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Original Article

Prevalence of metabolic syndrome among workers from the Company of Generation and Distribution of Energy in Rio de Janeiro, Brazil

Prevalência de síndrome metabólica entre os trabalhadores da Companhia de Geração e Distribuição de Energia no Rio de Janeiro, Brasil

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Abstract

Little is known about the prevalence of metabolic syndrome in the World's working force. We examined the prevalence of such disease in the Company of Generation and Distribution of Energy in Rio de Janeiro city, Brazil. **Methods:** A cross-sectional study was designed to analyze data from employees submitted to the annual company medical check-up in 2008. Medical charts were reviewed for collection of clinical and laboratorial information. **Results:** The total prevalence of metabolic syndrome was 48.6% (95%CI 46.0–51.2). It increased with age and reached 58.7% (95%CI 56.1–61.3) in employees older than 60 years. The age-adjusted prevalence was 38.2% (95%CI 35.7–40.7). Increased waist circumference was the most prevalent component of the syndrome (94.2%; 95%CI 92.1–95.7), followed by high blood pressure (69.3%; 95%CI 65.7–72.7). In a multivariate analysis age, sedentary lifestyle and level of uric acid were significantly associated with the metabolic syndrome. **Conclusion:** Metabolic syndrome is highly prevalent in the studied working population in Rio de Janeiro. Our study will help delineating key risk factors for the development of metabolic syndrome in Brazil and may help the creation of new preventive public health policies.

Keywords: metabolic syndrome X; cardiovascular disease; diabetes mellitus; hypertension; obesity.

Resumo

Pouco sabe-se sobre a prevalência da síndrome metabólica em trabalhadores no mundo. Foi examinada a prevalência dessa doença na Companhia de Geração e Distribuição de Energia da cidade do Rio de Janeiro, Brasil. **Métodos:** Um estudo transversal foi projetado para analisar os dados dos funcionários, apresentado à empresa durante o *check-up* médico anual realizado em 2008. Foram revisados os prontuários para coleta de informações clínica e laboratoriais. **Resultados:** A prevalência de síndrome metabólica foi de 48,6% (IC95% 46,0–51,2). Ele aumentou com a idade e chegou a 58,7% (IC95% 56,1–61,3) em empregados com mais de 60 anos. A prevalência ajustada por idade foi de 38,2% (IC95% 35,7–40,7). O aumento da circunferência da cintura foi o componente de maior prevalência da síndrome (94,2%; IC95% 92,1–95,7), seguido por pressão arterial elevada (69,3%; IC95% 65,7–72,7). Em uma análise multivariada, idade, sedentarismo e nível de ácido úrico foram significativamente associados com a síndrome metabólica. **Conclusão:** A síndrome metabólica é altamente prevalente na população ativa estudada no Rio de Janeiro. Nosso estudo vai ajudar a delinear os principais fatores de risco para o desenvolvimento da síndrome metabólica no Brasil e pode ajudar na criação de novas políticas preventivas de saúde pública.

Palavras-chave: síndrome X metabólica; doença cardiovascular; diabetes mellitus; hipertensão; obesidade.

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INTRODUCTION

As the worldwide prevalence of obesity and type 2 diabetes continues to rise, the metabolic syndrome and its associated risk factors might have an enormous burden on world's economy and public health. For instance, it is estimated that by 2030 the number of overweight and obese adults in the world will be close to 2 billion[1]. In Brazil alone, data from 2009 demonstrated that 50.1% of men and 48.0% of women were overweight[2], and in a recent systematic review that included 10 studies of different regions in Brazil, the prevalence of metabolic syndrome was in 29.6%[3].

