Public Health Nutrition: 24(12), 3825–3833 doi:10.1017/S1368980021002032

Relationship between childhood obesity and socio-economic status among primary school children in Costa Rica

Tatiana Gamboa-Gamboa[1,*], Romain Fantin[1,2,3], Jeancarlo Cordoba[1], Ivannia Caravaca[4] and Ingrid Gómez-Duarte[1]

[1]Universidad de Costa Rica, Escuela de Salud Pública, San Pedro 11801, San Jose, Costa Rica: [2]Centro Centroamericano de Población, Universidad de Costa Rica, San Jose, Costa Rica: [3]Escuela de Medicina, Facultad de Medicina, Universidad de Costa Rica, San Jose, Costa Rica: [4]Costa Rican Minister of Health, San Jose, Costa Rica

Submitted 25 June 2020: Final revision received 29 April 2021: Accepted 7 May 2021: First published online 12 May 2021

Abstract

Objective: This article analyses the relationship between socio-economic status and the prevalence of overweight and obesity in the primary school population in Costa Rica.

Design: A National School Weight/Height Census was disseminated across Costa Rica in 2016. The percentage of children who were overweight or obese was calculated by sex, age and socio-economic indicators (type of institution: private, public, mix; type of geographic location: rural, urban and the level of development of the district of residence: quartiles). A mixed-effects multinomial logistic regression model and mixed-effects logistic regression model were used to analyse the association between the prevalence of being overweight or obese and district socio-economic status.

Setting: The survey was carried out in public and private primary schools across Costa Rica in 2016.

Participants: In total, 347 366 students from 6 to 12 years were enrolled in public and private primary schools.

Results: The prevalence of overweight and obesity among children was 34·0 %. Children in private schools were more likely to be overweight or obese than students in public schools (OR = 1·10 [1·07, 1·13]). Additionally, children were less likely to be overweight or obese if attending a school in a district of the lowest socio-economic quartile compared with the highest socio-economic quartile (OR = 0·79 [0·75, 0·83]) and in a rural area compared with the urban area (OR = 0·92 [0·87, 0·97]).

Conclusions: Childhood obesity in Costa Rica continues to be a public health problem. Prevalence of overweight and obesity in children was associated with indicators of higher socio-economic status.

Keywords
Childhood overweight obesity
Socio-economic status
Socio-economic determinants
School children

The excessive weight of children globally is one of the most critical public health problems[1,2]. From 2010 to 2016, the percentage of overweight and obese people from 5 to 19 years of age worldwide increased from 10 % to almost 20 %[3–5]. Subsequently, the WHO's global goal of stopping the increase in the overweight and obesity prevalence by 2025 is far from being reached[2,4,6]. Excessive weight has negative effects on children in both the short and long term. In the short term, in addition to depression and social problems, being overweight or obese may encourage the early onset of chronic diseases such as type 2 diabetes and metabolic syndrome; in the long term, it is a predictor of obesity in adulthood, which has vast economic and health implications[1,2].

Childhood obesity is not merely due to 'bad choices' taken by children, youth and their families. Obesogenic environments are associated with urbanisation and globalisation, which reduce physical activity and modify the diet in children[6–12]. Traditional diets containing a low amount of processed foods have changed to diets high in ultra-processed foods, resulting in higher energetic content, as well as an increase in critical nutrients such as saturated fats and simple sugars[2,3,11,13–15].

However, this environment does not affect all children equally. When compared with high-income countries, an increase in overweight and obesity prevalence in low- and middle-income countries has been seen in the past

*Corresponding author: Email sandra.gamboa@ucr.ac.cr

decade[2,3]. Additionally, in low- and middle-income countries, children from the highest socio-economic status have a higher prevalence of overweight and obesity, which is different from high-income countries, where the trend is the opposite[5,10,16–20]. A systematic review reported socio-economic differences in overweight and obesity trends among primary school age children. The same review found mixed results about sex. Some studies included in this systematic review found that socio-economic differences in overweight and obesity did not differ by sex, but other studies found discrepancies in boys, girls or both[20].

In Costa Rica, research published in 2017 using a sample of female adults from two urban areas showed that in female adults, the relationship between obesity and socio-economic status (SES) is the opposite from children as the percentage of obesity is higher in lower than in higher SES.

This research seeks to analyse the relationship between SES and the prevalence of overweight and obesity in the primary school population in Costa Rica.

Methods

Study design and data collection

Data for this analysis were derived from the 2016 Costa Rican School Weight/Height Census (SWHC). The SWHC was a national cross-sectional survey carried out jointly by the Ministry of Health and the Ministry of Education, from May to November 2016, in 2629 primary schools. A nutritionist from the Ministry of Health developed the staff training. In-person and virtual activities were used to explain standardised procedures for measuring weight and height, as well as procedures for logging data[21]. At the operational level, implementation was achieved through the principals and school teachers using two validated forms. The first form, filled by Principals, collected the general information of each primary school. The second form collected the weight and height measurements of each child.

Data collection was carried out through two mechanisms: physical forms for schools that did not have computer equipment or internet access and a digital form through a web platform for those that did. Teachers used new and standard anthropometric equipment to perform weight and height measurements. This included a portable stadiometer and an electronic scale with high capacity and stability to ensure the accuracy of the results[21].

