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Relationship between Motor Development and the Nutritional Status of Schools in a City of Vale dos Sinos Region, RS, Brazil

Relação entre o Desenvolvimento Motor e o Estado Nutricional de Escolares de uma Cidade da Região do Vale do Sinos, RS, Brasil

Rafael da Silva Selbach[a]; Diego Matheus Schaab*[a]; Denise Bolzan Berlese[a]; Gustavo Roese Sanfelice[a]

[a]Universidade Feevale. RS, Brazil
[b]Universidade Feevale, Stricto Sensu Graduate Program in Cultural Diversity and Social Inclusion. RS, Brazil
*E-mail: diego_schaab.sss@hotmail.com

Abstract

This descriptive, quantitative, and cross-sectional study aimed at the relationship between motor development and the nutritional status of schoolchildren aged eight to ten years from the city of Novo Hamburgo. One hundred forty-five students (80 boys and 65 girls) participated in the study, duly enrolled in the municipal school system, and belonged to different schools and regions of the same municipality. The study instruments used were Ulrich's Test of Gross Motor Development - Second Edition (TGMD-2) (2001), the Ministry of Health's food frequency questionnaire, and anthropometric assessments of weight, height, and body mass index (BMI). For data analysis, mean, dispersion measure, frequency and percentage were used. To compare the data, Student's t test was used with tabulation of primary data in the program SPSS 26.0. The results showed that there was no relationship between the nutritional status and motor development of those investigated. However, it was observed that there is a statistically significant difference regarding the time that students spend watching television. Thus, it is understood that the nutritional status is related to the prolonged use of screens, which leads to overweight and obesity and keeps students away from physical activities.
Keywords: Motor Skills. Nutritional Status. Child.

Resumo

O presente estudo descritivo, de caráter quantitativo e transversal, buscou a relação entre o desenvolvimento motor e o estado nutricional de escolares de oito a dez anos de idade, da cidade de Novo Hamburgo. Participaram do estudo 145 escolares (80 meninos e 65 meninas) matriculados na Rede Municipal de ensino que pertenciam a diferentes escolas e regiões do mesmo município. Como instrumentos de estudo foram utilizados o Test of Gross Motor Development – Second Edition (TGMD-2) de Ulrich (2001), o questionário de frequência alimentar do Ministério da Saúde e avaliações antropométricas de peso, estatura e o índice de massa corporal (IMC). Para análise dos dados, utilizou-se média, medida de dispersão, frequência e percentual. Para a comparação dos dados utilizou-se o teste estatístico t de Student com tabulação dos dados primários no programa SPSS 26.0. Os resultados apontaram que não houve relação entre o estado nutricional e o desenvolvimento motor dos investigados. Entretanto, observou-se que há diferença estatística significativa quanto ao tempo em que os escolares permanecem assistindo televisão. Desse modo, entende-se que o estado nutricional pode estar relacionado ao uso prolongado de tela, o que conduz ao sobrepeso e obesidade e afasta os escolares de atividades físicas.

Palavras-chave*: Destreza Motora. Estado Nutricional. Criança.*

1 Introduction

In recent years, childhood obesity has been the cause of numerous studies and concerns, since its association with metabolic changes such as hypertension, increased glucose and cardiovascular problems, previously reserved for adults, are now possible to be diagnosed in the younger age group.[1]

According to the Surveillance System of Risk Factors and Protection for Chronic Diseases by Telephone Survey[2] Brazil has been undergoing a nutritional transition process since 1975 with a sudden reduction in the rates of child malnutrition (from 19.8% to 7.6%), as well as an increase in adult obesity (from 5.7% to 9.6%).

