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Risk factors for overweight among Brazilian adolescents of low-income families: a case–control study

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Abstract

Objective: To study risk factors for overweight among Brazilian adolescents of low-income families.
Design: Case–control study of obese and non-obese adolescents.
Setting: Anthropometric survey including 1420 students (aged 14–19 years) attending a public high school in São Paulo, Brazil.
Methods: Selection of 83 overweight (body mass index (BMI) >85th percentile) and 89 non-overweight (BMI >5th percentile and <85th percentile) subjects, frequency-matched by age, gender, pubertal development and socio-economic status. Among the nutritional, familial and behavioural data available, five covariates (parents' obesity, adolescents' past obesity, to have a best friend, dietary restriction and habit of napping) were included in the fitted hierarchical conditional logistic regression models.
Measurements: Parents or guardians and adolescents were weighed, measured and answered a pre-tested questionnaire applied by trained nutritionists and paediatricians.
Results: The prevalence of overweight was 15.2%. As previous risks, obese parents and obesity during infancy presented odds ratios (OR) and 95% confidence intervals (CI) of 2.23 (1.15–4.35) and 3.60 (1.47–8.80), respectively. As concurrent factors, the habit of napping, to have a best friend and reported dietary restriction presented OR (95% CI) of 3.43 (1.32–8.92), 5.15 (1.76–15.07) and 7.26 (2.95–17.88), respectively. Dietary patterns, frequency of obesogenic foods and other physical activity indicators presented no statistical significance.
Conclusion: In case–control studies, OR may overestimate the true risks. Parents' obesity and previous childhood obesity were identified as risk factors; therefore these factors should be the target for preventive programmes and policies in order to prevent the burden of obesity in the near future.

Keywords
Overweight
Obesity
Risk factors
Adolescents
Case–control study

The prevalence of obesity during childhood and adolescence is increasing rapidly in both the developed and the developing world and has already reached epidemic proportions[1]. In a 2004 issue of *Obesity Reviews*, the Obesity Task Force to the World Health Organization estimates that about 10% of young people aged 5–17 years worldwide are overweight, among which 2–3% are obese[2]. In the USA, the results from the 1999–2000 National Health and Nutrition Examination Survey (NHANES) indicate that 15% of children and adolescents aged 6–19 years are overweight[3]. In Brazil, a population-based survey including the Northeast and Southeast regions in 1996/97 showed overweight and obesity prevalences of 10.1% and 7.3% for children (2–9 years), while for adolescents (10–20 years) such prevalences were 9.9% and 1.8%, respectively[4]. More recent surveys have shown that both overweight and obesity are increasing among children and adolescents. Ribeiro *et al.*[5] found prevalences of overweight and obesity of 13.0% and 10.5%, respectively, among children (7–10 years), while Monteiro *et al.*[6] found prevalences of 20.5% for overweight and 7.7% of obesity among adolescents (14–16 years) in a city in the Southwest region of Brazil.

Although there are both genetic and environmental causes of obesity, the increase in obesity prevalence is likely to be more closely associated with changes in environmental factors[7]. In developed countries, evidence suggests that obesity is socially distributed, with certain social groups at increased risk[8]. Some studies have shown that individuals from low social class have lower levels of recreational physical activity and are less likely to consume a healthy or low-fat diet than individuals of

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high social class[9–11]. In a review focused on the relationship of obesity to quality of the diet, energy density and costs, Drewnowski and Specter[12] observed that foods with high energy density are less expensive and highly tasty. There is some information that leads one to conclude that the same process is also happening in developing countries. A study investigating the effects of socio-economic status on obesity knowledge (such as fat content of foods and beverages, weight-loss methods, energy expenditure, food preparation methods, and the relationship between obesity and health) of 1272 ninth-grade students in six Latin American cities observed that, although adolescents from both higher and lower socio-economic groups needed more information about obesity, socio-economic status exerted a powerful influence over obesity knowledge in favour of adolescents of wealthier families in all cities, except for one[13].

