

# Prevalence of metabolic syndrome and related factors in bank employees according to different defining criteria, Vitória/ES, Brazil

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**OBJECTIVE:** To determine the prevalence of metabolic syndrome and related factors in bank employees in the city of Vitória/ES, Brazil.

**METHODS:** This was a cross-sectional study that included 521 working men and women  $\geq 20$  years of age. Sociodemographic, lifestyle, anthropometric, biochemical, and hemodynamic characteristics were collected. Metabolic syndrome was diagnosed using the criteria of the National Cholesterol Education Program-ATPIII and the International Diabetes Federation. A logistic regression model was used to calculate the crude and adjusted OR of the variables, and the statistical level of significance was set at 5.0%.

**RESULTS:** We identified 86 (17.2%) and 113 (22.6%) subjects with metabolic syndrome according to the criteria of the National Cholesterol Education Program-ATPIII and the International Diabetes Federation, respectively. The risk of developing metabolic syndrome was higher in individuals with a high school education (OR 2.6 [CI<sub>95%</sub>, 1.1-6.1]). In overweight and obese subjects, the risks were also higher (OR 12.6 [CI<sub>95%</sub>, 4.8-33.2,  $p=0.000$ ] and OR 43.7% [CI<sub>95%</sub>, 16.1-118.9,  $p=0.000$ ], respectively).

**CONCLUSION:** A large number of bank employees have metabolic syndrome, which can be associated with an increased risk of developing cardiovascular disease. Individuals who had college degrees had a higher prevalence of metabolic syndrome; this finding can be explained by the high rates of overweight and obesity found in subjects with college and graduate school educations.

**KEYWORDS:** Metabolic Syndrome; Employees; Obesity; Insulin Resistance.

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## INTRODUCTION

Metabolic syndrome (MS) is a growing concern worldwide because it is associated with cardiovascular co-morbidities (1). MS is characterized by the presence of dyslipidemia, glucose intolerance, hypertension, overweight, abdominal obesity, and other abnormalities; the association of MS with type 2 diabetes mellitus and cardiovascular disease (CVD) is also important (2). According to multiple researchers, insulin resistance appears to link the alterations present in MS (3,4) and increased abdominal adiposity. Although individual lifestyle factors, such as a lack of regular exercise, smoking,

and diet, are determinants of cardiovascular diseases (5), little attention has been paid to the risk factors inherent in work activities. The substantial increase of acute and chronic circulatory system disorders in the population warrants further research on these diseases.

The worldwide prevalence of MS varies from 13.6% to 46% (6-9), depending on the diagnostic criteria being applied and the population being evaluated. MS research in workers has been rare in Brazil (10,11); to date, MS studies, specifically of bank employees in Brazil, have not been found in the literature. Cavagione et al. (2008) (10) studied 258 men who were professional long-haul drivers and found an MS prevalence of 24%, according to the NCEP-ATP III criteria. A study of administrative officials from the petroleum industry used the NCEP-ATP III criteria and found the MS prevalence to be 15% and determined that sex, age, and smoking were associated with the presence of MS in the study population (11). In this context, occupation might correlate with MS development (12). This study aimed to determine the prevalence of MS in bank

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employees and identify the risk factors associated with developing MS in a large banking network in Vitoria, ES, Brazil.

## METHODS

We conducted an observational, cross-sectional study of employees, aged 20 to 64 years, from a state-owned banking network located in southeastern Brazil. Data were collected from August 2008 to August 2009. The study was approved by the Research Ethics Committee (no. 059/08) of the Center for Health Sciences, Federal University of Espirito Santo. The sample size was calculated to estimate the prevalence of MS in a population of 1,410 bank employees. We used simple random sampling for a prevalence of 20%, a 3% level of error and a 95% significance level. The quotas were calculated based on occupation (general direction and agency), sex, and age. Thus, the minimum sample size was 461 bank employees. Because of a possible low response rate, 525 bank employees were invited to participate. The data were collected at the workplace, and the employees were relieved of their duties during the data collection. Socioeconomic status was determined according to the Brazilian Economic Classification (13). Ethnicity was self-identified as black, brown, white, yellow, or indigenous, according to the IBGE (14).

