



Trabajo Original

Epidemiología y dietética

Double burden of malnutrition in rural and urban Guatemalan schoolchildren *Doble carga de malnutrición en escolares urbanos y rurales de Guatemala*

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Abstract

Introduction: Guatemala has been experiencing a lifestyle transition. While chronic malnutrition remains prevalent obesity, has increased substantially.

Objective: The study aimed to provide current information on nutritional status trends in Guatemala.

Methods: A cross-sectional study was conducted in two different regions of Guatemala. A random sample of 392 children and adolescents (aged 5-18 years), stratified by geographical location (rural and urban), sex and age, was selected.

Results: Approximately 62% of the children and adolescents in the urban sample are overweight, whilst 13.8% are obese. Amongst urban participants the prevalence of overweight and obesity was higher in the 5-10 year age group. In the rural sample, the prevalence of overweight was 23.8% with 1.1% obesity. The highest prevalence of overweight and obesity was found in the 11-14 year age group. The urban group shows a higher prevalence of overweight and obesity compared to any of the age categories of the rural group (except in the 15-18 year age group where obesity in the rural group is slightly higher). A significantly higher prevalence of stunting was observed in the rural group than in the urban group, except in 15-18 year age group. Underweight was significantly higher in the 5-10 year age category of the rural group (25 vs. 1.2%). The prevalence of thinness was also significantly higher in rural areas for all age groups except the 5-10 year age group.

Conclusion: A double burden of malnutrition and a high prevalence of underweight and overweight exist among children and adolescents in Guatemala.

Key words:

Double-burden.
Malnutrition. Children.
Adolescents.
Guatemala.

Resumen

Introducción: Guatemala ha estado experimentando una transición en sus estilos de vida. Mientras que la desnutrición crónica sigue siendo prevalente, se ha experimentado un aumento sustancial de los casos de obesidad.

Objetivo: proporcionar información actualizada sobre las nuevas tendencias en cuanto al estado nutricional en Guatemala.

Métodos: se diseñó un estudio transversal con una muestra de 392 niños y adolescentes (5-18 años) seleccionados de manera aleatoria. El muestreo fue estratificado según su ubicación geográfica (rural y urbana), sexo y edad.

Resultados: alrededor del 62% de la muestra urbana presentó problemas de sobrepeso y un 13,8 de obesidad. Entre los participantes urbanos, la prevalencia de sobrepeso/obesidad fue mayor en el grupo de 11-14 años. El grupo urbano presentó una mayor prevalencia de sobrepeso/obesidad que el grupo rural para todos los grupos de edad (excepto en el grupo de 15-18 años que presentó unos índices de obesidad ligeramente más elevados en el grupo rural). Se observó una mayor prevalencia de retraso en el crecimiento en el grupo rural, excepto para el grupo de edad de 15-18 años. La prevalencia de bajo peso fue significativamente mayor en el grupo rural (25% vs. 1,2%) así como la prevalencia del delgadez, excepto para el grupo de edad de 5-10 años.

Conclusión: la alta prevalencia de bajo peso y la de sobrepeso/obesidad coexisten en los niños y adolescentes en Guatemala.

Palabras clave:

Doble carga.
Malnutrición. Niños.
Adolescentes.
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INTRODUCTION

Guatemala is a low-middle income country with large inequalities in nutritional and socio-economic status (1). This country has gone through a nutritional and lifestyle transition. While chronic malnutrition remains prevalent (2) substantial increases in overweight and obesity have taken place in the recent years (3).

An abundance of literature has documented health inequalities between rural and urban children. Studies have shown that children living in urban areas are less likely to suffer stunting or underweight than those living in rural areas (4). However, changes in diet and lifestyle have contributed to change this trend recently. These changes have resulted in the coexistence of both overnutrition (overweight and obesity) with undernutrition (stunting or underweight), which is known as “double burden”. This double burden has been observed at national and familiar levels (5).

This double burden is currently taken place in Guatemala (6). While nutritional stunting is still highly prevalent (45.6%) (7), overweight is an emerging public health concern (32.6% and 32.5% in public and private school children, respectively) (8). This has been attributed to the nutritional transition that commonly follows rapid economic transition and urbanization (9), characterized by rapid secular trends of refined, energy-dense and fat foods (10), and a sedentary lifestyle (11).