Demographic, epidemiological and nutritional transition processes have different characteristics in different countries[14]. In Brazil, obesity is ceasing to be associated with relatively high socio-economic status and is becoming a marker of poverty, as in developed countries[15]. When studying trends in overweight and obesity among adolescents living in the poorest and the richest regions of Brazil, da Veiga *et al.*[16] observed that the prevalence of overweight/obesity increased from 1975 to 1997 in both regions, suggesting that this problem affects the entire population. Risk factors may vary among and within societies exposed to different environmental influences[17]. The effects of dietary changes are usually exacerbated by a parallel decline in energy expenditure associated with a reduction in daily physical activity[18].

Overweight and obesity in adolescence have deleterious social, economic[19], psychological[7] and health consequences[20,21]. However, the most important consequence of overweight and obesity in adolescence is the greater risk of obesity in adulthood[22–25]. Obesity and overweight represent the biggest risk factor for development of diseases such as type 2 diabetes, cardiovascular diseases, arterial hypertension and some types of cancer. These, in turn, represent the biggest cause of mortality and disability, accounting for 59% of the 57 million deaths annually and 46% of the global burden of disease[26]. The losses caused by the consequences of obesity include the loss of labour potential at a still productive age and increase the costs of the health-care system as a whole. In Western countries, obesity accounts for 2–8% of the total costs of caring for the sick[27]. In their study on the economic and psychological implications of the obesity epidemic, Kottke *et al.*[28] foresee a dark future where the consequences of obesity will lead to an increase in poverty and disability ratios all over the world. These authors alert us to the need of acting promptly and effectively against the global epidemic of obesity.

The best solution to halt the increasing prevalence of obesity and avoid a collapse of health services and economies is to develop obesity prevention policies. Such prevention policies should be directed mainly at children and adolescents[29].

Thus, nowadays, obesity during adolescence is an important public health problem in developed, as well as in developing societies. In spite of the magnitude of problem, however, little is known about the factors that determine this process in different sociodemographic groups. The present study attempts to study risk factors associated with overweight and obesity among Brazilian high-school students of low-income families.

Methodology

The case–control study was carried out in the city of São Paulo, state of São Paulo, Southeastern Brazil, from June to December 2002.

For the selection of cases and controls, a team of trained nutritionists and paediatricians weighed and measured 1420 adolescents born between 1 January 1983 and 31 December 1988, accounting for 98.66% of all students enrolled in a public high school of São Paulo city. Sixteen youngsters refused to be evaluated, and three were not found after at least three attempts.

From the screened adolescents 104 were identified as cases, with body mass index (BMI) percentile >85th according to the criteria of Must *et al.*[30]. Controls (114) were frequency-matched by age, gender, pubertal development and socio-economic status, and were randomly selected from subjects presenting BMI between the 5th and 85th percentiles[18].

The adolescents were measured during their physical education classes and when eligible to participate in the study, they were invited to come to school with their parents on a Saturday morning to be informed about the research objectives and to obtain the parents' signature on the Term of Consent. Of the 218 (104 cases and 114 controls) eligible adolescents, 42 (19.3%) refused to participate in the study (comparison of the 17 cases and 25 controls who refused participation vs. the 176 adolescents remaining regarding the variables BMI and age revealed no differences) and four cases were excluded due to hypothyroidism diagnosed after medical examination and were administered thyroid hormones. The final sample study comprised 172 (83 cases and 89 controls) adolescents.

A standardised and pre-tested questionnaire was applied by trained nutritionists and paediatricians to both case and control adolescents. The following variables were considered: frequency and duration of physical activity; habit of napping; walking less than 1 hour per day; hours watching television, playing video games and using a computer per day; dietary patterns analysed by 4-day food records; frequency of obesogenic foods (fast foods, sweet, soft drinks, snacks and apparent fat-free meat); snacking between meals; past treatment for weight

loss (dieting or use of drugs); smoking; use of narcotics (marijuana, cocaine, LSD, ecstasy, crack, benzene, glue and ethyl chloride); alcohol intake (consumption of alcohol equal to or more than three times a week); use of oral contraceptives; relationship with parents and siblings; to have a best friend; to have a boyfriend/girlfriend; to have a group of friends; and school performance. Questions regarding the use of narcotics, alcohol, cigarettes and oral contraceptives were asked of the adolescents in private, without the presence of parents, in order to avoid any embarrassment.

