Nutritional status of urban adolescents: individual, household and neighborhood factors based on data from *The BH Health Study*

Estado nutricional de adolescentes urbanos: fatores individuais, domiciliares e de vizinhança, *Estudo Saúde em Beagá*

Estado nutricional de los adolescentes urbanos: factores a nivel individual, familiar y de vecindad, *Estudio Salud en Beagá*

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Abstract

The increasing prevalence of overweight in young people suggests that adolescent nutritional status is influenced by environmental factors. Using hierarchical modelling, this study aimed to analyse the association between individual, household and neighborhood factors and adolescent nutritional status and well-being. The study used data from a population-based household survey conducted in Belo Horizonte, the capital of the State of Minas Gerais, Brazil, between 2008 and 2009. Data was obtained from an adult and adolescent in each household using a confidential questionnaire and anthropometric measurements. Adolescent nutritional status was evaluated using multinomial regression analysis considering distal and proximal influences. The prevalence of overweight and thinness among the sample of 1,030 adolescents was 21.9% and 4.6%, respectively. Although variables from all blocks remained in the final model, head of household education level, family habits and family nutritional status were shown to strongly influence adolescent nutritional status. New approaches to public health are needed which focus on raising awareness and promoting health education targeting teenagers and their social context.

Nutritional Status; Overweight; Obesity; Adolescent

Resumo

A crescente prevalência do excesso de peso em idades jovens sugere influência do ambiente no estado nutricional. O estudo objetivou verificar, de forma hierarquizada, fatores individuais, domiciliares e de vizinhança que estão associados ao estado nutricional do adolescente por meio de inquérito de base populacional realizado em dois distritos sanitários de Belo Horizonte, Minas Gerais, Brasil, entre 2008 e 2009. Coletaram-se dados de adultos e adolescentes com uso de questionário e avaliação antropométrica. O estado nutricional do adolescente foi avaliado considerando influências distais e proximais mediante análise de regressão multinomial. A prevalência de excesso de peso foi 21,9% e de magreza 4,6%, entre 1.030 adolescentes. No modelo final, permaneceram variáveis de todos os níveis, sendo que a escolaridade da família, hábitos domiciliares e o estado nutricional no domicilio pareceram influenciar fortemente o estado nutricional do adolescente. Novas abordagens da saúde pública devem ser voltadas para a conscientização da família e educação, atingindo o adolescente e seu vínculo social.

Estado Nutricional; Sobrepeso; Obesidade; Adolescente

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Introduction

The prevalence of overweight and obesity among individuals of all ages has increased considerably over the last 30 years in high-income countries and during the last two decades in medium and low-income countries [1,2]. Patterns of overweight and obesity vary from country to country depending on the stage of nutrition transition. In this respect, medium and low-income countries face the double burden of malnutrition in which underweight and overweight coexist [3]. Brazil, for example, is in an advanced stage of nutrition transition, with high rates of overweight (39.7%) and low rates of underweight (less than 5%) [4].

Although rates have decreased, underweight is still a major problem in a number of medium and low-income countries [5,6]. Currently, however, weight gain is the single biggest public health concern as the worldwide prevalence of overweight in adult men and women between 1980 to 2013 increased from 28.8% to 36.9%, and 29.8% to 38% , respectively [7].

This sharp worldwide increase in overweight and obesity cannot be explained by genetics alone. Obesity is a multifactorial chronic disease that is influenced by genetic, nutritional, behavioural and contextual factors. The upward trend in overweight has been correlated with worldwide social changes associated with intense urbanization, highlighting the importance of social and behavioural factors [8]. Habits and behaviours, such as diet and physical activity, have a direct influence on weight, while contextual factors, such as physical and social environment, have an indirect influence [2,8,9]. According to Christakis & Fowler [10], there is a particularly significant association between increase in body weight and social environment, since contact with obese people may lead to changes in tolerance towards overweight and influence the adoption of certain behaviours associated with weight gain.

Adolescents are particularly vulnerable to the influence of the social context and therefore merit attention. Adolescence is a transitional phase of human development involving rapid growth and physical and emotional changes in which the adolescent creates his/her own identity based on previous and current experiences. The habits formed during this period have a significant impact on several aspects of future life, including food choices, physical activity, body image and well-being [11,12,13]. Obesity during adolescence can have an impact on both emotional health, leading to low self-esteem, depression, anxiety and social isolation [14], and physical health, since the risk of obesity and associated comorbidities in adult life is related to the earliness and intensity of the development of obesity in adolescence [6,15].

The majority of current research addressing weight gain in adolescents focus on correlated individual factors. As a result, population-based studies of excess body weight using conceptual frameworks that go beyond the individual level of analysis are scarce [16,17]. Furthermore, according to Mafra et al. [18], although the relationship between exposure and event is often modelled by the binomial distribution, the dichotomous classification of study samples into only normal weight and overweight is not always the most appropriate method. The use of multinomial response models to explore the relationship between nutritional status and thinness, normal weight and overweight contributes to providing a better understanding of the complexity of the nutrition transition and the increase in prevalence of overweight.

