



ARTIGO ORIGINAL

ESTADO NUTRICIONAL E CRESCIMENTO DE ESCOLARES ADOLESCENTES DO SUL DO BRASIL**NUTRITIONAL STATUS AND GROWTH OF ADOLESCENT SCHOOLCHILDREN IN SOUTHERN BRAZIL**Jane Laner Cardoso ¹Claudio Leone ²**RESUMO**

Introdução: o objetivo do estudo foi avaliar correlação do estado nutricional e crescimento de escolares adolescentes. Método: estudo descritivo, transversal, com amostra por conveniência de 7.225 escolares de 10 a 16 anos de idade, de escolas públicas do Sul do Brasil, em 2013. Obteve-se peso, estatura, índice de massa corporal e classificou-se o estado nutricional (Ministério da Saúde do Brasil) distribuindo escolares por idade, sexo; médias de peso, estatura, desvio padrão e em z score, por idade e sexo. Comparou-se tercís de escore z de IMC e z de Estatura (zE) conforme as médias e medianas nos sexos masculinos e femininos (*Kruskal-Wallis*); de zIMC com os grupos masculino e feminino, zE do de altos e baixos (*Spearman*) e em relação as médias e medianas de idade (*U de Mann-Whitney* e *Mann-Whitney*). Comparou-se o zIMC Masculinos Baixos (MB), zIMC Masculinos Altos (MA), zIMC Feminino Altos (FA), zIMC MA com zIMC Feminina Baixas (FB), zIMC de MB com zIMC de FA e esses versus o zIMC do FB distribuídos em tercís. Resultados: Houve diferença estatisticamente significativa entre IMC de Masculino Altos (IMC) versus IMC de MB ($p < 0,0001$) e entre IMC de Feminino Alto versus IMC de Feminino Baixo, ($p < 0,0001$) IMC MA versus IMC FA ($p = 0,0005$). Existe uma correlação entre z IMC e zE do sexo masculino ($p = 0,0023$) e de zIMC com sexo masculino GB zE ($p < 0,001$). Conclusão: o estudo sugere que a altura elevada não protege do subsequente ganho de peso e aumento do IMC na adolescência.

Descritores: Adolescente, Crescimento, Estado nutricional, Obesidade.

ABSTRACT

Introduction: The objective of the study was to analyze the growth achieved and its relation with nutritional status among school adolescents attending public schools in capital of the South of Brazil.

Method: cross-sectional, analytical study with a convenience sample of 7,225 schoolchildren aged 10 to 16 years of age from public schools, selected from the anthropometric evaluation (weight, height, and Body Mass Index - BMI) of the Health Program of School. Classification according to groups of height for age: Group of Heights (GA) with z Height (zE) for Age greater than 1, Medium Group (GM) zE 1 and less 1 and, Group of Low (GB) and zE below of less than 1, for both sexes. BMI z score values (z IMC) of GA and GB were compared and z IMC correlation and sex were found. The *Kruskal-Wallis*

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test and Mann-Whitney test and Spearman's correlation coefficient were used. The study was approved by the Ethics Committee on Research in Human Beings. **Results:** There was statistically significant difference between BMI of Male Altos (BMI) versus BMI of Male Low (MB) ($p < 0.0001$) and between BMI Female High (BMI) versus BMI Female Low, ($p < 0.0001$) statistically significant BMI MA versus BMI FA ($p = 0.0005$). There is a correlation between z IMC and zE of male GA ($p = 0.0023$) and z IMC with male GB zE ($p < 0.001$). **Conclusion:** fast growth is associated with body weight gain and the tendency of overweight and obesity, stressing the importance of monitoring both height and body mass in adolescence.

Keywords: Adolescent, Growth, Nutritional status, Obesity.

1. INTRODUCTION

Growth assessment is an important step in monitoring health and nutrition conditions for both individuals and populations. For the population evaluation, both anthropometric indicators can be used at different times or at different locations. However, in the individual evaluation, anthropometry is an auxiliary instrument, needing to be evaluated in each specific context, besides being considered the light of the clinical history, the physical examination of the patient, the data of the parents and the speed of growth and age evolution bone, along with the socio-environmental conditions⁽¹⁾.