In addition to the interview with the adolescent, parents or guardians were also interviewed. At that time, data were collected concerning the adolescent (birth weight; total breast-feeding duration; infant feeding foods; past obesity; number of siblings; and the adolescent's chronological position in the family) and the biological parents (weight and height, measured by trained nutritionists). Parents were considered obese[1] when presenting BMI $>30\,kg\,m^{-2}$.

Data were codified by the interviewers daily and revised by the field study coordinator. The database was structured using Epi-Info 6.0[31] software and double-entered for correction of possible errors. Analyses were performed using Stata software[32].

Sample size allows the detection of an odds ratio of 3.00, given a prevalence of family obesity among controls of 25%. Assuming 80% power, and an alpha error of 5%, results in a sample of 65 cases and 65 controls. This was increased by 10% for possible losses and 10% for stratified analysis, leading to a total sample of 78 cases and 78 controls.

Initially the univariate analysis of all information collected was carried out, calculating the proportions for the categorical variables. As the next step, bivariate analyses were performed, calculating exposure prevalence for cases and controls, association tests (Pearson's chi-square test) and odds ratios (OR) with their respective 95% confidence intervals (CI). Finally, the multivariate analysis was carried out – a conditional logistic hierarchical regression model[33]. In each hierarchical level the variables associated to overweight with $P < 0.20$[34] were maintained for their status as possible confounders. In the final models only variables with $P < 0.05$ were kept.

The study was approved by the Ethics Committee of Federal University of São Paulo, according to the World Medical Association Declaration of Helsinki.

Results

The prevalences of obesity (BMI >95th percentile) and overweight (BMI between 85th and 95th percentiles) were respectively 4.4% and 10.8% among the 1420 students. Table 1 shows the prevalence of risk factors for cases and controls, crude OR with their respective 95% CI, as well as statistical significance tests for categorical variables.

Parents' nutritional status was directly and significantly associated with overweight in adolescents. Youngsters with obese parents were twice more likely (OR = 2.04) to be overweight than those whose parents were non-obese. With regard to family structure, to be the first-born child presented a risk factor for obesity nearly double that of other children in the family (OR = 1.89), while having no siblings and being the youngest child did not reach statistical significance.

Birth weight was analysed by considering cut-off points for low birth weight (<2500 g) and high birth weight (>4000 g). This variable, as well as breast-feeding duration, was not identified as a significant risk factor for adolescent overweight.

Childhood overweight at some earlier phase of life showed a direct relationship with overweight during adolescence. Obesity in infancy seems to be a more adequate indicator of previous overweight since it is not directly related to the beginning of puberty. To be obese in the infant phase of life more than tripled (OR = 3.63) the chance of being overweight in adolescence.

Past weight-loss treatments presented significant statistical differences in cases and controls. Adolescents who said they had dieted with the objective of losing weight had more than six times (OR = 6.17) times the chance of being overweight than others who had never been on a diet. Adolescents using drugs for weight loss were more than eight times (OR = 8.65) more likely to be overweight in adolescence.

Dietary habits were analysed qualitatively and quantitatively. Both presented no significant differences between cases and controls. With regard to the assessment of physical activity/inactivity, it was observed that the habit of napping carried a risk factor for overweight (OR = 2.01). Other variables related to physical activity presented no statistically significant differences.

With reference to life habits that directly influence health, alcohol consumption was more frequent among controls (OR = 0.29).

On the aspect of behaviour/relationships, having a boyfriend/girlfriend was more frequently found among controls than cases (OR = 0.53). On the other hand, cases more frequently had a best friend than controls (OR = 5.44).