Each teacher collected the data and recorded the measurements; meanwhile, the Ministry of Health staff carried out supervision and monitored the data quality. Five percent of all schools (n 130) were randomly selected. The Ministry of Health personnel visited these schools and evaluated the organisation and physical space for data collection and techniques for measuring weight and height.

Children were measured with clothes on but without shoes. Garments such as coats, necklaces or objects in their pockets that could affect their weight, as well as hair ties or hair clips that could affect good posture, were removed. Two weight and height measurements were performed for each child, by alternating weight, height, weight and height. Weight or height measurements with differences >200 g or 0·5 cm were repeated, and the data with the greater difference were discarded based on the methodological guidelines created for the SWHC[21].

Population

The SWHC reached 406 021 students from 6 to 12 years, enrolled in public and private primary schools, representing 91·1 % of the total primary school enrollment in 2016 in Costa Rica. From the total observations, 58 655 (13·3 %) were excluded due to reasons such as incomplete data like missing date of birth, measurement day or measurement, ages outside the evaluation range, differences between the two height measurements > 0·5 cm and differences between the two weight measurements greater than 200 g. Table 1 presents the characteristics of the population according to their nutritional status. The final sample used in the analysis was 347 379 students. Details about observation exclusions are shown in Fig. 1.

Nutritional status

Children were classified according their nutritional status in thin, normal, overweight and obese. For this study, nutritional status was the dependent variable with two possible categories: 'With overweight or obesity' and 'without overweight or obesity.' The average weight, average height and age at the measurement date were used to determine this classification. WHO Growth reference data for 5–19 years were used[23]. Children were classified as thin (BMI-for-age z-score ≤ −2 SD), overweight (+1 SD < BMI-for-age z-score ≤ +2 SD) and obese (BMI-for-age z-score > +2 SD).

Socio-economic data

Costa Rica is administratively divided into 477 districts. Each district was described using the Population and Housing Census 2011. Population and Housing Census covered 94 % of the population of Costa Rica[24].

The geographic location type and development level were assigned from the school district, using a previously published methodology. A district is considered urban if more than 80 % of its population lives in urban areas, mixed if 20 to 80 % live in an urban area and rural if less than 20 % of its population lives in urban areas[24]. It should be noted that in Costa Rica, the rural area is less developed than the urban area[25]. The level of development of the district was classified using Basic Unmet Needs. The percentage of people with at least one Basic Unmet Needs is used to measure poverty at the geographical level. It comprises four dimensions: access to a decent shelter, access to a healthy life, access to knowledge and access to other goods and services[24].

https://doi.org/10.1017/S1368980021002032 Published online by Cambridge University Press

Table 1 Demographic and socio-economic characteristics among Costa Rican children from schools: Censo Escolar 2016 according to their nutritional status

	Nutritional status										
	Thiness		Normal		Overweight		Obesity		Total		
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	Height (cm)
Sex					*						*
Boys	3231	1·8	111 502	62·5	34 077	19·1	29 601	16·6	178 411	51·4	134·2
Girls	3066	1·8	111 498	66·0	34 864	20·6	19 527	11·6	168 955	48·6	134·9
Age					*						*
6 years	440	1·6	19 091	71·5	4184	15·7	2968	11·1	26 683	7·7	118·8
7 years	796	1·4	40 260	69·2	9775	16·8	7350	12·6	58 181	16·7	122·9
8 years	847	1·5	37 765	65·1	10 876	18·7	8559	14·7	58 047	16·7	128·4
9 years	908	1·6	35 290	62·4	11 530	20·4	8826	15·6	56 554	16·3	134·0
10 years	1091	2·0	33 807	61·1	11 851	21·4	8548	15·5	55 297	15·9	139·7
11 years	1279	2·3	33 950	60·7	12 490	22·3	8171	14·6	55 890	16·1	145·6
12 years	936	2·5	22 837	62·2	8235	22·4	4706	12·8	36 714	10·6	150·3
Type of school					*						*
Public	5940	1·9	207 029	64·5	62 857	19·6	45 164	14·1	320 990	92·4	134·4
Private	357	1·4	15 971	60·6	6084	23·1	3964	15·0	26 376	7·6	135·8
Area					*						*
Rural	899	1·9	31 148	67·3	8752	18·9	5494	11·9	46 293	13·3	133·9
Mix	2340	2·0	77 354	65·6	22 282	18·9	15 928	13·5	117 904	33·9	134·4
Urban	3058	1·7	114 498	62·5	37 907	20·7	27 706	15·1	183 169	52·7	134·8
District socio-economic status					*						*
First quartile (lowest)	1996	2·0	67 660	67·2	18 696	18·6	12 266	12·2	100 618	29·0	133·9
Second quartile	1783	2·0	58 050	64·8	17 151	19·2	12 553	14·0	89 537	25·8	134·4
Third quartile	1395	1·6	53 864	62·7	17 737	20·6	12 970	15·1	85 966	24·7	134·8
Fourth quartile (highest)	1123	1·6	43 426	61·0	15 357	21·6	11 339	15·9	71 245	20·5	135·3

*Significant results (χ^2 was used to estimate the significance of the relationship between each variables).