In the last decades, data on the epidemiological and nutritional profile of children and adolescents reveal a public health problem, since in spite of reaching an adequate growth in this age range, elevated prevalence of overweight and obesity, practically all over the world. In the United States of America, obesity affects not only these age groups but the population as a whole. Recent data using NHANES data show differences in prevalence among different ethnicities: data show that 23% of Mexican American boys aged 2 to 19 years are obese, a higher prevalence than whites (16%) and black (17%) in the same age group. Among girls in the same study, the prevalence of obesity was higher among black non-Hispanic girls (24%), followed by Mexican American girls (18%) and non-Hispanic white girls (14%)^(2,3).

In Brazil, increasing levels of obesity are also worrying. A northeastern study showed that the prevalence of overweight/obesity in school-age adolescents was similar to that observed in national studies, but boys had a higher socioeconomic level and girls were the subgroups that were more likely to be overweight/obese, of this relevant public health problem⁽⁴⁾.

In addition, pediatric obesity has been considered a major risk factor for adult obesity, so that strategies to control the adult obesity epidemic have emphasized the importance of studying the growth characteristics of children at risk of developing obesity in adulthood. As a clinical measure of obesity, Body Mass Index (BMI) is recommended for nutritional assessment in both children and adolescents as well as adults. There is evidence of the association between childhood BMI and BMI in adulthood and therefore, this index in childhood has been advocated as a significant and easily assessed marker from which clinicians and researchers can identify children at risk for BMI high when adults⁽⁵⁾.



Also, one of the factors that should be highlighted is the effects of early restriction of child growth on the development of obesity in later life stages. The results of a study of a Brazilian cohort that performed this analysis, and followed children from birth to adulthood, evidenced these effects, but especially emphasized the need to avoid rapid weight gain after 4 years of life, to avoid the increase of visceral adipose tissue and its effect on cardiovascular disease⁽⁵⁾.

The age of menarche may also be influenced by nutritional status and growth patterns, even during childhood, as a consequence of overweight and obesity. Thus, maintaining a "normal" growth pattern is important to prevent health problems throughout life⁽⁶⁾.

The association between obesity and morbidity that results in chronic diseases is already well known. A systematic review addressed studies on the role of rapid growth in childhood as a possible determinant of overweight and obesity later in life. The study reviewed MEDLINE for research reporting growth in childhood as well as measures of later weight or adiposity in adolescence or adulthood. Despite differences in the definitions used, 13 articles reported early rapid growth evidencing significant associations with overweight or adiposity⁽⁷⁾.

The correlation between obesity and height has been established in studies in several countries. A Dutch survey evaluating data collected in 1980, 1997 and 2008 showed that children 5 to 14 years of age have a higher prevalence of overweight and obesity than their lower peers, evidencing the influence of height in the definition of overweight at later ages⁽⁸⁾.

Another study, which also studied the relationship between height and obesity in schoolchildren, but in sub-Saharan Africa, showed that children who are higher for their ages tend to have higher adiposity by showing a linear relationship with BMI, as well as abdominal circumference, both in boys and girls⁽⁹⁾.

A study conducted in a German cohort of children followed up to adolescence found that the risk of overweight/obesity in adolescence can be predicted in children aged 6 years. It concludes that targeted intervention programs, including prevention and therapy measures, are needed early for those children identified as being at high risk⁽¹⁰⁾.

Considering the importance of the theme for Collective Health, the present research aims to analyze the growth achieved and its relation with the nutritional status among school adolescents attending public schools in a capital of the South of the Country.

2. METHOD

A cross-sectional, analytical study with a convenience sample of 7,225 schoolchildren aged 10 to 16 years of age from public schools in Florianópolis, Santa Catarina, selected from the anthropometric evaluation carried out by the School Health Program in 2013. We measured weight, (BMI), according to methods of collection and analysis of anthropometric data in health services (Technical Standard of the Food and Nutrition Surveillance System). The data were recorded in Excel spreadsheets and were



classified the nutritional status, according to the criteria of the Ministry of Health of Brazil. The means and standard deviations (SD) of weight, height, and BMI were obtained, as well as their z-score distribution, by age and sex^(11,12).