Table 2 shows the results of the multivariate analysis, carried out by means of a hierarchical conditional logistic regression. In the first model level, parents' BMI, infant obesity and to have a best friend were adjusted among themselves. All were strongly associated with overweight in adolescence. Previous dietary restriction and habit of napping were the variables added in the second model level. As in the bivariate analyses (Table 1), these variables maintained their statistical significance in the fitted model.

Table 1 Frequencies and odds ratios (OR) with their respective 95% confidence intervals (CI) for variables related to overweight in adolescents aged 15–19 years enrolled in a public school in the city of São Paulo, Brazil

	Cases			Controls				
		Yes			Yes			
Variable	*n*	*n*	%	*n*	*n*	%	Crude OR (95% CI)	*P*-value*
Parents' obesity								
Parents' BMI $>30\,kg\,m^{-2}$	83	43	51.8	87	30	34.5	2.04 (1.05–4.00)	**0.022**
Family structure								
No siblings	82	10	12.2	89	6	6.7	1.92 (0.60–6.36)	0.221
First-born child	83	40	48.2	88	29	33.0	1.89 (0.97–3.71)	**0.042**
Youngest child	43	34	79.1	59	44	74.6	1.29 (0.45–3.69)	0.597
Adolescent's history								
Birth weight <2500 g†	83	65	78.3	85	65	76.5	1.11 (0.50–2.45)	0.775
Birth weight >4000 g†	83	8	9.6	85	6	7.1	1.40 (0.41–4.88)	0.545
Total breast-fed <6 months	83	51	61.4	87	47	54.0	1.36 (0.70–2.63)	0.328
Past obesity								
Infant	82	24	29.3	88	9	10.2	3.63 (1.46–9.24)	**0.002**
Pre-school	82	24	29.3	88	2	2.3	17.79 (3.80–114.97)	**0.000**
School	82	36	43.9	88	9	10.2	6.87 (2.84–17.08)	**0.000**
Adolescent	82	30	36.6	88	6	6.8	7.88 (2.85–23.00)	**0.000**
All periods	83	15	18.1	89	1	1.1	19.41 (2.55–410.49)	**0.000**
Treatment of obesity (past)								
Dietary restriction	82	40	48.2	81	11	13.1	6.17 (2.69–14.45)	**0.000**
Use of drugs for weight-loss reasons	83	8	9.6	84	1	1.2	8.65 (1.04–191.99)	**0.018**
Dietary patterns								
Energy intake $>100\%$ of RDA for sex and age	77	14	18.2	83	20	24.1	0.70 (0.30–1.62)	0.361
Total fat intake $>30\%$ of total energy	77	38	49.4	83	51	61.4	0.61 (0.31–1.21)	0.124
Frequency of obesogenic foods								
Soft drinks every day	83	11	13.3	88	16	18.2	0.69 (0.27–1.72)	0.377
Snacks >3 times/week	82	1	1.2	87	2	2.3	0.52 (0.02–7.69)	0.522
Sweets every day	83	43	51.8	88	55	62.5	0.65 (0.33–1.25)	0.158
Fried foods >3 times/week	83	31	37.3	88	36	40.9	0.86 (0.44–1.68)	0.634
Fast food >3 times/week	83	58	69.9	88	62	70.5	0.97 (0.48–1.99)	0.935
Meat with apparent fat	83	16	19.3	88	14	15.9	1.26 (0.53–3.01)	0.563
Snacking between meals	83	68	81.9	89	79	88.8	0.57 (0.22–1.48)	0.204
Physical activity								
<3 times/week and <30 min	83	64	77.1	89	64	71.9	1.32 (0.62–2.80)	0.434
TV/video/computer >4 h/day	83	16	19.3	89	16	18.0	1.09 (0.47–2.53)	0.827
Habit of napping	83	24	28.9	89	15	16.9	2.01 (0.91–4.48)	**0.059**
Walking <1 h/day	83	34	41.0	89	36	40.4	1.02 (0.53–1.98)	0.945
Health habits								
Use of cigarettes	83	31	37.3	89	37	41.6	0.84 (0.43–1.63)	0.571
Use of narcotics‡	83	2	2.4	88	4	4.5	0.52 (0.06–3.46)	0.369
Alcohol intake >3 times/week	83	6	7.2	89	19	21.3	0.29 (0.10–0.83)	**0.009**
Use of oral contraceptives	82	5	6.1	85	4	4.7	1.31 (0.29–6.17)	0.477
Relationship/behaviour								
Relationship difficulties with parents	83	4	4.8	89	4	4.5	1.08 (0.21–5.40)	0.601
Relationship difficulties with siblings	73	2	2.7	82	1	1.2	2.28 (0.16–66.13)	0.456
To have a boyfriend/girlfriend	83	15	18.1	89	26	29.2	0.53 (0.24–1.16)	**0.087**
To have a best friend	83	78	94.0	89	66	74.2	5.44 (1.81–17.53)	**0.000**
To have a group of friends	83	82	98.8	89	87	97.8	1.89 (0.13–54.50)	0.526
Bad school performance	83	5	6.0	89	5	5.6	1.08 (0.25–4.55)	0.582

