Association between nutritional status and physical activity in Municipal Schools in Corumbá – MS

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ABSTRACT

A sedentary life style is a factor of risk for the development of overweight and childhood obesity, conditions associated with dyslipidemia, arterial hypertension and insulin resistance, among other disorders. The objective of this study was to evaluate the nutritional status and the association with the profile of physical activity in Municipal Schools in Corumbá – MS. A cross-sectional study was carried out in a sample of 403 pupils, aged 7-10 years, in which children with Body Mass Index (BMI) values $\geq$ 85th and < 95th and $\geq$ 95th percentile were classified in risk of overweight and overweight, respectively. The index of physical activity was determined by a specific questionnaire for the study, to obtain data about duration (minutes), intensity (metabolic equivalent) and energy expenditure (kcalories) of both active and sedentary physical activities. A prevalence of 6.2% e 6.5% to risk of overweight and overweight, respectively, was verified, with higher prevalence in girls than in boys. Most physical activities performed by children were light (< 3 METs) and moderated (3 a 6 METs); no vigorous (> 6 METs) physical activity was recorded. The older the children, the lesser the time spent in active physical activities. Normal-weight children are more active, practice more intense physical activities and spend less time watching television and playing video-games than overweight children. The data emphasize the importance of promoting changes in the life-style through the introduction of healthy habits, since infancy, and their maintenance for the whole life. Active children favor an active healthy adult population too, which can contribute, consequently, for a reduction in the incidence of morbidity and mortality at adulthood.

Keywords: Nutritional status. Physical activity. Body composition. Overweight.

INTRODUCTION

Sedentarism has an important role in the childish overweight and obesity development[1-3], increasing the body fat levels[4,5] and exposing obese children to a higher risk of hypercholesterolemia (increasing LDL-cholesterol levels in the serum) compared to non-obese children[6]. When present since early ages, obesity contributes for an increasing prevalence of the adult's morbidity and mortality[7].

The physical activity is a protective factor against obesity and overweight. More active children present lower body fat percentage[8], as well as lower values of the Body Mass Index (BMI)[9]. Compared to non-obese children, obese children are less active and participate less in moderate and/or intense activities, with predominance of low intensity activities[10,11]. However, when it is considered that the chance for an obese child to be less active is twice higher than a normal weight children[12], this reinforces the hypothesis that the body's fat can determine the level of the physical activity in obese children[2], and to make difficult to control the excessive body's fat. This means that those children are less active than the obese ones, rather than being obese simply because they are less active. But it is worthy to mention the importance to practice physical activities, once active children from early ages are more likely to remain active in the adult age[9].

To fight against sedentarism is the main focus in the interventions directed to children when treating and controlling the obesity, and it is necessary to raise data to fundament the application of appropriate educational politics to the population. The purpose of this study was to assess the nutritional state and the association to the physical activity pattern in 7 to 10 years old students from the Corumbá City's (MS) schools.

METHODOLOGY

It was performed a cross sectional study comprising 403 students aging from 7 to 10 years old from the 1st to the 4th grade of both genders from the Corumbá City's schools (MS), which has 14 schools located in the urban area with 5,074 students, according to the City's Secretary of Education. The schools and students were randomly selected. The city was subdivided in four areas as per their geographic location: three peripheral schools, and one from the central area of the city, in which it was observed a higher acquisition power than in other areas. It selected a school from each area, amounting four schools. The same procedure was adopted to choose the classes. The research was performed in one class of each of the scholar grades (1st, 2nd, 3rd, and 4th) from each school, totalizing four classes per school. The amount of students in each school was representative of the amount of students enrolled in each area.

The research project was approved by the Ethics Committee of the Viçosa Federal University. Before starting the data collection, the school board and the children's parents or caretakers were informed on the purposes and utility of the research. The children participated voluntarily in the research, and their participation was duly approved by their parents or caretakers, following the Rules of the Guidance to Research Involving Human Beings from the National Health Council[13]. The data collection started only after obtaining the consent from the children and their parents or caretakers, and within a total period of four months the research was performed in two steps: along October and November, 2003 two of four selected schools were analyzed for the study, and in February and March, 2004, the two remaining schools were assessed. For each school, the mean time spent was four to five weeks.

