high SES (*P* < 0.01). In both the low and the high SES groups, the prevalence of stunting was higher than the prevalence that would be expected based on the cutoff value of 2.5% (<-2 *z*-scores). The prevalence of underweight was 14.6 % in girls of low SES and 4.8% in girls of high SES; both of those values were higher than the reference value of 2.5%. For overweight classification, in girls of low SES the prevalence was 10.9%, which resembles the 10% prevalence of overweight in the CDC reference. In girls of high SES the prevalence of overweight was 16.5%. For obesity, girls of low SES showed a prevalence of 0.7%, far less than the CDC reference value of 5%. The prevalence of obesity in girls of high SES was 11.2%, more than two-fold the CDC reference value. The prevalence of stunting in boys of low SES was 27.7 %, which is much higher than in boys of high SES (5.8 %),

FIGURE 1. The prevalence of stunting (by National Center for Health Statistics (NCHS) height-for-age *z*-score criteria),underweight (by National Center for Health Statistics (NCHS) weight-for-age *z*-score criteria), overweight and obesity (by the Centers for Disease Control and Prevention (CDC) 2000 body-mass-index (BMI)-for-age centile criteria) for girls of all age groups, Quetzaltenango, Guatemala, 2005
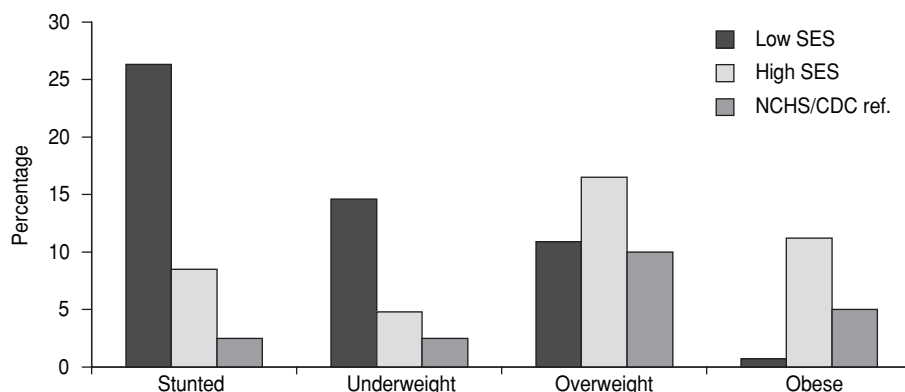

FIGURE 2. The prevalence of stunting (by National Center for Health Statistics (NCHS) height-for-age *z*-score criteria), underweight (by National Center for Health Statistics (NCHS) weight-for-age *z*-score criteria), overweight and obesity (by Centers for Disease Control and Prevention (CDC) 2000 body mass index (BMI)-for-age centile criteria) for boys of all age groups, Quetzaltenango, Guatemala, 2005
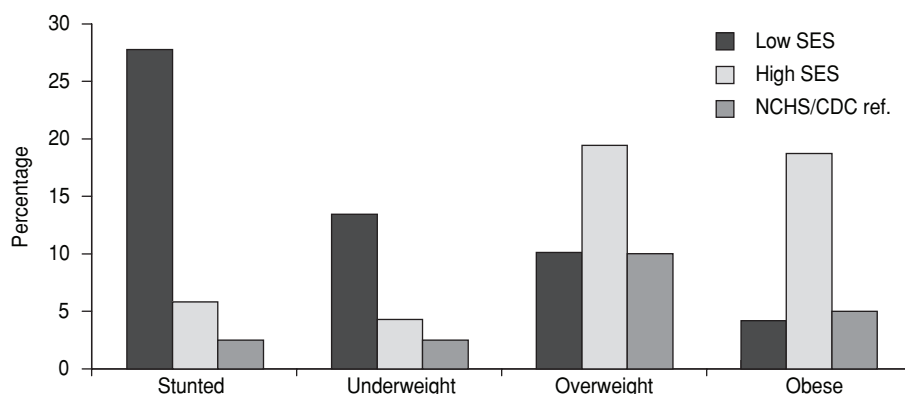
and also higher than the CDC reference value of 2.5%. The prevalence of underweight in boys of low SES was 13.4 %, and in boys of high SES this prevalence was 4.3%; both of them were higher than the CDC reference of 2.5%. Some 10.1% of boys of low SES were overweight and 4.2% of this

TABLE 4a. Association between socioeconomic status (SES) and stunting, by age (years), for schoolchildren, expressed as Mantel-Haenszel common odds ratio (OR), with a 95% confidence interval (CI), Quetzaltenango, Guatemala, 2005

| SES | Stunted % | Age 8 | OR (95% CI) | |
			Age 9	Age 10
Low	27.0	…[a]	3.97 (2.03–7.80)	5.06 (1.84–13.87)
High[b]	7.3	…[a]	1.00	1.00

[a] In age group 8, *n* (high SES x stunted) is < 5.
[b] The high SES group is the reference category.

