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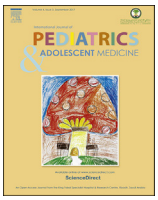

Increase in the prevalence of abdominal obesity in Brazilian school children (2000–2015)

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ABSTRACT

Introduction: The prevalence of overweight and obese children and adolescents is a public health concern. Few studies have critically evaluated this problem in a Brazilian population, despite the growth of community-based programs to combat childhood obesity in this country.
Objective: To study the anthropometrics of Brazilian adolescents over a fifteen-year period.
Methods: In a cross-sectional analysis, we investigated the anthropometric status of male and female adolescents in Brazil. The anthropometric data and nutritional status of 595 schoolchildren in the year 2000 were compared to 636 schoolchildren in 2015.
Results: We found a significant increase in the prevalence of overweight or obese adolescents in 2015 compared to 2000 (23.4% vs. 18.3%, $p = .027$). A sub-analysis stratified by sex showed that this increase only occurred in females. No statistically significant difference was observed in body mass index between the groups. Waist circumference (73.5 cm vs. 77 cm, $p < .001$) and the prevalence of abdominal obesity (30% vs. 47.9%, $p < .001$) were significantly greater in 2015, regardless of sex.
Conclusion: Overweight or obese children, as well as abdominal obesity were more prevalent in 2015 than in preceding decades. This is a worrying trend as abdominal obesity increases the risk for cardiometabolic morbidity and mortality in adult life.

1. Introduction

Over the past several decades, the prevalence of obesity has increased in epidemic proportions, particularly in developed and developing countries. Data from the World Health Organization (WHO) revealed that 1.9 billion adults were overweight in 2014 and at least 600 million were obese. Given the health risks associated with obesity, it is estimated that excessive body weight is the underlying cause of approximately 2.8 million deaths per year [1].

Regional data from Brazil points to a similar scenario. Between 2002 and 2009, data from the Brazilian Institute of Geography and Statistics (IBGE 2009) [2] showed an increase in the prevalence of overweight or obese adults. Prevalence in males increased to 50.1% (from 41.4% in 2002) and prevalence in females increased to 48% (from 40.9% in 2002). For Brazilian individuals between 10 and 19 years old, the prevalence increased from 20.8% to 27.6% for males and from 18.1% to 23.4% for females over the same 7-year period. More recent data from the Brazilian Ministry of Health [3] showed that 52.5% of Brazilians over 18 years of age are overweight and 17.9% are obese.

Although childhood obesity is associated with poor health outcomes, 70%–80% of obese adolescents become obese adults. This can have sustained and negative implications on their future quality of life and overall life expectancy. Obesity is associated with many comorbidities, including type 2 diabetes mellitus (DM2), dyslipidemia, hypertension, cardiovascular disease and cancer and is the third costliest health condition in the world [4]. In Brazil alone, costs attributed to obesity-related disabilities were Brazilian Real billion per year, which is equivalent to 2.4% of the country's Gross Domestic Product [5].

In the past two decades, the Brazilian government has adopted public policies to promote healthy eating to combat childhood obesity, but the effects of these policies are not yet known [6].

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Therefore, the primary purpose of this study was to evaluate body mass and abdominal obesity of schoolchildren from Marília, Brazil, over a fifteen-year period. We hypothesized that despite efforts to promote healthy eating habits and physical activity, excessive body weight and abdominal obesity would still be more prevalent than in recent years.

2. Methods

We analyzed cross-sectional anthropometric data of schoolchildren from Marília, Brazil, that were collected in 2000 and 2015. The city of Marília is located in the state of São Paulo, in the southeastern region of Brazil. It has a human development index of 0.798 and an estimated population of 230 thousand inhabitants (9976 adolescents enrolled in high school in 2015) [7].

All reasonable efforts were made to identify a sample of schoolchildren that was representative of the whole population. Schoolchildren between 12 and 18 years of age of both sexes were included in this study. Parents or guardians of all children signed the Free and Informed Consent Form (Termo de Consentimento Livre e Esclarecid; TCLE) prior to participating in any facet of this study. Adolescents were excluded if they presented with debilitating chronic diseases that affected physical function, type 1 diabetes mellitus, physical or mental disability that prevented participation, systemic conditions that affected general health, or if they were pregnant.

Anthropometric measurements were performed by trained evaluators at each time point. Body weight was obtained using a calibrated digital scale. During the weight acquisition, subjects stood with their arms at the side of their body, did not wear shoes and were instructed to wear light clothing. Subjects fasted prior to the weight assessment. Height was measured using a ruler fixed to the wall above a smooth floor. All subjects were barefoot during the height measurement and were instructed to stand in an upright position with their backs to the wall and heels together. Height was recorded in centimeters. Body mass index (BMI) was calculated using the conventional formula BMI = weight(kg)/height(m) [2]. Waist circumference (WC) was measured at the end of a non-forced expiration at the midpoint between the lower edge of the last rib and the iliac crest. A non-elastic anthropometric tape with an accuracy of 0.1 cm was used for all WC measurements [8].

