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Obesity and association of anthropometric indicators with risk factors in teachers

Obesidade e associação de indicadores antropométricos com fatores de risco em professores

Rômulo José Mota Júnior[1,2]
Renata Aparecida Rodrigues Oliveira[1,2]
Mayse Faria Fialho Resende[3]
Luciana Moreira Lima[2,3]
Sylvia do Carmo Castro Franceschini[3]
João Carlos Bouzas Marins[2,3]

Abstract – The aim of this study was to verify general and central obesity, as well as the association of anthropometric indicators with cardiovascular risk factors (CvRF) in teachers of the private network of Viçosa-MG. A cross-sectional observational study was conducted with 150 teachers. Body Mass Index (BMI), Conicity Index (CI), Body Adiposity Index (BAI), Waist-to-Hip Ratio (WHR), Waist-to-Height Ratio (WHtR), Waist Circumference (WC), Abdominal Circumference (AC) and Body Fat Percentage (%BF); Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP); Glycemia (GL), Total Cholesterol (TC), High Density Lipoprotein (HDL-C), Low Density Lipoprotein (LDL-C) and Triglycerides (TG) were evaluated. The prevalence of general and central obesity was calculated in addition to the simple linear regression to verify the association of anthropometric indicators between themselves and with CvRF. General and central obesity was identified in 19% and 17% of teachers respectively. The best associations between anthropometric indicators were between BMI and WHtR (R^2 = 0.81), WHtR and AC (R^2 = 0.78) and BMI and AC (R^2 = 0.76), all of which were positive. Between anthropometric indicators and CvRF, the best associations were found between WHtR and TG (R^2 = 0.25), AC and SBP (R^2 = 0.18) and WHR and HDL-c (R^2 = 0.19), the first two associations being positive and the last negative. It was concluded that approximately one in five teachers presented obesity. The general obesity indicator, BMI, was positively associated with anthropometric indicators and with most CvRF. However, central obesity indicators presented greater explanatory power on CvRF.

Key words: Body Composition; Cardiovascular diseases; Obesity; School Teachers.

Resumo – *O objetivo deste trabalho foi verificar a obesidade geral e central, e a associação de indicadores antropométricos com fatores de risco cardiovascular (FRCv) em professores da rede privada de Viçosa-MG. Foi realizado um estudo observacional com delineamento transversal em 150 professores. Foram avaliados Índice de Massa Corporal (IMC), Índice de Conicidade (IC), Índice de Adiposidade Corporal (IAC), Relação Cintura Quadril (RCQ), Relação Cintura Estatura (RCE), Circunferência de Cintura (CC), Circunferência Abdominal(CA), Percentual de Gordura Corporal (%GC); Pressão arterial sistólica(PAS) e Pressão arterial diastólica (PAD); glicemia (GL), colesterol total (CT), lipoproteína de alta densidade(HDL-C), lipoproteína de baixa densidade (LDL-C) e triglicerídeos (TG). Foi realizado o cálculo das prevalências de obesidade geral e central, além da regressão linear simples para verificar a associação dos indicadores antropométricos entre si e com os FRCv. Obesidade geral e central foi identificado em 19% e 17% dos docentes respectivamente. As melhores associações entre os indicadores antropométricos se deram entre IMC e RCE (R^2=0,81), RCE e CA (R^2=0,78) e IMC e CA (R^2=0,76), sendo todas positivas. Entre indicadores antropométricos e FRCv, as melhores associações encontradas foram entre RCE e TG (R^2=0,25), CA e PAS (R^2=0,18) e RCQ e HDL (R^2=0,19), sendo as duas primeiras associações positivas e a última negativa. Conclui-se que aproximadamente um a cada cinco docentes apresentou obesidade. O indicador de obesidade geral, IMC, associou-se positivamente com os indicadores antropométricos e com a maioria dos FRCv. Contudo, os indicadores de obesidade central apresentaram um maior poder de explicação sobre os FRCv.*

Palavras-chave: *Composição corporal; Doenças cardiovasculares; Obesidade; Professores Escolares.*

1 "Governador Ozanam Coelho" Faculty. Ubá, MG. Brazil.

