

Anthropometric Nutritional Status in Children from a School Community in Southern Brazil: Comparison with WHO-2007 Reference

Antropometria Nutricional de Crianças de uma Comunidade Escolar da Região Sul do Brasil: Comparação com Referência OMS-2007

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Abstract

Identify nutritional inadequacies in specific segments of the child population may offer subsidies for public health intervention. The aim of this study was to assess the anthropometric nutritional status in a sample of children from a city in the southern region of Brazil. The sample comprised 23 thousand subjects of both sexes who ranged in age from 5 to 10 years. The anthropometric nutritional status was identified by height and body weight. The comparisons were based on the corresponding distributions of percentiles of the World Health Organizations, 2007 reference. Analysis of results indicated that the distributions of percentiles of the height and BMI values in both sexes were statistically different of those from WHO-2007 reference. The data showed high proportion of children with low height (< 10 Percentile) and indication of excess of body weight (> 90 Percentile). The nutritional impairment translated by the high proportion of low height and excess body weight alerts to the need to implement public policies for healthy eating practices and physical activity.

Keywords: Nutritional Status. Growth. Malnutrition. Height. Obesity.

Resumo

Identificar inadequações nutricionais em segmentos específicos da população infantil pode oferecer subsídios para intervenção em saúde pública. O estudo analisou estado nutricional antropométrico em amostra de crianças escolares de uma cidade da região sul do Brasil. A amostra foi constituída por 23 mil sujeitos de ambos os sexos, com idade entre 5 e 10 anos. O estado nutricional antropométrico foi identificado mediante medidas de estatura e peso corporal. As comparações estatísticas foram estabelecidas com base nas correspondentes distribuições de percentis da referência proposta pela Organização Mundial da Saúde, 2007. Os resultados encontrados mostraram que, em ambos os sexos, as distribuições de percentis equivalentes aos valores de estatura e peso corporal foram estatisticamente diferentes da referência OMS-2007. Foram identificadas elevadas proporções de crianças com baixa estatura (< 10 Percentil) e indicação de excesso de peso corporal (> 90 Percentil). O comprometimento nutricional traduzido pela elevada proporção de baixa estatura e excesso de peso corporal alerta para necessidade de implantar políticas públicas direcionadas às práticas de alimentação saudável e atividade física.

Palavras-chave: Estado Nutricional. Crescimento. Desnutrição. Obesidade.

1 Introduction

Association among anthropometric indicators utilized to identify possible inadequacies of nutrition and health is well-documented in the literature. Evidences available in the literature suggest that deficit in the growth of height in children ages can affect cognitive development, promote the emergence of contagious diseases, limiting the physical capacity¹ and subsequently increase the risk factors for numerous degenerative diseases². On the other hand, excess weight is a known outcome related to the development of diabetes, heart disease, osteoarthritis and some types of cancer, among other chronic diseases³. Children with overweight or obese tend to have a higher incidence of problems related to self-esteem and self-concept, affecting the interpersonal relationship⁴.

Nutritional transition describes a process in which changes in the patterns of food and physical activity over time are observed. Although currently it is reaching the whole population, particularly of companies in the process of development, this process can differentiate themselves as to

when and to the degree of occurrence, as the epidemiological context considered. A fundamental characteristic of the process of nutritional transition is the reduction in the prevalence of growth deficits in height and the increase in the incidence of excess body weight, the so-called double burden of malnutrition⁵. Thus, identifying possible inadequacies in nutritional specific segments of the youth population, in the sequence, may offer subsidies for the intervention programs in the area of public health.

Following the process of nutritional transition observed in Latin American countries in recent decades, specifically in Brazil, it has been observed an important change in the prevalence of nutritional inadequations⁶⁻⁹. In this sense, the objective of this study was to analyze the nutritional status with particular attention to the prevalence of deficiency in growth of height and excess weight in a sample of school children of both sexes of a medium-sized city in the southern region of Brazil.

2 Material and Methods

This is a cross-sectional study involving school children of both sexes, aged between 5 and 10 years old, enrolled in the municipal public school network of the city of Londrina, Paraná. Data collection was carried out between the months of August and October 2015 and the protocols of intervention used were approved by the Research Ethics Committee at the University of Northern of Paraná - Platform Brazil (Legal Opinion 95.056/2012).