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The size of the sampling was set according to the Lwanga and Lemeshow proposal[14], with 10% of maximal overweight frequency expected for the age level to be assessed (7 to 10 years old), taking as reference, recent national studies performed by Balaban and Silva[15], Abrante *et al.*[16], and Leão *et al.*[17]. The confidence interval was 95%, and the minimal sampling set for the study was 140 children.

The anthropometric measurements were performed at the school. The body weight (kg) was set on an electronic digital scale. A stadiometer was used to measure the height (cm). The waist circumference (cm) was measured around the lower curvature located between the iliac crest and the ribs with an inextensible metric band[18,19]. The tricipital cutaneous folds (TCF) and the subscapular cutaneous folds (SCF) were attained using a Langer caliper (± 1 mm). The techniques employed for the anthropometric measurements were described by Jelliffe[20]. The fat percentage (%F) was estimated from the sum of both cutaneous folds using the predictive equation proposed by Lohman (1986), and used by Cintra *et al.*[21]: **%F = 1.35 (Triceps + Subscapular) – 0.012 (Triceps + Subscapular)² – C**, where: **C** is a constant differentiated by the age and gender. In male individuals, C is equal to 3.4 (7 to 9 years old), and 4.4 (10 years old); in female individuals, the corresponding values are 1.4 and 2.4, respectively. For the obesity prevalence related to the %F, a larger than 30% cut spot was used, according to the definition suggested by Cintra *et al.*[21]. The classification of the nutritional state was set by the revised BMI/age curve from NCHS/CDC[22], according to the following cut spots: low weight for a < 5 percentage; eutrophia for ≥ 5 and < 85 percentages, overweight risk of ≥ 85 and < p95 percentage, and overweight for ≥ 95 percentage.

The Physical Activity index was set from a questionnaire based on different physical activity questionnaires[23], with the purpose to record the physical activities along a usual week. They are: displacement to the school on foot or by bicycle, playing, practicing formal physical exercises (swimming, ballet, soccer, etc.), performing housekeeping tasks, day and night sleeping hours, watching TV and/or playing videogame, studying and/or reading, and time spent at school (classroom, recreation, and Physical Education classes). The questionnaire was applied to the students' mothers in the same period the anthropometric measurements were made, but separated from each other: children's during the classroom, and mothers' in a prescheduled time, and according to their availability. Only 20% out of all mothers did not answer to the questionnaire.

The activities were classified according to their Metabolic Equivalent (MET), following the Physical Activities Compendium[24,25], and assessed as to their duration (minute/day) and intensity (MET/day). For the minute/day unit, it was summed up the time spent along seven days of the week, and later, the mean was calculated in minute/day.

From that result, the MET value was multiplied by the activity, in order to attain the MET/day unit for each physical activity contained in the questionnaire. With the information related to the duration (minute/day) and value in MET/day for each activity, and considering that 1 MET corresponds to 1 kcal/kg/hour, it was estimated the daily energetic expenditure (Kcal/day) related to the recorded activities, applying the equation below[25,26]:

$$\text{Kcal} = \frac{\text{MET x time of the activity (minutes/days) x body weight (kg)}}{\text{60 minutes}}$$

From these results, the activities were divided in two new groups: Total Physical Activity (TPA), and Specific Physical Activity (SFA). To the TFA, only those activities that better expressed the children's life-style and that would differentiate them were considered: displacement to the school (on foot or by bicycle), playing, and/or practicing formal physical exercises and watching TV and/or playing videogame.

As to the type of activity categorized by its specific MET, every physical activity was gathered according to the classification proposed by Pate *et al.*[27]: mild activity (< MET or < 4 kcal/min), moderate activity (3 to 6 MET, or 4 to 7 kcal/min), and vigorous activity (> 6 MET or > 7 kcal/min).

The statistical analyses were performed on the Epi-Info, SAEG and SAS software. It was calculated the Prevalence Ratio, with 95% confidence interval (CI) for the BMI and gender associations. The Pearson Correlations (r) were performed between the Physical Activity and anthropometric measurement variables. An exploratory analysis was performed, having the Nutritional State as independent variable, and the Physical Activity and anthropometric measurements as dependent variables both in the male and female groups. Later, it was applied the Tukey Test to make a comparison between means. In a second step, it was adopted as independent variables the Nutritional State, the School and the Gender. The Age was considered a continuous co-variable, and the Specific Physical Activity was considered a dependent variable. To the significant effects, it was applied in the means the *t* Student test, adjusted by the minimum square method. For those variables that presented a significant effect in function of the age, it was estimated the Linear Regression equation. For every analysis, it was fixed the 5% rejection level of the null hypothesis ($p < 0.05$).

