Body Mass Index and Waist Circumference: Association with Cardiovascular Risk Factors

Fabiane Aparecida Canaan Rezende, Lina Enriqueta Frandsen Paez Lima Rosado, Rita de Cássia Lanes Ribeiro, Fernanda de Carvalho Vidigal, Ana Carolina Junqueira Vasques, Ivana Sales Bonard, Carlos Roberto de Carvalho
Universidade Federal de Viçosa, Viçosa, MG, Brazil

Objective: To evaluate the association between cardiovascular risk factors and the anthropometric values - body mass index (BMI) and waist circumference (WC).

Methods: It was studied 231 employees of Federal University of Viçosa, Brazil, 54,1% of them were men (21-76 years old) were measured. Glycemia, total cholesterol, LDL, HDL, triglycerides, blood pressure, BMI, WC, waist-to-hip ratio and body fatness. It was also investigated smoking, alcohol consumption and physical activity.

Results: The prevalence of overweight/obesity in this population was high mainly in women. The abdominal obesity was observed in 74% of the women and 46,1% of the men. The average of BMI, body fatness, total cholesterol, HDL and triglycerides were significantly higher in men than in women. ($p < 0,05$). The sedentary lifestyle was a risk factor for obesity. Smoking and alcohol consumption were more common among men and normal weight volunteers. Most of the correlations between anthropometric indices and risk factors for cardiovascular diseases were significant, but weak and the WC was the index that had the strongest correlation and that associated with the largest number of variables. It was observed that with an increase of the BMI and the abdominal fat, there was also an increase of the glycemia, triglycerides and blood pressure and a decrease of HDL. The metabolic syndrome was more common among men and overweight and obese volunteers.

Conclusion: In this study, the frequency of cardiovascular risk factors increased along with BMI and WC.

Key words: Body mass index, abdominal circumference, cardiovascular risk factors.

Demographic transition, mainly characterized by a decrease in fecundity and reduction in infant and preschooler mortality, has resulted in an increasingly higher life expectancy in the Brazilian population[1]. Because of this new condition, different eating and nutritional disorders arise, and they are important in the nutritional transition process, in which a reduction in the prevalence of malnutrition among children and an increase in the prevalence of overweight/obesity among adults are observed[2-6].

In this new epidemiological situation characterized by a high prevalence of obesity, cardiovascular diseases appear as the major public health problem, representing the major cause of death in Brazil as a whole (32%) and in all its regions[7].

Interventions related to health promotion, and prevention and control of obesity and cardiovascular diseases, such as encouraging physical activity, quitting smoking and nutritional education of the population have become very important because they result in desirable alterations such as reduction of weight and of plasma levels of lipids and glucose, as well as in the reduction of blood pressure levels[8-11].

The objective of this study was to verify the association between excess weight and body fat distribution and cardiovascular risk factors, since obesity, mainly abdominal, is associated with important metabolic alterations such as dyslipidemias, glucose intolerance or diabetes, and high blood pressure[8,12,13].

Methods

The study was conducted in the Health Division of the *Universidade Federal de Viçosa* (UFV), linked to the Program of Cardiovascular Health Care (Procardio), after approval of the Research Ethics Committee of the UFV.

This is a cross-sectional study conducted in a cohort of employees of the *Universidade Federal de Viçosa,* who were included in the study by lot ($n = 129$) or by medical referral ($n = 102$).

All volunteers underwent clinical evaluation performed by a cardiologist, followed by nutritional assessment, after informed consent. Clinical evaluation included biochemical tests such as fasting plasma glucose, total cholesterol, LDL, HDL and triglycerides, and blood pressure measurement. Nutritional assessment included measurements of weight, height, waist and hip circumferences, and body fat measurement using the tetrapolar bioimpedance method. Data related to lifestyle, such as smoking habit, alcohol consumption and physical activity were also obtained and divided into two groups

Mailing Address: Fabiane Aparecida Canaan Rezende •
Rua Padre Anchieta, 147/101 36570-000 – Viçosa, MG, Brazil
E-mail: bibh_99@yahoo.com
Manuscript received August 31, 2005; revised manuscript received November 14, 2005; accepted January 12, 2006.

according to positive or negative answers.