The aim of our study was to provide current information on nutritional status trends in Guatemala schoolchildren. To such end two groups of subjects from two different geographical populations (rural and urban) were studied through anthropometric assessment. This data will help identify vulnerable groups and facilitate the development of focused nutrition strategies according to the region.

MATERIAL AND METHODS

SUBJECTS

A cross-sectional study was conducted in two different regions (rural and urban) of Guatemala. The rural zone was located in Departamento of Izabal and the urban zone was located in the capital city, where children and adolescents from school were evaluated. A random sample of 392 children and adolescents (aged 5-18), stratified by geographical location (rural and urban), sex and age (5-10 years, 11-14 years and 15-18 years), was selected (Table I). In the case of rural participants two groups were studied: boarders (participants enrolled as a boarder in a school) and non-boarders (participants who attend and had a meal but do not live at the school). Urban participants lived and ate at home.

The sample comprised apparently healthy Guatemalan boys and girls, aged 5-18 years, who were not physically handicapped and had no obvious genetic disorders.

All participants took part voluntarily and in accordance with the Declaration of Helsinki regarding ethical research. The bioethical committee for human research of the University of Granada

approved the study. Informed consent was also obtained from parents or tutors.

ANTHROPOMETRIC ASSESSMENTS

Guidelines of the International Society for the Advancement of Kinanthropometry (ISAK) (12) were followed. The following instruments were used: GPM Stadiometer (± 1 mm accuracy), Tefal scale (± 50 g accuracy), Holtain skinfold compass (± 1 mm accuracy), Holtain caliper (± 1 mm accuracy) and Holtain flexible metallic metric belt (± 1 mm accuracy). The following measurements were taken: height, weight, skinfolds (triceps, biceps, subscapular, suprailiac, supraspinal, abdominal, thigh, and calf), perimeters (waist, hip, mid-upper arm, flexed and contracted biceps, thigh and calf) and diameters (bicondylar humerus, bistoloid and bicondylar femur). Body mass index (BMI) was calculated from height and weight. We compared the results gathered from the sum of the 8 skinfolds (triceps, biceps, subscapular, suprailiac, supraspinal, abdominal, thigh, and calf) with fat percentage which was calculated using the Slaughter equation (13). The anthropometric status of the participants was determined against the WHO growth reference for those aged 5-18 (14). Cut-off values were: -2 SD for stunting and thinness, 1 SD for overweight and 2 SD for obesity. It was not possible to obtain anthropometric parameters for the 15-18 years age group in urban or rural areas.

STATISTICAL ANALYSES

All anthropometric measurements provided quantitative variables whereas gender, geographical location (rural or urban), status (boarder or non-boarder) and age group (5-10 years, 11-14 years and 15-18 years) provided qualitative variables.

Table I. Number and percentage of participating by age group, sex and geographical location

	5-10 years		11-14 years		15-18 years		Total	
	<i>n</i>	%	<i>n</i>	%	<i>N</i>	%	<i>N</i>	%
<i>Urban</i>								
Girls	39	19.2 ^u	26	12.8 ^u	39	19.2 ^u	104	51.2 ^u
Boys	45	22.2 ^u	32	15.8 ^u	22	10.8 ^u	99	48.8 ^u
Total urban	84	21.4	58	14.8	61	15.6	203	51.8
<i>Rural</i>								
Girls	49	25.9 ^R	29	15.3 ^R	14	7.4 ^R	92	48.7 ^R
Boys	43	22.8 ^R	38	20.1 ^R	16	8.5 ^R	97	51.3 ^R
Total rural	92	23.5	67	17.1	30	7.7	189	48.2
Total	176	44.9	125	31.9	91	23.2	392	100

^uConditioned to urban: % among the urban sample; ^RConditioned to rural: % among the rural sample.

Numerical variables were studied as marginal and conditioned to qualitative ones. The analysis was mainly a descriptive analysis by subset regarding the inference. Parametric and non-parametric hypothesis tests were applied to compare multiple variables (significance level $\alpha = 0.05$). Statistical analysis was performed using Statgraphics Plus package version 5.1, Statistical Graphics Corp. Copyright 1994-1999 and SPSS IBM SPSS Statistics 22.0.