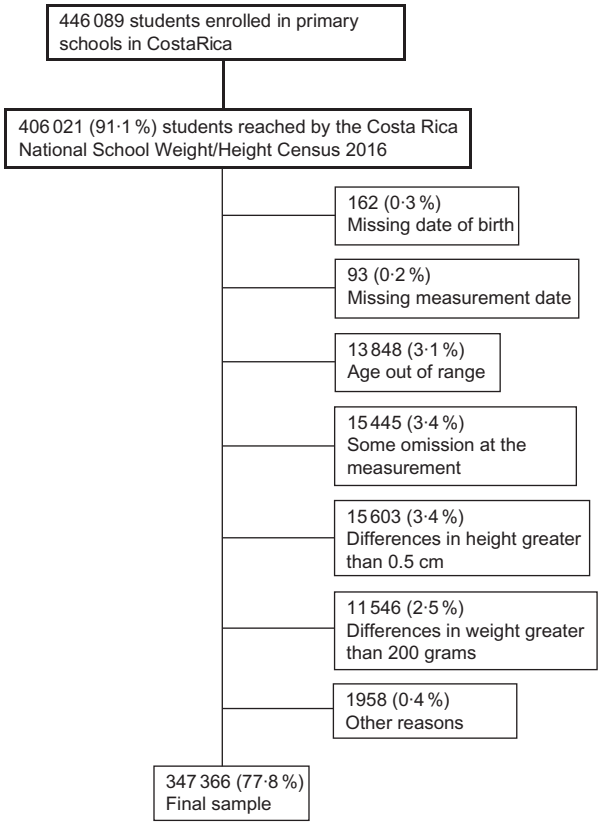

Fig. 1 Study population flow chart

The type of institution was classified between public and private. In Costa Rica, on average, children from families with high socio-economic status attend private centres[26]. For example, in districts classified as more developed, 18 % of children attend private schools, compared with less than 2 % in poorer districts.

Statistical analysis

STATA 14.0 (StataCorp) was used for all statistical analyses. The percentage thinness in normal, overweight or obese children was calculated by sex, age, type of institution, geographic location and level of development of the district of residence divided into quartile. A χ^2 test was used to estimate the significance of the relationship between nutritional status and each variable.

The mixed-effects multinomial logistic regression model using the generalised structural equation modelling function was conducted to obtain a relationship between being overweight and obese with children's characteristics. The response variable is multinomial with three possible outcomes:(1) thinness or normal,(2) overweight and(3) obese, where thinness and normal were set as a reference category.

A logistic regression regression model was used to compare overweight/obesity prevalence by socio-demographic factors. The cluster was the district. Two separate analyses were performed to verify the robustness of the results after changing the threshold (overweight or

https://doi.org/10.1017/S1368980021002032 Published online by Cambridge University Press

obesity): thinness/normal against overweight/obesity and thinness/normal/overweight against obesity. The results were presented in the entire population, by sex and by area.

The non-stability hypothesis suggesting a difference in the OR between children from wealthy areas and children from poor areas across the age range was tested. Children < 78 months of age were excluded because the number of observations was insufficient (*n* 1261, 0·4 %). The parameters associated with the interaction between the continuous indicator of socio-economic status and a polynomial function of age (two and three degrees) were estimated by sex. The overall *P*-values were calculated using the test of linear hypotheses after estimation (function test) for the two or three parameters jointly.

The OR of the difference between children over 78 months of age from the most and least developed districts based on cross-sectional data was analysed. The parameters associated with a polynomial function (three degrees) of age, by sex, were estimated separately in the most developed districts (Q4) and the least developed districts (Q1) (xtlogit function). The cubic function was previously chosen based on the distribution of the percentage of overweight in the different sub-groups. Based on those parameters, the overweight rate in the two groups according to age was estimated, and the OR was calculated using the most developed districts as a reference. CI and *P*-values were calculated using the bootstrap method.

According to the measure of wealth in the district, to test the robustness of results, the principal analysis was run using the four categories of Social Development Index 2013 instead of the Basic Unmet Needs measure[22].

Results

Table 1 shows the descriptive statistics of the sample. Of the 347 366 children who participated in the SWHC, 1·8 % were thin, 19·9 % overweight and 14·1 % obese. As a result, 34·0 % were overweight or obese. Overweight and obesity were more frequent in boys (35·7 %) than girls (32·3 %, $P < 0·01$). Overweight and obesity increased with age between 6 and 11 years, going from 26·8 % at 6 years of age to 37·0 % at 11 years. At 12 years of age, overweight and obesity was 35·2 %. The three economic indicators showed that overweight and obesity increased as socio-economic status increased. Indeed, students in private schools were more likely to be overweight (38·1 %) than students in public schools (33·7 %, $P < 0·01$). Also, the proportion of children overweight and obese increased as you went from rural to urban areas.

Thinness was marginal in each sub-population; the highest rate was 2·5 % for 12-year-old children. A negative association was founded between socio-economic status and thinness prevalence (Supplementary material). Indeed, students in public schools were more likely to be thin (1·9 %) than students in private schools (1·4 %, $P < 0·01$). The proportion of child thinness increased from urban (1·7 %) to rural areas (1·9 %, $P < 0·01$).