Weight was measured using a digital scale with a 150kg maximum capacity and 100g divisions according to standards established by Jelliffe[14]. Height was measured using a tape measure fixed on a 2.00m long wall with no baseboard, divided into centimeters and subdivided into millimeters, with a plastic viewer and square coupled to one of its ends according to standards established by Jelliffe[14]. Body mass index (BMI) was calculated using weight and height measurements according to the equation BMI = weight (kg) /height^2 (cm). The BMI cut-off points adopted were those established by the WHO[9], that is, low weight (BMI < 18.5); normal weight (BMI 18.5–24.99); overweight (BMI 25–29.99), and obesity (BMI ≥ 30.00). Waist circumference (WC) was measured at the smallest circumference between the ribs and the iliac crest, using a flexible non-stretchable tape measure without compressing tissues. When the smallest circumference could not be identified, the measurement was taken 2 cm above the navel. The cut-off points used for waist circumference (WC) were established by Lean et al[15] according to the cardiovascular risk level: increased risk for women (WC > 80 cm) and for men (WC > 94 cm), and very increased risk for women (WC > 88 cm) and for men (WC > 102 cm). Hip circumference was measured with a flexible non-stretchable tape measure, placed around the hip at the most protuberant area without compressing the skin.

Body fat was measured using the tetrapolar bioimpedance method (Biodynamics model 310 device) with the individual lying on a non-conductive surface in supine position with arms and legs at 45° abduction. Immediately before the electrodes were placed, the contact area was cleansed with alcohol. An emitting electrode was placed next to the metacarpophalangeal joint on the dorsal surface of the right hand and the other distal to the transverse arch of the upper surface of the right foot. A detecting electrode was placed between the distal prominences of the radius and ulna of the right wrist, and the other, between the medial and lateral malleoli of the right ankle, according to the manufacturer's instructions.

Values of triglycerides ≥ 150 mg/dl, blood glucose ≥ 110 mg/dl, total cholesterol ≥ 200 mg/dl, LDL ≥ 130 mg/dl, and HDL < 40 mg/dl for men and < 50 mg/dl for women, systolic blood pressure ≥ 130 mmHg and diastolic blood pressure ≥ 85 mmHg were defined as cardiovascular risk factors.

The presence of a metabolic syndrome was defined according to NCEP – ATPIII criteria[16], which require the presence of three or more of the following five factors: a) abdominal obesity: waist circumference greater than 88 cm for women and greater than 102 cm for men; b) plasma level of triglycerides ≥ 150 mg/dl; c) plasma level of HDL-c lower than 40 mg/dl for men and 50 mg/dl for women; d) systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg; e) fasting blood glucose ≥ 110 mg/dl.

Data obtained were stored and analyzed in the Epi Info version 6.0 and in the Sigma Stat for Windows version 2.06 software programs. All variables were tested for normality using the Kolmogorov-Smirnov test. The results were presented as mean ± SD when the variables had a normal distribution, and as median when the distribution was non normal. To verify associations between risk factors the chi-square test (χ^2) and the Odds Ratio (OR) were used, and when the frequency expected was lower than five the Fisher's test was used. The Student's t test was used for comparison of two means when the variable had a normal distribution, and the Mann-Whitney test was used when the distribution was non normal. Correlation analyses were used to verify the level of correlation between continuous variables using Pearson's correlation when the two variables had a normal distribution and Spearman's correlation when at least one of the variables had a non-normal distribution. P values lower than 0.05 were considered statistically significant.

All participants were informed of the assessment results and had medical and nutritional guidance whenever necessary. All hypertensive, diabetic, dyslipidemic and obese individuals were treated and followed on an outpatient basis at the Health Division of the UFV.

Results

Two hundred and thirty one individuals were studied, of whom 106 (45.9%) were females and 125 (54.1%) were males, with ages ranging from 21 to 76 years, with a higher predominance of individuals in the age range of 40 to 49 years both for females (45.3%) and males (40.8%).

When BMI was analyzed, the frequency of overweight and obesity among females was 42.5% and 24.5%, respectively, and 40.0% and 15.2% among males, respectively. Women had greater chances of having excess weight considering BMI ≥ 25.0 [OR = 1.86; 95% CI: 1.03 – 3.35; p < 0.05] and BMI ≥ 30.0 [OR = 2.47; 95% CI: 1.11 – 5.53; p < 0.05], but not when only the overweight category was considered (χ^2 = 2.57; p = 0.10).

As regards central fat distribution, 32% of the women had WC between 80 and 88 cm, and 42% above 88 cm. Among males, 23.9% had a WC between 94 and 102 cm, and 22.2% above 102 cm.