Using hierarchical modelling, this study therefore aimed to analyse the association between individual, household and neighborhood factors and adolescent nutritional status, and investigate adolescents' perceptions of their life, health and body image based on their nutritional status.

Methods

Study design

This cross-sectional study used data from *The BH Health Study,* a population-based survey conducted between 2008 and 2009 in two health districts in Belo Horizonte (Barreiro and Oeste), the capital of the State the Minas Gerais, Brazil, chosen due to its geographical proximity and the internal heterogeneity of demographic, socioeconomic and health indicators. This survey was conducted by the Belo Horizonte Observatory for Urban Health (OSUBH, acronym in Portuguese) of the Federal University of Minas Gerais (UFMG) and is described by previous studies [19,20].

The sample was stratified in three stages: (1) census tract within the health district; (2) household; and (3) household members (adults aged ≥ 18 years, and adolescents aged 11 to 17 years) using the methodology designed by Marques & Berquó [21] which does not take into account degree of kinship between household members. The age of adolescents was set at 11 to 17 years in order to include those at primary and secondary schools.

Data collection

Data was obtained using separate questionnaires for adolescents and adults designed by researchers from the OSUBH based on national and international epidemiological approaches. The questionnaires for adolescents were self-administered and confidential, while the questionnaires for adults were completed during an interview. Both questionnaires included questions about lifestyle, physical activity, nutritional status, diet, perception of well-being, and sociodemographic characteristics. The adult questionnaire also included questions about subjective perceptions of neighborhood conditions.

The following anthropometric measurements of participants were taken in accordance with the 2004 Food and Nutrition Surveillance System (SISVAN, acronym in Portuguese) guidelines [22]: weight, using the TANITA Ironman BC 553; and height, using a WSC/Wood Cardiomed stadiometer.

Study variables

The dependent variable was adolescent nutritional status based on body mass index (BMI) classified by age and sex according to World Health Organization (WHO) cut-off points [23]: "thin" when the curve was less than or equal to the third percentile; "normal weight" when between the third and 85th percentile; and "overweight" when equal to or greater than the 85th percentile.

A conceptual framework, developed based on the work of Lytle et al. [9] and other authors, was used to analyse the association between distal and proximal risk factors and nutritional status (Figure 1) [8,24,25] in which variables were categorised into proximal and distal blocks (sociodemographic, neighborhood, household and individual).

The most distal block was made up of sociodemographic variables: age and sex; household income, categorized as < 2, 2 to 5, 5 to 10, or > 10 minimum wages based on the minimum wage in Brazil in 2008/2009 (BRL 415.00 = US$ 178.50, according to the on an exchange rate of US$ 1.00 = BRL 2.32); and head of household education level categorized as years of schooling (0 to 4 years, 5 to 8 years, or ≥ 9 years).

The second block was divided in two subgroups and consisted of variables related to adults' perceptions of the physical and social environment of the neighborhood. The first subblock was used as a proxy for neighborhood violence measured based on a small or large risk of aggression, and perception of safety during the day and evening. The second sub-block, at the same hierarchical level, was composed of variables related to favourable conditions for diet and physical activity: condition of streets, street lighting and sport areas (good or bad); pleasant neighborhood for children and adolescents; the ease of obtaining healthy food and the presence of shops (bakery, market, butcher shop) in an walkable distance; and the presence of people exercising in or around the area.

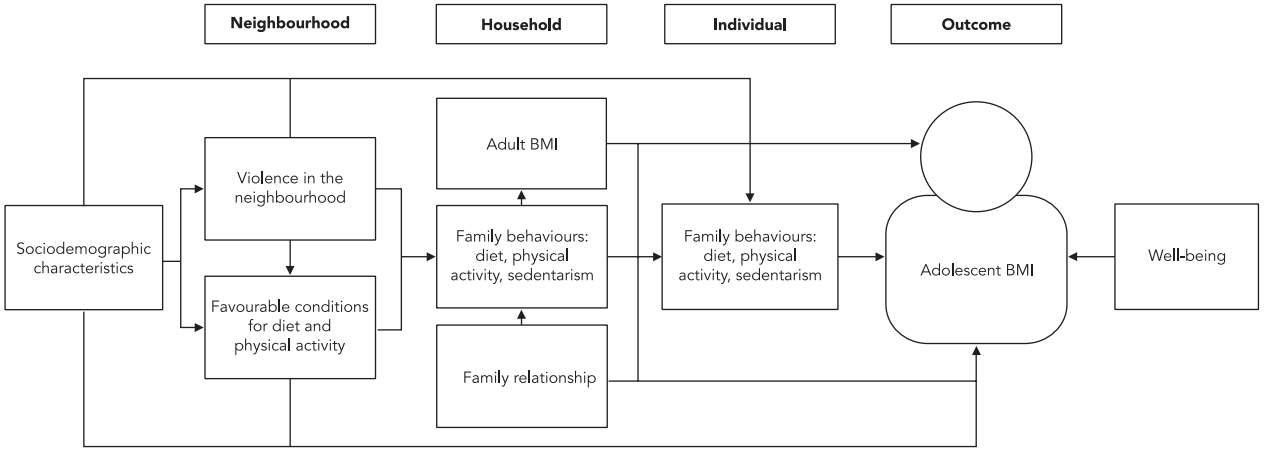
The third block comprised variables related to the household, subdivided into three subblocks. The first sub-block contained variables relating to family relationships, using a score based on the responses made to dichotomous questions by the adolescents about their feelings in relation to their parents or guardians: whether they stand by the adolescent; whether they make them feel bad or loved; whether the adolescents are given enough attention; whether there are fights in the family; and whether the adolescent is able to share his/her problems.