Metabolic syndrome is a clustering of risk factors that raises the risk of cardiovascular disease and type 2 diabetes, which was first called "Syndrome X", in 1988, by Reaven[4]. These factors include dysglycemia, high blood pressure, elevated triglyceride levels, low high-density lipoprotein cholesterol levels (HDL-C), and obesity. Several definitions of metabolic syndrome have been proposed, making it difficult to compare its prevalence between different studies[5-7]. In 2009, several major organizations, such as the International Diabetes Federation, the American Heart Association and National Heart, Lung and Blood Institute, attempted to unify these criteria[8], which was adopted in the present study.

Studies suggest high prevalence of metabolic syndrome in the working population compared to the general population, and an association between work stress exposure and risk of metabolic syndrome[9-12].

However, to our knowledge, metabolic syndrome prevalence in the working force in Brazil has not been addressed in scientific studies. In view of the recent economic growth and increases in the formal employment rate in Brazil, it is imperative that we determine the burden of metabolic syndrome in the Brazilian working force. To approach this gap, we examined the prevalence of metabolic syndrome in the work force of the Company of Generation and Distribution of Energy in the city of Rio de Janeiro, Brazil.

MATERIAL AND METHODS

Study design

This cross-sectional study was designed to analyze data from employees of the Company of Generation and Distribution of Energy (city of Rio de Janeiro, Brazil), who were submitted to the annual company medical check-up, in 2008. The studied population is represented by workers of offices in non-laborious activities and during regular working hours of the day. The great majority with high level of education consisted of engineers, but some were architects, biologists, and physicians. Those at the medium level of education were mainly personnel in office support. Every medical chart was reviewed for collection of clinical and laboratorial data. Only cases with complete information for all items relevant to the diagnosis of metabolic syndrome were included. No other exclusion criteria were applied.

Definition

Metabolic syndrome and its components were diagnosed employing the consensus definition[8]. This requires the presence of three or more of the following risk factors: increased waist circumference (≥90 cm in men and ≥80 cm in women for the South American population); triglycerides ≥150 mg/dL (1.70 mmol/L) or treatment for high triglycerides; HDL-C <40 mg/dL (1.04 mmol/L) for men or <50 mg/dL (1.30 mmol/L) for women or treatment for reduced HDL-C; blood pressure ≥130/85 mm Hg or anti-hypertensive drug treatment; and glucose ≥100 mg/dL (5.55 mmol/L) or treatment for high glucose.

Clinical evaluation

The database was developed to include sociodemographic variables like gender, age, ethnicity and education; medical history of diabetes, hypertension and hyperlipidemia; and lifestyle parameters such as smoking and physical activity.

Blood pressure was taken in the left arm in the sitting position, after five minutes at rest, using an aneroid sphygmomanometer with a 5-mmHg accuracy. The first and fifth Korotkoff sounds were recorded, and the mean value of three measurements was used for analysis. Body weight was measured with light clothing and without shoes applying an adjusted scale. Height was calculated without shoes using a stadiometer attached to the scale to the nearest 0.1 cm. The body mass index (BMI) was achieved as the weight (in kilograms) divided by the square of the height (in meters). The following cutoffs were employed to classify individuals according to the BMI (kg/m^2): underweight <18.5, normal ≥18.5 to <25, overweight ≥25 to <30, and obese >30[13]. Waist circumference was measured at the midpoint between the lowest rib and the iliac crest. Trained nurses took all measurements.

Laboratorial evaluation

Blood and urine analyses were performed in the laboratory of the company in samples obtained after at least 12 hours of fasting. The serum levels of fasting plasma glucose, uric acid, creatinine, total cholesterol, high-density lipoprotein cholesterol (HDL-C), and total triglycerides were measured by enzymology using an automatic Selectra-E (Wiener Lab, Rosario, Argentina).

Statistical analysis

All statistical analyses were conducted using the Statistical Package for Social Sciences, SPSS 17.0 (Chicago, IL, USA).

