Anthropometric indicators of the nutritional status of children in early childhood education

https://doi.org/10.56238/sevened2024.014-007

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ABSTRACT

Knowledge of the growth and development profile of children cared for in daycare centers allows the implementation of health promotion and disease prevention actions, contributing to the design of public policies, intersectoral articulation and awareness of the population, enabling the child to achieve a healthy and harmonious development. The aim of this study was to evaluate the neuroanthropometric indicators of the nutritional status of preschool children. A cross-sectional epidemiological study was carried out in 13 daycare centers located in peripheral neighborhoods of a municipality on the western border of RS, with 530 children, 277 girls and 253 in the age group between one and five years old. The anthropometric variables measured were weight, height, and head circumference of the children. The Pearson Correlation Test was used to verify the relationship between head circumference and weight, at a significance level of 5%. The results showed a strong positive correlation between the weight and height of the children, indicating that the tallest children had the highest weights, which is in accordance with the normative tables of the World Health Organization. There was also a strong positive correlation between head circumference and weight, which corroborates what is expected in the specialized literature. It is concluded that the neuroanthropometric indicators of nutritional status, such as weight, height and head circumference, are measures that portray the child's health status and that their periodic evaluation should be adopted in schools in order to monitor the child's growth and development.

Keywords: Child, Growth, Weight, Height, Head circumference, Nutritional status.

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INTRODUCTION

Child development is multidimensional, integral and continuous, but it also depends on the interrelations between health and the environment, whose influence can be positive or negative, insofar as it promotes conditions that promote well-being or, on the other hand, contribute to the onset and maintenance of diseases, injuries and traumatic injuries1.

Children's health is related to a series of indicators influenced by the conditions of the environment in which the child lives and highly dependent on the sufficient and appropriate provision of care, which involve the family's social conditions, access to health services, nutrition, and growth and development are considered the main indicators of their health condition2. Knowledge of these indicators can provide support for the implementation of disease prevention and health promotion actions in daycare centers and schools3, and stimulation activities are equally important for the child's neuropsychomotor development to occur harmoniously with growth4.

Thus, early intervention becomes an effective strategy to allow the child to grow and develop in an emotionally healthy way5,6.

The Ministry of Health adopts the recommendations of the World Health Organization (WHO) on the use of reference curves in the assessment of nutritional status7,8, which constitute an important technical instrument for measuring, monitoring and evaluating the growth of all children and adolescents aged 0 to 19 years, regardless of ethnic origin, socioeconomic status or type of diet.

Anthropometry is a simple, non-invasive and low-cost method used to assess the size, proportions and composition of the human body9. Since growth and body dimensions at all ages reflect the health and well-being of individuals and populations, anthropometric measurements can be used as indicators of health, performance, and survival10. Recent studies have expanded the applications of anthropometry to identify economic and social inequalities, point out which population should receive intervention, and evaluate responses to interventions9,10.

The W/A indicator is used worldwide in childcare, in the evaluation of children up to five years of age, reflecting weight according to the child's chronological age. Weight is a very sensitive measure and its serial assessment allows for early identification of changes in nutritional status. However, this indicator used alone is not capable of detecting the nature of the disease, i.e., whether it is past or current11. In addition to this limitation, the W/A indicator does not identify the body compartment that is more or less affected by the disease.

Therefore, it is necessary to associate other anthropometric measurements such as height and head circumference to define the nutritional status of the child12. Thus, the nutritional profile of the child offers valuable information for the planning of actions, aiming at prevention and the programming of care directed to those with deficits already installed and implementing actions that enable the prevention of their effects12,13.

Head circumference is described as the "frontoccipital" circumference or as the "Frankfurt Plane" circumference, corresponding to the maximum head circumference14. As brain growth occurs predominantly in the first three (3) years of life, this fact has meant that the study of head circumference has been restricted to this period and, to a certain extent, neglected, with few investigations or evaluations that use it after three years of age15. Some authors, however, have pointed out that its measurement, after three years of age, would be very useful to detect the conditions of nutrition that occurred early and, more than height, the head circumference would be the most appropriate measure to detect malnutrition that occurs in the first years of life16,17. Since this measure is highly correlated with brain size, several studies have sought to clarify the influence of severe and early malnutrition on brain growth18,19. Although the brain presents a certain plasticity in the face of involvements, and neuromotor development depends not only on physiological factors, but also on the environment, it is necessary to have a better understanding of the deleterious effects of malnutrition on the nervous system, as these can lead to the most serious sequelae of the "survivors" of malnutrition in childhood. There is evidence that head circumference may reflect nutritional deficiencies that occurred early in[life17,18], and may be a very useful indicator in the planning of actions aimed at minimizing or preventing the effects of early malnutrition20. Reference curves for head circumference are important for the follow-up of children with neurological problems and for a better and more complete nutritional assessment of infants, according to the recommendations of the World Health Organization20 and, at school age, to assess nutritional history21.