The second sub-block encompassed adult behaviour in relation to physical activity and diet. Physical activity was measured in accordance with the *International Questionnaire of Physical Activity* (IPAQ) [26] long version, which estimates the time spent on weekly physical activity. Those with a score of ≥ 150 minutes/week were considered active, while those who practiced less than 150 minutes/week were considered insufficiently active, and those who participated in no activity were considered inactive. Sedentary activities were measured based on variable 'screen time', which considers the total amount of time spent in front of the television, computer and on games categorised into less than two hours or two hours or more. The following eating habits were investigated: removing the skin and visible fat from chicken and meat, consumption of fruit and vegetables and soft drinks (five or more days a week, or less than five days a week), and type of milk consumed (fat-free milk, or whole milk). The third sub-block was composed of adult weight status according to WHO BMI categories (overweight, defined as BMI ≥ 25kg/m²; not overweight defined as BMI < 24.9kg/m²)[27].

The most proximal block comprised habits among adolescents: time spent daily watching TV and playing video games (< 1, 1 to 2, > 2 hours/day), physical activity, having breakfast (everyday, sometimes/never), and weekly consumption of fruit (5 or more days a week, 1 to 4 days a week, or never/almost never). Physical activity was measured in accordance with the *Brazilian National School-Based Health Survey* (PeNSE, acronym in Portuguese) guidelines[28], based on the frequency of and time spent on

Figura 1

Conceptual framework of factors associated with the nutritional status of urban adolescents.



BMI: body mass index.

activities such as going to school, school sports, and out-of-school physical activity in the last seven days. Those who spent ≥ 300 minutes/week on physical activity were considered active, while those who spent one to 299 minutes/week were considered insufficiently active, and those who participated in no activity were considered inactive.

Variables regarding the adolescents' psychological and personal well-being and self-rated health and body image were not included in the model but analysed separately due to the proximity with the studied events.

Body image dissatisfaction was evaluated using a silhouettes scale validated for use with the Brazilian population by Kakeshita et al. [29] which consists of 15 body silhouettes representing BMI ranges for each sex. Adolescents chose which silhouette best represented the current shape of their body and which they would most like to have. Body image dissatisfaction is the degree of discrepancy between the current and desired silhouette.

Respondents rated their health as excellent, good, fair, poor or very poor [30]. Psychological well-being was evaluated using the Faces Scale developed by Andrews [30] which is a seven-point scale consisting of stylized faces that illustrate the predominant mood in the last two weeks. The adolescents were asked to mark the figure that best resembled the way they felt about their life. Based on a previous study [31], answers were categorized into high level of psychological well-being (faces 1 and 2), and moderate well-being (faces 3-7). Personal well-being was categorised into "good well-being" or "bad well-being" based on a score derived from the answers to three questions about how adolescents felt in relation to others: (1) left out or excluded; (2) awkward or uncomfortable in situations like parties; and (3) lonely.

Data analysis

Multinomial regression was performed, considering normal weight as the reference category. First, univariate analysis was performed to calculate the odds ratio and a 90% confidence interval to identify the variables associated with adolescent nutritional status.

Hierarchical multiple regression was performed of blocks containing variables which obtained a p-value of < 0.20 in the univariate analysis, using backward stepwise selection. The order of entry went from the most distal (sociodemographic) to the most proximal (individual) block, where the distal variables served as adjustment factors for the hierarchically inferior blocks. Since this study involved a large number of covariates, a more flexible level of significance ($p < 0.10$) was adopted.

Clustering was taken into account using the svy prefix command of the Stata 10.0 statistical package (StataCorp LP, College Station, USA). Model adjustment was evaluated using the Akaike Information Criterion (AIC) measure.

Ethical issues

The project was approved by the Ethics Research Committee of the Federal University of Minas Gerais (UFMG, acronym in Portuguese) (ETIC 253/06). Participation in the study was voluntary and all information obtained was treated as confidential. The adolescents and their parents or guardians signed separate terms of consent forms.

Results

A total of 1,030 adolescents participated in this study, 52.5% of which were male. Average age was 13.9 years (SD ± 1.95), 21.9% of adolescents were overweight (13.8% overweight and 8.1% obese), and 4.6% were classified as thin. A complete descriptive analysis was detailed by a previous study [32].

Household income was between two to five minimum wages in most households (45.4%), and 30% of households had an income of less than two minimum wages. The number of years of schooling of the head of the household was over nine years in 40% of households, and zero to four years in 31.4% of households. A significant association was found between nutritional status and all sociodemographic variables apart from age (Table 1).