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) measurements were performed during the interviews, three times in each individual; the first SBP and DBP measurements were discarded. The digital OMRON 742® (OMRON Healthcare Inc, China) calibrated and validated by Inmetro, was used for blood pressure measurements. Prior to the measurements and after having been asked to empty their bladders, the participants remained seated and at rest for approximately five minutes. They refrained from consuming food, alcohol, coffee, or cigarettes during the previous 30 minutes. For the data analysis, the mean value of the two measurements was considered. Blood pressure was measured again if the difference between the readings was greater than 4 mm Hg. The blood pressure levels were measured according to the VII Joint National Committee criteria (15). Clamps suitable for obese patients were used when needed.

All of the anthropometric measurements were performed by trained researchers. Body weight was obtained using a TANITA® electronic scale, which was accurate to within 0.1 kg, and the individuals were asked to be weighed with empty bladders and wearing only underwear. Height was measured in meters using a Sanny® stadiometer, which was accurate to 0.1 cm, while the subjects were barefoot with their arms along their bodies and their eyes fixed on a spot on the horizon. The body mass indices were calculated ( $BMI = \text{weight}/\text{height}^2$ ) as recommended by the World Health Organization (16) to assess nutritional status. The following cutoff points were used to classify individuals according to BMI ( $\text{kg}/\text{m}^2$ ): underweight  $BMI < 18$ ; normal  $\geq 18.5$  and  $< 25$ ; pre-obese  $\geq 25$  and  $< 30$ ; and obese  $\geq 30$ . The types of obesity, including grades I to III, were pooled in the analysis to ensure that the groups would be more representative. Waist and hip measurements were obtained using a metal tape. To measure the waist circumference (WC), the tape was positioned at the natural waist or at the lower curvature located between the last rib and the iliac crest (17). Biochemical tests were performed in the reference

laboratory using commercial kits (Roche Diagnostics Ltd., with the COBAS e601 analyzer, Roche, Rotkreuz, Switzerland) to measure the levels of glucose, total cholesterol, HDL cholesterol, VLDL cholesterol, triglycerides, uric acid, and ultra-sensitive CRP. The LDL cholesterol level was calculated using the Friedewald formula (18). The insulin dosage was determined using a commercial kit from Siemens with the IMMULITE® 2000 analyzer (Siemens Healthcare Diagnostics Inc., NY, USA).

Five parameters were used to characterize MS: waist circumference, blood pressure, serum concentrations of fasting glucose, TG, and HDL-C. Moreover, the parameters were characterized according to two different sets of criteria. The first set of criteria, initially proposed by the NCEP-ATPIII (2001) (19), described the diagnosis of MS in the presence of at least three of the following criteria: waist circumference  $> 88$  cm for females or  $> 102$  cm for males; HDL-C  $< 50$  mg/dL for females or  $< 40$  mg/dL for males; TG  $> 150$  mg/dL; blood pressure values  $> 130/85$  mm Hg; and fasting glucose  $> 110$  mg/dL. The second set of criteria, proposed by the IDF (20), reduced the threshold values for fasting glucose ( $> 100$  mg/dL) and waist circumference ( $> 80$  cm for women and  $> 90$  cm for men); however, these parameters were established by South Asians and not for individuals from South or Central America.

Statistical analyses were conducted using SPSS for Windows, version 15.0 (SPSS Inc., Chicago, USA). The mean values were compared using Student's T-test for independent samples, and when the normality was not verified by the Kolmogorov-Smirnov test, we used the nonparametric Mann-Whitney U-test. To analyze the differences in proportions, we used the chi-squared test ( $\chi^2$ ). The level of significance for all tests was set at  $\alpha = 0.05$ . After a bivariate analysis, a logistic regression analysis was performed using a dependent variable in the presence of MS according to the NCEP-ATP III criteria. Crude and adjusted OR were calculated from the variables that were entered into the logistic regression model. All variables with  $p < 0.20$  in the bivariate analysis were inserted into the regression model. In the final model, only those variables that retained  $p < 0.05$  were determined to be significant.

