

Assessing schoolchildren's growth

Avaliação do crescimento de crianças escolares

Evaluación del crecimiento de los niños em edad escolar

Letícia de Lima Sudré Pereira¹ ; Juliana Maria Rego Maciel Cardoso¹ ; Carina Bulcão Pinto¹ ;
Italo Rodolfo Silva¹ ; Giovana de Oliveira Monteiro Queiroz¹ ; Thiago Privado da Silva¹ 

¹Universidade Federal do Rio de Janeiro, Macaé, Brazil; ¹¹Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil

ABSTRACT

Objective: to evaluate the growth of lower secondary school children at a public school in the town of Macaé, Rio de Janeiro. **Method:** in this quantitative, cross-sectional study of 217 schoolchildren between six and 14 years old, the data were analyzed using RStudio® software and Fisher's Exact Test was used, to a 95% confidence level. The research protocol was approved by the research ethics committee. **Result:** in the morning shift, the second year was found to have the highest proportion (90.48%) of children with weight appropriate to their age. In the afternoon shift, the highest proportion of children with BMI appropriate to their age was found in the first year (83.33%). A statistically significant difference in the relationship BMI-to-age was found between morning and afternoon fifth-year students (p-value of 0.0278). **Conclusion:** the results point to the need for nutritional and health guidance and education for children and their families, in order to foster growth more appropriate to their age. **Descriptors:** Pediatric Nursing; School Health Services; Child; Anthropometry; Child Development.

RESUMO

Objetivo: avaliar o crescimento de crianças do ensino fundamental matriculadas em uma escola pública no município de Macaé, Rio de Janeiro. **Método:** estudo transversal de abordagem quantitativa. Participaram da pesquisa 217 escolares com idades entre seis e 14 anos. A análise de dados foi feita pelo *software* RStudio® e o Teste de Exato de Fisher foi utilizado, considerando índice de confiança de 95%. Protocolo de pesquisa aprovado pelo Comitê de Ética em Pesquisa. **Resultado:** no turno matutino, identificou-se que o segundo ano apresentou uma maior proporção de crianças com peso adequado para idade (90,48%). No turno vespertino, a maior proporção de crianças com IMC adequado para idade está no primeiro ano (83,33%). Na relação IMC/idade, identificou-se diferença estatística significativa entre os alunos do quinto ano manhã/tarde (p-valor=0,0278). **Conclusão:** os resultados apontam a necessidade de uma orientação/educação alimentar e em saúde para as crianças e suas famílias, a fim de obter um crescimento mais adequado para a idade. **Descritores:** Enfermagem Pediátrica; Serviços de Saúde Escolar; Antropometria; Criança; Desenvolvimento Infantil.

RESUMEN

Objetivo: evaluar el crecimiento de niños en edad escolar matriculados en una escuela pública de la ciudad de Macaé, Rio de Janeiro. **Método:** estudio transversal con enfoque cuantitativo. Participaron en la investigación un total de 217 niños con edades comprendidas entre seis y 14 años. El análisis de los datos se realizó mediante el *software* RStudio® y se utilizó la Prueba Exacta de Fisher, considerando un nivel de confianza del 95%. El protocolo de investigación fue aprobado por el Comité de Ética en Investigación. **Resultado:** en el turno de la mañana se encontró que el segundo año tuvo mayor proporción de niños con peso adecuado para su edad (90,48%). En el turno de la tarde, la mayor proporción de niños con un IMC adecuado para su edad se encuentra en el primer año (83,33%). En la relación entre el IMC y la edad, se identificó una diferencia estadísticamente significativa entre los estudiantes de quinto año de la mañana/tarde (P-valor de 0,0278). **Conclusión:** los resultados apuntan hacia la necesidad de orientación/educación nutricional y en salud a niños y familias, para obtener un crecimiento más adecuado respecto a su edad. **Descriptores:** Enfermería Pediátrica; Servicios de Salud Escolar; Antropometría; Servicios de Salud Escolar; Desarrollo Infantil.