Mean height was associated with socio-economic characteristics, where children living in the poorest districts were smaller (133·9 cm) than children living in the wealthiest districts (135·3 cm) ($P < 0·001$), and children living in a rural area were smaller (133·9 cm) compared with children living in an urban area (134·8 cm) ($P < 0·001$).

Table 2 shows the multilevel multinomial logistic regression model describing overweight and obesity according to the sex, age and socio-economic data. The main results of the model describing obesity and overweight were confirmed. In particular, the relations with the district's characteristics (area and wealth) remained similar. There is a positive social gradient ($OR_{Q3} = 0·92$ [0·90, 0·97], $OR_{Q2} = 0·85$ [0·82, 0·89], $OR_{Q1} = 0·76$ [0·73, 0·79]) and an independent relation between each of the three socio-economic indicators and overweight and obesity rates.

However, there were some differences. There was no relationship between obesity and type of school and a lower prevalence in private schools compared with public schools in girls. The difference between boys and girls for obesity was more substantial (OR = 0·66 [0·65, 0·67], $P < 0·01$) compared with overweight (OR = 1·02 [1·01, 1·04], $P = 0·01$). These data were confirmed using the mixed-effects logistic regression model analysis (supplementary material).

Table 3 shows the mixed-effects logistic regression model describing overweight and obesity according to sex and area. The relation between the three socio-economic indicators and overweight and obesity was still significant in the general model after adjustment for the other variables. Overweight and obesity rates in urban areas were more prevalent than in rural areas. A positive social gradient was identified in that the wealthier a district was, the higher the prevalence of overweight and obesity was. Finally, after adjusting for the district's characteristics, children studying in private schools had a higher prevalence of overweight and obesity than children studying in public schools. The results are similar when categorised by sex. Increased overweight and obesity is observed among boys between 6 and 10 years and among girls between 6 and 11 years of age. Nevertheless, there is not a statistically significant difference between the models in boys and girls. The results were remarkably stable between urban, rural and mixed areas. In particular, a positive social gradient was observed in both areas.

There was a significant interaction between the polynomial function of age (quadratic or cubic) and the continuous ecological indicator of socio-economic status, suggesting that the relationship between SES and overweight and obesity was not stable over time. In boys, the interaction between the ecological continuous indicator of socio-economic status and the polynomial function of age was significant for both quadratic ($P = 0·05$) and cubic

https://doi.org/10.1017/S1368980021002032 Published online by Cambridge University Press

Table 2 Multilevel multinomial logistic regression model analysis* of demographic and socio-economic factors correlated with overweight and obesity among school children in Costa Rica (*n* 347 366)

	Overweight		Obesity	
	OR	95 % CI	OR	95 % CI
Sex				
Boys (ref)	1		1	
Girls	1·02	1·01, 1·04	**0·66**	**0·65, 0·67**
Age				
6 years	**0·90**	**0·87, 0·94**	**0·85**	**0·81, 0·89**
7 years (ref)	1		1	1
8 years	**1·18**	**1·15, 1·22**	**1·24**	**1·20, 1·28**
9 years	**1·34**	**1·30, 1·38**	**1·36**	**1·32, 1·41**
10 years	**1·43**	**1·38, 1·47**	**1·37**	**1·32, 1·41**
11 years	**1·49**	**1·45, 1·54**	**1·30**	**1·25, 1·34**
12 years	**1·46**	**1·41, 1·51**	**1·10**	**1·06, 1·15**
Type of school				
Public (ref)	1		1	
Private	**1·17**	**1·13, 1·21**	**0·98**	**0·98, 1·06**
Area				
Rural	0·96	0·93, 1·00	**0·86**	**0·83, 0·90**
Mix	**0·93**	**0·91, 0·95**	**0·90**	**0·90, 0·95**
Urban (ref)	1		1	
District SE status				
First quartile (lowest)	**0·84**	**0·81, 0·87**	**0·76**	**0·73, 0·79**
Second quartile	**0·86**	**0·84, 0·89**	**0·85**	**0·82, 0·89**
Third quartile	**0·94**	**0·91, 0·97**	**0·92**	**0·90, 0·95**
Fourth quartile (highest) (ref)	1		1	

*OR and 95 % CI were derived from multilevel multinomial logistic regression model analysis.
Ref = reference category; in bold are the OR that are statistically significantly different from the reference's OR ($P < 0·01$).

Table 3 Mixed-effects logistic regression model analysis* of demographic and socio-economic factors correlated with overweight and obesity among school children in Costa Rica by sex and area (*n* 347 366)