Regarding the physical characteristics of the neighborhood, the majority of the adults considered that the streets, street lighting and sport areas were in good condition (59.9%), that the neighborhood was pleasant for children and adolescents (84.1%), reported the presence of people exercising in the area (76.7%), said there were food stores within an walkable distance (87.9%), and reported that it was easy to purchase healthy food (78.9%). With regard violence in the neighborhood, 88.6% of adults thought there was a small risk of aggression and 44.4% felt secure during the day and evening. A statistically significant association was found between nutritional status and the variables risk of aggression, perception of safety during the day and evening, and presence of food stores in a walkable distance (Table 1).

With respect to the household block, 66.9% of adults were inactive, 54.6% reported removing the skin and visible fat from chicken and meat, 40.3% consumed fruit and vegetables five or more times a week, 32.9% consumed soft drinks very often and 57.1% reported drinking whole milk. A statistically significant association was found between adolescent BMI and the variables adult BMI, physical activity, removing the skin and visible fat from chicken and meat, and the consumption of soft drinks and whole milk (Table 1).

Regarding behaviours among adolescents, 40.6% were considered physically active, 52.5% spent less than one hour a day playing videogames, 57.8% spent three or more hours a day watching TV, 64.3% had breakfast every day, and 34.8% consumed fruit on five or more days during the week. An inverse statistically significant association was found between thinness and video gaming and skipping breakfast, while a direct association was also found between time spent in front of the TV and overweight (Table 1).

Final model

In the first block analysed in the final model (Table 2), a statistically significant association was found between thinness and being male (OR = 2.86; p = 0.004), household income between two and five minimum wages (OR = 0.33; p = 0.017), and household income between five and 10 minimum wages (OR = 0.30; p = 0.036), while overweight was only associated with household income between five and 10 minimum wages (OR = 1.73; p = 0.056).

An association was found between thinness and risk of aggression (OR = 0.08; p = 0.002) and overweight and feeling safe during the day and evening (OR = 1.49; p = 0.068).

An inverse association was found between thinness and the household variables presence of an overweight adult in the household (OR = 0.50; p = 0.090), consuming chicken skin/fatty meat (OR = 0.29; p = 0.021) and the consumption of whole milk (OR = 0.48; p = 0.078), while a direct association was observed between thinness and consumption of soft drinks (OR = 2.34; p = 0.054). Furthermore, a direct association was found between overweight and the presence of an overweight adult in the household (OR = 3.09; p < 0.001), while the presence of an active adult was inversely associated (OR = 0.51; p = 0.014) with being overweight among adolescents.

In the individual block, being overweight was still associated with spending between one and two hours watching TV (OR = 2.41; p = 0.007) and skipping breakfast (OR = 0.39; p = 0.068), while the consumption of fruit five or more times a week (OR = 1.95; p = 0.026) was found to be associated with thinness, despite not being associated with nutritional status in the univariate analysis.

The final model tested the interaction between family income and schooling of the head of household. A bivariate analysis of adolescent

Table 1

Nutritional status (reference group: normal weight) and sociodemographic, neighborhood, household and individual factors (p-value < 0.20) among adolescents aged between 11 and 17 years resident in two health districts of Belo Horizonte, Minas Gerais State, Brazil, 2008 to 2009.

Variable	Category	Thinness		Overweight	
		OR (90%CI)	p-value	OR (90%CI)	p-value
Block 1 – Sociodemographic					
Sex	Female	1.00		1.00	
	Male	2.41 (1.34-4.33)	0.014	0.74 (0.53-1.04)	0.150
Age	-	0.86 (0.74-0.99)	0.082	0.95 (0.88-1.03)	0.370
Income (minimum wage)	< 2	1.00		1.00	
	2-5	0.35 (0.17-0.73)	0.019	1.14 (0.75-1.75)	0.605
	5-10	0.27 (0.11-0.66)	0.016	1.3 (0.83-2.04)	0.336
	≥ 10	0.37 (0.11-1.25)	0.178	1.01 (0.58-1.78)	0.964
Education (years of schooling)	0-4	1.00		1.00	
	5-8	1.32 (0.64-2.71)	0.522	1.03 (0.70-1.51)	0.89
	≥ 9	0.60 (0.28-1.29)	0.272	0.65 (0.44-0.98)	0.084
Block 2 – Neighborhood					
Violence					
Risk of aggression	Small	1.00		1.00	
	Large	0.80 (0.02-0.28)	0.001	0.70 (0.40-1.23)	0.302
Safety perception (day and evening)	No	1.00		1.00	
	Yes	1.12 (0.66-1.93)	0.714	1.57 (1.11-2.21)	0.029
Favourable conditions for diet and physical activity					
Stores in an walkable distance	No	1.00		1.00	
	Yes	3.55 (1.04-12.05)	0.089	1.30 (0.77-2.19)	0.401
People exercising in and around the area	No	1.00		1.00	
	Yes	1.32 (0.57-3.05)	0.514	0.71 (0.45-1.12)	0.145
Block 3 – Household					
Family relationship	Good	1.00		1.00	
	Bad	1.35 (0.45-4.12)	0.649	1.63 (0.91-2.91)	0.164
Adult behaviour					
Chicken skin/meat fat	Remove both	1.00		1.00	
	Remove only one	0.77 (0.40-1.49)	0.523	1.14 (0.76-1.72)	0.598
	Don't remove	0.42 (0.18-0.98)	0.095	1.16 (0.75-1.80)	0.578
Soft drink (days/week)	< 5	1.00		1.00	
	≥ 5	2.10 (1.12-3.93)	0.051	0.94 (0.65-1.36)	0.787
Type of milk	Fat-free	1.00		1.00	
	Whole milk	0.53 (0.29-0.93)	0.063	1.08 (0.78-1.50)	0.684
Physical activity	Inactive	1.00		1.00	
	Insufficiently active	0.49 (0.17-1.44)	0.277	0.66 (0.37-1.19)	0.247
	Active	0.44 (0.19-1.00)	0.103	0.56 (0.37-0.83)	0.017
Adult BMI					
BMI	Not overweight	1.00		1.00	
	Overweight	0.80 (0.43-1.50)	0.564	3.27 (2.27-4.68)	0.000