The city of Londrina, scenario of this study, is a city located in the northern region of Paraná State, subtropical climate, population close to 550 thousand inhabitants and has its economy based on farming, in the provision of public services and industry in development, characterized as a strong Center in the southern region of the country. According to the Atlas of Human Development in Brazil, it is a city with a high Human Development Index (HDI), value of 0.817¹⁰. The infant mortality rate, another indicator classically used to assess the level of development of a region, the information available indicate 11 deaths per 1000 live births.

The selection of subjects for the study was performed upon invitation to all universe of students enrolled from 1st to 5th grade of 74 existing schools in Londrina. According to information from the statistics of the Municipal Department of Education, at the beginning of the school year of 2015, 32,000 students were enrolled approximately within five years of schooling, which was the focus of the study. The following criteria for exclusion of participants in the study sample were used: (A) no permission from parents or guardians; (b) the absence to school on the day scheduled for the data collection; (c) any physical problem that prevented them from performing the anthropometric measurements at that time; and (d) chronological age less than 5 years and more than 10 years. It was opted to choose only children aged ≤ 10 years, time in which probably the children had still not begun puberty, minimizing in this way, possible impact of individual variations equivalent to biological maturation in measurements of height and weight. In this sense, 23,055 children were gathered to study (11,368 girls and 11,687 boys).

The chronological age of the youths was determined in years and months, from the confrontation between the data collection and date of birth. The indicators associated with nutritional anthropometry were defined from the measurement of height and the relation weight-for-height, in accordance with the criteria proposed recently by the World Health Organization¹¹. For the determination of the measures of height, a stadiometer was used with a scale of 1 mm, brand Seca (Hamburg, Germany), model 870, while

for the realization of measures equivalent to the body weight anthropometric scales were used with definition of 10 grams, brand Seca (Hamburg, Germany), model 879, measured every ten successive weighings, from procedures provided by the World Health Organization¹². The team of evaluators was composed by physical education teachers from schools with experience in performing anthropometric measurements with these characteristics. Regarding the data quality, replicas of measures of height and weight were performed every 10 subjects who participated in the definitive sample of the study. The magnitudes of the technical error of measurement varied between 1 and 5 mm for the measures of height and 30 and 50 g for the measures of body weight.

The data statistical treatment was performed by the Statistical Package for the Social Sciences - SPSS, version 22. The anthropometric data were initially compared with the normal curve using the Kolmogorov-Smirnov distance. The measures of height and weight showed distribution of normal frequency. To characterize the sample selected using the procedures of descriptive statistics (mean and standard deviation) and the analysis of variance of type two-way with interaction involving two classification criteria: age and sex. When this was the case, multiple comparison test of Scheffe was used to identify specific differences. For analysis of measurements of height and weight-for-height of children selected in the sample in relation to reference WHO-2007, the testing procedures of adhesion chi-square were used (χ^2) among the relative frequencies observed and ranges of percentile distribution presented by reference WHO-2007 (< P10, P10-P20, P20-P30, P30-P40, P40-P50, P50-P60, P60-P70, P70-P80, P80-P90; > P90). The ranges of distribution of the percentiles were calculated by means of the equivalent values to L, M and S for each sex and age presented by reference WHO-2007. Statistical differences between both sexes were identified by use of the test of homogeneity chi-square (χ^2) among the relative frequencies observed in girls and in boys equivalent to intervals of the distribution of the percentiles of the reference considered.

3 Results and Discussion

In Table 1 statistical information is presented equivalent to the measures of height and weight that characterize the sample selected for the study. Girls and boys presented measures of height and weight statistically similar; however, the values found in both anthropometric indicators showed a growing increasing as age advanced.