			Sex				Area			
	Overall		Boys		Girls		Rural and mixed		Urban	
	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Sex										
Boys (ref)	1						1		1	
Girls	**0·85**	**0·84, 0·87**					**0·86**	**0·64, 0·66**	**0·84**	**0·85, 0·88**
Age										
6 years	**0·88**	**0·85, 0·91**	**0·88**	**0·84, 0·92**	**0·88**	**0·84, 0·92**	**0·90**	**0·86, 0·94**	**0·86**	**0·82, 0·90**
7 years (ref)	1		1		1		1		1	
8 years	**1·21**	**1·18, 1·24**	**1·22**	**1·18, 1·26**	**1·20**	**1·15, 1·24**	**1·20**	**1·16, 1·24**	**1·22**	**1·18, 1·26**
9 years	**1·35**	**1·32, 1·38**	**1·38**	**1·33, 1·43**	**1·32**	**1·27, 1·37**	**1·35**	**1·30, 1·40**	**1·35**	**1·31, 1·40**
10 years	**1·40**	**1·37,1·44**	**1·46**	**1·39, 1·49**	**1·35**	**1·30, 1·40**	**1·43**	**1·37, 1·48**	**1·39**	**1·34, 1·43**
11 years	**1·41**	**1·37, 1·45**	**1·44**	**1·39, 1·49**	**1·38**	**1·33, 1·43**	**1·44**	**1·38, 1·49**	**1·39**	**1·34, 1·44**
12 years	**1·31**	**1·28–1·34**	**1·27**	**1·22, 1·32**	**1·35**	**1·30–1·41**	**1·36**	**1·30, 1·41**	**1·27**	**1·22, 1·32**
Type of school										
Public (ref)	1		1		1		1		1	
Private	**1·10**	**1·07,1·13**	**1·16**	**1·12, 1·20**	1·04	1·00–1·08	**1·16**	**1·12, 1·20**	**1·09**	**1·06, 1·12**
Area										
Rural	**0·92**	**0·87, 0·97**	0·93	0·88, 0·98	**0·91**	**0·85, 0·96**	0·97	0·92, 1·02		
Mix	0·96	0·92, 1·00	0·96	0·91, 1·00	0·95	0·91, 1·00	1			
Urban (ref)	1		1		1					
District SE status										
First quartile (lowest)	**0·79**	**0·75, 0·83**	**0·77**	**0·72, 0·81**	**0·82**	**0·77, 0·87**	**0·80**	**0·71, 0·90**	**0·80**	**0·75, 0·86**
Second quartile	**0·88**	**0·83, 0·92**	**0·85**	**0·81, 0·90**	**0·89**	**0·84, 0·95**	0·89	00·79, 1·00	**0·88**	**0·84, 0·93**
Third quartile	0·97	0·92, 1·02	0·95	0·90, 1·00	0·98	0·92, 1·03	1·00	0·88, 1·13	0·95	0·91, 1·00
Fourth quartile (highest) (ref)	1		1		1		1		1	

*OR and 95 % CI were derived from mixed-effects logistic regression model.
Ref = reference category; in bold are the OR that are statistically significantly different from the reference's OR ($P < 0·01$).

https://doi.org/10.1017/S1368980021002032 Published online by Cambridge University Press

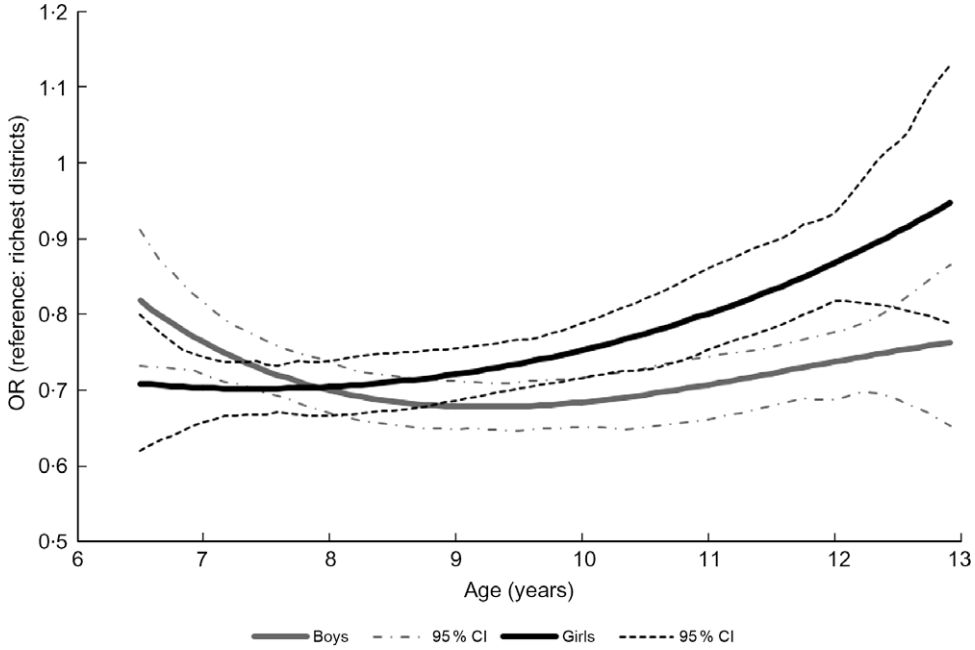

Fig. 2 Associations between socio-economic status (SES)[a] districts and overweight and obesity by age and sex. [a] Richest districts were the reference groups and were compared with the poorest districts, CI were calculated using the bootstrap method

functions ($P = 0{\cdot}03$). In girls, only the interactions with the quadratic function were significant ($P < 0{\cdot}01$). To better illustrate these results, Fig. 2 shows the difference in the proportion of overweight and obese children (OR) between the wealthiest and the poorest districts according to age and sex. A difference between boys and girls can be seen. In boys, the difference of those living in the poorest districts compared with the wealthiest districts is relatively similar from 6·5 and at age 12. There was an increase in the difference between 6·5 (OR = 0·82 [0·73, 0·91]) and 9 (OR = 0·68 [0·65, 0·71]) ($P < 0{\cdot}01$) and a slight decrease between 10 (OR = 0·68 [0·65, 0·72]) and 12 years of age (OR = 0·74 [0·69, 0·78]) ($P < 0{\cdot}01$). In girls, the difference was steady between 6·5 and 8 years and decreased sharply between 8 (OR = 0·70 [0·67, 0·74]) and 12 years of age (OR = 0·87 [0·82, 0·93]) ($P < 0{\cdot}01$). From 8 years, the difference between students who live in the poorest districts compared with the wealthiest districts is more noticeable in boys than in girls.