INTRODUCTION

It is known that school is an important context for education and citizenship development, where students relate to each other, to the teachers and to the community in the teaching and learning process. Thus, it is understood that it is a relevant space for human relationships that favors social, cognitive, physical and psychological development of children and young people.

This situation implies thinking of this space as a favorable context for health promotion actions. To such end, joint actions between the health and education sectors are necessary, in order for interdisciplinarity and integrality to be successful. From this perspective, the Health at the School Program (*Programa Saúde na Escola, PSE*) was established by Decree No. 6,286 on December 5th, 2007, as an intersectoral health and education policy, representing a strategy to face the vulnerabilities that affect children and young people in the public school network¹.

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Corresponding author: Thiago Privado da Silva. E-mail: thiagopsilva87@gmail.com
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In the scope of the PSE, actions to promote food and nutritional security, healthy eating and prevention of childhood obesity emerge as necessary and should be developed through shared management and planning between the health and education sectors¹. For this reason, children's anthropometric assessment at school is appropriate and emerges as a priority to guide the planning of actions involving this topic.

Anthropometric assessments in schoolchildren make it possible to evaluate infant growth, which can be understood as a human and continuous process and involves changes in body image and size^{2,3}. Such assessment is made through the relationship established between the anthropometric measures, namely: weight, cephalic perimeter and Body Mass Index. Monitoring these measurements is important in assessing the health conditions of children and young people in different care settings, including schools, by enabling the identification of abnormal growth patterns, as well as by supporting parents' understanding of healthy growth².

Regarding the aforementioned, a study conducted in Ethiopia with female adolescents enrolled in high schools from the city of Bahir Dar identified that the prevalence values for underweight, overweight and obesity were 15%, 8.4% and 4.7%, respectively. In this same study, there was high prevalence of overweight and obesity in the private schools, when compared to the public institutions⁴.

In Brazil, a study on infant malnutrition in the North region revealed that this area still presents high rates in terms of childhood growth deficits⁵. Malnutrition also persists in the African region, where 25 of all 47 countries in this area have high (>30%) or very high (>40%) chronic malnutrition rates with implications for health⁶.

On the other hand, it is noted that, at the global level, there are already more than 40 million children with excess weight, which represents a ten-million increase since 2000. In part, this reality can be the result of strong investments in industry marketing and of greater access to processed food products, associated to low levels of physical activity⁷. Regarding this aspect, the literature reveals the importance of adopting, both in the family and at school, measures to mitigate intensified consumption of high-calorie food products and with low nutritional values publicized in the media⁸.

Data from the National School Health Survey conducted with adolescents aged from 13 to 17 years old identified that, in the week prior to the survey, 32.8% of the schoolchildren consumed sweet treats, 28.8% ate vegetables and legumes, 26.9% dried fruits, 17.2% soft drinks, and 5.9% reported eating fast food three days or more⁹. These data are important because nutrition is one of the factors that condition children's growth^{2,3}.

Given the relevance of the issue for the promotion of children's health and the lack of epidemiological data revealing the growth of schoolchildren in the municipality of Macaé, this study aimed at evaluating growth in Elementary School children enrolled at a public school from the municipality of Macaé, Rio de Janeiro.

METHOD

A cross-sectional and descriptive study with a quantitative approach. The participants were schoolchildren enrolled in a school belonging to the public network from the municipality of Macaé, Rio de Janeiro. This school is part of the basic education network of the municipality of Macaé and offers Elementary Education to children in the morning and afternoon shifts, from first to the fifth grade, and children can choose to attend school in the morning or in the afternoon.

The inclusion criteria were as follows: age over six years old, being enrolled in the school where the study was developed, and being present in the classroom at the data collection moment. The exclusion criterion corresponded to children with special health needs.

The data were collected between August and December 2019. A schoolchildren's growth assessment form was used, prepared by the author himself and which was applied by the researchers in a school room exclusively intended for this purpose. The form consisted of the following data: name, date of birth, age, gender, grade and class, weight, height, Body Mass Index (BMI), weight categorization by age, height categorization by age, and Body Mass Index categorization by age.