2 Federal University of Viçosa. Graduate Program in Physical Education associated Federal University of Viçosa / Federal University of Juiz de Fora. Viçosa, MG. Brazil.

3 Federal University of Viçosa. Viçosa, MG. Brazil.

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INTRODUCTION

Excess body weight is characterized by increased deposition of adipose tissue in the body, and obesity is a complex chronic disease of multifactorial origin, associated with numerous comorbidities, including type 2 diabetes, arterial hypertension and cardiovascular diseases (CVD)[1,2]. Its etiology is associated with high caloric intake, low levels of physical activity, genetic, socioeconomic, environmental and personal factors, all of which play a crucial role in the pathogenesis of obesity[3].

Obesity has increased significantly in the last 25 years worldwide, especially in underdeveloped countries, which account for 62% of the world's obese population[4]. In Brazil, more than half of the population is overweight, a rate higher than the world average, and obesity accounts for 17.9% of this percentage, reflecting a 52% increase from 2006 to 2016[5].

In addition to high prevalence, obesity causes high costs for the public health system, social security and institutions in which these individuals are inserted. In the United States, direct and indirect costs with obesity are estimated at US$ 275 billion a year, and the costs involved with each obese individual are 42% higher compared to normal-weight individuals. In addition, companies pay US$ 6.4 billion due to work leave and US$ 30 billion due to reduced productivity attributed to obesity[3].

Evaluating obesity through anthropometric indicators has been frequently performed in population studies[6-12]. These indicators are easily obtained, present low operating costs, allow the evaluation of a large population contingent and have good agreement with instruments considered gold standard for its evaluation[13,14].

Changes in the working conditions of many professional categories, especially teachers, have contributed to several lifestyle-related diseases, including obesity. Behavioral and environmental characteristics have been shown to be the main responsible for these alterations[15].

Studies have been carried out to identify the association of obesity, evaluated by means of anthropometric indicators, with cardiovascular risk factors (CvRF)[6-9]. However, these are limited to associating a single anthropometric indicator to several CvRF[6] or, a single CvRF to several anthropometric indicators[7,8]. In the specific population of teachers, there are some investigations addressing this association; however, they are limited to public network[10,12] or higher education teachers[11].

Considering the effects of obesity on health, its prevalence, economic impacts, association with other pathologies, as well as the need for studies evaluating different anthropometric indicators and its association with CvRF in the population of private school teachers, justify the performance of this research, whose aim was to verify general and central obesity, and the association of anthropometric indicators with CvRF in teachers of the private network of Viçosa-MG.

METHODOLOGICAL PROCEDURES

An observational study with cross-sectional design was conducted with teachers of the private network of Viçosa-MG. Data were obtained during the year 2015 in the 6 private schools in the city. The study began after the approval of the project by the human research ethics committee of the Federal University of Viçosa (CAAE 48845415.0.0000.5153), according to Resolution 466/12 of the National Health Council.

To determine the sample size, sample calculation was performed using the OPENEPI software. For the calculation, the following was taken into consideration: population of teachers of the private network of Viçosa-MG in 2015 (310); mean prevalence of risk factors for CVD of the population of Belo Horizonte (25%); standard error of 5% and confidence interval of 95%. With this information, sample size of 150 individuals was obtained, corresponding to 48% of the universe of teachers.

Initially, a visit to schools was made, where the aims and procedures of the study were presented to teachers and principals. Those interested in participating were registered and evaluated according to the inclusion and exclusion criteria of this study, as follows: to have at least 3 years of practice, not being on medical or maternity leave, not being pregnant, not having participated in this same research in teachers of the public network and to have no organic and / or metabolic impairment that would prevent from participating in the study.

After meeting the inclusion criteria, each volunteer was individually scheduled to fill out the informed consent form and to perform data collection procedures.

Data collection took place in the school environment, in a reserved room, where only the researcher and the volunteer were present. Anthropometric, blood pressure and questionnaire measurements lasted 40 minutes and were performed by a single, previously trained evaluator with experience in the application of these instruments.