TABLE 4b. Associations between socioeconomic status (SES) and overweight or obesity (combined), by age (years), for schoolchildren, expressed as Mantel-Haenszel common odds ratios (OR), with 95% confidence intervals (CI), Quetzaltenango, Guatemala, 2005

| SES | Overweight or obese % | Age 8 | OR (95% CI) | |
			Age 9	Age 10
Low	12.9	0.40 (0.16–1.00)	0.30 (0.15–0.56)	0.30 (0.14–0.65)
High[a]	32.1	1.00	1.00	1.00

[a] The high SES group is the reference category.

TABLE 4c. Association between stunting and overweight or obesity (combined), in all age groups combined, for schoolchildren, expressed as Mantel-Haenszel common odds ratio (OR), with a 95% confidence interval (CI),[a] Quetzaltenango, Guatemala, 2005

Stunting	Overweight or obese (%)	OR (95% CI)
Stunted	6.5	0.19 (0.08–0.44)
nonstunted[a]	26.9	1.00[a]

[a] The nonstunted group is the reference category.

group was obese, very near the respective CDC reference values of 10% and 5%. Of all four strata, boys of high SES showed the highest prevalence of overweight and obesity, 19.4% and 18.7 %, respectively.

Associations across variables

In Table 4a the association between SES and stunting is shown, and in Table 4b the association between SES and overweight is presented. In both tables, these associations are expressed as odds ratios (ORs), with the high SES group as the reference. As can be seen in Table 4a, the risk of being stunted was much higher in children of low SES than in children of high SES. The relation between SES and overweight, as shown in Table 4b, was reversed: low-SES children had a smaller risk of being overweight than did high-SES children, in all three age groups. In Table 4c the relation between stunting and overweight is shown, with non-stunted children as the reference group. We combined all three age groups, since insufficient sample size prevented separate analysis by age. In our population, being stunted was protective against being overweight (OR = 0.19; 95% CI = 0.08–0.44).

DISCUSSION

The aim of this study was to establish evidence for the nutrition transition amongst children in the city of Quetzaltenango. Our findings show that the prevalence of overweight in children of high SES is about twice that of children of low SES in our sample, and the prevalence of obesity in children of high SES is almost five times higher than in children of low SES. The prevalence of stunting in children of low SES is about four-fold the prevalence of stunting in the children of high SES in our sample.

When comparing SES groups, we found that the prevalence of stunting in low SES children in our study was far higher than that in high SES children. Even children (four of them) with a height-for-age below –3 *z*-scores were present in this population. However, when comparing the results of our study to findings of Bogin et al. (25), low-SES children from this urban area still seemed to have more favorable growth outcomes than did low-SES children from a rural area. Although mean height of the children of low SES in our study was low in comparison to the elite children in the same urban area, for 9-year-olds and 10-year-olds there is still about a 5-cm height advantage as compared to Guatemalan children measured in rural areas in 1998. Follow-up studies done by other researchers (38, 39) have found that stunted subjects who remained in the setting in which they became stunted experienced little or no catch-up in growth. However, almost complete reversal of stunting is possible, and children can reach their own potential height if the limiting environmental factors are changed early in life. This can be seen with the children of Mayan immigrants in the United States, who are taller than the Mayan children living in Guatemala (25, 40).

Because of the growing attention to overweight and obesity in the United States and the need to develop a measure that would more accurately assess childhood overweight, several standards for defining overweight and obesity have been developed (41, 42).

These include the NCHS/CDC 2000 BMI-for-age growth charts for the United States population from ages 2 to 20 years, and a reference developed by Cole et al. (30) applying to the same age range but based on large juvenile populations in six different nations. For our 8-, 9-, and 10-year-olds, we chose to use the CDC 2000 growth curves (36, 37).