Table 1 - Means values, standard deviations and statistics “F” equivalent to the measures of height, weight and body mass index (BMI) of children involved in the study

Age (Years)	Height (cm)		Weight (Kg)	
	Girls	Boys	Girls	Boys
5	113.98±5.83	114.95±5.71	21.11±4.70	21.74±6.53
6	120.45±6.18	121.12±6.30	24.09±6.20	24.65±7.55
7	126.47±5.90	126.95±6.01	27.27±6.95	27.57±6.72
8	132.55±6.49	132.56±6.30	31.35±8.73	31.15±8.17
9	138.18±7.15	137.89±6.69	35.03±9.12	35.34±8.89
10	144.70±7.67	143.07±7.09	40.20±9.56	39.46±9.67
F _{age}	413.903 (p < 0.001)		818.864 (p < 0.001)	
F _{sex}	0.024 (p = 0.877)		2.455 (p = 0.117)	
F _{interaction}	14.636 (p < 0.001)		4.131 (p < 0.001)	

Source: Research data.

With the classification of measures of height and weight-for-height of each child in relation to the ranges of distribution of the percentiles shown by reference WHO-2007, the relative frequency observed in each decile, separately was shown by gender and age (5-7 years and 8-10 years). The information equivalent to the measures of height are provided in Table 2. In both sexes and in both age groups in consideration the distribution has a greater accumulation of children in the first deciles accompanied by gradual reduction of the frequency in more elevated decile, thereby suggesting a high prevalence of measures of height lower than the expected for age. The relative frequency showed similar values of 15-17% and 3-5% in the first and the last deciles, respectively, when the expected would be 10%, which reveals important height deficit. In both sexes, the chi-square test among the relative frequencies observed and uniform proportion expected of 10% showed no significant difference among the ages in consideration. However, the highest prevalence observed in the boys' height deficit was appointed statistically ($\chi^2 = 7.493$; $p = 0.018$).

Table 2 - Proportion (%) of children with measures of height, located in the distribution of percentile presented by reference WHO-2007

Percentile	Girls		Boys	
	5 – 7 Years	8 – 10 Years	5 – 7 Years	8 – 10 Years
< 10	15.3	16.0	17.3	17.6
10 – 20	13.8	14.1	15.2	15.4
20 – 30	12.2	12.6	13.7	14.2
30 – 40	11.0	11.6	12.6	12.8
40 – 50	10.4	10.7	10.7	10.7
50 – 60	9.7	9.6	9.3	9.5
60 – 70	8.9	8.9	6.6	7.9
70 – 80	7.3	6.4	5.8	5.3
80 – 90	6.4	5.7	4.6	3.9
> 90	5.0	4.4	4.2	2.7
χ^2_{age}	1.021 (p = 0.539)		1.286 (p = 0.461)	
χ^2_{sex}	7.493 (p = 0.018)			

Source: Research data.

Table 3 shows the relative frequency observed in body weight-for-height located among the percentiles of distribution presented by reference WHO-2007. Unlike to what was found regarding to measures of height, in both age groups,

the concentration of cases observed in the first decision was lower than the 10% expected, pointing higher deficit of body weight among the boys. In the sequence, it was observed a clear tendency of gradual increase in the frequencies in the highest deciles, reaching remarkable similarities between the relative frequencies observed and reference WHO-2007 in the intermediate percentiles. At the extremelly superior deciles (P70-80, P80-90 and P > 90), the relative frequencies demonstrated indexes above the 10% expected, particularly among girls. Upon chi-square test is is verified that, in both sexes, the relative frequencies were significantly different from the corresponding deciles proposed by reference WHO-2007 ($\chi^2 = 64.823$; $p < 0.001$). Homogeneity test shows that the relative frequencies observed in the two groups are statistically identical; however, the differences observed between both sexes are evidenced statistically speaking ($\chi^2 = 6.798$; $p = 0.024$).

Table 3 - Proportion (%) of children with measures of weight to height, located in the distribution of percentile presented by reference WHO-2007

Percentile	Girls		Boys	
	5 – 7 Years	8 – 10 Years	5 – 7 Years	8 – 10 Years
< 10	3.7	2.8	3.0	1.9
10 – 20	4.8	3.6	4.2	4.0
20 – 30	5.6	4.4	5.6	5.4
30 – 40	7.8	6.3	8.0	7.6
40 – 50	8.9	8.4	9.3	9.5
50 – 60	9.7	10.2	10.5	10.3
60 – 70	10.4	13.8	11.8	12.5
70 – 80	14.6	15.3	13.9	14.4
80 – 90	17.1	17.2	16.4	16.7
> 90	17.4	18.0	17.3	17.7
χ^2_{age}	1.498 (p = 0.341)		2.054 (p = 0.195)	
χ^2_{sex}	6.798 (p = 0.024)			