Height measurement was performed using a WCS® portable stadiometer (Cardiomed, Brazil), with accuracy of 1 mm, with volunteer with his/her back to the instrument, in an anatomical position. Body mass measurement was performed using a Plenna® portable scale (Acqua SIM09190, Plenna, Brazil), with accuracy of 100 grams, with volunteer barefoot and wearing light garments. Body mass index (BMI) was calculated using these two variables, according to the World Health Organization[2].

Body circumferences were measured using an inelastic anthropometric tape brand Sanny Medical® (SN4010, Sanny, Brazil), graduated in millimeters. Waist (WC) and hip (HC) circumferences were measured according to recommendations of the International Society for the Advancement of Kinanthropometry: the first, by placing the tape measure at the midpoint between the last rib and the iliac crest; and the second, in the region of greatest hip circumference[16]. In addition, WC was used to evaluate central obesity, classified according to WHO recommendations (overweight men>

94cm and women> 80cm, obesity-men> 102cm and women> 88cm)[17]. Abdominal circumference (AC) was measured at the point of the scar. After obtaining these variables, waist-to-height (WtHR)[18] and waist-to-hip ratio (WHR)[17] and body adiposity (BAI)[19] and conicity indexex (CI) were calculated[20].

Skinfolds were measured to estimate body fat percentage (% BF), according to recommendations of Jackson and Pollock[21] and Jackson et al.[22]. Three measurements were performed alternating in three distinct points (pectoral, abdominal and thigh in men and triceps, supra iliac and thigh in women), considering the average value between them. For measurements, a Cescorf® scientific skinfold caliper (Top Tec, Cescorf, Brazil) was used. The conversion of body density into %F was performed using the formula: (% F = [(4.95 / SF) - 4.50] x 100).

Systolic (SBP) and diastolic blood pressure (DBP) were measured after a 5-minute rest in the sitting position. For this, *Premium®* sphygmomanometer (ESFHS501, Wenzhou, China), with precision of 3 mmHg was used, duly calibrated and with standard cuff for adults. All procedures for obtaining blood pressure followed recommendations of the Brazilian Society of Cardiology[24].

At the end of anthropometric and blood pressure procedures, each patient received a request for blood analysis, which should be performed up to 7 days after obtaining data. Blood sample was collected for the analysis of biochemical parameters at the laboratory of clinical analyses of the Federal University of Viçosa. Analyses were fasting glycemia (FG) (glucose oxidase method), total cholesterol (TC), high density lipoprotein (HDL-C) and triglycerides (TG) (enzymatic colorimetric method) after 12 hours of fasting. Low-density lipoprotein (LDL-C) was obtained using the Friedewald equation[25]. For the analysis, the Cobas Mira Plus device (Roche Diagnostics, Montclair, NJ, USA) and Bioclin-Quibasa kits were used. All blood collections were performed between 7am and 9am by professionals responsible for the laboratory.

After obtaining data, the normality assumption for all variables was tested using the Komolgorov-Smirnov test, and only BMI, AC, WHR, CI, %BF and TC had normal distribution. Data were then analyzed by calculating the prevalence of general and central obesity.

The association between anthropometric indicators and between these and CvRF was evaluated through simple linear regression. For the linear regression, the logarithmic transformation (base 10) of independent variables that did not present normal distribution was made. A significance level of 5% was adopted. All statistical analyses were performed by the SPSS software, version 20.0 (Chicago, USA).

RESULTS

One hundred and fifty teachers (108 women and 42 men) participated in this study, corresponding to 48% of the population working in this teaching network. The mean age of the sample was 40 ± 11 years and the average time of work was 14 ± 10 years.

The evaluation of general obesity, performed through BMI, indicates that 19% of teachers are obese. Central obesity, identified by CO, was present in 17% of teachers (Figure 1).