Prevention of this disease extends to public health, where prevention is encouraged, since treatment at the early stage is less costly to the state. Thus, the fight against non-communicable chronic diseases (NCDs), such as obesity and overweight, should be initiated in childhood, with a view to mobilizing health policy makers, at high cost, the incipient strategies in the face of the awareness of healthy eating habits and the importance of physical activity.[3,4]

The post-industrial representative aspects point out that technological changes are influencing students to sedentary lifestyle due to the daily facilities that technology brings, such as elevators, escalators, remote controls, and the replacement of games and street games by electronic and computerized toys. These reasons contribute to the development of physically inactive children and adolescents and increase the prevalence of NCDs.[5]

In view of this, motor development is compromised, making it difficult to register children's motor behavior, especially in

children aged eight to ten years, who are at an exponential stage of motor development.[6] Thus, Batista *et al.*[7] pointed out that motor development, worked properly, contributes to the children's psychosocial aspects, promoting healthy habits, favoring the practice of physical activity, it also cooperates in results about the child's physical inactivity and supports a probability of an active and healthy adult life, reducing the risk of obesity and non-transmissible chronic diseases. In this perspective, investigating the child and relational motor development with nutritional status contributes to the great area of health, not only in the understanding of childhood transformations, but also helps to combat obesity in adult life.[8]

In this sense, the relationship between nutritional status and the motor development of 145 schoolchildren, aged eight to ten years, from the 2nd to the 5th year of elementary school, of both genders, duly registered in the Municipal Education Network of the city of Novo Hamburgo/RS, was investigated.

2 Material and Methods

The present study is characterized as descriptive, quantitative and cross-sectional. From this perspective, 145 schoolchildren aged between 8 and 10 years (80 boys and 65 girls) duly enrolled in the 2nd to 5th year in seven different schools of the Municipal School Network of New Hamburgo/RS were evaluated.

The city of Novo Hamburg is situated at Vale dos Sinos, about 40 kilometers from Porto Alegre, the capital of the state of Rio Grande do Sul. The municipality comprises an area of 223 km² and its population is estimated to be 246,452 inhabitants.[9] The city has 188 municipal schools, located in 10 large regions, districts and towns of the municipality: Canudos Leste, Canudos Oeste, Rondônia, Santo Afonso, Ideal, Boa Saúde, São José, Rosêlandia, Guarani and Centro.[10]

According to the City of Novo Hamburg Municipal Department of Education,[11] it is estimated that 24,296 children are regularly enrolled in elementary school from year 1st to 9th year, and 6,560 students are in the age range from 8 to 10 years of age.

Using a draw made by the "Names Draw" (*Microsoft*) software, which randomly selects the information presented, the following regions/districts in the city of Novo Hamburg/RS have been selected: Canudos Leste, Canudos Oeste, Rondônia, Roselândia, Ideal, Centro and Guarani. From that, a school was randomly selected in each area, through the same program, to perform the research.

As one of the instruments of the study *Test of Gross Motor Development – second Edition* (TGMD-2) protocol was used, which consists of a normative evaluation of the common global motor skills and which is divided into two types of evaluation:

1. Locomotor evaluation: running, galloping, 1 foot hop, stride, horizontal jump and horizontal running;
2. Evaluation with object control: striking, bouncing , catching, kicking, overarm throwing and rolling the ball underneath.

The development of each child was recorded with the help of an *Epson HD20* digital camera for further analysis. All tasks had points and criteria for their development regarding the movement qualitative investigation. The school that fulfilled the task specifications received 1 point, those that did not fulfill the parameters, received zero. Thus, the sum of the points in each subtest was acquired, totaling the gross scores.

The Ministry of Health's food frequency questionnaire based on the "Ten steps to healthy eating" was also used as a study tool.[12] It contains 17 questions about how many times a week students consume a specific food and what meals the respondent have each day.[13] The data were collected between February and March 2020.

In addition, anthropometric measurements of weight and height were carried out with the support of a digital scale with precision of 100 g, *a® Leader* model, a *Tonelli®* stadiometer, fixed in a wall without a footer. The students were evaluated with as little clothing as possible, barefoot and without head extras, according to the methodology proposed by Sangali *et al.*[14].

The data were analyzed by calculating body mass index (BMI) and classified by z-score, according to World Health Organization growth curves.[15] The children who presented score-z of >score-z +1 and ≤ score-z +2, obesity, >score-z+2 and ≤ score-z + 3, eutrophy, >score-z -2 and ≤ score-z + 2 and thinness, ≥ score-z – 3 and < score-z – 2.