BMI – body mass index; RDA – recommended daily amount.
* *P*-values are taken from the corresponding chi-square tests. Significant *P*-values are indicated in bold.
† 24.6% of the birth weights were copied from maternity discharge cards; the remaining were informed by mothers.
‡ Marijuana, cocaine, LSD, ecstasy, crack, benzene, glue and ethyl chloride.

Discussion

Limitations of the case–control study design are recall bias and the tendency of the case subjects to misreport putative risk factors.

The prevalence of obesity/overweight found in the present study (15.2%) is in accordance with the findings of other Brazilian epidemiological studies on low-income populations. In their study comparing the trends in overweight among adolescents living in the poorest and richest regions of Brazil in 1997, da Veiga *et al.*[16] observed a prevalence of obesity/overweight of 8.46% among 1080 adolescents aged 10–19 years living in the poorest region. Gama[35], studying 408 adolescents aged 10–19 years from two public schools in São Paulo city, found a 16.42% prevalence of obesity/overweight. A 17.6% prevalence of obesity was found by von der Heyde[36] in a population of adolescents in public schools of Curitiba city. When

Table 2 Hierarchical conditional logistic regression of risk factors for obesity in adolescence: among adolescents aged 15–19 years enrolled in a public school in the city of São Paulo, Brazil

Variables (yes = risk)	Adjusted OR (95% CI)	*P*-value*	Model†
Parents' obesity			
Parents' BMI $>30\,kg\,m^{-2}$	2.23 (1.15–4.35)	0.018	1
Past obesity			
Infant obesity	3.60 (1.47–8.80)	0.005	1
Relationship/behaviour			
To have a best friend	5.15 (1.76–15.07)	0.003	1
Treatment of obesity (past)			
Dietary restriction	7.26 (2.95–17.88)	0.000	2
Sedentarianism			
Habit of napping	3.43 (1.32–8.92)	0.012	2

OR – odds ratio; CI – confidence interval, BMI – body mass index.
* *P*-values are taken from the corresponding chi-square tests. All *P*-values were significant.
† Model 1 – parents' BMI, pre-school obesity and to have a best friend adjusted among themselves; Model 2 – Model 1 + dietary restriction + habit of napping.

analysing a sample of 1053 students of both genders aged 7–18 years in the city of Florianópolis, Giuliano[37] detected an overweight prevalence of 14%. All these results stand very close to the findings of the present study.

There was a positive association in this study between parents' obesity and adolescents' overweight. In both bivariate and multivariate analyses, overweight adolescents' chances of having obese parents were about double those of non-overweight ones. Similar results were found by Neutzling *et al.*[38]. Familial obesity aggregation is frequently observed and is explained by the sum of genetic influence and environmental factors such as dietary habits and family lifestyle[25].

To be a first-born child presented a positive association with overweight (OR = 1.89). When Stettler *et al.*[39] studied risk factors presented at birth for adiposity in a sample of 447 African American adults, they found that being the first-born increased by fourfold the risk of having greater adiposity at the beginning of adulthood.