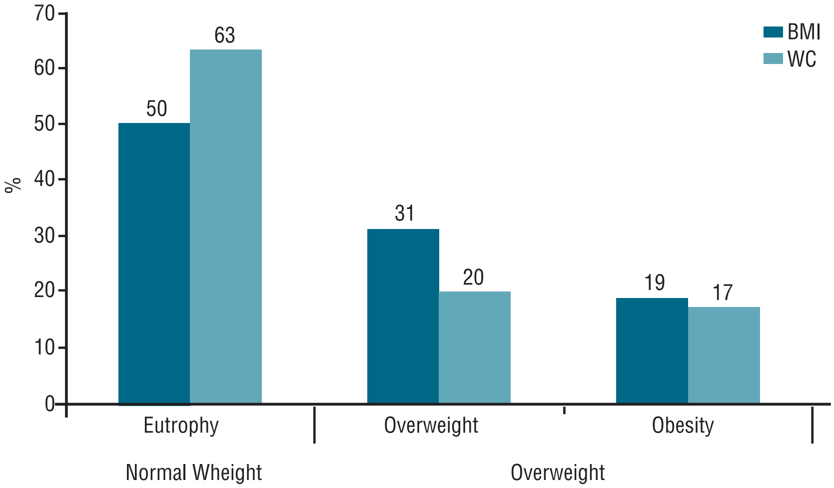

Figure 1. General (BMI) and Central Obesity (CO) in private school teachers, Viçosa-MG, Brazil (n = 150).

Linear regression analysis revealed a positive association between almost all the anthropometric indicators, especially the relationship between

Table 1. Linear regression between anthropometric indicators of general and central obesity in teachers of the private network, Viçosa-MG, Brazil (N = 150)

Variables		BMI	%BF	AC	WtHR	WHR	BAI	CI
BMI	P	-						
	R^2	-						
	β	-						
%BF	P	< 0.001	-					
	R^2	0.21	-					
	β	0.31	-					
AC	P	< 0.001	< 0.001	-				
	R^2	0.76	0.16	-				
	β	0.33	0.22	-				
WtHR	P	< 0.001	0.342	< 0.001	-			
	R^2	0.27	0.00	0.49	-			
	β	25.55	-5.72	90.13	-			
WHR [a]	P	< 0.001	< 0.001	< 0.001	< 0.001	-		
	R^2	0.81	0.15	0.78	0.51	-		
	β	70.64	44.84	179.9	1.13	-		
BAI [a]	P	< 0.001	< 0.001	< 0.001	0.003	< 0.001	-	
	R^2	0.31	0.42	0.08	0.05	0.23	-	
	β	34.05	58.07	47.05	-0.29	0.44	-	
CI	P	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.152	-
	R^2	0.16	0.13	0.56	0.33	0.34	0.01	-
	β	23.78	32.07	115.78	0.68	0.52	7.96	-

BMI: Body Mass Index; % BF body fat percentage; AC: abdominal circumference; WHR: waist-hip-ratio; WtHR: waist-to-height-ratio; BAI: body adiposity index; CI: conicity index; [a] Transformed into logarithmic value (base 10).

BMI and WHR, BMI and AC, and WHR and AC. Negative association was observed between BAI and WHR. In addition, there was no association between % BF and WHR and between BAI and CI (Table 1).

The association between anthropometric indicators and C_VRF is expressed in Table 2.

Table 2. Linear regression between anthropometric indicators of general and central obesity with cardiovascular risk factors, Viçosa-MG, Brazil (N = 150)

Variables		BMI	%BF	AC	WtHR	WHR	BAI	CI
SBP[a]	p	< 0.001	0.140	<0.001	<0.001	<0.001	0.238	<0.001
	R^2	0.14	0.02	0.18	0.15	0.17	0.00	0.11
	β	32.76	15.52	96.12	0.68	0.54	9.65	0.48
DBP[a]	p	< 0.001	0.203	<0.001	<0.001	<0.001	0.610	<0.001
	R^2	0.09	0.01	0.14	0.14	0.13	0.00	0.09
	β	24.40	12.23	77.67	0.60	0.43	3.81	0.40
Glucose[a]	p	< 0.001	0.016	<0.001	0.009	<0.001	0.025	<0.001
	R^2	0.08	0.04	0.11	0.05	0.10	0.03	0.08
	β	21.25	21.46	63.39	0.32	0.36	15.61	0.35
TC	p	0.130	0.056	0.012	0.001	0.001	0.296	<0.001
	R^2	0.02	0.02	0.04	0.07	0.08	0.00	0.08
	β	0.01	0.03	0.07	0.001	0.001	0.01	0.001
HDL-C[a]	p	< 0.001	0.255	<0.001	<0.001	<0.001	0.828	0.060
	R^2	0.15	0.01	0.15	0.19	0.15	0.00	0.02
	β	-15.38	-5.53	- 39.92	-0.35	- 0.23	-0.82	-0.10
LDL-C[a]	p	0.137	0.340	0.011	<0.001	0.001	0.764	0.001
	R^2	0.02	0.06	0.04	0.10	0.07	0.00	0.07
	β	4.73	4.48	20.71	0.25	0.16	1.09	0.18
TG[a]	p	< 0.001	0.048	<0.001	<0.001	<0.001	0.017	<0.001
	R^2	0.20	0.03	0.21	0.17	0.25	0.03	0.09
	β	9.47	5.01	25.08	0.17	0.16	4.66	0.10

