

Association between physical inactivity and overweight among adolescents in Salvador, Bahia – Brazil

Associação entre inatividade física e excesso de peso em adolescentes de Salvador, Bahia – Brasil

Abstract

Objective: To assess the association between physical inactivity and overweight in an adolescent 10-14 year-old population of students in Salvador (Bahia, Brazil). **Methods:** Cross-sectional study assessing adolescents enrolled in state and municipal schools of the city of Salvador (Bahia, Brazil). Subjects' anthropometric status, level of physical activity, sexual maturation, and food consumption were investigated as well as their socioeconomic and environmental status. A BMI equal to or above the 85th percentile ranked an adolescent in the overweight category. Physical inactivity characterized the adolescent who practiced moderate or vigorous physical activity for less than 300 minutes per week. A multivariate logistic regression analysis was used to check the associations of interest. **Results:** The prevalence of excess weight was 11.8%. A positive association was shown between physical inactivity and overweight/obesity ($PR_{\text{male}}: 2,263$ 95%CI: 1,132 – 4,258), only statistically significant for male subjects. **Conclusions:** Results suggest a positive association between physical inactivity and overweight only among male participants. The investigation of this gender difference is vital and the authors suggest studies with more appropriate designs to elucidate the relationship.

Keywords: Overweight. Obesity. Physical inactivity. Adolescents.

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Resumo

Objetivo: Avaliar a associação entre inatividade física e excesso de peso em população de adolescentes do ensino fundamental de Salvador/BA. **Métodos:** Trata-se de um estudo transversal que avaliou adolescentes matriculados na rede pública municipal e estadual de ensino da cidade do Salvador/BA. Foram investigados o estado antropométrico, o nível de atividade física, a maturação sexual, o consumo alimentar, além das condições socioeconômicas e ambientais dos participantes. O IMC igual ou acima do percentil 85 classificava o adolescente na categoria de excesso de peso. A inatividade física caracteriza o adolescente que praticava atividades físicas moderadas ou vigorosas por um tempo menor do que 300 minutos/semana. Realizou-se análise de regressão logística multivariada para verificar as associações de interesse. **Resultados:** A prevalência de excesso ponderal foi de 11,8%. Os achados indicaram associação positiva e estatisticamente significativa entre inatividade física e sobrepeso/obesidade entre os rapazes ($RP_{\text{masculino}}: 2.263$ IC 95%: 1.132 – 4.258). **Conclusões:** Os resultados indicam associação entre inatividade física e excesso de peso somente entre os participantes masculinos. A investigação desta diferença entre os sexos é fundamental, o que nos motiva sugerir a adoção de estudos com desenhos mais adequados.

Palavras-chave: Sobrepeso. Obesidade. Inatividade física. Adolescente.

Introduction

Obesity is a chronic, multifactor condition that results from the accumulation of fat tissue, regionally located throughout the body, due to the positive difference between food consumption and energy expenditure¹. Obesity, a state preceded by overweight, is currently one of the major health problems both in developed and developing countries¹.

Studies performed in several countries have underscored the occurrence of excessive weight gain at increasingly younger ages. Roughly 22% of boys and 27.5% of girls in the age group from 2 to 15 years of age are overweight, worldwide². In the United States there has been a growth in the prevalence of obesity from 6.5% to 17% for the 6-to-11-year-old group and from 5% to 17.6% for those with ages between 12 and 19 years³. National surveys performed in the past three decades^{4,5,6,7,8,9} have revealed a gradual decrease in the prevalence of malnutrition in children, adolescents and adults, while also indicating growth in the occurrence of overweight and obesity in the Brazilian population, pointing toward an epidemic trend of the problem¹⁰. Recent data, obtained from studies performed in different cities of the country, have been highlighted by Silva et al (2010), showing a prevalence of overweight ranging from 8.4% to 19.0%, and obesity from 3.1 to 18.0% among younger age groups¹¹.

The practical contribution of regular physical activity associated with health and well-being, and the negative consequences of a sedentary lifestyle related to some diseases, have been well documented in the literature^{12,13}. Although most studies have involved the adult population, one assumes that there are advantages in youth becoming physically active¹⁴. Results of some studies corroborate the theory that physical inactivity is associated with overweight and with obesity among youth^{15,16}. Thus, the present study intends to contribute to the expansion of the knowledge on the issue, given this relationship has not yet been

clearly established. The authors, therefore, intend to develop information relevant for the establishment of interventions to reduce physical inactivity and overweight/obesity among adolescents and provide elements to motivate programming studies with appropriate designs for understanding the cause and effect relationship between the events.