The recommendations for the collection of anthropometric data in health services were followed, according to the Ministry of Health. The categorization of weight, BMI and height by age was performed based on the Z score^{9,10}.

After data collection and categorization of the children's weight, BMI and height by age, the data were submitted to the statistical analysis with application of Fisher's Exact Test. In Fisher's Exact Test, a 5% significance level (or 95% confidence level) was considered, observing the p-value, which when less than/equal to 0.05 reveals a statistically significant difference between the proportions compared. The test was used in order to identify if there was a

statistically significant difference between the study classes and shifts in terms of the classifications of the anthropometric measures. Data analysis was performed in the *RStudio*® software.

Regarding Resolution No. 466/2012 of the Ministry of Health, data collection was initiated after approval of the research project by the proposing institution's Research Ethics Committee. Initially, the child's parents or legal representatives received clarifications about the objectives, methodology and potential risks of the child's participation through a letter with information about the research. Those who consented to the child's participation were asked to sign the Free and Informed Consent Form in two copies, assuring them of their right to access the data and to refuse consent.

Subsequently, each child with an FICF signed was clarified details about the research and asked about their willingness to participate or not. For the children who agreed to participate in the research, the Free and Informed Assent Form was handed out by the executing team for signature collection. The aspects related to the children's anonymity will be considered in the presentation of the results.

RESULTS

Of all 123 students enrolled in the morning shift, 112 met the inclusion criteria. In the afternoon shift, 105 of all 114 enrolled students met these criteria. Consequently, 217 students aged between six and 14 years old participated in the study.

Table 1 shows the proportion of students from the morning and afternoon shifts considering the classifications resulting from the relationships established between the anthropometric measurements, namely: weight/age, height/age, and BMI/age. It is noted that, in this study, the growth assessment considering the weight/age relationship was possible by using the growth chart made available by the WHO, covering children from birth to ten years of age, which explains the absence of data from third grade on, where it was possible to find some children aged 11 years old.

TABLE 1: Proportion of students with adequate BMI, height and weight attending the morning and afternoon shifts. Macaé, RJ, Brazil, 2019.

(Grade / Shift)	Morning			Afternoon		
	Adequate BMI	Adequate Height	Adequate Weight	Adequate BMI	Adequate Height	Adequate Weight
1 st	75.00%	100.00%	85.00%	83.33%	100.00%	94.44%
2 nd	76.19%	100.00%	90.48%	54.55%	95.45%	81.82%
3 rd	53.85%	100.00%	--	63.64%	100.00%	--
4 th	45.83%	100.00%	--	52.17%	100.00%	--
5 th	38.10%	100.00%	--	75.00%	100.00%	--

In the morning shift, it can be identified that the highest proportions of children with adequate BMI for the age are found in second grade (76.19%) and in first grade (75.00%), respectively. The highest proportions of children with inadequate BMI for the age is in fifth grade (61.90%) and in fourth grade (54.17%), respectively. In this same shift, 100% of the children are with adequate height for the age, and second grade presented a higher proportion of children with adequate weight for the age (90.48%) when compared to first grade (85.00%).

On the other hand, in the afternoon shift it was possible to identify that the highest proportions of children with adequate BMI for the age are found in first grade (83.33%) and in fifth grade (75.00%), respectively. The highest proportions of children with inadequate BMI for the age are in fourth grade (47.83%) and in second grade (45.45%), respectively. In the same shift, only second grade presented a percentage of 95.45% of children with adequate height for the age, as 100% was identified in the other classes. In relation to weight, first grade (94.44%) presented a higher proportion of children with adequate weight than second grade (81.82%).

Table 2 shows the result of Fisher's Exact Test to identify the difference between the proportions of students with Adequate and Inadequate BMI for the age attending the morning and afternoon shifts.

TABLE 2: Difference between the proportions of students with Adequate and Inadequate BMI for the age attending the morning and afternoon shifts. Macaé, RJ, Brazil, 2019.