RESULTS

Table I shows the number of participants in the three age strata stratified by sex and geographical location. A final sample of 392 children and adolescents participated in the study. Of the recruited participants, 51.8% were urban and 48.2% were rural. Girls represented 50% of the sample. In addition, 44.9% were children aged between 5 and 10, 31.9% were aged between 11 and 14 and 23.2% were aged between 15 and 18.

Table II shows the anthropometric characteristics of children and adolescents in rural areas stratified by age and status. No significant difference for any parameter was found between boarders and non-boarders of different age groups. However, significantly higher values ($p < 0.05$) were found between male boarders and non-boarders in average age, height, weight and BMI.

As shown in table III, Guatemalan children and adolescents had negative mean of weight-for-age z-scores (WAZ), height-for-age z-scores (HAZ) and BMI-for-age z-scores (BAZ) irrespective of sex and geographical location with some exceptions. Positive scores for BAZ were obtained in male boarders aged between 5 and 10 and in female boarders aged between 11 and 14. BAZ was positive in boys in the age group 15-18 years in the non-boarder group. The urban group only showed negative mean for HAZ. Urban participants in every category had significantly higher WAZ, HAZ and BAZ than the rural participants ($p < 0.05$) except in HAZ 15-18 year-old participants. In general, the difference in z-scores between the genders did not reach statistical significance, except for HAZ in 11-14 year-old urban participants. Urban participants in every category had significantly higher WAZ, HAZ and BAZ than the boarder participants ($p < 0.05$) except in HAZ in 15 to 18 year-old participants. Urban participants in every category had significantly higher WAZ, HAZ and BAZ than non-boarder participants ($p < 0.05$) except in HAZ in the 5-10 years and 15-18 year age group. No significant differences were found between boarders and non-boarders except for higher HAZ in the age group of non-boarders.

Table IV shows that approximately 62% of the children and adolescents in our urban sample are overweight, whilst 13.8% are obese. Amongst urban participants the prevalence of overweight and obesity was higher in 5-10 year age group than in the other two groups irrespective of gender. In our rural sample, the prevalence of overweight was 23.8% with 1.1% obesity. The prevalence of overweight and obesity was highest in the 11-14 year age group, again irrespective of gender. The urban group have a higher prevalence of overweight and obesity than the rural group in every age category (except in the 15-18 year age group where obesity

Table II. Anthropometric parameter by age group, sex and status

	5-10 years		11-14 years		15-18 years		Total		Total			
	Boys		Girls		Boys		Girls		Boys		Girls	
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	
Rural children												
Boarder												
Height	118.38 \pm 9.95	120.27 \pm 9.44	141.37 \pm 10.09	143.72 \pm 13.78	163.90 \pm 5.39	150.83 \pm 5.84	142.51 \pm 19.20 [†]	131.59 \pm 16.70	136.83 \pm 18.65			
Weight	24.21 \pm 4.57	25.16 \pm 5.20	37.84 \pm 6.41	45.56 \pm 15.12	54.15 \pm 10.50	47.33 \pm 5.09	39.41 \pm 13.51 [†]	34.33 \pm 13.79	36.77 \pm 13.81			
BMI	17.07 \pm 0.80	17.23 \pm 2.34	18.86 \pm 2.01	21.45 \pm 4.78	19.99 \pm 2.82	20.91 \pm 3.45	18.76 \pm 2.31 [†]	18.99 \pm 3.84	18.88 \pm 3.18			
% Fat Slaughter	12.43 \pm 3.69	15.53 \pm 2.45	10.55 \pm 5.19	17.70 \pm 2.14	—	—	12.09 \pm 3.69	15.83 \pm 2.48	14.58 \pm 3.39			
MUAC	17.94 \pm 1.46	17.86 \pm 1.09	20 \pm 1.41	18.66 \pm 2.08	—	—	18.31 \pm 1.61	17.97 \pm 1.22	18.09 \pm 1.35			
Σ Skinfolds	51.22 \pm 14.68	56.21 \pm 13.26	42.5 \pm 20.50	73.33 \pm 10.26	—	—	49.63 \pm 15.06	58.54 \pm 14.03	55.57 \pm 14.78			
Non-boarder												
Height	119.99 \pm 9.91	121.35 \pm 8.23	142.56 \pm 8.51	143.44 \pm 7.85	157.2 \pm 7.52	153.37 \pm 5.34	131.18 \pm 16.06	133.68 \pm 15.14	132.35 \pm 15.62			
Weight	23.24 \pm 4.53	25.75 \pm 6.34	39.51 \pm 10.62	41.15 \pm 10.31	56.34 \pm 5.64	48.68 \pm 6.51	31.82 \pm 12.90	34.43 \pm 12.11	33.03 \pm 12.55			
BMI	15.97 \pm 1.67	17.15 \pm 2.73	19.04 \pm 3.04	19.77 \pm 3.96	22.76 \pm 1.58	20.76 \pm 3.45	17.63 \pm 3.07	18.58 \pm 3.57	18.07 \pm 3.33			
% Fat Slaughter	11.86 \pm 3.48	14.65 \pm 2.75	16.80 \pm 0.51	16.21 \pm 4.13	—	—	12.15 \pm 3.57	15.08 \pm 3.19	13.59 \pm 3.67			
MUAC	17.25 \pm 1.63	17.83 \pm 1.82	20.00 \pm 1.41	20.61 \pm 2.67	—	—	17.41 \pm 1.72	18.59 \pm 2.40	17.99 \pm 2.15			
Σ Skinfolds	44.09 \pm 15.63	53.08 \pm 16.30	72.00 \pm 15.55	63.66 \pm 26.28	—	—	45.73 \pm 16.77	55.96 \pm 19.66	50.77 \pm 18.83			