The results of continuous variables were expressed as mean and standard deviation if distribution was Gaussian, and alternatively as median and range if the distribution was not normal. Categorical variables were expressed as frequencies. Comparisons between both groups were accomplished through the unpaired *t* test in case of normal distribution or, alternatively, by its non-parametric equivalent, Mann-Whitney's test. Analyses of the frequencies were performed using the χ^2 test. The prevalence of metabolic syndrome was calculated and adjusted by age using data of 2008 from the Brazilian Institute of Demography and Statistics (IBGE)[14] by the direct method. Association of risk factors with metabolic syndrome was assessed by the backward conditional method of logistic regression. Only variables that were not part of the adopted diagnostic criteria of metabolic syndrome were included in the model. Effective addition of the variable in the multivariate model required a high probability of association with metabolic syndrome in a univariate analysis ($p<0.10$). P-values lower than 0.05 were deemed significant.

Ethical aspects

The study was approved by the research ethics committee of the Medical School of Universidade Federal Fluminense (UFF, Niterói, Rio de Janeiro, Brazil).

RESULTS

After reviewing 1,743 medical charts of the employees submitted to the annual company check-up in 2008, data of 1,413 (81%) patients were included in the study. In Table 1, the anthropometric, metabolic and lifestyle characteristics of our sample are presented. The mean age of the participants was 49.4±8.8 years, and the great majority of the subjects included in the study were male (75.6%; 95%CI 73.13–77.61) and white (90.5%; 95%CI 88.88–91.95).

As shown in Table 2, the total prevalence of metabolic syndrome was 48.6% (95%CI 46.0–51.2). It increased with age and reached 58.7% (95%CI 56.1–61.3) in employees older than 60 years leading to an age-adjusted prevalence of 38.2% (95%CI 35.7–40.7).

In Table 3, the anthropometric, metabolic and lifestyle characteristics of employees with and without metabolic syndrome are compared. Subjects with such disease were older, predominantly male and had a higher proportion of non-white ethnicity and sedentary life style. The population with metabolic syndrome also portrayed higher mean values for: waist circumference, BMI, and systolic as well as diastolic blood pressure. Mean serum values of glucose, triglycerides, uric acid (for both genders), and total cholesterol were all higher, whereas HDL-C was lower in the affected employees.

Table 1. General features of workers from the company of generation and distribution of energy in Rio de Janeiro/RJ, Brazil, 2008 (n=1,413)

Variables	n (%)
Sex (male/female)	1,066 (75.6) / 347 (24.4)
Age group	
20–29 years	22 (1.6)
30–39 years	191 (13.5)
40–49 years	318 (22.5)
50–59 years	761 (53.8)
>60 years	121 (8.6)
Ethnicity (W/NW)	1,279 (90.5) / 134 (9.5)
Education (high level)	838 (59.3)
Sedentary lifestyle	753 (53.3)
Smoking	173 (12)
	Mean±SD
Age (years)	49.4±8.8
Waist circumference (cm)	95.1±11.6
BMI (kg/m²)	27.3±4.6
SBP (mmHg)	120.1±17
DBP (mmHg)	76.6±11.2
Fasting plasma glucose (mg/dL)	99.4±22.6
Triglycerides (mg/dL)	140.9±89.8
HDL-C (mg/dL)	43.3±11.4
Creatinine (mg/dL)	0.78±0.2
Uric acid (mg/dL)	4.7±1.3
Total cholesterol (mg/dL)	203.2±37.9

SD: standard deviation; W: white; NW: non-white; BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; HDL-C: high-density lipoprotein cholesterol.

Table 2. Crude prevalence of the metabolic syndrome using the harmonized criteria among workers from the company of generation and distribution of energy in Rio de Janeiro/RJ, Brazil, 2008

Age group	Crude prevalence (%)	95%CI
20–29 years	22.7	10.12–43.44
30–39 years	31.4	25.25–38.3
40–49 years	40.9	35.62–46.36
50–59 years	55.3	51.77–58.82
>60 years	58.7	49.77–67.05
Overall	48.6	46.02–51.23

95%CI: 95% confidence interval.