BMI: Body Mass Index; % BF body fat percentage; AC: abdominal circumference; WHR: waist-hip-ratio; WtHR: waist-to-height-ratio; BAI: body adiposity index; CI: conicity index SBP: systolic blood pressure; DBP: diastolic blood pressure; TC: total cholesterol; HDL-C: high-density lipoprotein; LDL-C: low density lipoprotein; TG: triglycerides.[a] Transformed into logarithmic value (base 10).

DISCUSSION

The results of this research indicate similar general obesity (BMI) and central obesity (CO) among teachers of the private network of Viçosa-MG. The prevalence of general obesity (BMI) presented value similar to that observed in the population of the country's capitals by the Ministry of Health[5], where 17.9% of individuals presented this condition. On the other hand, it was higher than that obtained in university teachers[11], where only 8% presented obesity. This difference can be explained by the different educational levels among the population, which directly influence nutritional status.

Regarding central obesity (CO), the values obtained in this study (17%) are slightly lower than those obtained in the population of teachers of public schools in the same municipality, in which 23% of teachers presented obesity[10].

The results obtained through these two indicators allow us inferring that, despite evaluating different types of obesity, both presented values very close for the identification of this condition, but they diverged slightly in the identification of overweight and normal weight.

Overweight and obesity are changes in body composition characterized by excess body fat, which cause health damage, increasing the risks of cardiovascular diseases, several types of cancer, DM, directly impacting biochemical and pressure parameters [26]. The present investigation revealed that approximately one in five teachers presented some type of obesity. These results indicate the need for measures aimed at the control and treatment of obesity, since this population is at a risk for the development of associated morbidities.

Studies have used BMI as a tool to verify the prevalence of obesity in the general population and, in particular, of workers[10-12]. Although presenting limitations related to body composition, this indicator can be obtained through data of easy measurement, allowing comparisons between populations.

In the present investigation, BMI was associated with all anthropometric indicators, highlighting its positive association with WtHR ($p < 0.001$, $R^2 = 0.81$) and AC ($p < 0.001$; $R^2 = 0.76$), both indicators of central obesity. Haun et al.[27] corroborate the findings for the association between BMI and WtHR, and the study by Faria et al.[28] for the association between BMI and AC.

These results become relevant as they demonstrate that BMI, although an indicator of general obesity, may also be used to identify central obesity in this population.

Among the other anthropometric indicators, the linear regression analysis revealed a positive association between almost all of them, highlighting the relationship between WtHR and AC ($p < 0.001$; $R^2 = 0.76$). Between BAI and WHR, a negative association was observed ($p = 0.003$; $R^2 = 0.05$). In addition, between %BF and WHR ($p = 0.342$) and between BAI and CI ($p = 0.152$), there was no association. These results indicate that the use of a large number of these indicators, with exceptions, presents good capacity for identification of both general and central obesity in the referred population.

When analyzing the association of anthropometric indicators with CvRF, it is possible to notice that, among general obesity indicators (BMI, %BF and BAI), BMI was the one with the best associations with biochemical variables (glucose = ($P = 0.001$, $R^2 = 0.08$), and HDL-c ($p = 0.001$, $R^2 = 0.15$ negative) and TG ($p = 0.001$; $R^2 = 0.14$) and DBP ($p = 0.001$; $R^2 = 0.09$)). On the other hand, the other general obesity indicators were only positively associated with glucose and TG.