Relationship (Grade / Shift)	p-value*	CI (95%)	PR
1 st grade / Morning X 2 nd grade / Morning	1.0000	0.1759884 - 5.0049371	0.93900
1 st grade / Morning X 3 rd grade / Morning	0.2186	0.6210274 - 11.6228813	2.51876
1 st grade / Morning X 4 th grade / Morning	0.0685	0.8348875 - 16.2707175	3.44083
1 st grade / Morning X 5 th grade / Morning	0.0278	1.077411 - 23.518995	4.67299
2 nd grade / Morning X 3 rd grade / Morning	0.1376	0.6678944 - 12.3065767	2.68389
2 nd grade / Morning X 4 th grade / Morning	0.0664	0.897912 - 17.226974	3.66619
2 nd grade / Morning X 5 th grade / Morning	0.0278	- 1.15848 - 24.89637	4.97885
3 rd grade / Morning X 4 th grade / Morning	0.7775	0.3946544 - 4.8443235	1.36990
3 rd grade / Morning X 5 th grade / Morning	0.3806	0.3946544 - 4.8443235	1.86988
4 th grade / Morning X 5 th grade / Morning	0.7636	0.3581417 - 5.3643269	1.36527
1 st grade / Afternoon X 2 nd grade / Afternoon	0.0896	0.7922516 - 27.9107971	4.01895
1 st grade / Afternoon X 3 rd grade / Afternoon	0.2863	0.5276623 - 19.6049473	2.78414
1 st grade / Afternoon X 4 th grade / Afternoon	0.0505	0.8875243 - 30.2896087	4.41387
1 st grade / Afternoon X 5 th grade / Afternoon	0.2257	0.09277796 - 1.70844630	0.42451
2 nd grade / Afternoon X 3 rd grade / Afternoon	0.7597	0.172604 - 2.690955	0.69166
2 nd grade / Afternoon X 4 th grade / Afternoon	1.0000	0.2922349 - 4.1525983	1.09767
2 nd grade / Afternoon X 5 th grade / Afternoon	0.2087	0.08467576 - 1.75817405	0.40898
3 rd grade / Afternoon X 4 th grade / Afternoon	0.5499	0.4171928 - 6.2667151	1.58724
3 rd grade / Afternoon X 5 th grade / Afternoon	0.5143	0.1205583 - 2.6482851	0.59089
4 th grade / Afternoon X 5 th grade / Afternoon	0.2057	0.07817722 - 1.56723924	0.37248

*Fisher's Exact Test

Based on the data, it can be identified that there is a statistically significant difference for the Adequate BMI proportions for 1st and 5th grade in the morning shift (p-value=0.0278). Consequently, it can be asserted that 5th grade students are more prone to presenting inadequate BMI values than those attending 1st grade. It was also possible to notice a statistically significant difference for the inadequate BMI proportions in 2nd and 5th grade (p-value=0.0278). Consequently, 5th grade students are more prone to presenting inadequate BMI values than those attending 2nd grade. The other relationships were not significant, as their p-values were not lower than 0.05.

On the other hand, no relationship was statistically significant for the afternoon shift students, as none obtained p-values<0.05. This reveals that the BMI values across the grades are more homogeneous, and no statistically significant difference can be identified between the proportions of students with adequate BMI across the grades.

For the Adequate and Inadequate height for the age for the age categories, no statistical procedures were performed, as 100% of the morning shift students had adequate height for the age, regardless of the grade, and only one student from 2nd grade in the afternoon shift did not have adequate height for the age. This renders any statistical procedure unnecessary, as there is no observable difference between the proportions of the sample.

For the Adequate and Inadequate weight for the age categories, it was only possible to perform the hypothesis test for 1st and 2nd grade in the morning and afternoon shifts. It was verified that, for the students attending 1st grade/morning and 2nd grade/morning, there is no statistically significant difference in the Adequate and Inadequate weight for the age proportion (p-value=0.6628). The same happened with those attending 1st grade/afternoon and 2nd grade/afternoon (p-value=0.3555).

Table 3 shows that Fisher's Exact Test was also applied to identify possible differences between the proportions of Adequate and Inadequate BMI for the age, by relating the morning and afternoon shift students.