Men were observed to have higher plasma levels of total cholesterol, HDL and triglycerides. As regards nutritional status, men also had higher levels of BMI and body fat percentage (Tab. 1).

When the anthropometric and body composition profiles were assessed in both genders according to BMI categories, we observed that women had higher percentage values of body fat than those of men in all BMI categories. We also verified that in the overweight category for both genders, the individuals already had high waist circumference measurements (Tab 2). When the factors related to lifestyle were assessed, we verified that 38.7% of the women and 34.4% of the men had a sedentary lifestyle (χ^2 = 0.29; p = 0.59), and that 77% of those who had physical activity had an adequate frequency of at least three times a week during forty minutes. The frequency of smoking habit was 48.3% among males (χ^2 = 1.54; p = 0.21) and alcohol consumption was 1.58 times higher in comparison with women (OR = 2.74; 95% CI: 1.55-4.86; p < 0.001).

When the same variables were analyzed according to BMI, we verified that a sedentary lifestyle was a risk factor for obesity (OR = 3.47; 95% CI: 1.53-7.91; p < 0.01]. No association was

observed between nutritional status and alcohol consumption ($\chi^2 = 5.81$; $p = 0.12$), nor with smoking ($\chi^2 = 4.55$; $p = 0.20$), although these two factors had been more frequent among normal weight individuals.

Results obtained from the analyses of the correlation between lipid profile, blood glucose and blood pressure levels are shown in Table 3. Although significant, the correlations were generally weak. We can observe that WC was the body fat (BF) indicator that had a stronger correlation and with a number of variables larger than BMI and BF. When the components of the lipid profile were analyzed, we verified that triglyceride level was the only measurement that had a significant correlation with the three parameters assessed.

When the frequency of cardiovascular risk factors (CRF) was assessed according to BMI (Tab. 4) and to waist circumference (Tab. 5), we verified that increases in BMI and in abdominal fat were mainly related to an increase in fasting blood glucose and triglyceride levels; a reduction in HDL-c levels; and an increase in blood pressure. Likewise, we could observe that the frequency of metabolic syndrome was higher in the overweight and obesity group, mainly among males.

Discussion

In the present study, the frequencies of overweight and obesity were quite high when compared to those found in the 2002-2003 Family Budget Research (*Pesquisa de Orçamento Familiar* – POF)[3], in which approximately 40% of the adult individuals in the country were estimated to have excess weight (BMI ≥ 25 kg/m²), and 8.9% of males and 13.1% of females were obese.

This high frequency found can be explained by the fact that approximately 44% of our sample was composed by individuals referred to the Program by the doctor because of biochemical alterations or increased blood pressure, factors that are frequently associated with excess weight.

When the results of the 2002-2003 POF are compared with those of previous research conducted in the country in 1974-1975 (National Study on Family Expenses – *Estudo Nacional da Despesa Familiar* – ENDEF) and in 1989 (National Research on Health and Nutrition – *Pesquisa Nacional sobre Saúde e Nutrição* – PNSN), we can observe that excess weight and obesity show a continuous and intense increase among the male population, and that this progression is different among women in both the periods limited by the three studies: increases of approximately 50% between 1974-1975 and 1989 and a relative stability between 1989 and 2002-2003[3].

High prevalences of obesity have been observed in several States and cities in the country: 18% in Sao Paulo[18]; 37.5% in Cotia, SP[19]; 21% in Pelotas, RS[20]; 18.6% in Rio Grande do Sul[21]; 17% in Fortaleza, CE[22]; 12% in Rio de Janeiro, RJ[23]; and 17.8% in Campos, RJ[24], and a large number of studies also found a higher prevalence among women[20,22-25] and increased prevalence proportional to age[20,24].

Considering this growing trend of overweight and obesity in the Brazilian population and its association with cardiovascular risk factors corroborated by our study, interventions aiming at reducing body weight, especially central fat, are of the utmost importance for the prevention and control of cardiovascular diseases in the population[5,6,9].

