

Evaluation on body weight and its relation with abdominal circumference in the diagnosis of obesity in school students in Cacoal municipality, RO, Brazil

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Abstract — Obesity in school-aged children has reached epidemic levels, which is considered a chronic disease. Researchers have been on alert, given the rising prevalence of obesity in the last few decades. The objective of this study is to evaluate the relation between body weight and abdominal circumference as a predictor for nutritional status in school students from 7 to 12 years of age in the municipality of Cacoal, RO, Brazil. The current study is of a descriptive nature, with cross-sectional and quantitative analysis. The study sample had 482 school students, of both genders, 230 male ones and 252 female ones, divided into school students from the urban and teaching rural teaching areas. Body Mass Index (BMI), abdominal circumference, and body weight were the variants analyzed. Reading with general comprehension strategies. It was possible to notice that 13% of the school students from the rural area were obese. On the other hand, 25% of the school students from the urban area, including both genders, were obese. There was a significant relation in body weight variant versus abdominal circumference in both genders, in the two areas studied. The body weight variant showed a significant relation with abdominal circumference and with body weight index in both genders.

Keywords— School students; obesity; body weight; abdominal circumference.

I. INTRODUCTION

Obesity in school-aged children has reached epidemic levels, which is considered a chronic disease. Researchers are on alert given the rising prevalence of obesity in the last few decades[1].

The obesity has been gaining even more space in scientific field, in the media and newspapers. According to scholars, the tools, research methods and evaluations, which are used for understanding the subject, have proven ineffective for its “handling”[2].

In the 1990’s, the gold standard used for evaluating the weight consisted of underwater weighing (underwater or hydrostatic weighing). Most recently, imaging techniques, such as magnetic resonance, computed tomography, dual-energy X-ray absorptiometry (DEXA), have been used as alternatives. However, the cost and lack of necessary equipment prevent the use of these techniques in clinical practice, especially by physics teachers[3].

Other techniques have been used for obesity diagnosis: BMI, abdominal circumference (or waist), and its relation with body weight. According to Mendonça *et al.*[4], these techniques have become reliable for studies involving children and teenagers besides having a low cost and their easy applicability.

The question guiding the study is: Is body weight related to abdominal circumference in the obesity

diagnosis in school students in Cacoal municipality, RO, Brazil?

Based on this, the study aimed to evaluate the relation between body weight and abdominal circumference as a predictor of the nutritional status in school students from 7 to 12 years of age in Cacoal municipality, RO, Brazil.

II. MATERIAL AND METHODS

The current study is of a descriptive nature, with cross-sectional and quantitative analysis. For the conduct of the research, list sampling technique was used. A percentage of 11.76% was used through Kazmier's test (1982). The population was formed by 3,574 school students from 7 to 12 years of age. The study sampling included 482 school students of both genders, 230 male students and 252 female students, divided into students from urban and rural areas.

The selection process was performed by drawing lots from a roll call, which was performed in 16 city schools, and this resulted in 63 students per school, who were divided by the classroom numbers, among the students registered from 2nd to 7th grade.

For data collection, the students were questioned twice (2) per day on different days. On the first day, the Free and

Informed Consent Forms (FICF) were handed to the students so that they could take these forms to their parents for their due signatures. On the second day, evaluations on their weight, height, and abdominal circumference were performed.

For data analysis, SPSS 20.0 software was used and Kolmogorov-Smirnov test was applied for sampling normality, which made it possible to verify the samples within a normal level. In order to verify the differences among the groups, Student's t-test was applied to check the differences between the groups and Pearson's correlation coefficient was applied to relate the variants.

III. RESULTS

Overall, it was possible to notice that, for both locations, the school rates were not very distant from each other, considering their percentage, regarding the ages and male and female genders. There was a prevalence of the students who live in the rural area, because many of the students' parents did not sign the Free and Informed Consent Forms. Also, the rural schools represent the majority; more than 60% of the institutions belonging to the areas studied are located in the rural area (Table 1).

Table.1: Distribution of students according to their gender and location.