Low or high birth weight had no statistical significance among our groups of overweight and non-overweight adolescents. Among the risk factors for obesity, those that occur in the initial phase of life like birth weight have been analysed in other studies. Some authors have also found no statistically significant associations[38,39], while others have. Eriksson *et al.*[40] studied the relationship of obesity in adult life with growth and living conditions during childhood in 4515 men and women born in the Helsinki University Central Hospital, Finland, and found that the incidence of obesity in adult life had a positive and proportional association with birth weight among males but not females. Monteiro *et al.*[6] observed that high birth weight was directly associated with overweight in adolescence, but found no statistically significant results relating to obesity, in their study of birth weight in 1076 adolescents aged 14–16 years in the city of Pelotas, Brazil. Lack of association in our sample could be partially explained by sample size, along with the fact that few subjects were born weighing more than 4000 g.

In the present study, no statistically significant differences were found among cases and controls regarding breast-feeding. Exclusive breast-feeding as a protective factor against obesity has been studied extensively and the results are controversial. Some studies did not find this protective effect[5,40]. On the other hand, Hediger *et al.*[41], in studying the relationship between breast-feeding and the nutritional status of 2685 children aged 3–5 years from NHANES III (1988–1994)[42], showed that children who had been exclusively breast-fed presented a 37% (OR = 0.63) risk reduction for overweight and a 16% (OR = 0.84) risk reduction for obesity. Von Kries *et al.*[43] studied the effect and duration of breast-feeding in relation to obesity among 9357 German children aged 5–6 years. In the children breast-fed for at least 6 months or longer, the risks of being overweight or obese were reduced by >30% and >40%, respectively. The mechanisms proposed to explain the protection of maternal breast-feeding against obesity are based on the self-regulation of satiety[44], the composition of human milk and its metabolic and physiological responses[43,45,46].

In this study, childhood overweight at some earlier phase of life showed a direct and statistically significant relationship with overweight during adolescence. After adjustments for other analysed variables, to have been obese during the infant phase represented a 3.63-fold greater chance of being overweight in adolescence. Other studies that also investigated the tracking of adiposity from childhood to adolescence found this association. Neutzling *et al.*[38] showed that adolescents who were obese before 10 years old had 2.5 times the chance of remaining obese in the adolescence period. Monteiro *et al.*[6] observed that 17% of children obese at 2 years old, and 20% at 4 years old, would become obese adolescents. There are several studies in the literature analysing the tracking of adiposity from childhood to adulthood. In a review study Serdula *et al.*[22] observed that approximately one-third of obese pre-school children and one-half of obese school-children became obese adults. In another review, besides showing that obesity in childhood tends to persist in adulthood, Power *et al.*[23] also showed that the risk tends to increase with age. In an observational longitudinal study with approximately 115 Australian young adults born in 1975–1976, Magarey *et al.*[47] observed that from all overweight children at 2 years of age, only half of them remained overweight at 8, 11 or 15 years old; however, at the age of 20, 82% were overweight.

Another variable analysed in the present study was previous dietary restriction. The proportion of adolescents who had already attempted weight loss with diets was significantly higher in cases than in controls (OR = 7.26). Lluch *et al.*[48] found a positive correlation between dietary restraint and BMI. Neutzling *et al.*[38] found a similar result to ours when analysing this same variable. They point out

'the order of the events in this association, however, cannot properly be elucidated from this study. It is possible that overweight and obese adolescents may be on restrictive diets in order to improve their body image, or simply aiming at adopting a behavior coherent with their nutritional status'.