The sample was classified according to height-for-age groups: Group of the High (GH) with z Height for Age greater than 1, Group of Average (GA) between scores z 1 and less 1 and, the Group of the Low (GL), with z score below minus 1 for both sexes.

In the analysis, the mean height group was excluded by comparing the high and low groups.

The number of adolescents in each group was: Male High (MH) 670, Female High (FH) 686, Male Low (ML) 652 and Female Low (FL) 609 adolescents.

High and low adolescent groups were compared for z-score values of BMI (zBMI) using the Kruskal-Wallis test. Spearman's Correlation Coefficient was also used to verify the correlation between zBMI according to sex. The median age, according to the height and sex group, were analyzed by the Mann-Whitney test.

The present study obeys the ethical principles for research with human beings and was approved by the Research Ethics Committee of the University Center of Maringá.

3. RESULTS

Table 1 shows that the age distributions between the groups of stature did not present statistically significant differences, even considering the subdivision by group (Mann-Whitney MH and FA $p = 0.2917$ and ML and FL $p = 0.5212$).

Table 1 - Distribution of the age of the school adolescents, according to sex and height group.

Table 2 shows that, for the male, when analyzing the BMI of the MH versus the BMI of ML, there is a statistically significant difference ($p < 0.0001$), that is, the highest has a proportionally higher BMI. The difference between the medians was 1.2 zBMI Confidence Interval (CI95% = 1.1 to 1.4.) For the female, analyzing the BMI FH versus BMI FL, the difference was highly significant ($p < 0.0001$), the difference between the groups is 0.9 z scores (CI95% = 0.8 to 1.1). Analyzing BMI MA versus BMI FA there is a difference between sexes and this is statistically significant $p = 0.0005$, a difference of 0.3 scores (CI95% = 0.1 to 0.4).

When analyzing the difference between the lows, ie BMI FL versus BMI ML, there is no statistically significant difference.

Table 2 - Mean and median of zBMI by Group Height and sex of school adolescents.

Figure 1, shows the correlation between zBMI and z of the stature of the male adolescents of the High Group (GH), using the Spearman Coefficient $r = 0.1181$; CI95% = 0.0403 to 0.1444. The value was statistically significant ($p = 0.0023$).

Figure 1- Correlation of the zBMI score and height z score of the High Group of the male adolescents.



Figure 2 shows a correlation of zBMI with z of the stature of the adolescent male group, using the Spearman Coefficient $r = 0.1520$; CI95% = 0.07381 to 0.2284. The coefficient was statistically significant ($p < 0.001$).

Figure 2 - Correlation of zBMI score and the z score of the low height of male adolescents.

Figure 3 shows the correlation of zBMI with z of the stature of female adolescents of the High Group, using the Spearman Coefficient $r = 0.09915$; CI 95% = 0.02214 to 0.11750. The value was also statistically significant ($p < 0.0095$).

Figure 3 - Correlation of the zBMI score and height z score of the Group of high school adolescent.

Figure 4 shows the correlation of zBM and z of the stature of female adolescents of the Lower Group, using the Spearman Coefficient $r = 0.02584$; CI95% = -0.055600 to 0.1073, which did not show a statistically significant correlation ($p < 0.5241$).

Figure 4 - Correlation of the zBMI score and height z score of the Lower Group of the female adolescent.

4. DISCUSSION

In this study, it was found that, regardless of sex, the highest group had a significantly higher BMI. Among the tall group, boys have a higher BMI than girls, however. This difference between the sexes is larger, about a third than the difference that exists between high and low adolescents. In the group of lows, there was no evidence of a difference in BMI according to gender.

Because they are groups of the same age, this suggests that those who grow older tend to have a higher BMI, which may indicate a greater risk of developing overweight and obesity. The difference observed between tall boys and girls may, as a hypothesis, probably be due to the fact that adolescents of this age group are at a stage of pubertal development earlier than boys. As consequence, its greatest growth is probably due to the pubertal spurt, which in most boys has not yet occurred.