As regards abdominal obesity, a high percentage of women (42%) and men (22.2%) were found with this condition, considering waist circumference above 88 cm and 102 cm, respectively. In the overweight category both men and women were observed to have prior high-risk waist circumference

Variables	Female (n = 66)	Male (n = 89)	p
Age (years)1	47 (28 – 71)	47 (21 – 74)	NS
Blood glucose (mg/dl)[1]	91.25 (74 – 164)	92.5 (72.5 – 355)	NS
Total cholesterol (mg/dl)[2]	201.66 ± 39.45	215.75 ± 40.84	0.033
LDL (mg/dl)[2]	132.28 ± 34.28	132.38 ± 37.7	NS
HDL (mg/dl)[1]	41.65 (21.9 – 80)	45.2 (28 – 97)	0.010
Triglycerides (mg/dl)[1]	108.5 (25 – 396)	144 (43 – 389)	0.003
SBP (mmHg)[1]	130 (100 – 190)	120 (90 – 170)	0.051
DBP (mmHg)[1]	80 (60 – 110)	80 (50 – 100)	NS
Height (cm)[2]	166.32 ± 7.89	163.75 ± 9.02	NS
Weight (kg)[2]	70.16 ± 12.2	72.18 ± 13.94	NS
BMI (kg/m²)[2]	25.34 ± 3.92	26.91 ± 4.84	0.032
WC (cm)[2]	88.44 ± 10.3	89.21 ± 12.51	NS
WHR[2]	0.89 ± 0.07	0.87 ± 0.09	NS
Body fat (%)[2]	24.73 ± 6.78	28.19 ± 6,96	0.002

[1] median (minimum and maximum); [2] mean ± standard deviation; NS - non-significant difference; SBP - systolic blood pressure; DBP - diastolic blood pressure; BMI - body mass index; WC - waist circumference; WHR - waist-hip ratio.

Table 1 – Comparison between mean or median clinical, biochemical and anthropometric data among genders

Gender	Nutritional status	BMI (kg/m²)	Waist circumference (cm)	Waist-hip ratio	Body fat (%)
Female	Low weight (n=4)	16.27 ± 1.72	69.87 ± 12.42	0.75 ± 0.07	19.93 ± 5.06
	Normal weight (n=31)	22.18 ± 2.24	75.61 ± 6.47	0.78 ± 0.06	27.52 ± 5.16
	Overweight (n=45)	27.68 ± 1.72	88.08 ± 7.50	0.85 ± 0.05	33.42 ± 4.46
	Obesity (n=26)	34.02 ± 3.47	100.28 ± 9.63	0.87 ± 0.07	41.56 ± 8.52
Male	Low weight (n=0)	-	-	-	-
	Normal weight (n=56)	23.18 ± 1.85	84.80 ± 7.01	0.90 ± 0.10	21.29 ± 4.76
	Overweight (n=50)	27.98 ± 2.02	96.47 ± 6.15	0.95 ± 0.05	24.01 ± 4.00
	Obesity (n=19)	35.31 ± 4.64	115.25 ± 14.46	1.00 ± 0.05	28.95 ± 3.95

[1] Values in mean and standard deviation.

Table 2 – Anthropometric measurements and body composition according to gender and nutritional status[1]

measurement, thus confirming the presence of abdominal obesity even in individuals with BMI lower than 30, and reinforcing the importance of the use of this anthropometric indicator in daily clinical practice.

Studies on the prevalence of abdominal obesity, as well as research to verify the adequacy of these cut-off points are rare in the country[26-28] and show the need to investigate the balance between sensitivity and specificity of the indicators used in an attempt to identify more appropriate cut-off points for our population. As seen in the present study, even without the diagnosis of obesity, many individuals were already at risk of metabolic alterations as a result of excess abdominal fat.

When biochemical data were analyzed, men had higher mean and median values of total cholesterol, HDL, and triglycerides than women ($p < 0.05$). Similar results were described by other authors such as Araújo et al[29], who, in addition to finding statistically higher levels of triglycerides and HDL among men, also verified higher glucose levels in this group.

In relation to blood pressure, we did not find any differences between genders, both for DBP and SBP, in disagreement with the results of Guedes & Guedes[25] and Gus et al[30], which showed higher blood pressure levels among men.

Considering the importance of factors related to lifestyle in the etiology of obesity and cardiovascular diseases, we evaluated the frequency of smoking, sedentary lifestyle, and alcohol consumption and verified that, unlike results found in other studies[18,20,21], approximately 64% of the individuals had some physical activity, and 77% of them practiced at least three times a week during forty minutes. However, approximately 60% of the obese individuals were sedentary, confirming that physical inactivity is a risk factor for obesity (OR = 3.47; 95% CI: 1.53-7.91; $p < 0.01$) as seen in the literature[22]. A higher frequency of smoking habit and alcohol consumption was observed among males, the same found in other studies[18,21,30].