Σ Skinfolds: Sum of eight skinfolds; MUAC: mid-upper arm circumference; [†]Significant differences between urban and rural ($p < 0.05$).

Table III. Z-Scores by age group, sex, and urban and rural (boarder and non-boarder) residence

Children	5 – 10 years		11 – 14 years		15 – 18 years		Total	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
<i>Rural: Boarder</i>								
Height/Age	-2.33 ± 0.70	-1.81 ± 0.90	-1.93 ± 1.06	-1.63 ± 0.92	-1.72 ± 0.78	-2.16 ± 0.75	-1.97 ± 0.90	-1.82 ± 0.88
(B&G)	-1.96 ± 0.87 ^{a,b}		-1.81 ± 1.00 ^{b,c}		-1.88 ± 0.87		-1.89 ± 0.89 ^a	
Weight/Age	-1.22 ± 0.83	-0.81 ± 1.05	—	—	—	—	—	—
(B&G)	-0.93 ± 0.99 ^{b,c}		—		—		—	
BMI/Age	0.22 ± 0.44	-0.04 ± 0.89	-0.06 ± 1.18	0.27 ± 1.00	-0.81 ± 1.16	-0.5 ± 1.04	-0.22 ± 1.09	-0.02 ± 0.95
(B&G)	0.03 ± 0.79 ^{b,c}		0.07 ± 1.10 ^{b,c}		-0.70 ± 1.10 ^{b,c}		-0.12 ± 1.02 ^{b,c}	
<i>Rural: Non-boarder</i>								
Height/Age	-1.26 ± 1.18	-1.48 ± 1.05	-2.04 ± 0.57	-1.72 ± 1.12	-2.2 ± 0.44	-1.62 ± 0.74	-1.62 ± 1.03	-1.58 ± 1.02
(B&G)	-1.36 ± 1.12		-1.9 ± 0.87		-1.84 ± 0.68		-1.60 ± 1.02	
Weight/Age	-0.85 ± 1.04	-0.70 ± 1.06	—	—	—	—	—	—
(B&G)	-0.78 ± 1.05		—		—		—	
BMI/Age	-0.35 ± 1.01	0.00 ± 1.14	-0.22 ± 1.15	-0.16 ± 1.38	0.4 ± 0.54	-0.5 ± 1.06	-0.24 ± 1.04	-0.13 ± 1.20
(B&G)	-0.19 ± 1.07		-0.2 ± 1.24		-0.15 ± 0.98		-0.19 ± 1.12	
<i>Rural</i>								
Height/Age	-1.48 ± 1.18	-1.63 ± 0.99	-2.00 ± 0.80	-1.68 ± 1.03	-1.87 ± 0.71	-1.85 ± 0.77	-1.75 ± 1.00	-1.68 ± 0.97
(B&G)	-1.56 ± 1.08		-1.86 ± 0.91		-1.86 ± 0.73		-1.71 ± 0.98	
Weight/Age	-0.93 ± 1.00	-0.75 ± 1.05	—	—	—	—	—	—
(B&G)	-0.83 ± 1.03		—		—		—	
BMI/Age	-0.23 ± 0.94	-0.02 ± 1.03	-0.15 ± 1.15	0.00 ± 1.25	-0.43 ± 1.15	-0.50 ± 1.01	-0.23 ± 1.05	-0.08 ± 1.10
(B&G)	-0.11 ± 0.99		-0.08 ± 1.19		-0.46 ± 1.07		-0.16 ± 1.08	
<i>Urban</i>								
Height/Age	-1.22 ± 1.49	-0.92 ± 1.13	-0.90 ± 1.17 [†]	-1.57 ± 1.06	-1.90 ± 0.97	-1.97 ± 0.81	-1.27 ± 1.33	-1.48 ± 1.09
(B&G)	-1.08 ± 1.33 [†]		-1.20 ± 1.16 [†]		-1.95 ± 0.86		-1.37 ± 1.21 [†]	
Weight/Age	0.71 ± 1.30	0.76 ± 1.08	—	—	—	—	—	—
(B&G)	0.73 ± 1.20 [†]		—		—		—	
BMI/Age	1.73 ± 1.03	1.53 ± 0.99	1.5 ± 1.01	1.23 ± 1.06	0.68 ± 0.99	0.74 ± 1.11	1.42 ± 1.08	1.16 ± 1.10
(B&G)	1.64 ± 1.01 [†]		1.37 ± 1.04 [†]		0.72 ± 1.06 [†]		1.29 ± 1.10 [†]	