Prevalence of individual metabolic syndrome criteria is shown in Table 4. Increased waist circumference was the most common component of the syndrome (94.2%; 95%CI 92.1–95.7), followed by high blood pressure (69.3%; 95%CI 65.7–72.7). Elevated fasting glucose or treatment for hyperglycemia was present in only 38.3% (95%CI 35.7–40.7).

In order to explore the relationship between sociodemographic, lifestyle and laboratorial variables with metabolic syndrome, a multivariate regression analysis model was used. As shown in Table 5, only age (OR=1.05; 95%CI 1.03–1.06; $p<0.001$), sedentary

Table 3. Anthropometric, metabolic, and lifestyle characteristics among employees from the company of generation and distribution of energy in Rio de Janeiro/RJ, Brazil, 2008, considering the presence of metabolic syndrome in consideration

Variables	Metabolic syndrome		p-value
	Absent (n=726) n (%)	Present (n=687) n (%)	
Sex (male)	502 (69.1)	564 (82.1)	<0.001
Ethnicity (W/NW)	675 (93.0) / 51 (7.0)	604 (87.9) / 83 (12.1)	0.005
Education (high level)	447 (61.6)	391 (56.9)	0.075
Sedentary lifestyle (yes)	332 (45.7)	421 (61.3)	<0.001
Smoking (yes)	79 (10.9)	94 (13.7)	0.108
	Mean±SD	Mean±SD	
Age (years)	47.6±9.3	51.2±7.9	
Waist circumference (cm)	90±10	99±11	<0.001
BMI (kg/m²)	25.6±3.8	29.1±4.7	<0.001
SBP (mmHg)	114±14	127±18	<0.001
DBP (mmHg)	73±10	81±11	<0.001
Fasting plasma glucose	93±12	107±28	<0.001
Triglycerides (mg/dL)	99±46	185±103	<0.001
HDL-C (mg/dL)	49±12	38±8	<0.001
Creatinine (mg/dL)	0.76±0.21	0.80±0.26	0.001
Uric acid (mg/dL)	4.2±1.2	51±1.3	<0.001
Total cholesterol (mg/dL)	199±35	208±40	<0.001

SD: standard deviation; W: white; NW: non-white; SBP: systolic blood pressure; DBP: diastolic blood pressure; BMI: body mass index; HDL-C: high-density lipoprotein cholesterol.

Table 4. Prevalence rates of metabolic syndrome components among workers from the company of generation and distribution of energy in Rio de Janeiro/RJ, Brazil, 2008

Variables	n (%)	95%CI
Waist circumference	647 (94.2)	92.17–95.7
Blood pressure[a]	476 (69.3)	65.74–72.69
Fasting plasma glucose[a]	263 (38.3)	34.65–42.04
Triglycerides[a]	421 (61.3)	57.58–64.85
HDL-C[a]	428 (62.3)	58.62–65.85

[a]patients under treatment for laboratory or clinical abnormalities are also included; HDL-C: high-density lipoprotein cholesterol; 95%CI: 95% confidence interval.

Table 5. Association between metabolic syndrome and sociodemographic, lifestyle, and laboratorial variables among workers from the company of generation and distribution of energy in Rio de Janeiro/RJ, Brazil, 2008

Variables	Odds Ratio	95%CI	p-value
Age (years)	1.05	1.03–1.06	<0.001
Sedentary lifestyle (Y/N)	1.73	1.38–2.17	<0.001
Uric acid (mg/dL)	1.57	1.43–1.72	<0.001

Variables entered on step 1 – sex, age, ethnicity, education level, sedentary lifestyle, creatinine, and uric acid; 95%CI: 95% confidence interval.

lifestyle (OR=1.73; 95%CI 1.38–2.17; p<0.001), and level of uric acid (OR=1.57; 95%CI 1.43–1.72; p<0.001) were positively associated with higher risk of metabolic syndrome.