Discussion

The main finding of this study is the higher prevalence of overweight and obesity in children attending schools within high SES districts in Costa Rica. In boys, the difference between those who live in the poorest districts and those who live in the wealthiest districts is relatively similar at 6 and 12 years of age; the largest difference is at 9 years. In girls, the difference is stable between 6 and 8 years and decreases sharply between 8 and 12 years of age. Starting at age 8, the difference between children living in poorer districts and those living in the wealthiest districts is more substantial for boys than girls.

The relationship between SES and overweight and obesity found in this study is consistent with the findings in middle-income countries such as Colombia and Honduras[17,18]. Evidence shows the relationship between SES and prevalence of overweight and obesity varies according to the economic status of each country[16]. Contrary to our findings, an inverse relationship has been found between SES and overweight and obesity prevalence in developed countries[5,20,27].

Regarding sex, the results of this study show that the prevalence of overweight and obesity is higher in boys, which occurs in most regions of the world[1,28,29]. These findings can be explained from social theories of gender and adolescence, where adolescence is a stage of life in which social acceptance by peers is very important and a girl's body image may decline. The media and society establish 'beauty' standards associated with thinness, which generates tremendous pressure and concerns in young girls for being thin[5,30–33].

Another finding is that as age increased, the prevalence of overweight and obesity increased more in girls of low socio-economic status compared with girls with high socio-economic status. This resulted in a reduction in the difference in overweight and obesity prevalence between both socio-economic levels as it increased with age. The results are consistent with the findings of a systematic review in developed countries where it showed that a low socio-economic level might predict a higher prevalence of overweight and obesity in girls, but not in boys[5]. The main difference seen in Costa Rica is that girls with low

https://doi.org/10.1017/S1368980021002032 Published online by Cambridge University Press

socio-economic level have a lower prevalence of overweight and obesity at an early age and although the prevalence increases more, it does not exceed the prevalence of girls with high socio-economic level. However, a study carried out in adult girls in Costa Rica showed that the prevalence of overweight and obesity is higher in girls with low socio-economic status[34]. Another study from the United Kingdom concluded that overweight and obesity increased more in boys, and especially girls of lower socio-economic status than in others of varying SES status[35]. In this study, 34·0 % of children were overweight or obese.

In less than 10 years, the prevalence of childhood overweight and obesity has increased by 10 % in Costa Rica[36]. Other countries in the region have experienced similar situations, such as Argentina, Chile and Perú[3,16,37–39]. It is challenging to compare the prevalence of childhood obesity between countries because there is no standardisation in the methodology worldwide; different types of surveys are used with different sample sizes and age ranges, among other considerations.[28]. However, like Costa Rica, El Salvador carried out a School Census and Peru completed a National Survey. Although each country used different methodologies, the three countries have a prevalence of childhood overweight and obesity above 30 %[40,41]. According to the estimates of obesity by region published by Non-Communicable Diseases Risk Factor Collaboration, Costa Rica has a higher prevalence of childhood obesity than what is estimated for other countries of Latin America and the Caribbean. Costa Rica resembles western high-income countries such as Canada and the United States, as these countries have the highest rates of childhood obesity worldwide[1].

This research has some limitations. The first is that the school district's socio-economic data where the child was attending were used because the specific district of residence of each child was not available. However, in Costa Rica, children usually go to school districts close to their homes. The SWHC did not include information that would have been important to explain the results of the study, such as eating habits and physical activity. Also, the number of schools that did not participate in the census was not available for the researchers. However, based on the data's demographic distributions, we are confident that the study sample is representative. The strengths of the study include sample size, which provides greater statistical power, as well as having socio-economic data at the district level in Costa Rica, giving greater precision to the study. Both sample size and local level data make this study one of the few that has been developed in middle-income countries.

Childhood overweight and obesity in Costa Rica continues to be a public health problem. One of the main global strategies recommended by the WHO is leadership from the government in the formulation and execution of policies and programmes to curb this challenge[42]. Latin America, Mexico, Chile and Peru have been pioneers in the formulation and implementation of public policies focused on promoting healthy food environments. To do this, they have had to confront the economic interests of the food industry[24,25,34]. In Costa Rica, actions have been carried out in public schools to improve food environments such as limiting the sale of foods high in fats and sugars[43] and modifying the menus to be healthier[44]. However, there are still no clear and concrete actions to promote physical activity in this age group, tax sugary drinks, regulate the advertising of unhealthy foods aimed at children and adolescents, implement a front-of-pack nutrition label that is easy to understand and prioritise guidelines to counter childhood obesity worldwide[13,42,45–47]. Costa Rica must adopt the policies and actions that have been proposed at the international level in order to stop the increase in childhood overweight and obesity[2,4,6,11,48]; otherwise, the relationship between overweight and obesity prevalence and socio-economic level may become similar to developed countries where obesity has become a matter of social inequality.