A limitation of the present study, common to all studies assessing food consumption, is the use of dietetic inquiries, which are known to be of low accuracy and reproducibility[49]. However, these instruments, although imperfect, are the only ones available for this type of assessment in population studies[50]. Even applying the 4-day food record as we did in this study, the assessment of quantitative and qualitative food intakes did not find statistically significant associations with excess of adiposity. Other studies comparing food intake of obese and lean subjects have also failed to show that obese persons eat significantly more or qualitatively differently from their lean peers. In their analysis of the intake of 10 371 children and adolescents by 24-hour recall, Troiano *et al.*[51] found no significant association between intake of energy and total fat and nutritional status. Lluch *et al.*[48] studied the relationship between dietary intakes, eating style and overweight, finding a negative association between energy intakes and overweight in girls ($P < 0.01$) that almost reached significance in boys ($P < 0.06$). Margarey *et al.*[52] investigated secular trends of obesity in Australia, comparing data of two studies – the Australian Health and Fitness Survey in 1985 comprising 8492 schoolchildren aged 7–15 years and the National Nutrition Survey in 1995 comprising 2962 children aged 2–18 years. In this 10-year interval they observed an increase in the prevalence of overweight/obesity and a concomitant increase in the mean daily energy intake by children aged 10–15 years. Another important source of low accuracy is information bias, since obese adolescents tend to misreport their food consumption. More than this, they even tend to hide the items ingested, inadvertently changing their regular food habits during the 4-day foods record. Moreover, the order of the events in this association cannot be properly elucidated from this study. It is possible that overweight and obese adolescents may be on restrictive diets in order to improve their body image, or simply aiming at adopting behaviour coherent with their nutritional status. Thus, a possible limitation of this study is reverse causality, a bias frequently observed in case–control studies.

The habit of napping was statistically significant as a risk factor for overweight. Corroborating this result, secular trend studies of obesity in the USA and Britain suggest that the increased prevalence of obesity in these countries is much more related to modern inactive lifestyles than to the increase of energy intake[51,53]. Another longitudinal study between 1985 and 1997 with 10- to 11-year-old Australian children showed an increase not only in time spent on sedentary activities but also a decrease in physical activities[54]. Luke *et al.*[55], participating in a committee of the Canadian Academy of Sport Medicine, published a paper on the alarming increase of sedentary activity and the declining fitness of children in Canada. Some other indicators of physical activity assessed in the current study presented no significant results, although other studies showed that the regular practice of physical activity plays an important role in weight control and prevention of obesity[18,56].

Alcohol intake was significantly different among cases and controls. Controls presented a greater alcohol intake than cases (Table 1). This seems to be more related to the adolescents' social behaviour than to the effective alcohol consumption itself, since the amount of alcohol intake had insufficient energy content to cause obesity. In a comparative study of biopsychosocial aspects of obese and non-obese female adolescents aged between 13 and 15 years, Barboza[57] observed that 70% of the non-obese group revealed they go out to have fun with friends, while only 35% of the obese group did so. The author suggests that this behavioural difference of obese adolescents may be due to a fear of rejection by their group of friends, which tends to make the obese adolescents live less intensively. Falkner *et al.*[58] examined social, educational and psychological correlations with weight status in 5201 adolescents and found that obese girls and boys were respectively 1.63 and 1.91 times more likely to report not going out with friends. Another possible and additional explanation for obese adolescents having a less active social life may be related to their self-esteem. In a longitudinal study of 1520 children, Strauss[59] observed that obesity was a significant risk factor for low self-esteem at the age of 13–14 years in adolescents of both genders and all social classes.

To have a best friend was found more often in cases than in controls (OR = 5.44) and the variable that studied having a group of friends presented no statistically significant result among cases and controls. Falkner *et al.*[58] also observed that, in spite of having less social contact or even a minor number of friends, obese adolescents still have a group of friends, the same as eutrophic adolescents. The difference in socialisation in relation to the friendship of obese and eutrophic adolescents is perhaps due to the intensity and in-depth relationship of individuals belonging to a group of friends, which would explain the emphasis given to the existence of a best friend in the group of cases.

Our results add to the evidence that overweight and its consequences in adulthood are an important issue in public health among low-income urban groups from developing countries. Parents' obesity and previous obesity were identified as high risk factors to target for preventive programmes and policies. As for social costs, the precocious incapacity to work associated with the increased health service needs of obese adults will represent, in the near future, a challenge for developing societies. A wise health strategy would be to prevent

obesity and its consequences instead of being overloaded by curative health services and welfare bills.

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