For weight collection, the children remained standing on the scale platform, with their arms along the body, in a quiet attitude. Weight was recorded in kilograms (kg) and grams (g). The value found was recorded in a record sheet.

At height collection, children stood on a wooden surface, back to the metric scale, parallel feet, ankles joined and arms loose along the body. With the hand under the child's chin, the head was positioned so that the lower part of the eye orbit remained on the same plane as the outer hole of the ear. The cursor was fixed, and the ruler was read up to the nearest millimeter, and the score was recorded.

The tests were applied in the second shift, so that students would not miss any moment of class. In addition, the guardians were aware of each phase of the motor test, as explained in advance in a meeting marked by the policy team of the schools selected for the study.

All evaluations were carried out after the signing of the Consent Term for Minors, by parents and/or guardians, according to the provisions of Resolution 466 of December 12th of 2012, of the National Health Council.[16] The participants received information regarding their right to participate, as well as guarantees of anonymity. The study was approved by the Research Ethics Committee under number: 27001419.7.0000.5348.

For data analysis, mean, dispersion measure, frequency and percentage were used. To compare the data, Student's t test was used with tabulation of primary data in the program SPSS 26.0.

3 Results and Discussion

Motor development of 145 schoolchildren (80 boys and 65 girls) who participated in the study was evaluated using the TGMD-2 protocol and the classification of nutritional status of the respondents. In this sense, the mean locomotor, manipulative, general motor quotient and BMI according to sex are presented in Table 1.

Table 1 – Classification of nutritional status of the 145 investigated according to BMI and motor development according to gender

Variables	Male	Female	*p*
	Mean ± SD	Mean ± SD	
Locomotor development	30.45 ± 4	29.37 ± 5	*0.1*
Manipulative development	30 ± 4	30.48 ± 4	*0.6*
General motor quotient	60.24 ± 8	59.85 ± 8	*0.6*
Body Mass Index(BMI)	21.9 ± 5	19.64 ± 4	*0.1*

Student's t test. Significant difference when $p \leq 0.05$.
Source: Research data.

Table 1 shows that, when compared by gender, the schoolchildren investigated did not present statistically significant differences in relation to the variables of locomotor, manipulative development, general motor quotient and BMI. Regarding the mean presented by the students investigated for both genders regarding motor development, they presented very poor motor development, according to the TGMD-2 protocol (male gender 60.24 ± 8; female gender 59.85 ± 8). The mean BMI of the schoolchildren was overweight (Z score above 1), being above the body mass established for age (8, 9 and 10 years) and gender (WHO, 2007).

Corroborating the results of our study, Duarte *et al*. [17] analyzed the motor development and nutritional status of 1,387 9-year-old schoolchildren in the city of Manaus/AM. Motor development was evaluated through TGMD-2 and nutritional status was assessed using anthropometric measurements. The boys presented a higher prevalence of overweight comparing to the girls (22.8 ± 4; 17.63 ± 5, respectively). However, boys obtained better means than girls regarding motor development (58.14 ± 6; 55.43 ± 6, respectively). Thus, it is concluded that nutritional status did not influence the motor performance of the assessed schoolchildren, since there were no significant differences in the tests applied.

Melo et al.[18] classified the nutritional status and motor development of 110 schoolchildren, being 60 boys and 50 girls from the city Caetés/PE. Motor development was evaluated through TGMD-2 and nutritional status was assessed using anthropometric measurements. The prevalence of eutrophy corresponded to 82%, followed by overweight with 14% and thinness with 4% of the total sample, generating a means of 18.4 ± 3 for male and 15.33 ± 3 for female. Regarding motor development, the general motor quotient of both genders was 55.24 ± 5 (male) and 51.22 ± 5 (female).

In line with the results presented in the study herein, in Germany, Candéa[19] investigated the classification of motor development with the nutritional standard of 450 schoolchildren according to gender, 240 boys and 210 girls. TGMD-2 and BMI calculation were used as study instruments. The mean values obtained in the locomotor development were 33.5 ± 4 (male) and 20 ± 4 (female), indicating that boys have greater locomotor involvement than girls. Regarding the manipulative means, 30 ± 3 (male) and 31 ± 4 (female), the results showed that girls have greater potential in manipulative abilities. Whereas the mean nutritional status indicated a predominance of overweight, 23.21 ± 4 (male) and 20.65 ± 5 (female). The authors concluded that the students had a very poor motor development and that the prevalence of overweight is related to this result.