Because of obvious ethnic and environmental differences from the United States setting, the applicability of the CDC standards to children in Quetzaltenango may be questioned. We chose to use this reference not so much directly to compare our subjects to the North American population, but rather to be able to compare nutritional status between the two SES groups of interest. However, the cutoff criteria for overweight and obesity in the international reference of Cole are even higher than those of CDC 2000. Therefore, it can be fairly stated that the prevalence of overweight and obesity in our sample, if based on Cole's reference, would have been lower on average than those reported here using United States standards. Overweight and obesity cutoff criteria are so defined because of their putative implications for the risk of chronic diseases. However, the increase in health risk due to higher BMI differs among ethnic groups, due to biological differences in body constitution characteristics among populations (21). For example, Asian people tend to have a higher percentage of body fat at the same BMI than non-Asians (43), whereas black Americans tend to have a lower percentage of body fat for the same BMI as compared to white Americans (44). Therefore, we cannot draw conclusions about the health risks for the children in this population who are classified as normal weight, overweight, or obese.

As we know, underweight (low weight-for-age) may be a consequence of low height-for-age, low weight-for-height, or a combination of both. It would have been interesting to measure overweight/obesity and underweight with one instrument; to see both ends of nutritional status on one scale. However, until now, no validated reference for underweight, based on BMI, has been defined, as has been done for overweight.

An interesting finding in this study is the coexistence of stunting and overweight within the same population. On average, stunted children in our population had lower BMI-centiles than nonstunted children, which remained constant across age groups. However, some children, of high SES as well as of low SES, were stunted *and* overweight. In the population as a whole, mean HAZ is –0.94, whereas the mean BMI-for-age centile is 57.43. Our finding of relatively high BMI in combination with low stature is consistent with the observations of Schroeder and Martorell (45). Those researchers found that within a sample of rural Guatemalan children of mixed Spanish-indigenous ancestry, mean BMI was at or above the reference median of the United States population, whereas mean stature was shorter than that of North Americans. As shown by Bogin et al. (25), Mayan Guatemalan children have relatively short legs compared to children in the United States. This could be a reason that mean BMI in this Mayan Guatemalan juvenile population—and probably also in our population—is higher than that of United States children with the same height.

Within a society, child nutritional status is largely dependent on the level of family wealth, as indicated by income, parental education, and housing facilities (17, 46). Parents' choice for public or private school is considered a consequence of their disposable income capacity. In our study, only the most expensive among the local private schools were invited to participate, in an effort to maximize the contrast in SES between the two strata. In fact, we were able to include the third and fourth grades from all of the city's most elite private educational institutions, and we succeeded in matching all highest-class private schools to almost the same number of public schools. Based on family names, we found mainly *mestizo* children in the highest-class private schools, and in the public schools, mainly indigenous children. Another strength of the study is that we made use of anthropometrics. This enabled us to measure a large group of children. Our results can be compared to anthropometric data from other juvenile populations in which more advanced methods to assess nutritional status are not feasible. In this way, an overview of nutritional status in different countries and information about trends in nutritional status change can be easily obtained.

Some limitations should be mentioned. Low-income children may have been less well represented in the study. Low-income families are not always willing or able to send their children to study on a year-by-year basis. Poor children in Quetzaltenango within the ages of interest could have been missed because they were not enrolled in school in the first place. Once into the study, it became evident that children of public schools, on average, progress to third and fourth grade at a higher age than their peers at private schools. This could be a consequence of the irregular school attendance as described earlier. Our relative undersampling of 8-year-old boys and girls in the low SES stratum was undoubtedly due to this different age distribution in grades between the public and private schools. There may have been selection bias based on children who did or did not turn in the consent forms. Furthermore, some children at the extremes of nutritional status— underweight and obese—may have been reluctant to be measured, which may imply that the presented prevalence of obesity and underweight was smaller than the actual prevalence.

Finally, no sample size calculation was performed, since the study was meant to be cross-sectional and descriptive. All private schools were approached, and the sampling was meant to be comprehensive rather than representative. We did not have a hypothesis about the size of an eventual difference between groups, thus we did not calculate the minimal number of children needed. Instead, we included as many children as possible, aiming for universal inclusion of all children from the upper-income schools from our target grades.