(continues)

Table 1 (continued)

Variable	Category	Thinness		Overweight	
		OR (90%CI)	p-value	OR (90%CI)	p-value
Block 4 – Individual					
Adolescent habits					
Physical activity	Inactive	1.00		1.00	
	Insufficiently active	2.47 (0.82-7.45)	0.178	1.48 (0.89-2.43)	0.194
	Active	1.83 (0.60-5.59)	0.371	1.21 (0.72-2.02)	0.540
Video game (hours/day)	< 1	1.00		1.00	
	1-2	0.42 (0.18-0.99)	0.096	0.79 (0.51-1.22)	0.375
	> 2	0.69 (0.36-1.29)	0.325	1.01 (0.71-1.43)	0.965
TV (hour/day)	< 1	1.00		1.00	
	1-2	0.80 (0.30-2.10)	0.706	1.74 (1.02-2.97)	0.088
	> 2	0.82 (0.41-1.66)	0.648	1.35 (0.95-1.93)	0.153
Breakfast	Everyday	1.00		1.00	
	Sometimes/Never	0.43 (0.22-0.84)	0.039	1.31 (0.96-1.78)	0.154
Fruit	Never/Almost never	1.00		1.00	
	1-4 days/week	2.06 (0.96-4.41)	0.118	0.80 (0.55-1.16)	0.328
	≥ 5 days/week	0.97 (0.41-2.28)	0.951	0.95 (0.66-1.36)	0.817

90% CI: 90% confidence interval; BMI: body mass index; OR: odds ratio.

nutritional status and the level of education of the head of household stratified by income showed a protective gradient in the association between education and thinness or overweight for both income strata: households with better income and whose head had less years of schooling were more likely to be overweight (OR = 1.73; p = 0.054). However the risk of overweight decreased with increasing years of study of the head of the household, showing that the variable became a protective factor (OR = 0.68; p = 0.12) (Figure 2).

Adolescent's well-being was worse in both extremes of nutritional status: thin and overweight adolescents evaluated their health as very poor compared to normal weight adolescents. Those who were classified as thin had worse self-rated health compared to overweight adolescents (OR = 3.19; p = 0.016 versus OR = 2.19; p = 0.009), and a worse level of psychological and personal well-being (OR = 3.52; p = 0.04/OR = 2.26; p = 0.026), compared to their peers. Furthermore, body image dissatisfaction was worse in overweight adolescents (OR = 3.30; p < 0.001) than in normal weight adolescents (Figure 3).

Discussion

Using hierarchical modelling, this study aimed to evaluate the distal, intermediate and proximal factors associated with adolescent nutritional status, with an emphasis on overweight. The results show a high prevalence of overweight (21.9%) and an expected low rate of thinness (4.6%). Although expectedly low, thinness was included in the analysis in order to understand the relationship between behaviours and context and overall nutritional status. It was found that, in addition to individual behaviours, adolescent nutritional status is strongly associated with household and sociodemographic variables.

Middle income was inversely associated with thinness, and directly associated with overweight. Furthermore, the head of the household having over nine years of schooling was a protective factor for overweight, regardless of income (Figure 2). These findings therefore suggest that schooling may be more influential than income in determining nutritional status and healthy habits.

In Brazil, an emerging economy, income has increased due to a sustained period of economic growth over the past 15 years. This economic phenomenon lifted many people out of poverty, and has resulted in the rise of a "new middle class". However, as some authors advocate, this rise in income has not been accompanied by an increase in level of education, and therefore this group continues to be vulnerable in terms of health habits and behaviours [33,34].

Table 2

Factors associated with nutritional status (reference group: normal weight), using hierarchical entry of blocks, among adolescents aged between 11 and 17 years resident in two health districts of Belo Horizonte, the State of Minas Gerais, Brazil, 2008 to 2009.