Anthropometric status was determined from each BMI using the WHO criteria for underweight (<3rd percentile), overweight (≥85th to <97th percentile) and obese (≥97th), after adjusting for sex and age [9]. The presence of abdominal obesity was defined according to the International Diabetes Federation (IDF) criteria for adolescents aged from 12 to 16 years old (≥90th percentile), adjusted for age and sex. For adolescents older than 16 years, cut-offs for abdominal obesity were derived from adult IDF criteria (≥80 cm for women and ≥90 cm for men) [10]. Prevalence as total numbers and percentages was calculated for those who were underweight, overweight, obese, overweight or obese, or had abdominal obesity.

Statistical analyses were performed using StatView 5 software (SAS Institute Inc., Cary, NC). Analyses of variance (ANOVA) were used to compare continuous variables of age, height, weight, BMI, and WC between the 2000 and 2015 samples. Chi-square and Fisher tests were used to compare dichotomous variables (sex), as well as proportional variables (prevalence) between the 2000 and 2015 samples. Analyses were conducted for the whole sample, as well as stratified by sex. For all the variables tested, statistical significance was pre-defined as $p < .05$.

This study was authorized by the Municipal Secretary of Education of Marília and approved by the Committee of Ethics in Research in Human Beings of the Faculty of Medicine of Marília.

3. Results

A total of 1231 adolescents participated in the study, 595 in 2000 and 636 in 2015. The mean age (15.5 ± 1.1 vs. 15.3 ± 1.1 years), as well as the sex distribution (male:female ratio, 54.1:45.9 in 2000 vs. 60.7:39.3 in 2015, $p = .317$) did not differ between the groups. Height and waist circumference were greater in the 2015 group (Table 1). There was a significantly greater prevalence of overweight individuals (10.2% vs. 14.8%, $p = .020$) and overweight or obese individuals (18.3% vs. 23.4%, $p = .027$) in 2015 compared to 2000. There was also greater prevalence of abdominal obesity (30.0% vs. 47.9%, $p < .001$) in the 2015 sample (Table 1).

In a sex-stratified analysis (Table 2), females had greater height, weight, and WC in 2015 than in 2000. For males, height and WC were larger in 2015. There was no difference between the 2000 and 2015 groups for prevalence of overweight adolescents or obese adolescents; however, when overweight and obese individuals were grouped together there was a significantly larger prevalence for females in 2015 (25.6%) compared with 2000 (19.2%) ($p = .043$). The prevalence of abdominal obesity was larger in 2015 than in 2000 for both males (17.5% vs 33.6%, $p < .001$) and females (40.6% vs. 57.3%, $p < .001$). The 2015 sample also had a greater prevalence of underweight females (1.0% vs. 3.5%, $p = .003$), but not males (Table 2).

There was a significant positive linear correlation between BMI and WC in the two samples ($p < .0001$) (Fig. 1).

4. Discussion

Over a fifteen-year period, there was a significant and meaningful increase in the prevalence of overweight and obese schoolchildren in the city of Marília, Brazil. The difference was most dramatic for the rates of abdominal obesity, which showed a 60% increase in prevalence between 2000 and 2015. The result is alarming as it is well-known that children and adolescents are particularly vulnerable to deleterious cardiometabolic effects associated with obesity, including DM2, dyslipidemias, arterial hypertension, non-alcoholic fatty liver disease and atherosclerosis [11].

Our findings suggest a potential underlying cause for the increase in DM2 among young people aged 10–19 years that has been reported in the last two decades [12]. Approximately 85% of DM2 cases in this age group are associated with obesity and/or being overweight [13]. This is particularly concerning as recent studies have shown that many of these young people present with micro- and macrovascular dysfunction, which is a significant predictor of reduced life expectancy [13]. Beyond physiological complications, childhood obesity is associated with psychosocial problems, such as self-image disorders, attention deficit hyperactivity disorder, social isolation and discrimination, low self-esteem and depression [14].

Table 1
Anthropometric and clinical characteristics between groups.[a]

	2000 N = 595	2015 N = 636	*P* Value
Height, cm	164 (0.1)	166 (0.1)	.0003[a]
Weight, kg	58.8 (13.1)	59.8 (13.0)	.151[a]
BMI, kg/m^2	21.6 (4.2)	21.5 (4.2)	.822[a]
WC, cm	73.5 (10.0)	77.0 (10.0)	< .001[a]
Low weight, n (%)	6 (1.0)	22 (3.5)	.003[c]
Overweight, n (%)	61 (10.2)	94 (14.8)	.020[b]
Obese, n (%)	48 (8.0)	55 (8.6)	.757[c]
Overweight or Obese, n (%)	109 (18.3)	149 (23.4)	.027[b]
Abdominal obesity, n (%)	179 (30)	305 (47.9)	< .001[b]

Data expressed as mean (SD), except for prevalence, which is presented as number of individuals (percentage). BMI: body mass index; WC: waist circumference.
[a] Analyses of variance (ANOVA).
[b] Chi-square.
[c] Fisher test.

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