When environmental conditions meet physiological and emotional needs, the organism can reach the limits of normal development. On the other hand, malnutrition is a risk factor for development; because unfavorable social and economic conditions potentiate its deleterious effects21. It becomes evident that the malnourished child without school (lack of stimulation) is the one who is in the worst situation. Children with severe malnutrition have a small head and abnormal EEG for at least one year after the episode22.

Studying the growth and development of children in the context of health education, health promotion and intervention programs is essential for the development of public policies aimed at this age group. Children's health must be considered in a broad context taking into account physical, emotional and social well-being, as advocated by the World Health Organization (WHO). Many of the behaviors included in children's lifestyles can influence, directly or indirectly, their short- or long-term health22.

It is believed that childhood is an optimal period for pedagogical intervention in order to stimulate health habits and behaviors, which are expected to be maintained during the higher course of the child's life. In this context, the school/daycare center is a diversified space for development

and learning, that is, a place that brings together a diversity of knowledge, activities, rules and values and that is permeated by conflicts, problems and differences21. It is in this physical, psychological, social and cultural space that individuals process their global development, through activities programmed and carried out in the classroom and outside of it22.

To think about early intervention is to assume its complexity as an intervention methodology that is concerned not only with children in situations of social and economic vulnerability, but with all children. It is through intervention with transdisciplinary teams that it is believed that it is possible to prevent damage to the child's growth and development23.

The need for intersectoral and transdisciplinary actions, based on the articulation between the managers of the education and health policies of the municipality where the research is carried out, involving the participation of civil society and the university as an active member of this society, is present in order to cooperate in the effective transformation of the preschool environment into a space for managing and promoting health24, as well as contributing to regional development.

Despite the complexity and challenges that preschool faces, it cannot fail to recognize that its resources are indispensable for the overall formation of the child. Pedagogues and educational advisors are trained to carry out health interventions. It is in this space that reflections on the teaching-learning processes and the difficulties that arise in the classroom or at home are carried out23. The establishment of partnerships between education and health professionals can be advantageous for the construction of new methods, strategies and ways of thinking about how the theme "health" should be approached in the educational environment. From this point of view, the teacher is a health trigger, and can contribute to the process, because the students, especially the younger ones, have the teachers' attitudes as a reference. While this remains true, the way of teaching is less authoritarian and formal; Nowadays, social relationships are more open, favoring dialogue between teachers and preschoolers25.

It is known that diet is a determinant of the cognitive capacity of children and adolescents, and that growth (weight, length/height or head circumference) in the first years of life is consistently associated with better performance in intelligence tests26-28. Thus, the following research question emerged: What is the nutritional status of preschoolers aged between two and five years who attend municipal daycare centers in a municipality on the western border of the state of Rio Grande do Sul?

In order to answer the research question, the following general objective was outlined: to evaluate the neuroanthropometric indicators of the nutritional status of preschool children belonging to municipal daycare centers located in neighborhoods on the outskirts of a municipality in the interior of the state of Rio Grande do Sul.

METHODOLOGY

This is a cross-sectional epidemiological study, of an applied nature, with a quantitative approach, carried out with 530 children, 277 girls and 253 boys, living in peripheral neighborhoods of the municipality of Alegrete, on the western border of Rio Grande do Sul, aged between one and five years.

All thirteen public daycare centers located in neighborhoods on the outskirts of the city of Alegrete were visited, and data collection occurred only after authorization from the daycare center management and the signing of the free and informed consent form by the children's guardians. The measures were taken on the premises of the daycare centers, in accordance with the structural organization of the educational establishment. Data collection took place in the morning and afternoon shifts. The data were tabulated by the scientific initiation scholarship holders in an electronic spreadsheet of the Microsoft 365 Office Excel program.