Variables	Model 1 (OR)		Model 2 (OR)		Model 3 (OR)		Model 4 (OR)	
	Thinness	Overweight	Thinness	Overweight	Thinness	Overweight	Thinness	Overweight
Block 1 – Sociodemographic *								
Sex								
Female	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Male	2,86 **	0,74	2,83 **	0,74	3.12 **	0.76	4.02 ***	0.74
Age	0,89	0,95	0,89	0,95	0.84	0.93	0.83	0.93
Income (minimum wage)								
< 2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2-5	0,33 **	1,29	0,32 **	1,27	0.27 **	1.62 #	0.30 **	1.43
5-10	0,30 **	1,73 #	0,33 **	1,77 **	0.22 **	2.08 **	0.28 #	2.01 **
≥ 10	0,50	1,46	0,51	1,49	0.49	1.97	0.61	1.98
Education (years of schooling)								
0-4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5-8	1,34	0,99	1,26	0,96	1.38	1.02	0.96	1.02
≥ 9	0,75	0,57 **	0,73	0,55 **	0.74	0.69	0.58	0.63
Block 2 – Neighborhood ##								
Risk of aggression								
Small			1.00	1.00	1.00	1.00	1.00	1.00
Large			0,08 **	0,72	0.12 **	0.64	0.11 **	0.66
Safety perception								
No			1.00	1.00	1.00	1.00	1.00	1.00
Yes			1,04	1,49 #	0.97	1.61 **	0.99	1.59 #
Block 3 – Household ###								
Chicken skin/meat fat								
Remove both					1.00	1.00	1.00	1.00
Remove only one					0.47	0.98	0.58	1.06
Don't remove					0.29 **	1.40	0.24 **	1.52
Soft drink (days/week)								
< 5					1.00	1.00	1.00	1.00
≥ 5					2.34 #	0.79	1.88	0.79
Type of milk								
Fat-free					1.00	1.00	1.00	1.00
Whole milk					0.48 #	1.16	0.41 **	1.17
Physical activity								
Inactive					1.00	1.00	1.00	1.00
Insufficiently active					0.88	0.55	1.13	0.57
Active					0.28 #	0.51 **	0.39	0.49 **
BMI								
Not overweight					1.00	1.00	1.00	1.00
Overweight					0.50 #	3.09 ***	0.51	3.21 ***

(continues)

Table 2 (continued)

Variables	Model 1 (OR)		Model 2 (OR)		Model 3 (OR)		Model 4 (OR)	
	Thinness	Overweight	Thinness	Overweight	Thinness	Overweight	Thinness	Overweight
Block 4 – Individual §								
TV (hour/day)								
< 1							1.00	1.00
1-2							0.51	2.41 **
> 2							0.81	1.34
Fruit (days/week)								
Never/Almost never							1.00	1.00
1-4							1.56	1.29
≥ 5							0.49	1.95 **
Breakfast								
Everyday							1.00	1.00
Sometimes/Never							0.39 #	1.35

AIC: Akaike Information Criterion; BMI: body mass index; OR: odds ratio.

* Block 1 (AIC = 1364.311);

** p-value ≤ 0.05;

*** p-value ≤ 0.001;

p-value < 0.10;

Controlled by block 1 (AIC = 1348.899);

Controlled by blocks 1 and 2 (AIC = 1084.454);

§ Controlled by blocks 1, 2 and 3 (AIC = 1053.391).

Figura 2

Odds ratio (OR) and 90% confidence interval (90%CI) for schooling, income and adolescent body mass index (BMI). *The BH Health Study*, Minas Gerais State, Brazil, 2008 to 2009.