Acknowledgements

Acknowledgements: To the Costa Rican Minister of Health that provides de database. To Mollie Hadley and Aubrey Racz who critically revised the final manuscript. *Financial support:* The data used for this analysis came from a study funded by the Minister of Health, UNICEF Costa Rica and the Minister of Public Education. *Conflict of interest:* None of the authors has conflicts of interest. *Authorship:* Contributed to the conception and planning of the study: T.G., R.F., J.C., I.C. and I.G. Data analysis and interpretation: T.G and R.F. Prepared the manuscript: T.G., R.F. and J.C. Critical review of the manuscript: T.G., R.F., J.C., I.C. and I.G. *Ethics of human subject participation:* This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving research study participants were approved by the Consejo Nacional de Investigaciones en Salud (CONIS). Written informed consent was obtained from all parents of the participants. Verbal consent was witnessed and formally recorded.

Supplementary material

For supplementary material accompanying this paper visit https://doi.org/10.1017/S1368980021002032

References

1. Di Cesare M, Sorić M, Bovet P *et al.* (2019) The epidemiological burden of obesity in childhood: a worldwide epidemic requiring urgent action. *BMC Med* **17**, 1–20.
2. Fondo de las Naciones Unidas para la Infancia (UNICEF) (2019) *State of the World's Children 2019. Children, Food, and Nutrition. Growing Well in a Changing World*. New York: UNICEF.