To describe the variables, the data are presented in tables and graphs, with mean and standard deviation. Student's t-test was used to verify the difference between the means of found weight and reference weight, and found height and reference height, with a significance level of 5.0%. Pearson's correlation test was used to verify the degree of relationship between the variables weight and head circumference, with a significance level of 5.0%.

The study was submitted to the Research Ethics Committee of the School of Public Health of the State of Rio Grande do Sul, Opinion 2.497.512 and CAAE 60646416.4.0000.5312.

RESULTS AND DISCUSSIONS

The general objective of the research was to evaluate the neuroanthropometric indicators of the nutritional status of preschool children belonging to municipal daycare centers located in neighborhoods on the outskirts of the municipality of Alegrete, on the western border of the state of Rio Grande do Sul.

For this, 530 children, 277 girls and 253 boys aged between one and five years had their weight, height and head circumference measured and compared with the reference tables of the World Health Organization (WHO). Table 1 shows the means and standard deviations of weight, height, and head circumference (HC) of the boys grouped by age from 1 to 1 year and 11 months (Age I), from 2 to 2 years and 11 months (Age II), from 3 to 3 years and 11 months (Age III), from 4 to 4 years and 11 months (Age IV) and from 5 to 5 years and 11 months (Age V).

When comparing the mean weight of the boys in the age group I with the reference values, it was observed that the mean weight found was significantly higher ($p=0.0001$) than the reference (10.9 ± 0.81 kg); The same was true for height, i.e., the mean height of the boys was significantly higher ($p=0.009$) than the reference value (0.82 ± 0.04 cm). In the WC assessment, the boys had WC

values within the range recommended by the World Health Organization (WHO), as shown in Table 2 (43 to 48 cm).

The group in the age group II (2.6±0.28 years old) had significantly higher weight and height (p=0.0002; p=0.001, respectively) than the reference values (14.3±1.06kg; 0.91±0.0m, respectively). The boys' WC showed normal values for their age (45 to 51 cm) as shown in Table 2.

In the age group III it was no different, the mean weight of the boys was significantly higher (p=1.6 x $^{10-8}$) than the reference values (15.3 ± 0.54 kg); as well as in the comparison of the mean height with the values of height (0.99±0.21 m) (p=3.7 x 10-6). WC also presented normal values for age (46 to 52 cm).

In the analysis of the age group IV, both mean weight and height were significantly higher (p=1.56x10-7; p= 0.0001, respectively) when compared to the reference values (17.04 ± 0.54 kg; 1.06±0.13 kg, respectively). It was observed that the WC of the boys is within the recommended range (47 to 53 cm) for their age.

Also in the age group V, both mean weight and height were significantly higher (p=1.17x10-13; 1.64x10-14, respectively) when compared to the reference values (18.3 kg and 1.1 m, respectively). The mean WC value of five-year-old boys is also in the recommended range (47 to 53 cm).

Santos et al. (2023)[29] conducted a descriptive ecological study, based on secondary data recorded in SISVAN in the last 5 years, of schoolchildren aged 5 to 9 years in the state of Goiás and regional health centers (RS). The prevalence of overweight was around 35% in all health areas, especially in the city of Rio Vermelho, in the state of Rio Grande do Sul (39.2%).

Tables 3, 4, 5, 6 and 7 show the result of the correlation between WC, weight and height of the boys aged one, two, three, four and five years.

Table 3 shows a very weak correlation between WC and weight and WC and height of one-year-old boys, and the same intensity in the degree of correlation occurred with the two-year-old age group, as can be seen in Table 4. On the other hand, a strong positive correlation was observed between WC and weight in 3-year-old boys. The same did not occur between WC and height, where the correlation was weak, as can be seen in Table 5. Four-year-old boys showed a positive and regular correlation between WC and weight and a weak correlation between WC and height (Table 6). A weak correlation between WC and weight and height was observed (Table 7) in five-year-old boys.