SEX	AGE	URBAN AREA	RURAL AREA	BOTH			
MALE	7	9	17%	21	12%	30	13%
	8	5	10%	24	13%	29	13%
	9	18	35%	17	10%	35	15%
	10	15	29%	41	23%	56	24%
	11	4	8%	34	19%	38	17%
	12	1	2%	41	23%	42	18%
Average	9.7						
TOTAL		52	100%	178	100%	230	100%
FEMALE	7	15	25%	32	17%	47	19%
	8	11	19%	24	12%	35	14%
	9	13	22%	25	13%	38	15%
	10	18	31%	27	14%	45	18%
	11	2	3%	36	19%	38	15%
	12	0	0%	49	25%	49	19%
Average	9.5						
TOTAL		59	100%	193	100%	252	100%

Source: Authors, 2018.

Table 2 shows the rates for the variants for body weight, BMI, and abdominal circumference of the students in the Rural Area. It is possible to notice that, at ages lower

than 7 and 8, the girls have a slightly higher body weight than the boys, where these rates start to be balanced from 9 years of age onwards.

Table 2: Distribution of students in the rural area – gender, body weight, BMI, and abdominal circumference.

SEX	AGE	WEIGHT	BMI			ABDOMINAL CIRCUMFERENCE		
			Normal	Overweight	Obese	Without risk	Limit	Over limit
MALE	7	24,468	18	1	3	11	8	3
	8	27,334	15	8	0	16	7	0
	9	30,247	17	0	1	11	7	0
	10	35,210	32	3	5	29	10	1
	11	38,213	27	4	2	27	4	2
	12	49,321	29	9	4	25	15	2
Total			138	25	15	119	51	8
%			76,8	14,5	8,7	65,9	29,6	4,6
FEMALE	7	25,158	23	5	3	16	13	2
	8	29,783	18	2	4	15	5	4
	9	30,685	20	4	2	18	7	1
	10	34,010	21	5	1	21	4	2
	11	37,091	34	2	0	30	6	0
	12	47,110	41	7	1	30	17	2
Total			157	25	11	130	52	11
%			81	14	5	68,2	26,3	5,5

Source: Authors, 2018.

Table 3 shows rates for the variants for body weight, BMI, and abdominal circumference in students from the urban area. It was possible to notice that the boys, at age

12, outnumber the girls in body weight, and this suggests a late maturity in boys.

Table 3: Distribution of students in the urban area – gender, body weight, BMI, and abdominal circumference.

SEX	AGE	WEIGHT	BMI			ABDOMINAL CIRCUMFERENCE		
			Normal	Overweight	Obese	Without risk	Limit	Over limit
MALE	7	23,321	7	2	0	3	6	0
	8	30,031	2	3	0	3	2	0
	9	35,423	11	2	5	10	6	2
	10	34,654	12	2	1	8	6	1
	11	35,354	3	1	0	3	1	0
	12	43,500	1	0	0	1	0	0
Total			36	10	6	28	21	3
%			69	19	12	53,9	40,4	5,7
FEMALE	7	27,021	14	1	2	7	8	2
	8	25,321	11	0	0	8	2	1
	9	33,152	7	2	2	6	5	0
	10	36,023	13	2	3	12	3	3
	11	44,325	1	1	0	1	1	0
	12	42,511	1	0	0	0	0	0
Total			46	6	7	34	19	6
%			77	10	13	57,6	32,2	10,2

Source: Authors, 2018.

As shown in Table 4, the following variants are evaluated: weight, BMI, abdominal circumference in schools located in urban and rural areas. The results showed that, in the rural area, all the relations in male gender were significant, and there was a higher rate for body weight, BMI, and abdominal circumference variants with $r=0.89$. On the other hand, the students from the

urban area only showed a significant rate of $r=0.92$ for the relation between weight and BMI. In the female group from the rural area, the highest relation was for BMI with abdominal circumference variants of $r=0.91$. As for the female students from the urban area, the relation between body weight and BMI variants was $r=0.91$.

Table 4: Evaluation on the relation among body weight, BMI, and abdominal variants in male and female genders.