To compare our data to other studies of Guatemalan children, we would like to mention the cross-sectional Demographic and Health Surveys (DHS) that have been performed in 1987 and 1995 in Guatemala to give an impression of changing nutritional status in this country. A trend towards increasing overweight and obesity between 1987 (around 5%) and 1995 (around 10%) in the population of rural and urban preschool children in Guatemala could be seen (14). Ten years later we compared our results to the DHS data, even though a different age group and a different reference was used, and we found that the prevalence of overweight/obesity was already higher than 10%. For stunting, urban Guatemalan preschool children in 1995 showed a mean HAZ of –1.45 (47). In our population of urban school children, mean HAZ of high-SES children was almost 1 z-score higher, whereas for low-SES children it was comparable to the DHS study performed in 1995.

We do not have sufficient information about lifestyle of the study population to draw conclusions, but we can describe some factors that may have

been related to nutritional status of the children. In public as well as in private schools, sweets, fried foods, and regular sodas were sold during the recess breaks. Generally, in private schools, the assortment was larger and more children brought money and bought these foods. Daily food intake of the same study population was assessed in a parallel study of children from the same schools, but analysis is not yet complete. Some children of public schools reported that they had to help their parents in work and in household activities after school, possibly relating to additional after-school physical activity relative to other children.

In summary, a coexistence of undernutrition and overweight can be identified in this urban area of Guatemala. Our data clearly show a high prevalence of stunting in the public school children whom we measured, and of elevated BMI status in the private school children that we measured. These results are consistent with the expected pattern in a country undergoing the early phases of the nutrition transition. Continuing research is needed to identify the risk groups and to monitor the healthy growth and

development of children of all socioeconomic classes. Studies on food consumption patterns and physical activity in public and private school children and preschoolers would be helpful in the development of school-based nutrition and health interventions in Quetzaltenango, in order to prevent and address undernutrition in public schools, while averting an epidemic of overweight and obesity among private school children.

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RESUMEN

Estado nutricional de escolares urbanos de niveles socioeconómicos alto y bajo en Quetzaltenango, Guatemala

Objetivo. En muchos países en desarrollo se elevan las prevalencias de sobrepeso y de obesidad en niños, con el incremento del riesgo de enfermedades crónicas. El objetivo de este trabajo fue evaluar las prevalencias de retraso en el crecimiento, peso bajo, sobrepeso y obesidad en escolares de 8 a 10 años de edad de niveles socioeconómicos (NSE) alto o bajo en Quetzaltenango, la segunda mayor ciudad de Guatemala.

Métodos. Se realizó un estudio transversal entre abril y junio de 2005 en el que se midió el peso y la talla de 583 niños de escuelas primarias privadas y públicas. Para evaluar el retraso en el crecimiento, el peso bajo, el sobrepeso y la obesidad se utilizaron como referencias las puntuaciones z de la talla para la edad y del peso para la edad y los centiles de los índices de masa corporal para la edad, propuestos por los Centros para el Control y la Prevención de las Enfermedades (CDC) de los Estados Unidos de América en 2000.

Resultados. La talla, el peso y el índice de masa corporal medios fueron significativamente mayores en los 327 niños de NSE alto que en los 256 niños de NSE bajo en todos los grupos de edad y sexo. La prevalencia de retraso en el crecimiento fue significativamente mayor en los niños con NSE bajo que en los de NSE alto (27,0% frente a 7,3%; *P* < 0,01), al igual que la prevalencia de peso bajo (14,1% frente a 4,6%, *P* < 0,01). En contraste, la prevalencia de sobrepeso fue mayor en los niños con NSE alto que en los de NSE bajo (17,7% frente a 10,5%, *P* < 0,01), al igual que la prevalencia de obesidad (14,4% frente a 2,3%, *P* < 0,01). Las prevalencias de retraso en el crecimiento en los niños de NSE bajo y de sobrepeso y obesidad en los de NSE alto fueron mucho mayores que las referencias establecidas por los CDC en el año 2000.

Conclusiones. Se encontraron elevadas prevalencias de retraso en el crecimiento y de peso corporal excesivo en esta población urbana de Guatemala, con notables contrastes entre las clases sociales. La obesidad en los niños de familias con ingresos elevados indica que la ciudad está experimentando la transición nutricional, con las implicaciones que con lleva para los riesgos de enfermedades crónicas en el futuro. Se requieren intervenciones nutricionales y de salud para reducir esos riesgos.

Palabras clave Niño, trastornos de la nutrición del niño, antropometría, índice de masa corporal, sobrepeso, clase social, Guatemala.