Methods

The present work is a cross-sectional study of male and female adolescents with ages between 10 and 14 years. Adolescents were identified from a more ample investigation aimed at studying factors associated with iron-deficiency anemia in children and adolescents enrolled in the public educational system of the city of Salvador¹⁷. The sampling process of the original study involved a complex design, using the same two-level stratification of schools (state and municipal), followed by a three-stage cluster sampling procedure described as follows: the first stage was represented by sanitary districts, the second by schools, and finally, the last, by students. In order to estimate the prevalence of overweight/obesity in children and adolescents (10 to 14 years) enrolled in the public educational system of the city of Salvador, a prevalence for excess weight of 10%¹⁸ with a 95% confidence interval and absolute accuracy of 2% was adopted, and the resulting sample size was 604 schoolchildren. A percentage of around 35% was added to the value, anticipating possible losses in collection, totaling thus 815 adolescents in the final sample. Due to logistic field issues, the information on the students selected were extracted from six of the 12 districts of Salvador where there were 117 state schools and 173 municipal schools. State schools had 58,059 students and municipal schools, 56,555, so that in the present study, about 17 students of each state school and 4 students of each municipal school were selected to comprise the sample.

Weight was obtained using a micro-electronic, *Marte* brand model PP 200-50

scale, with capacity for 199.95 kg and 50 gram accuracy. Height was measured using a *Leicester Height Measure* brand stadiometer, graded in decimals of centimeters. Anthropometric measurements were collected at schools, by trained dietitians in a standardized fashion, following the procedures recommended by the Anthropometric Standardization Reference Manual¹⁹.

The body mass index (BMI) was calculated using anthropometric measurements (weight and height). The Centers for Disease Control and Prevention (CDC) 2000 standard reference percentiles tables for children and adolescents (2 to 20 years of age), according to age and sex,²⁰ were used in order to assess anthropometric status. Age was confirmed by looking at birth certificates or at national identification cards. Overweight was classified according to percentile cut-off points recommended by the WHO (1995)²¹; thus, a BMI equal to or above percentile 85 and lower than percentile 95 indicated overweight. Obesity was classified based on the recommendation of Must et al (1991)²², of a BMI equal to or higher than percentile 95. Participants with a BMI between percentiles 5 and 85 were considered eutrophic. Due to the low prevalence of obesity, the authors chose to add it to the overweight category. Therefore, individuals with excess weight resulted in a BMI located in the percentile equal to or higher than 85.

A questionnaire proposed by Florindo et al (2006)²³ validated specifically for epidemiological studies with adolescents was used for assessing regular physical activity²⁴. Adolescents who practiced moderate or vigorous physical activity for a period equal to or more than 300 minutes/week were considered active and those who exercised for shorter periods were considered inactive.

Sexual maturation stages were assessed based on the characteristics of breast and pubic hair for girls, and on genitals and pubic hair for boys²⁵. Female breasts and male genitals were assessed as to size; and pubic hair, as to characteristics, amount and distribution. Based on the staging components, which indicated proximity and finalization

of the most intense period of the growth spurt for height, adolescents were grouped, according to the stages of Tanner²⁵, in pre-pubertal and pubertal. These events were identified by self-portraying, from pictures presented to the interviewee.

The 24-hour recall survey method was used to assess food consumption. The Virtual Nutri Program, version 1.0, developed by the Department of Nutrition of the São Paulo University School of Public Health was used to calculate the centesimal composition of the diet. Food consumption of calories and macronutrients (carbohydrates, proteins and fat) was described using mean \pm standard deviation.

Data on the characteristics of the household and basic sanitation were used to build the living condition index, adapted from the model proposed by Issler and Giugliani (1997)²⁶. Each most favorable status received score 0, and the most unfavorable, score 1. The sum of the values characterized the living condition index in two strata: appropriate (score < 04) or inappropriate (score > 04).