Excess weight and especially abdominal obesity correlate with most of the cardiovascular risk factors, mainly with high levels of triglycerides and reduced levels of HDL, with a higher impact on the increase of blood pressure, as markedly

Variables	BMI	WC	BF
	R	R	r
Blood glucose[1]	0.179[a]	0.241[b]	0.004
Triglycerides[1]	0.160[a]	0.178[a]	0.165[a]
Total cholesterol[2]	0.117	0.119	0.179[a]
LDL-c[2]	0.121	0.173[a]	0.117
HDL-c[1]	-0.098	-0.295[b]	0.089
SBP[1]	0.361[b]	0.455[b]	0.149
DBP[1]	0.407[b]	0.495[b]	0.171[a]
Age[1]	0.154	0.204[a]	0.242[b]

[1] Spearman's rank correlation; [2] Pearson's correlation; [a] $0.05 < p < 0.01$; [b] $p < 0.01$; BMI - body mass index; WC - waist circumference; BF - body fat percentage; SBP - systolic blood pressure; DBP - diastolic blood pressure; r - correlation coefficient.

Table 3 – Correlations between age, anthropometric variables and body composition, and lipid profile, blood glucose and blood pressure (n = 155)

Gender	Nutritional status	Blood glucose ≥ 110 g/dl	Triglycerides ≥ 150 mg/dl	Total cholesterol ≥ 200 mg/dl	LDL-c ≥ 130 mg/dl	HDL-c[1]	SBP[2] (mmHg)	DBP[3] (mmHg)	MS[4]
Female	Low weight (n = 4)	0.0%	0.0%	75%	100%	25%	0.0%	0.0%	0.0%
	Normal weight (n=31)	3.2%	45.2%	45.2%	50%	50%	33.3%	14.8%	6.5%
	Overweight (n = 45)	15.9%	29.3%	58.1%	51.3%	55%	48.8%	32.6%	34.1%
	Obesity (n = 26)	26.9%	73.9%	68.0%	77.8%	60.0%	54.2%	50.0%	61.5%
Male	Low weight (n = 0)	-	-	-	-	-	-	-	-
	Normal weight (n=56)	7.3%	43.6%	50.9%	39.2%	44.4%	41.5%	28.3%	12.5%
	Overweight (n= 50)	26.5%	49.0%	60.0%	53.2%	42.9%	70.2%	55.3%	34.0%
	Obesity (n = 19)	26.3%	73.8%	50.0%	25.7%	68.4%	76.5%	58.8%	78.9%

[1] HDL-c < 40 mg/dl for men and HDL-c < 50 mg/dl for women; [2] Systolic blood pressure ≥ 130 mmHg; [3] Diastolic blood pressure ≥ 85 mmHg; [4] MS - Metabolic Syndrome; defined according to NCEP - ATPIII criteria.

Table 4 – Frequency of CVD risk factors and metabolic syndrome according to gender and nutritional status

Gender	Waist Circumference	Blood glucose ≥ 110 g/dl	Triglycerides ≥ 150 mg/dl	Total cholesterol ≥ 200 mg/dl	LDL-c ≥ 130 mg/dl	HDL-c[1]	SBP[2] (mmHg)	DBP[3] (mmHg)	MS[4]
Female	WC < 80 cm (n = 26)	0.0%	6.0%	61.5%	56.0%	36.0%	29.1%	12.5%	0.0%
	WC: 80-88 cm (n = 32)	13.0%	37.9%	61.3%	53.3%	56.7%	46.7%	20%	12.9%
	WC > 88 cm (n = 42)	23.8%	61.5%	69.3%	71.9%	61.8%	52.7%	50%	64.3%
Male	WC < 94 cm (n = 63)	11.5%	40.4%	44.0%	41.4%	39.3%	50%	31.7%	17.5%
	WC: 94-102 cm (n = 28)	21.4%	53.5%	67.8%	51.8%	60.7%	62.9%	44.4%	25.0%
	CA > 102 cm (n = 26)	23.1%	61.6%	64.0%	50.0%	64.0%	78.3%	73.9%	76.9%

[1] HDL-c < 40 mg/dl for men and HDL-c < 50 mg/dl for women; [2] Systolic blood pressure ≥ 130 mmHg; [3] Diastolic blood pressure ≥ 85 mmHg; [4] MS - Metabolic Syndrome; defined according to NCEP - ATPIII criteria.