Table 1. Mean and Standard Deviations of Weight, Height and WC of boys

Variable	**Age I 1.6 ± 0.34**	**Age II 2.6 ±0.28**	**Age III 3.5± 0.29**	**Age IV 4.4 ± 0.30**	**Age V 5.5 ±0.40**
n	20	39	64	67	63
Weight (kg)	13 ± 1.99	15.2±2.29	17.8±3.18	19.9± 4.16	23.2± 4.14
Height (m)	0.86± 0.06	0.94±0.06	1.03±0.05	1.08±0.06	1.17± 0.05
PC (cm)	46.6± 7.45	50.1±1.75	50.9±1.50	51.6±1.66	52.2 ±1.18

Source: Authors (2024)

Table 2. BW values of children from zero to five years of age according to the WHO

Age	Girls (cm)	Boys (cm)
At birth	31 a 36	31 a 37
1 year	42 a 47	43 a 48
2 years	44 a 50	45 a 51
3 years	45 a 51	46 a 52
4 years	46 a 52	47 a 53
5 years	47 a 52	47 a 53

Source: Authors (2024)

Table 3. Correlation between Weight, Height and WC of boys - 1 year

	Weight (Kg)	***Height (m)***	***PC (cm)***
Weight (Kg)	1		
Height (m)	0,69	1	
PC (cm)	0,26	0,35	1

Source: Authors (2024)

Table 4. Correlation between Weight, Height and WC of boys - 2 years

	Weight	*Stature*	*PC*
Weight (Kg)	1		
Height (m)	0,76	1	
PC	0,45	0,17	1

Source: Authors (2024)

Table 5. Correlation between Weight, Height and WC of boys - 3 years

	Weight	*Stature*	*PC*
Weight (Kg)	1		
Height (m)	0,72	1	
PC (cm)	0,61	0,54	1

Source: Authors (2024)

Table 6. Correlation between Weight, Height and WC of boys - 4 years

	Weight	*Stature*	*PC*
Weight (Kg)	1		
Height (m)	0,74	1	
PC (cm)	0,5	0,37	1

Source: Authors (2024)

Table 7. Correlation between Weight, Height and WC of boys – 5 years

	Weight	***Stature***	***PC***
Weight (Kg)	1		
Height (m)	0,58	1	
PC (cm)	0,38	0,22	1

Source: Authors (2024)

Table 8 shows the means and standard deviations of weight, height, and head circumference (HC) of the girls grouped by age from 1 to 1 year and 11 months (Age I), from 2 to 2 years and 11 months (Age II), from 3 to 3 years and 11 months (Age III), from 4 to 4 years and 11 months (Age IV) and from 5 to 5 years and 11 months (Age V).

Table 8. Mean and Standard Deviations of Weight, Height and WC of the girls

Variable	*Age I 1.5 ± 0.42*	*Age II 2.6 ±0.31*	*Age III 3.5± 0.28*	*Age IV 4.5 ± 0.29*	*Age V 5.5 ±0.42*
N	34	41	74	78	50
Weight (Kg)	11.5 ± 2.17	14.6±2.05	17.5±3.61	19.8±4.25	22.3±4.8
Height (m)	0.81± 0.07	0.93±0.06	1.0±0.05	1.1±0.64	1.2±0.07
PC (cm)	46.7±2.26	48.9±1.63	50.1±1.38	50.9±1.42	50.6±1.88

Source: Authors (2024)

One-year-old girls had significantly higher BW weight and BW (p=0.0006 and p=0.02, respectively) than the reference (9.98±1.11 kg; 45.9±1.5 cm), respectively. No significant difference (p=0.51) was observed in relation to height.

Statistically significant differences (p=1.47x10-6; p=0.005; p=0.0001) were observed in the weight, height and WC respectively of the two-year-old girls, with measurements higher than those shown in the table (12.7±0.66 kg; 0.9±0.02 m; 47.9±0.35 cm).

In the group of three-year-old girls, a significant difference was found in weight (p=4.36x10-9), higher than the table weight (14.8±0.6 kg) and in the BW (p=1.57x10-11), also higher than the reference values (48.9±0.21 cm). Three-year-old girls were adequate for their sex and age (p=0.56).

Girls in age group IV presented higher and significant values (p=6.8x10-8; p=0.001 and p=4.5x10-12) for weight, height and wor, respectively, when compared with the reference means (16.9±0.55kg; 1.05±0.12m and 49.6±0.16cm).

The results agree with the study conducted by the Ministry of Health (2022), which showed, when analyzing the temporal trend of overweight among preschoolers in the years 1989, 1996, and 2006, that there was a 160% increase in the prevalence of overweight children under 5 years of age, an average increase of 9.4% per year 30.