Piola et al.[20] verified the correlation between the nutritional status of 56 students, 30 boys and 26 girls, from 8 to 10 years of age in the city of Londrina/PR. The nutritional status indicator used was BMI and TGMD-2 was used for motor development. As a result, it was obtained the general motor quotient of 59.13 ± 5 (male) and 54.23 ± 4 (female), and BMI of 26.3 ± 3 (male) and 24.43 ± 4 (female), with a significant difference of $p<0.05$. The results pointed to a correlation between nutritional status and motor development, suggesting new investigations, including other behavioral variables that may influence BMI and motor development.

Dornelles *et al.*[21] classified the BMI and motor development of 64 students aged between 9 and 10 years of age, of both genders, in the city of Porto Alegre/RS. For the study development, TGMD-2 was used as a parameter for the motor development classification and, for nutritional status, BMI calculation. The results showed that both groups presented poor motor development, 61.9 ± 4 (male) and 55.57 ± 3 (female), and presented body mass above the normative values 28.2 ± 4 (male) and 26.23 ± 3 (female). It was concluded that physical activity and nutritional status may influence the children's physical fitness and motor development.

Oliveira et al.[22] investigated the nutritional status and motor development of 300 schoolchildren, 150 boys and 150 girls aged 9 years in the city of Patos/PB. For nutritional evaluation, anthropometric assessments were used and, for motor development, TGMD-2 was used. Regarding motor development, the authors observed the values 57.6 ± 4 (male) and 56.43 ± 4 (female). In addition, the same showed to be overweight, 29.3 ± 3 (male) and 28.33 ± 2 (female), with a significant difference of $p<0.05$.

Therefore, it is important to highlight the monitoring of the children's motor development and nutritional status in the school environment, since these indicators demonstrate the incidence and prevalence of overweight and obesity in Brazilian schoolchildren, as well as the influence of quality of life among schoolchildren.[23]

After demonstrating the classification of the motor development and BMI of the schoolchildren investigated and identifying a possible cause/effect, table 2 shows the comparison of the motor development classification with the anthropometric classification of the schoolchildren investigated.

Table 2 - Comparison of motor development classification with anthropometric classification of the 145 schoolchildren investigated

Variables N (%)		Very Poor N (%)	Poor	p
Anthropometric classification		134 (94)	9 (6)	0.1
Malnourished	13 (9)	0 (0)		
Eutrophic	57 (42)	6 (67)		
Overweight	24 (18)	3 (33)		
Obese	42 (31)	0 (0)		

Chi square test. Significant difference when $p \leq 0.05$.
Source: Research data.

It is observed in Table 2 that the comparison between motor development and anthropometric classification of schoolchildren does not present a statistically significant difference in relation to the variables. In this segment, the students verified demonstrated similar motor opportunities in their daily life, as well as seemed to be having an approximate number of meals.

Corroborating the results of this study, Miranda et al.[23] assessed the motor development and nutritional status of 380 schoolchildren aged eight to 10 years in Florianópolis/SC, using TGMD-2 and anthropometric measurements. It was observed that there was no significant difference between genders in locomotor manipulative abilities. Regarding nutritional status, 86% of the sample was eutrophic and 14% overweight. In addition, there was no association between nutritional status and motor development between the two groups, which leads us to realize that nutritional status did not influence the motor development of the evaluated schoolchildren.

Frônio *et al*.[24] and Pazin et al.[25] verified it there was an association between motor development and nutritional status in schoolchildren aged seven to 10 years using TGMD-2 and anthropometric measurements. The results showed that the students studied presented their motor development very poor, with a significant difference ($p \leq 0.03$) in locomotor abilities. Thus, obese children do not have adequate motor stimulation for their development, demonstrating that obesity seems to be negatively associated with motor development.