B&G: Boys and Girls; ^aSignificant differences between Boarders and Non-boarders, ^bbetween Boarders and Urban and ^cbetween Non-boarders and Urban ($p < 0.05$);

[†]Significant differences between Urban and Rural ($p < 0.05$); [‡]Significant differences between boys and girls ($p < 0.05$).

is slightly (non-significant) higher in the rural group). A significantly higher prevalence of stunting was observed in the rural group than in the urban group, except in the 15-18 year age group. There were no differences between genders except in the urban 11 to 14 year old group, where there was a higher prevalence in girls. Underweight was significantly higher in the rural group (25 vs. 1.2 %) in the 5-10 year age group. The prevalence of thinness was also significantly higher in rural areas for all age groups except the 5-10 year age group.

DISCUSSION

To the best of our knowledge, this is the first study to report the prevalence and the coexistence of undernutrition and overweight in a sample of Guatemalan schoolchildren. The present study aims to give an overview of the current nutritional status of this population and to enable comparisons between those living in urban and rural areas of Guatemala. The dual burden of malnutrition in children and adolescents in Guatemala shows that undernutrition

Table IV. Prevalence (%) of undernutrition and overnutrition by age group, sex and geographical location

Children	5-10 years		11-14 years		15-18 years		Total	
	% Boys	% Girls	% Boys	% Girls	% Boys	% Girls	% Boys	% Girls
<i>Rural</i>								
Stunting	53.5	61.2	79.0 [†]	48.3	81.3	78.6	68.0	59.8
(B&G)	57.6		65.7		80.0		64.0	
Underweight	30.2	20.4	—	—	—	—	—	—
(B&G)	25.0		—		—		—	
Thinness	9.3	6.1	13.2	13.8	18.8	21.4	12.4	10.9
(B&G)	7.6		13.4		20.0		11.6	
Overweight	16.3	20.4	34.2	34.5	18.8	14.3	23.7	23.9
(B&G)	18.5		34.3		16.7		23.8	
Obesity	0	2.0	0	3.5	0	0	0	2.2
(B&G)	1.1		1.5		0		1.1	
<i>Urban</i>								
Stunting	44.4	25.6	31.3 [†]	57.7	68.2	71.8	45.5	51.0
(B&G)	35.7 [†]		43.1 [†]		70.5		48.3 [†]	
Underweight	2.2	0	—	—	—	—	—	—
(B&G)	1.2 [†]		—		—		—	
Thinness	0	2.6	0	0	0	2.6	0 [†]	1.9
(B&G)	1.2		0 [†]		1.6 [†]		1.0 [†]	
Overweight	62.2	76.9	62.5	61.5	59.1	51.3	61.6	63.5
(B&G)	69.1 [†]		62.1 [†]		54.1 [†]		62.6 [†]	
Obesity	24.4	15.4	15.6	15.4	0	5.1	16.2	11.5
(B&G)	20.2 [†]		15.5 [†]		3.3		13.8 [†]	

B&G: Boys and Girls; [†]Significant differences between Urban and Rural ($p < 0.05$); [‡]Significant differences between boys and girls ($p < 0.05$).

is more common in rural areas, whereas overnutrition appears to be mainly an urban phenomenon.