RESULTS

From 403 students, 54.1% were male (218), and 45.9% were female (185) with mean age equal to 8.8 ± 1.12 years. It was verified a 12.7% prevalence for the overweighted population (6.2% with risk of overweight, and 6.5% overweighted), with 39% higher prevalence among female than in male individuals; 78.2% of the children was eutrophic, and 9.2% were underweighted. It was verified that 9.4% children (n = 38) had higher than 30% body fat percentage, and from that amount, 60.5% (n = 23) were female, and 39.5% (n = 15) were male, with no statistically significant differences between genders, but with higher values in girls than in boys. The %F and WC* mean had a progressive increase, and with statistically significant differences between classroom and nutritional state (table 1).

TABLE 1
Percentage of fat and waist circumference according to the gender and nutritional state represented by the mean (x) and standard deviation (SD) in students from the Corumbá City Schools-MS

Nutritional state	Boys (218) x ± ST	Girls (185) x ± ST
	Fat percentage (%F)	
Low weight*	9.48 ± 1.99 (a) n = 15	14.79 ± 2.68 (a) n = 22
Eutrophic*	13.69 ± 3.49 (b) n = 182	19.65 ± 4.63 (b) n = 133
Overweight risk*	25.39 ± 4.09 (c) n = 8	29.15 ± 3.63 (c) n = 17
Overweight*	31.29 ± 3.11 (d) n = 13	34.48 ± 2.68 (d) n = 13
	Waist circumference (cm)	
Low weight	52.50 ± 1.87 (a)	51.65 ± 2.28 (a)
Eutrophic	56.67 ± 3.36 (b)	57.22 ± 4.69 (b)
Overweight risk	66.29 ± 2.37 (c)	65.58 ± 5.14 (c)
Overweight	76.87 ± 7.99 (d)	78.20 ± 8.36 (d)

Same letters = equal means; different letters = different means (statistics related to the column); * $p < 0.05$ (statistics related to the line).

* Waist circumference.

The %F had a strong correlation to the BMI and the WC in both genders of the group as a whole (table 2). There was a weak correlation between the %F, BMI, WC and the variables of the physical activity both related to the duration (minute/day) and to the intensity (MET/day) of the activities, thus evidencing the negative correlation between the active physical activities and the positive correlation to the sedentary physical activities (television and/or videogame) (table 3).

TABLE 2
Pearson Correlation (r) between BMI, fat percentage and waist circumference, according to the gender in students from the Corumbá City Schools-MS

Variables	Male	Female	Total
BMI x %F	0.87*	0.86*	0.81*
BMI x WC	0.93*	0.95*	0.94*
%F x WC	0.84*	0.86*	0.79*

* p < 0.01; WC = waist circumference; %F = fat percentage.

TABLE 3
Pearson correlation (r) between anthropometric and physical activities variables, according to the gender in students from the Corumbá City schools-MS

Variables	M	F	T	Variables	M	F	T
BMI x TVmin	0.11	0.07	0.09	WC x Dmin	–0.11	–0.18**	–0.15*
BMI x Dmin	–0.15	–0.19**	–0.17*	WC x BRmin	–0.03	–0.07	–0.05
BMI x BRmin	0.002	–0.05	–0.02	WC x BRmet	–0.05	–0.06	–0.06
BMI x BRmet	–0.03	–0.03	–0.04	WC x Dmet	–0.10	–0.14	–0.12**
BMI x Dmet	–0.14	–0.16**	–0.15*	WC x TVmin	0.10	0.10	0.10
%F x Tvmin	0.17**	0.07	0.09	TVmin x Dmin	–0.21*	–0.01	–0.12**
%F x Dmin	–0.13	–0.15	–0.16*	TVmin x Dmet	–0.21*	–0.01	–0.12**
%F x Brmin	–0.06	–0.01	–0.06	TVmin x BRmin	–0.57*	–0.59	–0.57*
%F x Brmet	–0.07	–0.02	–0.12**	TVmin x BRmet	–0.55*	–0.52*	–0.52*
%F x Dmet	–0.11	–0.12	–0.15**	–	–	–	–

* p < 0,01 and **p < 0,05; M = male; F = female; T = total; Dmin = displacement to school (minute/day); Dmet = displacement to school (MET/day); BRmin = playing and/or exercises (minute/day); BRmet = playing and/or exercises (MET/day); TVmin = watching TV and/or videogame (minute/day).