When comparing the mean weight of the girls in age group V with the reference values, it was observed that the mean weight found was significantly higher (p=1.76x10-7) than the reference weight (22.3± 4.8 kg); the same was true for height, i.e., the mean height of five-year-old girls was significantly higher (p=4.35x10-8) than the reference value (1,09). In the WC assessment, the girls

had WC values within the range recommended by the World Health Organization (WHO), as shown in Table 2 (47 to 52 cm).

Silva *et al.*. (2023) comment that the early onset of consumption of industrialized products with low nutritional value is a contributing factor to the development of unhealthy habits in childhood and reflect on the role of school, where children spend a substantial amount of time, in promoting healthy eating31.

Tables 9, 10, 11, 12 and 13 show the *r* values when associating Weight and WC, Weight and Height and WC and Height. Table 9 shows a strong correlation between the above-mentioned variables. Table 10 shows a weak positive correlation between WC and height and a strong positive correlation between WC and weight. In the qualitative evaluation of the 3-year-old girls, the group of 3-year-old girls showed *a* positive and very weak correlation between WC and weight and WC and height (Table 11). As can be seen in Table 12, 4-year-old girls showed a weak positive correlation between WC and weight and between WC and height. On the other hand, when analyzing the group of five-year-old girls, a strong positive correlation between WC and weight and a regular positive correlation between WC and height was observed (Table 13).

Table 9. Correlation between Weight, Height and WC of girls –1 year

	Weight	*Stature*	*PC*
Weight (Kg)	1		
Height (m)	0,78	1	
PC (cm)	0,67	0,64	1

Source: Authors (2024)

Table 10. Correlation between Weight, Height and WC of girls – 2 years

	Weight	*Stature*	*PC*
Weight (kg)	1		
Height (m)	0,66	1	
PC (cm)	0,61	0,42	1

Source: Authors (2024)

Table 11. Correlation between Weight, Height and WC of girls – 3 years

	Weight	*Stature*	*PC*
Weight (Kg)	1		
Height (m)	0,69	1	
PC (cm)	0,38	0,33	1

Source: Authors (2024)

Table 12 Correlation between Weight, Height and WC of girls – 4 years

	Weight	*Stature*	*PC*
Weight (Kg)	1		
Height (m)	0,73	1	
PC (cm)	0,496	0,469	1

Source: Authors (2024)

Table 13 Correlation between Weight, Height and WC of girls – 5 years

	Weight	*Stature*	*PC*
Weight (kg)	1		
Height (m)	0,79	1	
PC (cm)	0,69	0,56	1

SOURCE: AUTHORS (2024)

FINAL THOUGHTS

The objective of this research was to evaluate the neuroanthropometric indicators of the nutritional status of preschool children belonging to municipal daycare centers located in neighborhoods on the outskirts of the municipality of Alegrete, on the western border of the state of Rio Grande do Sul.

Thirteen daycare centers in the city of Alegrete were visited and weight, height and head circumference measurements were measured and correlated with 530 children, 277 girls and 253 boys aged between one and five years, with mean ages of 3.76 years and 3.96 years, respectively.

When analyzing the correlation between Weight and Height, in all age groups, both for girls and boys, a strong positive correlation was found, as established by the WHO, with the exception of five-year-old boys who were borderline.

Interestingly, important differences were found between boys and girls at all ages, such as at the age of one year.

While there was a strong positive correlation between BW and weight and between BW and height in the group of girls, the same did not occur with boys who showed a weak positive correlation.

At the age of 3 years, the opposite was found in one-year-old children, that is, now boys showed a strong positive correlation between BW and weight, but the same did not happen with girls who showed a regular positive correlation. At five years of age, there was again a weak correlation between WC and height and WC and weight for boys, and a strong correlation between WC and weight for girls.

An important point to be mentioned was the opportunity to carry out the evaluation of all children regularly enrolled and present on the day of visitation to the daycare centers, which contributes to the safe interpretation of the results, ensuring their power of generalization.

It is intended to continue the research by evaluating children from private schools and municipal schools of basic education, that is, the entire population of children from zero to five years and eleven months residing and regularly enrolled in schools in the municipality, expanding the age and making the sample size more robust, with a goal of one thousand children.

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