Table 5 – Frequency of CVD risk factors and metabolic syndrome according to gender and waist circumference (WC)

observed in the literature[25,31-33].

The frequencies of high levels of total cholesterol and LDL remained practically unchanged with increases in BMI and waist circumference, as observed in other studies[25,33,34], possibly indicating a lower interference of excess weight and central fat distribution in increases in blood levels of these lipids.

The simultaneous presence of risk factors resulted in a frequency of approximately 31% of metabolic syndrome among men and women, and was higher in the overweight and obesity group, and among those with higher values of waist circumference.

In face of the results presented here, we conclude that individuals with excess weight, mainly with abdominal obesity, are more exposed to cardiovascular risk factors involved in the metabolic syndrome and, consequently, to a higher risk of morbidity and mortality when these alterations are not treated. Risk factors such as a sedentary lifestyle, overweight/obesity, central body fat distribution, smoking and excessive alcohol consumption are subject to intervention, demonstrating the importance of a clinical and nutritional follow-up in the reduction of cardiovascular risk factors and in the improvement of the quality of life of the population.

Supported by: Programa Institucional de Bolsas de Iniciação Científica - PIBIC/CNPq.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

References

1. Instituto Brasileiro de Geografia e Estatística (IBGE). Perfil dos idosos responsáveis pelos domicílios no Brasil, 2000. Rio de Janeiro; 2002. (Estudos & Pesquisas, n. 9).
2. Batista Fº M, Rissin A. A transição nutricional no Brasil: tendências regionais e temporais. Cad Saúde Pública. 2003; 19 (supl.1): S181-S191.
3. Instituto Brasileiro de Geografia e Estatística (IBGE). Pesquisa de orçamentos familiares, 2002-2003 (POF): análise da disponibilidade domiciliar de alimentos e do estado nutricional no Brasil. Rio de Janeiro, 2004.
4. Monteiro CA, Conde, WL. Tendência secular da desnutrição e da obesidade na infância na cidade de São Paulo (1974-1996). Rev Saúde Pública. 2000; 34 (supl 6): 52-61.
5. Monteiro CA, Benicio MH, Iunes R, Gouveia NC, Taddei JA, Cardoso MA. Nutritional status of Brazilian children: trends from 1975 to 1989. Bull World Health Organ. 1992; 70: 657-66.
6. Monteiro CA, Benicio MH, Conde WL, Popkin BM. Shifting obesity trends in Brazil. Eur J Clin Nutr. 2000; 54: 342-6.
7. Ministério da Saúde. [homepage na Internet]. Anuário estatístico de saúde do Brasil. 2001. [citado 2003 maio/0]. Disponível em: http://portal.saude.gov.br/portal/aplicacoes/anuario2001/index.cfm
8. Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. The evidence Report National Institutes of Health. Obes Res. 1998; 6 (Suppl. 2): 51S-209S.
9. Diet, nutrition and the prevention of chronic diseases. World Health Organ Tech Rep Ser. 2003; 916: 1-149.
10. Batista MCB, Franceschini SCA. Impacto da atenção nutricional na redução dos níveis de colesterol sérico de pacientes atendidos em serviços públicos de saúde. Arq Bras Cardiol. 2003; 80: 162-6.
11. Bloch KV, Salles GF, Muxfeldt ES, Rocha, NA. Orlistat in hypertensive overweight/obese patients: results of a randomized clinical trial. J Hypertension. 2003; 21: 2159-65.
12. Zhu S, Wang Z, Heshka S, Heo M, Faith MS, Heymsfield SB. Waist circumference and obesity-associated risk factors among whites in the third National Health and Nutrition Examination Survey: clinical action thresholds. Am J Clin Nutr. 2002; 76: 743-9.
13. Misra A, Vikram NK. Clinical and pathophysiological consequences of abdominal adiposity and abdominal adipose tissue depots. Nutrition. 2003; 19: 457-66.