As to the active physical activities (displacement to the school and playing and/or practicing formal exercises), it was verified a mean amount of 2.6 hours/day for males, and 2.4 hours/day for females. As to sedentary physical activities (watching TV and/or playing videogame), the mean was equal to 2/6 hours/day, and 2.5 hours/day in boys and girls, respectively. The physical activities practiced by children were in the majority mild activities. There were few moderate activities and no vigorous activity.

Eutrophic children had more displacement than overweighted children (table 4). There was no significant difference related to the MET/day, and to time related to the displacement activity (minute/day) was more significant than the energetic expenditure between classroom and nutritional state.

TABLE 4
Duration energetic expenditure and intensity to displace to school, according to the nutritional state represented by the mean (x) and standard deviation (SD), in students from the Corumbá City schools-MS

	Minute/day x ± ST	Kcal/day x ± ST	MET/day x ± ST
Low weight	17.5 ± 11.0 (a)	16.4 ± 10.2(a)	44.7 ± 28.3
Eutrophic	20.6 ± 13.3(a)(b)	23.6 ± 17.4(b)(c)	52.7 ± 34.3
Overweight risk	15.7 ± 9.7(a)(b)	24.4 ± 16.1(a)(c)	39.2 ± 26.6
Overweight	14.1 ± 7.2(a)(c)	26.2 ± 17.8(b)(c)	27.1 ± 23.0

p < 0.05; same letters = equal means; different letters = different means.

While playing and/or practicing formal exercises, it was verified a significant difference only in the caloric expenditure (kcal/day) related to the nutritional state (table 5). Boys presented a mean energetic expenditure higher than girls' (232.18 kcal/day, and 211.78 kcal/day, respectively, with p < 0.05, and this could be explained both by the higher body weight and the intensity (MET/day) once the boys presented a men's MET/day higher than girls' (436.98, and 380.69, respectively, and p < 0.01). Since the gender had no effect in minute/day, it can be concluded that boys practiced activities of higher intensity than girls.

TABLE 5
Duration, energetic expenditure and intensity of playing and/or practicing exercises, according to the nutritional state represented by the mean (x) and standard deviation (SD), in students from the Corumbá city Schools-MS

	Minute/day x ± ST	Kcal/day x ± ST	MET/day x ± ST
Low weight	130.2 ± 38.4	149.4 ± 39.8(a)	410.8 ± 110.4
Eutrophic	132.7 ± 51.4	197.2 ± 87.8(b)	438.8 ± 176.6
Overweight risk	128.6 ± 45.4	249.0 ± 120.7(c)	412.6 ± 182.9
Overweight	130.9 ± 45.1	292.3 ± 131.4(c)	396.6 ± 153.7

p < 0.01; same letter = equal means; different letters = different means.

Watching TV and/or playing videogame presented a significant difference only related to the duration (minute/day). The eutrophic children spent less time such activity than the overweighted children (table 6).

TABLE 6
Duration, energetic expenditure and intensity of watching TV and/or ´playing videogames, according to the nutritional state represented by the mean (x) and standard deviation (SD), in students from the Corumbá City Schools-MS

	Minute/day x ± ST	Kcal/day x ± ST	MET/day x ± ST
Low weight	162.9 ± 57.1(a)	60.2 ± 24.4	162.8 ± 57.1
Eutrophic	148.3 ± 70.1(a)(b)	68.5 ± 36.1	150.5 ± 72.5
Overweight risk	166.5 ± 101.8(a)(b)	94.8 ± 63.9	164.9 ± 101.9
Overweight	185.3 ± 68.3(a)(c)	144.1 ± 69.8	183.2 ± 68.4

p < 0.05; same letters = equal means; different letters = different means.

DISCUSSION

Despite the use of different cut spot, the values found for the overweight prevalence are fitted in the context of the scientific evidences. In 5 to 10 years old children in public schools from Bahia, it was verified a prevalence of the overweight (BMI ≥ 85p), and obesity (BMI ≥ 95p), according to the WHO (1995), and adopting the cut spots proposed by Cole *et al.* (2000), equal to 6.5 and 2.7%, respectively[28]. Leão *et al.*[17] have identified a total prevalence of obesity (BMI ≥ 95p) in children of the same age level, from private and public schools in the City of Salvador (BA), total prevalence of the obesity (BMI ≥ 95p), according to recommendation by Himes and Dietz (1994), and BMI distribution proposed by Anjos and colleagues (1998) equal to 15.8%, from which 30% were from private schools, and 8% were from public schools. Abrantes *et al.*[16] verified a higher prevalence of the obesity (higher than 2 *z* score for the Weight/Height index) in 0 to 10 years old children from the Southeast region (11.9%) related to children from the Northeast region (8.2%).