The MH, ML, FL groups have a correlation between Stature and BMI, with a low but statistically significant coefficient, indicating that BMI tends to be higher the higher the z score of stature that the adolescent presents.

The exception found was between the BMI z score and height in the group of lower boys, which may suggest that growth, without simultaneous pubertal development, has little influence on the risk of overweight.

Regarding the correlation of increased BMI and height, several studies show similar results, highlighting the strong association between childhood obesity and obesity in adulthood and the need to understand the growth factors already in childhood that may predict excess body weight in the future^(4,13,14).



The studies carried out by Quetelet⁽¹⁵⁾ in 1830, already suggested this possibility, since they emphasized that taller children are actually fatter. Considering height in the calculation of BMI, this index better demonstrates this relationship, when compared with other markers of adiposity and metabolic health. Dommelen et al⁽¹⁶⁾, however, consider this marker as a potential risk for overweight or fat gain or to develop a more abdominal fat distribution only in prepubescent children, minimizing the importance of age.

The underlying mechanism of the association between height and adiposity among young children is uncertain, but longitudinal studies have shown that increasing BMI and weight of children occurs before or concurrent with increases in height. This suggests that other hormones other than growth hormone may be associated with stature growth and therefore involved in the association⁽¹⁷⁾.

A study of Australian children over 8 years of age suggests a rewording of the BMI calculation and body fat percentage and recommends not using height because it represents a bias. They conclude that BMI and percentage of body fat are inadequate measures of body composition since both measurements are height related and overestimate body fat in high infants. However, both the BMI and the percentage of body fat remain measures frequently used in clinical and pediatric scientific work. The study suggests that it is necessary to develop a specific Body Fat Mass Index for the various age groups and ethnicities⁽¹⁸⁾.

Some authors point out that some of the insoluble cases of obesity may be results of the innate condition of very low muscle mass. They call attention to the interaction between less muscle and more adipose tissue and discuss from physiological and environmental perspectives with an emphasis in the early years of childhood. Lower muscle mass in childhood may lead to obesity. What leads to obesity (less muscle, more fat) in the population will result in morbid obesity when children are short of muscle tissue from early childhood. The studies conclude that among the taller and more obese children there is a percentage of children with lower muscle mass, noting that the consequences of low muscle mass may be very difficult to modify in adulthood and that they could be more successful if already started in childhood^(19,20).

For Johnson et al, linear growth patterns and skeletal maturation in overweight young adults demonstrate the effects of overweight or obesity on height and maturation rates⁽²¹⁾.

Our study shows that fast growth is associated with body weight gain and the tendency of overweight and obesity, emphasizing the importance of monitoring both height and body mass in childhood and adolescence. The study suggests, though clinicians should pay special attention to those children who are tall since high height in childhood does not appear to protect against subsequent high weight gain and increased BMI.

As a consequence, intervention programs targeted at schoolchildren targeting strategies for the prevention and detection of high-risk children for overweight and obesity in adolescence should include periodic assessments of their stature growth.



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FIGURAS E TABELAS

Table 1. Mean and median of age of the school adolescents, according to sex and height group.

Age/zStature	AFL n=609	AFH n=686	AML n=652	AMH n=670
Percentile 25%	10,60	10,50	10,70	10,60
Median	11,60	11,50	11,90	11,50
Percentile 75%	13,10	12,30	13,30	12,80
CI95%(Median)	11,30 -11,70	11,00-11,30	11,70-12,10	11,20-11,60

Table 2. Mean and median of zBMI by Group Height and sex of school adolescents.

Mean/Median	Group MH N= 670	Group ML N=652	Group FH N=686	Group FL N=609
Percentile 25%	0,20	-0,90	-0,10	-0,80
Median*	1,10	-0,20	0,90	-0,10
Percentile 75%	2,10	0,70	1,80	0,70
Mean	1,09	-0,10	0,85	-0,05
Std. Deviation	1,37	1,29	1,20	1,25

* Statistically different median values: $p < 0.0001$ (Kruskal-Wallis test).



Figure 1. Correlation of the Body Mass Index (BMI) Z score with the height Z score of the High Group (higher tertile) of the male adolescents.