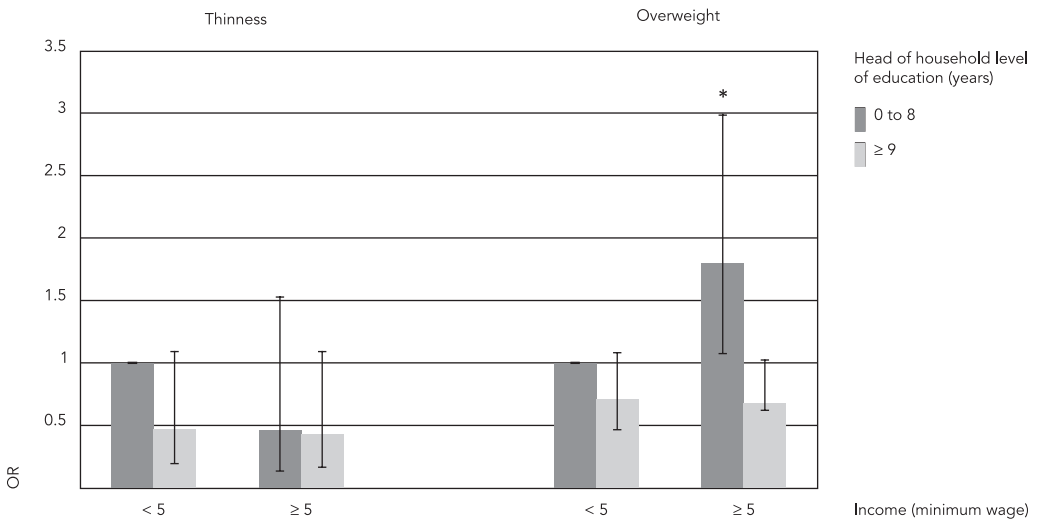
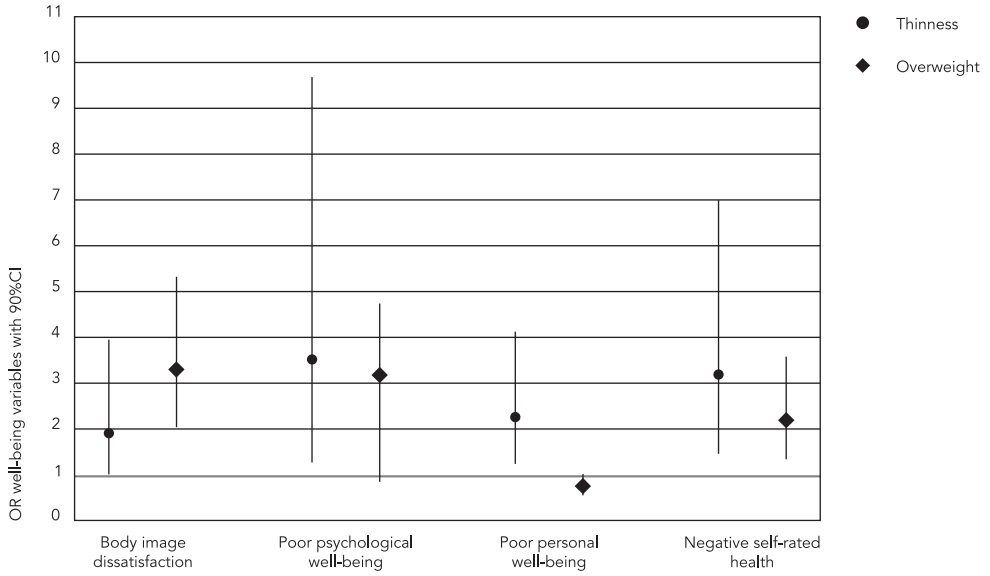


Figura 3

Adolescent well-being and nutritional status. *The BH Health Study*, Minas Gerais State, Brazil, 2008 to 2009.



90%CI: 90% confidence interval; OR: odds ratio.

Although the ways in which education influences the health of the population are not well understood, it is known that one of the changes it brings on is lifestyle. For example, Cutler & Lleras-Muney [35] claim that an increase in years of schooling is related to a lower likelihood of weight gain and harmful behaviours among adults. Furthermore, people with a higher level of education are more likely to practice regular physical activity and be concerned with preventive health care. The level of education of family members has an important influence on adolescent health, since it can influence family behaviours and adult nutritional status and, consequently, the behaviours and nutritional status of young people.

Regarding family behaviours, there was an association between nutritional status and physical activity and consuming chicken skin/fatty meat, soft drinks, and whole milk. The influence of family habits related to physical activity and diet is well documented in the literature [36,37,38]. However, the results showed no direct association between the consumption of soft drinks more than five days a week and thinness, and between being overweight and the habit of consuming fruit and vegetables among adults.

It is known that adolescents are more likely to consume a large number of soft drinks. A possible explanation for the association between thinness and increased soft drink intake is reverse causality, whereby a thinner family may allow themselves to drink a larger number of soft drinks, while an overweight family may be likely to underestimate intake because of the knowledge of the bad effects of this habit on their health. Another hypothesis is that weight is influenced by the type of soft drink consumed, which was not informed in this study [39].

It is also important to highlight the association between soft drink intake and income and education. The results of the univariate analysis showed that household intake of soft drinks was associated with income ($\chi^2 = 15.12$; $p = 0.023$). In this respect, intake was highest in middle class families and lower among families with lower (< two minimum wages) and higher (≥ 10 minimum wages) income. According to data from VIGITEL, soft drink consumption is more likely to decrease with increasing level of education [40]. The findings of the present study once again highlight the vulnerability of the "new middle class", and the importance of education to promote healthier habits.

The lack of association between fruit consumption and adolescent weight, and the direct association between consuming fruit more than five times a week and overweight may be

explained by information bias or changes in consumption patterns due to nutritional status. Similar results were found by an epidemiological survey in schools in Belo Horizonte [41]. Another possible explanation is that an increase in the intake of fruit without proper guidance can increase the daily energy intake due to the consumption of complementary foods which are high in calories and because some fruit are high in calories themselves [42].

A particularly relevant finding that confirms the influence of family behaviours on adolescent nutritional status is that thin adolescents were less likely to be from households with an overweight adult (OR = 0.50; p = 0.090), while overweight adolescents were 3.09 (p < 0.0001) times more likely to live with an overweight adult. Family history of overweight and obesity can be an indicator of genetic risk of becoming overweight. However, recent studies show that this factor is a proxy for unhealthy and sedentary behaviours. In most cases, the family creates and sustains an 'obesogenic environment', which begins during infancy and is maintained during adolescence [43,44]. Consequently, both adults and adolescents are influenced by the social context and, at the same time, responsible for building an obesogenic environment.