TABLE 3: Difference between the Adequate and Inadequate BMI for the age proportions for the students attending the morning and afternoon shifts. Macaé, RJ, Brazil, 2019.

Relationship (Grade / Shift)	p-value*	CI (95%)	PR
1 st grade / Morning X 1 st grade / Afternoon	0.6968	0.07978476 - 3.79983045	0.60805
2 nd grade / Morning X 2 nd grade / Afternoon	0.2027	0.6113919 - 12.5046738	2.60513
3 rd grade / Morning X 3 rd grade / Afternoon	0.5651	0.1770055 - 2.4604015	0.67235
4 th grade / Morning X 4 th grade / Afternoon	0.7732	0.2120166 - 2.8247942	0.77987
5 th grade / Morning X 5 th grade / Afternoon	0.0278	0.04251882 - 0.92815097	0.21400

*Fisher's Exact Test

It is observed that the proportion relationship between 5th grade/morning and 5th grade/afternoon resulted in p -value=0.0278. Thus, a statistically significant difference was identified between the students attending 5th grade in the morning/afternoon, as the p -value was lower than 0.05. Consequently, the students attending 5th grade in the morning shift tend to be more likely to having adequate BMI values for the age than those attending 5th grade in the afternoon.

Fisher's Exact Test was also used to identify possible difference between the proportions of Adequate and Inadequate BMI, considering the gender variable (male – adequate BMI: 63.93%; inadequate BMI: 36.07%; female - adequate BMI: 56.84%; inadequate BMI: 43.16%). In this study, gender does not seem to affect the chances of presenting adequate or inadequate BMI for the age (p -value=0.3273; 95% CI=0.4137949-1.3356809; PR=0.74400).

DISCUSSION

Growth assessments in schoolchildren are an important action strategy in school health that aims at monitoring children's growth. This assessment allows for early screening and identification of growth disturbances in children, as well as for appropriate interventions in order to avoid health situations that can impact adult life³.

In this study, growth assessment was performed with morning and afternoon shift children enrolled in a public Elementary School from the municipality of Macaé, Rio de Janeiro. It is noted that this is an action recommended by the Health at School Program, which also offers the municipality the possibility of joining the Growing Healthy Program, which aims at contributing to the prevention of childhood obesity in Brazil, through actions of nutritional surveillance, promotion of proper and healthy eating, encouragement of exercise and physical activity practices and actions aimed at providing care to children with childhood obesity¹.

In view of the above, the results show that, in the morning shift, it was identified that the highest proportions of children with adequate BMI for the age are as follows: 76.19% in second grade and 75.00% in first grade; whereas in the afternoon shift, the highest proportions of children with adequate BMI for age are as follows: 83.33% in first grade and 75.00% in fifth grade.

In the morning period, the highest proportions of children with inadequate BMI for the age are found in fifth grade (61.90%) and in fourth grade (54.17%), respectively; whereas in the afternoon period, the highest proportions of children with inadequate BMI for the age are in fourth grade (47.83%) and in second grade (45.45%), respectively.

The literature shows that nutrition is an important factor influencing growth, since excessive weight gain, which increases BMI, is associated with excessive consumption of calories². In addition to that, inadequate nutrition can result in the onset of malnutrition, overweight or obesity. In addition to reducing immunity, malnutrition can increase the risk of diseases such as anemia, rickets and alteration in brain development; whereas overweight and obesity increase the risk of diseases such as diabetes, high cholesterol, heart attack and cardiac diseases³.

Regarding adequate height for the age, only second grade from the afternoon shift showed a proportion of 95.45%. In the others, the proportion of children with adequate height for the age was 100%. In relation to weight, second grade from the morning shift was the one that presented the highest proportion of children with adequate weight for the age (90.48%), when compared to first grade. On the other hand, in the afternoon shift, first grade (94.44%) had a higher proportion of children with adequate weight for the age than second grade (81.82%).