Em Catanduva/SP, Biscegli *et al*.[26] compared the nutritional status and motor development of 113 schoolchildren, being 56 boys and 57 girls. Nutritional assessment was performed using BMI and motor development evaluation by means of TGMD-2. Among the children studied, 12% of acute malnutrition, 1% of past malnutrition and 16% of obesity were observed. The motor tests pointed to poor engine development for all the respondents. As a result, the high prevalence of nutritional disorders and possible delays in motor development were observed, which are related to socioeconomic factors, hindering the child development of these children.

Contreira *et al.*[27] investigated the relationship between motor development and nutritional status of schoolchildren aged 8 to 10 years in the city of Florianópolis/SC. 270 schoolchildren, 145 boys and 135 girls participated in the study. Motor development was evaluated using TGMD-2 and BMI was calculated for the assessment of nutritional status. Most of the participants presented eutrophic status, 98% of the sample, and only 2% of overweight regarding motor development; 98% presented poor motor development and 2% very poor. Based on the results, it was verified that the higher the BMI, the worse the motor performance, since only overweight students demonstrate a very poor motor development.

Nascimento *et al*.[28] assessed the motor development and nutritional status of 80 schoolchildren aged eight to 10 years in Belo Horizonte/MG, using TGMD-2 and anthropometric measurements. The students presented medium motor development and, also, mostly was in an eutrophic state, with some exceptions. As a result, there was a difference ($p \leq 0.05$) in locomotor and manipulative abilities, with a worse motor performance presented by students with a higher BMI index. In addition, the higher the BMI of schoolchildren, the worse the performance in balance.

Thus, such investigations point to aspects related to the health of the studied environment and possible drawbacks inherent to obesity. Such evaluations form important components that will help in the awareness and interventional actions associated with child motor development.[29]

In order to understand the high means of eutrophication and overweight seen in Table 2, the study will present in Table 3 the comparison between nutritional status and leisure time use of the respondents.

Table 3 – Comparison between nutritional status and leisure time use of the 145 respondents

Use of Leisure Time	No Time Watched N (%)	1 to 9 hours Watched N (%)	*p*
Watching TV	N (36)	N (109)	*0.03**
Malnourished	4 (11)	9 (8)	
Eutrophic	18 (50)	45 (42)	
Overweight	5 (14)	22 (20)	
Obese	9 (25)	33 (30)	
Playing video game	N (83)	N (62)	*0.2*
Malnourished	8 (9)	5 (8)	
Eutrophic	39(47)	24 (39)	
Overweight	13 (16)	14 (23)	
Obese	23 (28)	19 (30)	
Using the computer	N (104)	N (41)	*0.4*
Malnourished	9 (9)	4 (10)	
Eutrophic	44 (42)	19 (46)	
Overweight	21 (20)	6 (15)	
Obese	30 (29)	12 (29)	
Using cell phone	N (39)	N (106)	*0.4*
Malnourished	3 (8)	10 (10)	
Eutrophic	17 (44)	46 (43)	
Overweight	8 (20)	19 (18)	
Obese	11 (28)	31 (29)	

Student's t test. Significant difference represented by asterisk (*) when $p \leq 0.05$.
Source: Research data.

It is observed in Table 3 that when comparing nutritional status and leisure time use of the investigated, the students presented significant statistical difference in relation to the time they watch television ($p \leq 0.03$). In this sense, it can be said that the high overweight rates are related to the large number of hours that students spend sitting in front of television. Corroborating the results herein, Fidencio *et al.*[30], França *et al*.[31], Machado and Lavrador [32] and Maia *et al*.[33], upon verifying out how long students spend in front of the screen, they also found a significant statistical difference. In the same way as this study, the authors stated through their results that there is an interrelation of screen time with nutritional status, since the more electronic devices are used, the higher the prevalence of overweight and obesity is.

In Bento Goncalves/RS, Mas, Bernardi and Possa[34] investigated the habit of watching television and its relationship with overweight in 154 students aged 6 to 10 years. As an instrument of the study, they used a questionnaire to obtain food, demographic and television data. Anthropometric measurements were also obtained. Of those investigated, 78.7% of them were classified with four or more hours of daily television, 42.6% with excess weight and 7.4% with excess abdominal adiposity. As a result, there was no significant difference ($p \leq 0.08$). However, even without significant difference, the investigated children presented overweight and upper abdominal adiposity in children who watched television ≥ 4 hours when compared to children who watched < 4 hours (87.5% vs. 12.5%; 100% vs. 0%; respectively).