With respect to neighborhood variables, an association remained in the final model between the variables risk of aggression and safety perception. The literature shows that there is an association between neighborhood environment and energy expenditure because positive physical characteristics and safety of the environment favour physical activity [45,46]. Furthermore, the presence of supermarkets, affordable prices and the availability of health food are related to diet quality [47,48]. However, few studies have found an association between neighbourhood and nutritional status, especially in developing countries where violence is generally higher.

Two Brazilian studies found an association between excess body weight and presence of parks and places for practicing sports [49,50]. However, the methodology used by these studies was different to that used by the present study and information on neighborhood characteristics was obtained from geocoded data rather than adults' perceptions.

The associations found with household environment and lack of association with the neighborhood environment corroborate the findings of a 32-year cohort study conducted by Christakis & Fowler [10] which found no association between change in weight over time and living in the same area. However, having an obese friend increased the probability of a participant becoming obese by 171%, while having an obese sister, brother or partner increased the probability by 67%, 44% and 37%, respectively. This suggests that the social environment can have a greater influence on nutritional status over time than the physical characteristics of the living environment.

A strong association was found between low sense of well-being and overweight and thinness in adolescents. Sense of well-being is a particularly important factor, since low self-esteem and body image dissatisfaction, and the feeling of being rejected among adolescents, can often lead to eating disorders and risk behaviours such as alcohol and tobacco use, involvement in fights and self-harm [51]. According to Baur & O'Connor [52], overweight among young people is associated with low self-esteem and social isolation, which can be aggravated by the media and its excesses that dictate standards of beauty and decrease the acceptance of those who do not fit in [51].

Poor self-rated health was associated with thinness (OR = 3.19) and overweight (OR = 2.19). The adverse health effects of overweight and obesity are often publicised in the media, raising awareness among adolescents of the negative impact of poor nutritional status upon health. Furthermore, the physical appearance of very thin people can influence adolescents' perceptions of health [53].

This study has certain limitations. First, it was not possible to analyse a number of variables mentioned by the literature as being important in relation to diet, such as the consumption of fast food and sweets. Another limitation was the lack of information about the adolescents' school environment. This factor can have an important influence on adolescent behaviours and choices, since a significant amount of their time is spent at school. Furthermore, the cross-sectional nature of this study meant that we could not measure causality in relation to certain factors associated with nutritional status.

On the other hand, this study has a number of strengths. The fact that it utilized a population-based approach and a well-defined sample lowered the risk of systematic and methodological errors. Furthermore, the use of hierarchical modelling to explore the association between individual, household and contextual variables and overall nutritional status can be considered a pioneering initiative in Brazil.

It is known that sex and age also influence adolescent nutritional status, since adolescence is a period of sexual maturation which involves growth spurts and other biological and psychological changes. Although this study did not aim to focus on these aspects, it is suggested that fu-

ture studies should investigate these elements, focussing on the under and overestimation of these associations.

Nutritional extremes among Brazilian adolescents living in urban areas coexist and are influenced by various factors, ranging from individual and family health behaviours to neighborhood characteristics. This *complex variety* of factors comprises a major public health problem. Furthermore, determinants seem to be modulated by economic and educational factors and therefore health promotion which focuses solely on the individual is not enough to tackle the obesity epidemic. New approaches to public health directed at awareness raising and involving continuous investment in health education targeting young people should be adopted in order to reach both adolescents and adults within their social contexts.

Resumen

El aumento de la prevalencia de sobrepeso en edades tempranas sugiere que el medioambiente influye en el estado nutricional. El objetivo de este estudio fue verificar de manera jerárquica los factores individuales, familiares y de vecindario, relacionados con el estado nutricional de adolescentes y su bienestar. Es un estudio basado en la población que se realizó en Belo Horizonte, Minas Gerais, Brasil, entre 2008-2009. Se recogieron datos de adultos y adolescentes mediante un cuestionario y mediciones antropométricas. El estado nutricional de los adolescentes se evaluó considerando la influencia distal y proximal, usando la regresión multinomial. La prevalencia de sobrepeso fue de un 21,9% y un 4,6% la de delgadez entre 1.030 adolescentes. Las variables de todos los niveles se mantuvieron en el modelo final, pero la educación, la zona de residencia, así como los hábitos y el estado nutricional en el hogar parecían influir fuertemente en el estado nutricional de los adolescentes. Los nuevos enfoques de la salud pública deben centrarse en la sensibilización de la familia, y la educación, teniendo como objetivo los adolescentes y sus vínculos sociales.

Estado Nutricional; Sobrepeso; Obesidad; Adolescente

Contributors

S. Bispo contributed to data interpretation and analysis, writing and reviewing this paper and approved the final version. M. I. T. D. Correia contributed to data interpretation and reviewed the paper and approved the final version. F. A. Proietti contributed to the study design, reviewed the paper and approved the final version. C. C. Xavier and W. T. Caiaffa contributed to study design, data interpretation and writing and approved the final version.

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