Data on monthly family income and mother's schooling were also collected. For monthly family income, two strata were considered: less than one minimum wage (inadequate) and equal to or higher than one minimum wage (adequate). The variable- mother's schooling was classified in three levels, according to grades attended: I – up to four years of education; II – between five and eight years of education; and III – more than eight years of education.

Pregnant and breastfeeding adolescents; adolescents with physical trauma, who were immobilized at the time of anthropometric measurements were excluded from the study. Thin individuals, classified with a BMI below percentile 5, were not eligible for the study (11.7% of the sample).

Interviewers of the study team were trained in information collection techniques. After training the work team, a pilot study was performed to adjust field logistics, and check measurement instruments and techniques. The pilot sample (that was

not included in the general study sample) corresponded to about 10% of the sample calculated for the present study.

Initially the descriptive analysis was performed, using frequency distribution. The Delta method was used to estimate prevalence ratios in the analysis²⁷. The analysis of the association between physical inactivity and overweight/obesity was expressed as the prevalence ratio (PR) and respective 95% confidence intervals (CI: 95%). Bi-causal tests and a 5% significance level were adopted for statistical analyses. Stratification by sex was conducted for statistical analyses. Statistical analyses were corrected by a complex sample design, using the STATA SVY command sets (version 9.0).

The Project was approved by the Ethics Committee of the Instituto de Saúde Coletiva of the Universidade Federal da Bahia. Consent forms were signed by parents or guardians.

Results

The present study included 694 students, from 10 to 14 years of age, enrolled in the public education system of the city of Salvador. The percentage of losses was 4.6%.

The prevalence of excess weight was 11.8% [7.3% of overweight (95% CI, 5.36%-9.42%)] and [4.5% of obesity (95% CI, 2.96%-6.04%)], more pronounced among girls (female: 13.7%; male: 9.8%, $p=0.112$). Roughly 87.0% of youngsters were undergoing puberty (table 1).

Among total participants, there was a higher percentage of girls (52.7%) and with ages between 13-14 years (51.2%). Information related to the socioeconomic conditions of adolescents indicated that 38.3% of them were from families who lived in inappropriate living conditions. Of the families investigated, 24.0% earned less than one (1) minimum wage/month; 32.4% of mothers had up to four years of education; 35.1% had between 5 and 8 years of education; and 32.5% had more than eight years of education.

The mean energy consumption observed was 2,196.09 kcal \pm 913.77,

324.44g±133.91carbohydrates, 70.45g±37.37 proteins and 68.83g±39.75 lipids (table 1).

The percentage of physical inactivity was higher among girls (females: 50%; males: 28%, $p<0.001$). The proportion of inactive individuals was higher among adolescents who consumed less than 2,299.50 kcal calories ($p=0.002$). There was no differentiated distribution observed as to the physical inactivity status in relation to the remaining variables (data not presented).

Multivariate analysis was processed for the association between physical inactivity

and overweight/obesity according to sex. Results are presented in table 2. The data of the present study indicate a positive and statistically significant association between physical inactivity and overweight/obesity only for males (PR_{male} : 2,263 95% CI: 1,132 – 4,258).

Discussion

The prevalence of overweight in the present study is similar to the ones mentioned in other studies on adolescents, as those developed by Silva et al, (2002) (9%)²⁸,

Table 1 – Socio-demographic characteristics, of living conditions and food consumption among adolescents 10 to 14 years of age in the public school system of the city of Salvador, Bahia, Brazil, 2008.

Tabela 1 – Características sociodemográficas, de moradia e consumo alimentar, de adolescentes de 10 a 14 anos de idade da rede pública de ensino do município de Salvador, Bahia, Brasil, 2008

Variables	n	%
Sex		
Female	366	52.7
Male	328	47.3
Age (years)		
10 – 12	339	48.8
13 – 14	355	51.2
Pubertal Development		
Pre-Pubertal	86	12.5
Pubertal	602	87.5
Living Condition Index		
Inappropriate (> 4 points)	266	38.3
Appropriate (< 4 points)	428	61.7
Family income*		
< 1 minimum wage	164	23.7
> 1 minimum wage	527	76.3
Mother's schooling		
Up to four years of education	220	32.4
Between 5 and 8 years of education	238	35.1
More than 8 years of education	221	32.5
Food consumption		
Total energy consumption (calories)	2,196.09 ± 913.77	
Carbohydrate consumption (grams)	324.44 ± 133.91	
Protein consumption (grams)	70.45 ± 37.37	
Lipid consumption (grams)	68.83 ± 39.75	

*Salário mínimo vigente em 2007 (R\$ 380,00)

*Minimum wage in 2007 (R\$ 380.00).