3. Bentham J, Di Cesare M, Bilano V *et al.* (2017) Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. *Lancet* **390**, 2627–2642.
4. World Health Organization (2018) Taking action on childhood obesity report. https://www.who.int/end-childhood-obesity/publications/taking-action-childhood-obesity-report/en/%0Ahttp://www.who.int/end-childhood-obesity/publications/taking-action-childhood-obesity-report/en/ (accessed January 2020).
5. Kim TJ & Von Dem Knesebeck O (2018) Income and obesity: what is the direction of the relationship? A systematic review and meta-analysis. *BMJ Open* **8**, e019862.
6. World Health Organization (2014) Global targets 2025. To improve maternal, infant and young child nutrition. www.who.int/nutrition/topics/nutrition_globaltargets2025/en/ (accessed February 2020).
7. Mech P, Hooley M & Skouteris H (2016) Parent-related mechanisms underlying the social gradient of childhood overweight and obesity: a systematic review. *Child: Care Health Dev* 1–22.
8. Choukem SP, Kamdeu-Chedeu J, Leary SD *et al.* (2017) Overweight and obesity in children aged 3–13 years in urban Cameroon: a cross-sectional study of prevalence and association with socio-economic status. *BMC Obes* **4**, 1–8.
9. Lobstein T, Jackson-Leach R, Moodie ML *et al.* (2015) Child and adolescent obesity: part of a bigger picture. *Lancet* **385**, 2510–2520.
10. Poskitt E (2014) Childhood obesity in low- and middle-income countries. *Pediatr Int Child Health* **34**, 239–249.
11. Malo M, Castillo M & Pajita D (2017) Obesity in the world. *An la Fac Med* **78**, 173–178.
12. Swinburn BA, Sacks G, Hall KD *et al.* (2011) The global obesity pandemic: shaped by global drivers and local environments. *Lancet* **378**, 804–814.
13. World Health Organization (2017) *Report of the Commission on Ending Childhood Obesity. Implementation Plan: Executive Summary*. Geneva: World Health Organization.
14. Malik V, Pan A, Willett WC *et al.* (2013) Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. *Am J Clin Nutr* **98**, 1084–1102.
15. Juul F & Hemmingsson E (2015) Trends in consumption of ultra-processed foods and obesity in Sweden between 1960 and 2010. *Public Health Nutr* **18**, 3096–3107.
16. Gupta N, Goel K, Shah P *et al.* (2012) Childhood obesity in developing countries: epidemiology, determinants, and prevention. *Endocr Rev* **33**, 48–70.
17. Buitrago-Lopez A, Van den Hooven EH, Rueda-Clausen CF *et al.* (2015) Socio-economic status is positively associated with measures of adiposity and insulin resistance, but inversely associated with dyslipidaemia in Colombian children. *J Epidemiol Community Health* **69**, 580–587.
18. Ramírez-Izcoa A, Sánchez-Sierra LE, Mejía-Irías C, *et al.* (2017) Prevalence and factors associated with childhood overweight and obesity in public and private schools in Tegucigalpa, Honduras. *Rev Chil Nutr* **44**, 161–169.
19. Liu W, Lin R, Li B *et al.* (2016) Socio-economic determinants of childhood obesity among primary school children in Guangzhou, China. *BMC Public Health* **16**, 1–8.
20. Chung A, Backholer K, Wong E *et al.* (2016) Trends in child and adolescent obesity prevalence in economically advanced countries according to socio-economic position: a systematic review. *Obes Rev* **17**, 276–295.
21. Ministerio de Salud (2017) *Methodological Report School Census Weight/Size in Costa Rica, 2016*. San Jose: Ministerio de Salud.
22. Ministerio de Planificación Nacional y Política Económica (2013) *Social Development Index*. San José: MIDEPLAN.
23. World Health Organization (2013) Growth reference data for 5–19 years. https://www.who.int/growthref/en/ (accessed March 2020).
24. Fantin R, Santamaría Ulloa C & Barboza-Solís C (2020) Socioeconomic inequalities in cancer mortality: Is Costa Rica an exception to the rule? *Int J Cancer* **147**, 1286–1293.
25. Fantin R, Gómez-Duarte I & Sáenz-Bonilla J (2019) Measuring socioeconomic position from the social inequalities in health perspective? The case of Costa Rica. *Odovtos – Int J Dent Sci* **3**, 143–153.
26. Del Valle F (2013) Educational inequality in Costa Rica: the gap between public and private school students. Analysis with the results of the International Assessment PISA. https://repositorio.cepal.org/bitstream/handle/11362/35932/RVE111FernandezDelValle_es.pdf?sequence=1&isAllowed=y (accessed March 2020).
27. Rogers R, Eagle T, Sheetz A *et al.* (2015) The relationship between childhood obesity, low socioeconomic status, and race/ethnicity: lessons from Massachusetts. *Child Obes* **11**, 691–695.
28. Mazidi M, Banach M & Kengne AP (2018) Prevalence of childhood and adolescent overweight and obesity in Asian countries: a systematic review and meta-analysis. *Arch Med Sci* **14**, 1185–1203.
29. Yanez J, Arrieta E, Lozano J *et al.* (2019) Prevalence of overweight and obesity in child population. A study of a cohort in Castile and Leon, Spain. *Endocrinol Diabetes Nutr* **66**, 173–180.
30. Muazzam A, Waheed T, Ahmed S *et al.* (2019) Dieting beliefs among adolescent girls. *J Social Clin Psychol* **17**, 61–67.
31. Romo L, Mireles-Rios R & Hurtado A (2016) Cultural, media, and peer influences on body beauty perceptions of Mexican American adolescent girls. *J Adolesc Res* **31**, 474–501.
32. Duno M & Acosta E (2019) Corporal image perception in university adolescents. *Rev Chil Nutr* **46**, 545–553.
33. Salazar Mora Z (2008) Adolescence and body image in the time of thinness. *Reflexiones* **87**, 8.
34. Bekelman T, Santamaría-Ulloa C, Dufour D *et al.* (2017) Using the protein leverage hypothesis to understand socio-economic variation in obesity. *Am J Hum Biol* **29**, e22953.
35. Fantin R, Delpierre C & Dimeglio C (2016) Disentangling the respective roles of the early environment and parental BMI on BMI change across childhood: a counterfactual analysis using the Millennium Cohort Study. *Prev Med* **89**, 146–153.
36. Ministerio de Salud (2010) *Costa Rican Nutritional National Survey, 2008–2009*. San Jose: Ministerio de Salud.
37. Orden A, Lamarque M & Apezteguía M (2019) Trend in childhood obesity reflects socio-economic status in Argentina. *Ann Hum Biol* **46**, 7–8.
38. Vio F & Kain J (2019) Description of the progression of obesity and related diseases in Chile. *Rev Med Chil* **147**, 1114–1121.
39. Chávez J (2017) Prevalence of overweight and obesity in Peru. *Rev Peru Ginecol Obstet* **63**, 593–598.
40. Ministerio de Salud (2017) *Summary: National Census in Schools Weight/Height 2016*. San Jose: Ministerio de Salud.
41. Ministerio de Salud de El Salvador (2016) *IV National Census of Weight and I National Census of Weight in Schools*. San Salvador: Ministerio de Salud.
42. World Health Organization (2016) *Population Approaches to Prevention of Obesity Childhood*. Geneva: WHO.
43. Ministerio de Educación Pública (2012) *Decreto Ejecutivo: 36910 Regulation for the Operation and Administration of Food Service in Public Schools*. San Jose: MEP Costa Rica.
44. Ministerio de Educación Pública. (2020) Menús para implementar en comedores escolares (Menus for the public school nutrition program). https://www.mep.go.cr/menus-implementar-comedores-escolares (accessed March 2020).

https://doi.org/10.1017/S1368980021002032 Published online by Cambridge University Press

45. World Obesity Federation (2019) *Atlas of Childhood Obesity*. London: World Obesity Federation.
46. Gamboa-Gamboa T, Blanco-Metzler A, Vandevijvere S *et al*. (2019) Nutritional content according to the presence of front of package marketing strategies: the case of ultra-processed snack food products purchased in Costa Rica. *Nutrients* **11**, 2738.
47. Pan American Health Organization/ World Health Organization (2015) *Ultra-Processed Food and Drink Products in Latin America: Trends, Impact on Obesity, Policy Implications*. Washington, DC: PAHO.
48. Pan American Health Organization/World Health Organization (2014) *Action Plan for the Prevention of Obesity in Childhood and Adolescence*. Washington, DC: PAHO.

Public Health Nutrition

https://doi.org/10.1017/S1368980021002032 Published online by Cambridge University Press