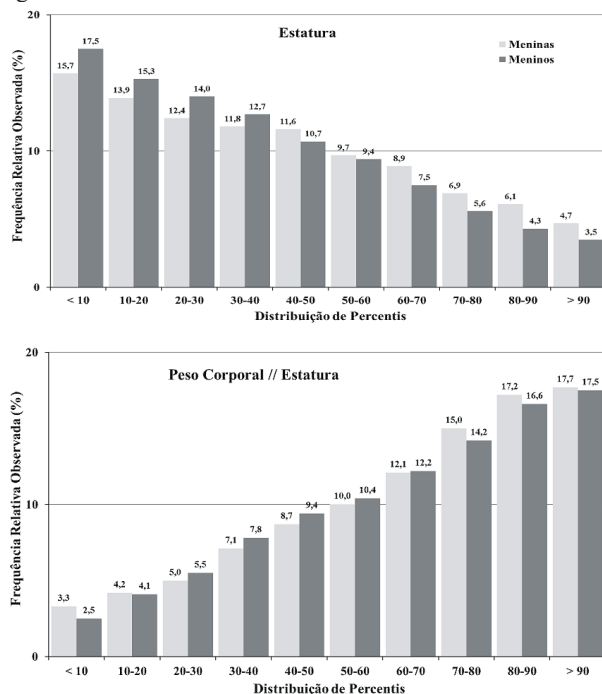
Source: Research data.

From the measures associated with height and weight-for-height, it is possible to establish estimates of nutritional status upon resources in anthropometric resources in representative sample of school children from the city of Londrina, Paraná. The distribution of relative frequencies observed did not correspond to the deciles of the reference WHO-2007, since

there were no uniform proportions of 10%. The relative frequencies equivalent to those measures of height, in both sexes, were significantly higher in the first and deficient in the last deciles, suggesting that the levels of physical growth of children selected in the study are lower than the internationally accepted standards. As for the weight-for-height, the highest concentrations of relative frequencies were found in the upper deciles, pointing more high prevalence of children with excessive body weight.

Specifically concerning measures of height, the relative frequencies observed in the first decile (15.7% of girls and 17.5% of boys) were almost twice the expected 10%, while only 4.7% of girls and 3.5% of the boys were above the 90th percentile. Regarding the values of body weight-for-height, the relative frequencies observed in the more elevated decile (17.7% of girls and 17.5% of boys) also approached two times more than the 10% expected, while in the lower decile, the relative frequencies observed did not outnumber the four percentages (3.3% of girls and 2.5% of boys) - Figure 1.

Figure 1 - relative frequency observed (%) equivalent to the measures of height and weight-for-height before the percentiles distribution of the reference WHO-2007 for children aged between 5 and 10 years of a school community in the southern region of Brazil.



Source: Research data.

Upon consulting the results of other studies, it was found that the greatest deficits in height and risk of overweight/obesity in young populations of regions in the process of development occur precisely at the time that precedes the beginning of the outbreak of maturity¹³⁻¹⁷. This fact is explained based on the justification that, during this period of human development, there are significant changes related to physical growth, thus requiring proper and balanced provisions regarding

the amount of metabolic energy, amino acids, vitamins and minerals associated with the various endogenous secretions¹⁸. Also, delays in the growth of height identified at the beginning of adolescence may represent specific disturbances as a result of late and cumulative effects of nutritional stress occurring in children ages¹⁹.

The proportions associated with the height deficit and the presence of excess body weight are not distributed equally in both sexes in the segment of the population analyzed in this study. If, on the one hand, the proportions of stature were significantly higher among boys, on the other hand, in the case of the proportions of excess of body weight, the girls showed significantly higher values. In other studies available in the literature important differences were also found between genders regarding the occurrence of stature and excess of body weight¹³⁻¹⁷.