14. Jelliffe DB. The assessment of the nutritional status of the community. Geneva: WHO; 1966.
15. Lean MEJ, Han TS, Morrison CE. Waist circumference as a measure for indicating need for weight management. BMJ. 1995; 311: 158-61.
16. Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Cholesterol. JAMA. 2001; 285: 2486-97.
17. Dean AG, Dean JA, Burton AH, Dicker RC. Epi Info, version 6.01: a word processing, database, and statistics program for epidemiology on micro-computers. Georgia: CDC; 1990. 367p.
18. Rego RA, Berardo FAN, Rodrigues SSR, Oliveira ZM, Oliveira MB, Vasconcellos C e cols. Fatores de risco para doenças crônicas não-transmissíveis: inquérito domiciliar no município de São Paulo, SP (Brasil). Metodologia e resultados preliminares. Rev Saúde Pública. 1990; 24: 277-85.
19. Cervato AM, Mazzilli RN, Martins IS, Marucci M de F. Dieta habitual e fatores de risco para doenças cardiovasculares. Rev Saúde Pública. 1997; 31: 227-35.
20. Gigante DP, Barros FC, Post CLA, Olinto MT. Prevalência de obesidade em adultos e seus fatores de risco. Rev Saúde Pública. 1997; 31: 236-46.
21. Gus I, Fischmann A, Medina C. Prevalência de fatores de risco para doença arterial coronariana no Estado do Rio Grande do Sul. Arq Bras Cardiol. 2002; 78: 484-90.
22. Sabry MOD, Sampaio HAC, Silva MGC. Hipertensão e obesidade em um grupo populacional no Nordeste do Brasil. Rev Nutr. 2002; 15: 139-47.
23. Sichieri R. Dietary patterns and their associations with obesity in the Brazilian City of Rio de Janeiro. Obes Res. 2002; 10: 42-8.
24. Souza LJ, Neto CG, Chalita FEB. Prevalência de obesidade e fatores de risco cardiovascular em Campos, Rio de Janeiro. Arq Bras Endocrinol Metab. 2001; 45: 475-80.
25. Guedes DP, Guedes JERP. Distribuição de gordura corporal, pressão arterial e níveis de lipídeos-lipoproteínas plasmáticos. Arq Bras Cardiol. 1998; 70: 93-8.
26. Pereira RA, Sichieri R, Marins VMR. Razão cintura/quadril como preditor de hipertensão arterial. Cad Saúde Pública. 1999; 15: 333-44.
27. Velásquez-Meléndez G, Kac G, Valente JG, Tavares R, Silva CQ, Garcia ES. Avaliação da capacidade preditiva da circunferência abdominal para obesidade global e hipertensão arterial em mulheres residentes na Região Metropolitana de Belo Horizonte, Brasil. Cad Saúde Pública. 2002; 18: 765-71.
28. Martins IS, Merinho SP. O potencial diagnóstico dos indicadores da obesidade centralizada. Rev Saúde Pública. 2003; 37: 760-7.
29. Araújo F, Yamada AT, Araújo MVM, Latorre MR, Mansur AJ. Perfil lipídico de indivíduos sem cardiopatia com sobrepeso e obesidade. Arq Bras Cardiol. 2005; 84: 405-9.
30. Gus M, Moreira LB, Pimentel M, Gleisener AL, Moraes RS, Fuchs FD. Associação entre diferentes indicadores antropométricos de obesidade e prevalência de hipertensão arterial. Arq Bras Cardiol. 1998; 70: 111-4.
31. Siani A, Cappuccio FP, Barba G, Trevisan M, Farinaro E, Lacone R et al. The relationship of waist circumference to blood pressure: The Olivetti Heart Study. Am J Hypertens. 2002; 15: 780-6.
32. Freitas OC, Carvalho FR, Neves, JM, Veludo PK, Parreira RS, Gonçalves RM et al. Prevalência de hipertensão na população urbana de Catanduva, São Paulo, Brasil. Arq Bras Cardiol. 2001; 77: 16-21.
33. Carneiro G, Faria NA, Filho FFR, Ribeiro Filho FF, Guimarães A, Lerario D et al. Influência da distribuição da gordura corporal sobre a prevalência de hipertensão arterial e outros fatores de risco cardiovascular em indivíduos obesos. Rev Assoc Med Bras. 2003; 49: 306-11.
34. Cercato C, Mancini MC, Arguello AMC, Passos VQ, Villares SM, Halpern A. Systemic hypertension, diabetes mellitus, and dyslipidemia in relation to body mass index: evaluation of a Brazilian population. Rev Hosp Clín Fac Med S Paulo. 2004; 59: 113-8.