A study carried out with 200 teachers of the public network of Viçosa-MG[10], identified an association of BMI with pressure and biochemical variables, corroborating the findings of this investigation. However, the magnitude of associations differed slightly, being those evidenced in this investigation higher for SBP, HDL-C and TG, equal for Glucose and lower for DBP. These results reinforce the use of this indicator in the identification of cardiovascular risk, given its association with several CvRF.

An investigation conducted in 964 individuals from Viçosa-MG[29] evaluated the association between BAI and presence of diabetes, hypertension and hypercholesterolemia. In this investigation, this general obesity indicator was not associated with any CvRF. In the present investigation, BAI was only associated with glucose and TG, but with low power of explanation about them. Thus, the use of this indicator for the identification of cardiovascular risk should be carried out with caution, requiring new investigations.

In the present investigation, central obesity indicators (AC, WHR and WtHR) were associated with all CvRF analyzed, highlighting the positive association between WHR and TG ($p < 0.001$, $R^2 = 0.25$) and AC and SBP ($p < 0.001$, $R^2 = 0.18$), as well as negative association between WHR and HDL-C ($p < 0.001$; $R^2 = 0.19$). Several investigations have evaluated the use of anthropometric indicators of central obesity as predictor of cardiovascular risk[9,13,27]. In their study, Haun et al.[27] evaluated different anthropometric indicators as predictors of cardiovascular risk in 968 individuals from Salvador, and concluded that central obesity indicators are better to discriminate high cardiovascular risk, and WtHR stands out among them. These findings corroborate those obtained in the present investigation, in which central obesity indicators AC, WHR and WtHR were associated with all CvRF, and the association between WtHR and TG was the most significant among all identified ($p < 0.001$, $R^2 = 0.25$).

In an investigation carried out with 126 university employees from Bahia, whose aim was to analyze the relationship between AC and CvRF, this indicator was associated with SBP in men and with SBP, DBP, TG, HDL-c and LDL-C in women[9]. These results are in line with those obtained in the present investigation, in which the association of AC with all risk factors analyzed (SBP, DBP, Glucose, TC, HDL-c, LDL-c and TG) is highlighted.

In a literature review[13], whose aim was to compare the most commonly used anthropometric indicators of central obesity and to identify which of them have greater predictive power to discriminate high coronary risk, the author concluded that both WtHR and CI are good predictors of this condition and should be used.

In the present investigation, such a finding was also obtained for WtHR, given its associations with CvRF analyzed; however, for CI, this association should be interpreted with care. This indicator was positively associated with almost all CvRF analyzed, especially its association with SBP ($p = <0.001$; $R^2 = 0.11$). However, it had low power of explanation about all of them. In addition, CI was not associated with HDL-c ($p = 0.060$).

According to information obtained, it is possible to infer that the central obesity indicators presented the best associations with risk factors, reinforcing the findings of previous investigations. These associations can be explained by the fact that fat deposited in the abdominal region excessively increases the production of free fatty acids in the visceral region, which contributes to the development of type 2 diabetes, dyslipidemia, arterial hypertension and CVD[30].

This research presents some limitations, highlighting the absence of statistical tests to verify the influence of covariates on the association between anthropometric indicators and CvRF. In addition, this is a cross-sectional study, which allows the occurrence of reverse causality. However, in order to avoid this causality, sample calculation was performed, thus contributing to the validity of the study.

CONCLUSION

Approximately one in five teachers presented some type of obesity. The indicator of general obesity, BMI, was positively associated with anthropometric indicators and with most CvRF. However, central obesity indicators AC, WtHR and WHR presented greater power of explanation about CvRF, and could therefore be an interesting resource used in population studies.

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CORRESPONDING AUTHOR

Rômulo José Mota Júnior
Travessa Brás Cataldo, número 72,
apartamento 203
Bairro Centro, Tocantins, MG, Brasil
CEP 36512-000
E-mail: romulo.junior@fagoc.br