A study that sought to learn about the progression of height and BMI in schoolchildren and adolescents from 1985 to 2019 in 200 countries and territories identified that the paths followed by height and BMI over age and time are highly variable across countries, indicating heterogeneity in nutritional quality, risks and advantages for health over the course of life¹¹. For example, this study found that, in some countries, five-year-old children started out with a healthier height or BMI than the global median, although they became progressively less healthy as their age advanced and did not grow as much in height, as was the case with boys in Austria and Barbados and with girls in Belgium and Puerto Rico.

It is acknowledged that weight, height and BMI are not only conditioned by the child's nutrition, but also by genetic and external factors such as formal education of the parents, access to health services, socioeconomic and demographic conditions, housing conditions, living area (rural or urban) and family size, among others^{4,12-14}. For this reason, looking at anthropometric data in isolation implies limiting the understanding of possible factors that may influence children's growth.

A study conducted in Ethiopia with adolescent female students enrolled in public and private schools identified that a high prevalence of overweight and obesity was found among private schools, and that adolescent girls with monthly family incomes above 6,500 Ethiopian birrs were 12.7 times more likely to be overweight than those with

monthly family incomes below 2,500 Ethiopian birrs (AOR: 12.7, 95% CI: 2.47-65.62). In that same study, female adolescents who ate meat twice or more times a week were 2.1 times more likely to be overweight than others (AOR: 2.07, 95% CI: 1.47-9.14); regarding excess weight control, it was found that it was low in the female adolescents that ate fruits at least once a week when compared to those who did not do so (AOR: 0.20, 95% CI: 0.05-0.78)⁴.

Using Fisher's Exact Test allowed identifying that the students attending fifth grade in the morning period are more likely to having inadequate BMI than those in first grade (p -value=0.0278) and in second grade (p -value=0.0278). On the other hand, the students attending 5th grade in the morning shift tend to be more likely to having adequate BMI values for the age than those attending 5th grade in the afternoon.

It is noted that the students attending fifth grade, both in the morning and afternoon shifts, are entering adolescence, a phase in which peer influence is greater than the parents'. Body image becomes a priority in this phase, and having inadequate BMI, be it due to thinness, overweight or obesity, can be a reason for social isolation with impacts on mental health.

A study conducted with adolescents in Amsterdam, Netherlands, identified that overweight or obese adolescents reported psychosocial problems and suicidal thoughts more frequently than those with adequate weight for the age¹⁵. In the same study, the associations between obesity and psychosocial problems (Indirect OR: 6.2; 95% CI: 2.8-14.7 and Direct effect OR: 1.4; 95% CI: 1.0-2.0) or suicidal thoughts (Indirect OR: 4.5; 95% CI: 2.3-9.1) and Direct effect OR: 1.5; 95% CI: 1.1-2.0) were even stronger¹⁵.

In addition, in this study, gender does not seem to affect the chances of presenting adequate or inadequate BMI for the age (p -value=0.3273; 95% CI=0.4137949-1.3356809; PR=0.74400). This result is in line with a study conducted with 3,798 adolescents attending school in Terengganu, Malaysia, which identified that there were no significant differences in the BMI status between boys and girls¹³.

On the other hand, this result is in line with a study conducted in Nigeria with 1,187 Elementary School children from semi-urban areas, which identified that overweight and obesity are associated with the female gender, with attending private schools, and to families with higher socioeconomic levels¹⁴.

Study limitations

It is acknowledged that the sample of this study is small and that other variables are necessary to better evaluate the anthropometric measures, considering the complex and multidimensional character involving infant growth. However, this study signals the need to invest in actions at the school where the research was developed, involving health promotion, diet guidance/education, exercise and practice of physical activity among children and their families.

CONCLUSION

The results of this study reveal that, although most of the schoolchildren presented important proportions of adequate weight and height for the age, the proportions of adequate and inadequate BMI for the age indicate variations in terms of school grade and shift. In the morning shift, the students attending fifth grade are more prone to presenting inadequate BMI for the age than those from first and second grade. In the afternoon shift, the BMI values across the grades are more homogeneous.

In addition, a statistically significant difference was identified among the students attending fifth grade in the morning/afternoon shifts, as the morning shift participants tended to present more chances of adequate BMI than those from the afternoon shift.

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