Guatemala has the third highest rate of chronic malnutrition (stunting) in the world (54.5%) (15). In some municipalities, particularly in the Western Highlands of the republic, this prevalence can reach 80%. Our study supports previous finding and identifies undernutrition in Guatemala as a severe public health problem that still persists. A recent important longitudinal study which observed Guatemalan children over a period of 40 years (16) suggested increased HAZ scores and a reduction of severe growth retardation. However, there was no long-term change in the prevalence of overweight and obesity. In our study higher age groups demonstrate more stunting than lower age groups. Other studies have shown that indigenous children suffer disproportionately, with rates of stunting almost twice that of non-indigenous children (17). Urbanization, however, has been long recognized as a modifying factor for growth and development in low-income societies (18). Our study showed a higher prevalence of stunting in rural areas (64%) than in urban areas (48.3%). However this rate of stunting is higher than the national percentage of 45.6 %, or the 53.9 and 40.3 % reported in 2008 for total and urban Chimaltenango Guatemalan first grade primary school children (19). Although stunting

is a problem that affects the entire Guatemalan population, significant disparity between Guatemala's Ladino and indigenous population groups can be found (20).

Thinness defined as BMI-for-age z-scores, < -2 SD has been adopted to indicate recent nutritional deprivation. In Latin American school-aged children, the prevalence of underweight and thinness is generally lower and less than 10 %. Our study found a range of 11.6% (rural areas) to 1% (urban areas). Underweight and thinness indicates insufficient dietary intake and can inevitably result in adverse health outcomes. Immediate health consequences to school-aged children of being excessively thin include delayed pubertal maturation and reduced muscular strength and work capacity (21).

Childhood obesity is a public health concern which increasingly affects low/middle income countries, with increases of 65% over the past two in low/middle income countries and 48% in high-income countries. Currently 81% (35 million) of affected children live in low/middle income countries (22). While nutritional stunting is still highly prevalent overweight is now becoming a public health concern. Sixty-seven percent of Guatemalans aged 15 and above are overweight, 29% of which are obese (23). We found similar results in urban children and adolescents with a prevalence of 65.6% and

13.8% for overweight and obesity respectively. However, the prevalence in rural participants is lower (23.8% overweight and 1.1% obese). A low percentage of undernutrition (predominantly stunting) and a high percentage of overweight and obesity have been found in urban areas in other Latin American populations (24-26). Overweight and obesity also have a negative impact on health, which includes indicators of metabolic syndrome as well as psychological disturbance (27). The alarming consequence of obesity, among other things, is a greater risk factor for the onset of type 2 diabetes in children (28).

It has been highlighted that cities experience the greatest increase of overweight and obesity because they are much more advanced along the nutritional transition than the countryside (29-30). In urban contexts the range of food choices is greater and prices are generally lower. In addition, urban employments often demand less physical exertion than rural ones, and a greater proportion of women work away from home and are too busy to shop for, prepare and cook healthy meals at home (31).

The simultaneous prevalence of overnutrition (i.e. overweight or obesity) and undernutrition (i.e. stunting) within the same group of children has been previously reported in low/middle income countries (32-35). Both undernutrition and overnutrition during the school age years have detrimental impacts on overall development and on health.

Limitations of the present research are the inclusion of only two geographical regions and relatively small numbers in some subgroups. Due to the cross-sectional nature of the study, we are also unable to reliably assess the causal processes of the double burden of malnutrition. In addition, it was not possible to obtain anthropometric parameters for the 15-18 year age group in urban or rural areas. Finally, the WHO growth reference for those aged 5-18 years does not show values for WAZ in 11-18 year groups.

CONCLUSIONS

In conclusion, a double burden of malnutrition exists in children and adolescents in Guatemala. A high prevalence of underweight and overweight exists in school-aged children. Health authorities must develop nutritional and physical activity programs in order to reverse this double burden in Guatemala and other related countries.

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