DISCUSSION

Metabolic syndrome is a worldwide public health problem; however, absence of a uniform diagnostic criterion makes comparison between different study populations very difficult. Herein, we present the first study in Brazil that determines the prevalence of metabolic syndrome in workers using the consensus definition. A very high prevalence rate of metabolic syndrome was found in our study.

The study population included mostly office workers. The age-adjusted prevalence rate of 38.6% (95%CI 35.7–40.7) found in the present study is higher than the ones reported for workers in either national or international samples[9-11,15]. Since work related stressors might affect the development of metabolic and cardiovascular diseases, we expected a higher prevalence of metabolic syndrome in the working forces versus the general Brazilian population. In fact, the total prevalence rate of the study population (48.6%) was even higher than the one of a non-randomized sample with a raised prevalence of diabetes and hypertension extracted from a community-based population in Rio de Janeiro metropolitan area (42.5%)[16].

Aging and predominance of males could account for the high frequency of metabolic syndrome in our study. We found that employees with metabolic syndrome were more likely to be older and male compared to those without it. The prevalence rates of metabolic syndrome for men and women vary widely across different populations[17-20].

Ethnic-related factors may also influence the prevalence of metabolic syndrome. In the present study, the proportion of non-whites in the affected population was higher. Two previous investigations in the United States reported low appearance among black subjects[17,19]. The strategy adopted to collect

this information may account for the differences. In our study, ethnicity was self-reported. It should also be pointed out that the degree of miscegenation in Brazil is very high making comparisons between races hard to be interpreted.

In agreement with the majority of the studies worldwide, sedentary lifestyle was associated with metabolic syndrome in the study population[10,17]. Despite suggestion of a negative relation between education level and risk of metabolic syndrome by previous studies[10,11,17], such variable did not seem to be an influent factor herein. Potentially modifiable working related stressors as difference in workload and day and night shifts may also affect the prevalence of metabolic syndrome and need to be explored in future studies in the Brazilian working force[21].

Hypertension was the most seen criteria of metabolic syndrome among adults from China and the United States[17,18]. Differently, increased waist circumference was the most frequent component of metabolic syndrome identified in our study. Such finding is probably associated with the adopted parameters for waist circumference. The values of waist circumference used in the consensus definition have not been validated for the South American population, which is not a homogeneous ethnic group.

With the aim of better individually evaluating the factors associated with metabolic syndrome, the variables that were not part of the adopted diagnostic criteria of metabolic syndrome were assembled in a model of backward multivariate analysis. Gender was included in our model but no association was found. This is not surprising, considering that a gender effect on the prevalence of metabolic syndrome is not a uniform finding[3]. In our analysis, age and sedentary lifestyle were confirmed as independent factors associated with the syndrome. It is worth mentioning the uric acid, whose association with cardiovascular diseases has been observed since the late 19th century[22], emerged as an independent associated factor with the presence of metabolic syndrome, a finding previously reported in 2005[23].

The present study had several limitations, such as its cross-sectional design that did not allow for causal inferences as to the associations found. Another potential limitation was that it was conducted in an employee population of one company in Rio de Janeiro, which limits the generalization of the results. Additional studies including the general Brazilian working force are needed to check if our findings can be extrapolated to multiple demographic and geographic groups. Finally, collected data refers to the year of 2008 and some minor changes may have occurred in the prevalence of risk factors of metabolic syndrome when compared to the present time.

CONCLUSION

In conclusion, our findings indicated that the prevalence of metabolic syndrome is distressingly high in a working population in Rio de Janeiro. Positive association with age, sedentary lifestyle, and level of uric acid was found. Routine check-ups in workers present an opportunity to implement effective preventive programs that could benefit workers to improve their health. Future studies may help identifying specific work related risk factors modifiable for the development of metabolic syndrome in the Brazilian working force. Such studies will help developing new public health policies for the Brazilian workers.

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