Fidencio *et al.*[30] analyzed the association between screen consumption and nutritional status of 174 schoolchildren from a private school in Joinville/SC. The participants were evaluated in relation to the anthropometric indicator (BMI/age), to food consumption, through a Food Frequency questionnaire, and to screen consumption time. It was observed that about 89% of the respondents are overweight, 2% obese and 9% eutrophic, as well as 51.06% of the students investigated spent more than three hours watching television, playing video games or surfing the Internet. Thus, the results indicate that the large number of hours that students consume on a daily basis is directly related to the high overweight index of this region.

In line with the results presented in this study, in Suzano/SP, França *et al*.[31] verified the association of nutritional status with video game time of 164 students from 8 to 10 years of age. Anthropometric variables and time of game were verified. In girls, there was a higher prevalence of overweight (39.53%), whereas obesity was higher in boys (14.1%). About the time playing video games, 26.92% of boys spend more than 2 hours playing daily, while only 11.62% of girls play more than two hours. Therefore, there was a higher prevalence of overweight in females and obesity in males. As a result, there was a significant difference ($p \leq 0.02$) in the correlation between the time of gameplay and BMI for females.

Grilleo *et al.*[35] assessed the nutritional status related to the time of computer use in 121 schoolchildren aged 9 to 10 years of age in the public network of Balneario Piçarras/SC. Through the mental recollection, it was possible to stipulate the quantity of daily hours that students use the computer. The nutritional assessment was performed by means of BMI and waist circumference. The predominant nutritional status was eutrophy (77%) followed by overweight (23%). The average of screen time on weekdays, weekends and daily was 4.8 hours. There were no significant differences in nutritional status between genders ($p \leq 0.06$), however, the boys presented higher waist circumference. In conclusion, the time that the respondents spend using the computer was not significantly associated with nutritional status.

Still in line with the results herein, Machado and Lavrador[32] assessed the nutritional status associated with the screen time of 276 students of 10 years of age in the city of Fortaleza/CE, through a semi-structured questionnaire. Nutritional assessment was performed using BMI. The results pointed that there was an interrelation between screen time and nutritional status, since the higher the use of electronic equipment, the higher the prevalence of overweight and obesity, generating a significant difference ($p \leq 0.03$) among the respondents.

Maia *et al.*[33] investigated the association between nutritional status and cell phone use in 179 schoolchildren aged 8 to 10 years, according to sex, in Porto Alegre/RS. As a study tool, mental recollection was used to stipulate the quantity of weekly hours that students use the cell phone and also if they ate some food in the meantime. BMI was used to determine nutritional status. The prevalence of excess weight in the sample was 34% for boys and 69.6% for girls. The average time spent using the cell phone by the students was 3 hours daily, regardless of the day of the week. However, only in the time of the weekends, there was a direct association with the increase in BMI, and only in those days did the students eat some food when they were using the cell phone. The results pointed that the excess weight of the students evaluated was associated with the time of cell phone use on the weekends, since about 97% of the sample consumed some food during this period while using the device, resulting in a significant difference of $p \leq 0.05$.

Therefore, the dynamics of motor development monitoring and nutritional status of children in the school environment make it possible to observe and analyze indicators, prevalence rates, as well as to expose the issues to be worked on, promoting an association between nutritional status and the motor development of schoolchildren.[31]

4 Conclusion

Upon associating the nutritional status and the motor development of 145 schoolchildren, aged eight to ten years, from the 2nd to the 5th year of elementary school, of both genders, duly registered in the Municipal Education Network

of the city of Novo Hamburgo/RS, it was evidenced that there is no association between the nutritional status and the motor development of the respondents.

However, when the nutritional status is associated with leisure time activities, it was observed that there is a statistically significant difference as to the time when school children stay watching television. Therefore, it is understood that nutritional status may be associated with prolonged use of screen, which leads to overweight and obesity and moves schoolchildren away from physical activities.

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