Ramos et al, (2003) (7.3%)²⁹, and Ribeiro et al, (2006) (8.4%)³⁰. However, it was lower than the one registered by Anjos et al, (2003) (33.8%)³¹, Silva et al, (2005) (14.5%)¹⁸, Dutra et al, (2006) (19.3%)³², Terres et al, (2006) (20.9%)³³, Nunes et al, (2007) (18.3%)³⁴, and by Suñé et al, (2007) (21.3%)³⁵. Regarding the prevalence of obesity, the finding of the present study is compatible with the one found in other studies, such as Ramos et al, (2003) (3.5%)²⁹, Terres et al, (2006) (5%)³³, and Suñé et al, (2007) (3.5%)³⁵. However, the figure is lower than those registered by other authors such as Silva et al, (2002) (11%)²⁸, Anjos et al, (2003) (13.1%)³¹, Silva et al, (2005) (8.3%)¹⁸, and Siqueira et al, (2007) (26%)³⁶ in studies performed in several regions of Brazil.

The criteria adopted for the diagnosis of overweight/obesity in each study may justify the variability observed. However, regardless of the criteria, in general terms, the prevalence of weight gain among adolescents in all macro-regions of Brazil should be highlighted, especially in the southeast and south regions. In the northeast region, when weight indicators are compared throughout time, a tendency toward growing prevalences of excess weight is currently observed in the direction of figures compatible with those registered for the richer regions of the country¹¹.

The data of the present study indicate a more pronounced association between physical inactivity and overweight/obesity among male adolescents (PR_{male}: 2,263 95%CI: 1,132 – 4,258). The association

between physical inactivity and obesity has been reported in other domestic studies^{33,34,35}. However, the analyses were not stratified by sex. Recently, Silva et al (2008)¹⁵, in a study on a group of adolescents from 15 to 19 years of age of public schools (n=5,028) of the state of Santa Catarina also identified that among boys weight excess was associated with practicing less physical activity (OR: 1.74 95%CI: 1.08-2.79), whereas the association was absent for girls (OR: 0.98 95%CI: 0.59- 1.60). The results observed for girls, may be credited to retro-causation. In this sense, when adolescents perceive themselves as obese, they change their behavior, becoming more physically active. However, only studies conducted preferably with a cohort type design and larger samples allow a more in-depth understanding of the temporal aspect of the association detected.

It is important to highlight the limitations of the present study, imposed mainly by the study design. Thus, we underscore that a cross sectional design limits the interpretation of results based on causation, given it is not possible to establish a causal relationship because a time sequence between exposure and effect is not taken into account. However, the results found have biological plausibility and are compatible with what is registered in the literature consulted, which is, increases in the levels of physical activity associated with healthy eating habits are important components in the prevention of excess weight. These results are also generated by interventional studies^{37, 38}.

Table 2 – Prevalence Ratio to evaluate the association between overweight / obesity and physical inactivity in adolescents 10 to 14 years of age in the public school system of the city of Salvador, Bahia, Brazil, 2008.

Tabela 2 – Razão de prevalência para avaliar a associação entre sobrepeso/obesidade e inatividade física de adolescentes de 10 a 14 anos de idade da rede pública de ensino do município de Salvador, Bahia, Brasil, 2008.

Variables	Boys		Girls	
	PR	CI: 95%	PR	CI: 95%
Level of physical activity				
>=300 minutes/ week	1 (ref)		1 (ref)	
< 300 minutes/ week	2.263	1,132 – 4,258	0.724	0,427 – 1,253

Despite the limitations presented, the results of the present study suggest the association between physical inactivity and excess of weight only among boys. Investigating this difference between genders by adopting appropriate study designs is vital to elucidate the relationship. It is important

to point out, however, the possibility of schools being an environment that favors the promotion of a healthy lifestyle, aimed at promoting adequate diet and physical activity, so as to promote health, and therefore, avoid early weight gain among thousands of youngsters.

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