The differences observed in the proportions of stature deficit between boys and girls possibly can be explained due to the peculiarities observed regarding the biological sensitivity to environmental problems, especially of nutritional order. Although the justifications and the mechanisms of this phenomenon are not well defined, Stinson²⁰ gathered several studies that seek to point the male organisms as being more sensitive to environmental influences. In this case, boys under stressful environmental conditions have higher risk associated with pre-natal mortality, with delayed physical growth and the emergence and development of contagious diseases in comparison to the girls.

In contrast, it is suspected that the highest proportions of excess of body weight among girls may partly be explained by the greater vulnerability of the female organism to accumulate higher stocks of body fat caused by sex hormones in ages close to puberty²¹. Differences regarding the habits of physical activity can also contribute to the variations in the prevalence of overweight between both sexes. Since the beginning of the school period, the boys prove to be consistently more physically active than girls, either through daily activities or systematic programs of sport, differences which are accentuated with age².

Possibly the simultaneous presence of stature and excess of body weight in the sample of children selected may be related to the epidemiological transition observed more recently in Brazilian regions in the development process. In this case, specifically in the northern region of the state of Paraná, the target population of this study, the social advances and infrastructure in public services, especially in the educational and health sector observed in recent years, together with assistance programs and income-transfer programs currently existent, may be impacting more strongly the elevation of body weight than the maintenance of the growth potential of height of children. Some years ago, during the neonatal period and early childhood of today's children and that interfere strongly in the definition of height in the future, it was almost inexistent the initiatives with these characteristics. Thus,

the high proportion of stature observed may also represent nutritional specific disturbances occurred at earlier ages. A similar phenomenon was found in young populations from other Brazilian regions^{23,24} and African countries²⁵, modifying the trends in prevalence of anthropometric indicators related to nutritional status.

Regarding this matter, low body weight/underweight, an event so important in past decades in the child population in Brazil²⁶, it seems to be a nutritional problem in the process of overcoming in the segment of the population analyzed, since, according to statistical criteria used for the classification for epidemiological nutritional deficit, prevalence of up to 2.5% is acceptable in populations with good nutritional status¹². The proportions of values equivalent to the weight-for-height found in lower decile in the present study were closer to 3%; therefore, quite similar to the acceptable proportion. However, if there are indications as to the possible control of the occurrence of low body weight/underweight, it is noted that the relative frequencies of values equivalent to the weight-for-height in extreme superior deciles reached levels above 10% expected, indicating the necessity of urgent actions for prevention and control.

Among the main limitations of this study it is highlighted the delimitation of the sample selected. Because this is a specific population group, school children of both sexes from 5 to 10 years from Londrina, Paraná, can present restrictions regarding the generalization of the results to the young population of other Brazilian regions. However, in light of the selection procedures of the subjects and the largest sample size selected, it becomes more likely that the results found reflect, with satisfactory conditions, the anthropometric nutritional status of young population from cities of the northern region of Paraná. Also, the cross-sectional design used in this study prevents the establishment of causality effect among the outcomes related to the height deficit and excess weight found in selected children.

4 Conclusion

In conclusion, upon confirming the information related to the measurements of height and weight-for-height observed in the study with data of the reference WHO-2007, the findings indicate a significant distancing in the distributions of the percentiles. The children gathered in the study showed significant deficits in height and, although the study has been dealing with a population segment inserted in a region still in the process of economic development, the excess weight-for-height presented itself as another important problem associated with nutritional status. The high proportions of excess of body weight recorded alert to the urgent need to implement public policies aimed at health promotion, especially directed to the practices of healthy eating and physical activity.

Considering that, not only the height deficit but also the excess of body weight are problems with implications in the

short and long term to health, the purpose of the profile found in both nutritional indicators, highlights the importance of maintaining the actions aimed at the control of hunger and malnutrition in the population. However, it is necessary to adjust the guidelines of current actions and clearly define the beneficiaries' profile, due to the possible effects that the foods of high calorie density and low nutritional value associated with the low level of physical activity may offer to a greater accumulation of body fat. In this case, it is suggested that the population's access to foods must be accompanied by the specific educational process oriented to adequate consumption and that meets the nutritional needs and the regular physical effort that will raise the energy expenditure.

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