RURAL AREA				URBAN AREA		
SEX	WEIGHT	BMI	AC	WEIGHT	BMI	AC
MALE						
Average	36,4	18,3	62,7	32,7	18	59
r W x BMI		0,78*			0,92*	
r W x AC		0,89*			-0,019	
r BMI x AC		0,79*			-0,044	
FEMALE						
Average	35,5	17,4	61,2	31,3	18,4	62,2
r W x BMI		0,83*			0,91*	
r W x AC		0,88*			0,10*	
r BMI x AC		0,91*			0,11*	

r WxBMI= relation Weight vs. BMI; r WxAC= relation Weight vs. Abdominal Circumference; r BMIxAC= Relation BMI vs. Abdominal Circumference, *significant

Source: Authors, 2018.

IV. DISCUSSION

Overall, it is possible to notice that the rates did not show big significant differences in percentage for both locations, regarding the age and male and female gender. In both genders, it is possible to notice the prevalence in students who studied in the rural area. There was a small compliance proportion from the students' parents in the urban area, and this was noticeable at the moment many students failed to deliver the Free and Informed Consent Term, which resulted in more than 60% of students belonging to the rural area.

It is possible to notice that, in the last eight years, obesity numbers in school students have been rising in alarming rates. Romanholo *et al.*[3] estimated that 20% of the students were obese. Nowadays, according to OMS[5], it is possible to notice an increase from 5% to 8% in this proportion, that is, a total of almost 30% of students are obese or overweight.

Besides, some researches performed by Romanholo *et al.*[3], Veber[6], Herrmann[7], Del Vecchio *et al.*[8], indicate obesity can be influenced by environment, psychological, and social factors.

Herrmann *et al.*[7], evaluated school students upstate Paraná, and noticed that 10% of children from 7 to 12 years of age were affected by abdominal obesity. When we compare this with the current study, it is possible to

notice that the students from Cacoal municipality, when adding the gender and both areas studied, it is possible to reach the rate of 25% of students who are above the risk of developing heart diseases.

In another study, which was carried out by Del Vecchio *et al.*[8], in Santo André, in São Paulo state, the authors detected a strong association between obesity and abdominal circumference. They also noticed a significant rise in the students' blood pressure. The rates found in the study range around 20%, which shows approximate rates when compared with the current study.

Stamatakis *et al.*[9], who evaluated the obesity in Portuguese children, noticed that 12% of the children were obese by checking the Body Mass Index (BMI) and fat percentage. When comparing with the current study, evaluating BMI variant by adding the genders and the location where they study, the sample rate is 24%, which is double the rate of what was mentioned above.

Schommer *et al.*[10], evaluated the excess in body weight rates and the anthropometric variants by using abdominal circumference. In that study, the authors noticed a significant relation between the excess weight and the abdominal circumference $r=0.462$.

Nascimento *et al.*[11], evaluated the heart failure risk rate and blood hypertension in students by using abdominal circumference. That study showed a

significant relation of $r=0.345$ between the accumulation of abdominal fat (abdominal circumference) and the rise of the students' blood pressure.

Mendonça *et al.*[4], carried out a study about the nutritional status of public school children from the municipality of Japarutuba in Sergipe state. In that study, some relations were established between weight/abdominal circumference. In the study, there was a positive relation among the variants with a rate of $r=0.567$.

Souza *et al.*[12], evaluated the relation between body weight and abdominal circumference. Children and teenagers from four to 19 years of age, originated from rural and urban schools in a municipality in Rio Grande do Sul. There was a positive relation rate in the variants evaluated: $r=0.67$.

When comparing the studies mentioned above with the current one, we notice that there is a tendency of using these benchmarks as a predictor for nutritional evaluation. The current study showed a strong relation in all genders and in rural and urban areas.

V. CONCLUSION

We can affirm that these variants give us a reliable diagnosis in the evaluation of nutritional aspects when relating the body weight to abdominal circumference.

In this study, the body weight variant had a significant relation with abdominal circumference; also, with the body mass index in both genders.

Therefore, for the population studied, we can use the body weight resource and relate it to fat distribution located in the abdomen with a pattern to diagnose this syndrome.

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