In the correlations between the BMI and the WC, Giugliano e Melo[29] evidenced similar results in 6 to 10 years old students from Brasilia, with strong BMI correlation to the %F (r = 0.84 in boys, r = 0.75 in girls), and of the BMI to the WC (0.88 in boys, r = 0.89 in girls). The inverted relation between the physical activity

and body composition reinforces the importance of the WC together with the BMI.

The negative correlation to active physical activities (displacement to the school and playing and/or practicing formal exercises) and the positive correlation to the sedentary physical activities (TV and/or videogame) show that less active children have lower fat percentage and BMI values[2,4,5,9]. The mean time spent in active physical activities is in accordance to other studies where these values vary from 1.8 to 2.2 hours/day[1,8]. In sedentary physical activities, the mean found is coincident with recent 2 to 3 hour/day data[30-32].

Overweighted children had a lower displacement amount to the school than eutrophic children, and such result is supported by other studies in which the displacement to the school favors the body weight gain[33,34], and can differentiate the active or sedentary life-style[35]. Considering that no significant difference was observed related to the MET/day for that activity and the caloric expenditure was not equivalent to the body weight, the time destined to the displacement (minute/day) was more significant than its energetic expenditure as to the nutritional state, that means, the time spent in physical activities can be more important than its energetic cost[31].

When playing and/or practicing formal exercises, only the caloric expenditure had significant differences, and this explains why obese children usually spend more calories than non-obese children, due to the higher body weight and the strength spent to perform the same physical activity[36]. As to the gender, the higher caloric expenditure verified in boys may be due both to the body weight and the intensity (MET/day) of the activities. Boys presented a mean MET/day higher than girls', and as there was no gender effect in minute/day, boys practiced activities of highest intensity than girls. Studies confirm such predisposition as to boys practicing more physical activities than girls[3,8,35].

Watching TV for more than 3 hours/day and playing videogame for more than 2 hours/day are risk factors for overweight and obesity[30]. Eutrophic children spent less time in these activities than overweighted children, supporting evidences where children who watch TV for more than 4 hours/day are less active and obese[12], or more willing to be overweighted[1,37] proving a positive correlation between the time spent in this activity and the BMI[8,38]. The Framingham Children's Study, a cross sectional study with 4 to 11 years old children confirms those higher BMI values in the group who watched more TV ($\geq$ 3 hours/day), and lower values in the group who watched less TV (< 1.75 hours/day)[32]. The American Academy of Pediatrics recommends that the limit to watch TV and play videogame is 2 hours/day[39]. The moderate and inverse correlation verified between playing and/or practicing exercises against watching TV and/or playing videogame for both genders evidences that more sedentary children watch TV for a longer time than more active children do, and they are more exposed to acquire body weight, and these results are in accordance to other studies[1,32].

Although recent researches[40,41] point out the importance of children practicing physical activities during their recreation time, data collected in the scholar environment (physical education classes and playtime) were not used in the analysis. It was included in this research only the three more predominant activities of the children's routine, according to the previously mentioned methodology. It was verified that along the daily fifteen minute playtime, boys and girls practice mild physical activities[27] of intensity equal to 3.5 and 2.6 MET, respectively. In the physical education classes, it was set a 5 MET intensity for both genders for 120 minutes a week. Therefore, the data show that the school propitiates little physical activity, suggesting mainly the playtime to be a matter for further researches, and an important resource to be used in promoting the physical activity in the scholar environment.

It can be concluded that eutrophic children are more active and spend less time in sedentary activities than overweighted children, evidencing that it is fundamental to educate the adoption of healthy habits since the childhood. Social interventions involving the school, families, and professionals from the health area must propitiate nutritional guidance, to make the population aware aiming to reduce the sedentarism, and to incentive the practice of physical activities for children and adolescents, emphasizing not only their initiation, but mainly their maintenance along the youth and the adult age, to promote the public health and a better quality of life for everyone.

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