## RESULTS

Of the 525 individuals who were invited to participate in the study, 521 attended the interviews; however, 20 did not submit to the biochemical tests and were excluded from the analysis. Therefore, the dataset included 501 subjects, 255 (50.9%) men and 246 (49.1%) women; the representative percentages were similar to the overall study population.

Table 1 shows the prevalence of MS by sex, age, occupation, social status, education, race/ethnicity, and marital status, based on the NCEP-III and IDF criteria. We identified 86 (17.2%  $CI_{95\%}$ , 13.8-20.6) and 113 (22.6%  $CI_{95\%}$ , 18.8-26.3) individuals with MS based on the criteria from the NCEP and IDF, respectively. MS prevalence varied by sex according to the IDF criteria (males 27.8% vs. females 17.1%,  $p = 0.004$ ). An increase in age correlated with an increase in MS using both sets of criteria (NCEP and IDF,  $p = 0.004$  and  $p = 0.001$ , respectively). Individuals who worked in agencies or in customer service in banks showed a higher prevalence of MS compared with the general rate ( $p = 0.034$ ), according to the NCEP criteria. No significant differences were observed in race or socioeconomic status, although



**Table 1** - Prevalence of MS according to the NCEP-III and IDF criteria by gender, sex, age, position, social status, education level, race/ethnicity and marital status of the study population.

Variable	Category	Total (N = 501)	NCEP N (%)	p-value	IDF N (%)	p-value
Sex	Male	255	50(19.6)	0.140	71(27.8)	0.004
	Female	246	36(14.6)		42(17.1)	
Total			86(17.2)		113(22.6)	
Age	<30 years	90	5(5.6)	0.004	8(8.9)	0.001
	31 to 40 years	41	6(14.6)		5(12.2)	
	41 to 50 years	270	60(18.5)		68(25.2)	
	>50 years	100	25(25.0)		32(32.7)	
Position	General direction	279	39(14.0)	0.034	56(20.1)	0.113
	Agencies	222	47(21.2)		57(26.0)	
Social status	A1+A2	10	1(11.1)	0.680	1(11.1)	0.74
	B1	80	16(20.0)		20(25.0)	
	B2	189	30(15.9)		44(23.7)	
	C	204	38(18.6)		46(22.5)	
	D	18	1(5.6)		2(11.1)	
Education*	Junior high	6	-	0.016	1(0.9)	0.156
	High school	123	31(36.0)		36(32.5)	
	College	241	42(48.8)		55(48.2)	
	Graduate school	121	13(15.1)		21(18.4)	
Ethnicity	Black	26	7(26.9)	0.291	8(30.8)	0.109
	Mixed	168	28(16.7)		32(19.0)	
	White	292	51(17.5)		73(25.3)	
	Yellow	10	-		-	
	Indian	5	-		-	
Marital status**	Single	120	9(10.5)	0.005	15(12.5)	0.005
	Married/Live together	325	67(77.9)		87(26.8)	
	Separated/Divorced/Widowed	55	10(11.6)		11(20)	

$p < 0.05$ , Chi-squared test \* N = 491 \*\* N = 500.

MS was identified according to the National Cholesterol Education Adult Treatment Panel Program's-III (NCEP-ATP III) and International Diabetes Federation (IDF, 2005) criteria. Social Status A to E: based on the scholarship of the family head and items purchased.

education level affected the distribution of MS according to the NCEP criteria ( $p = 0.016$ ). Marital status had a significant influence on the prevalence of MS according to both sets of criteria ( $p = 0.005$ ).

The biochemical, anthropometric, and hemodynamic indicators for individuals with and without MS are shown in Table 2. Individuals with and without MS syndrome showed higher mean values of fasting plasma glucose according to both sets of criteria, whereas individuals diagnosed using the IDF criteria showed higher insulin levels. Those subjects with MS according to the NCEP criteria had the highest average total cholesterol as well as lower HDL levels. The CRP levels were significantly elevated in the individuals with MS, according to both sets of criteria. The anthropometric indicators were similar using either criteria; the average WC values were slightly higher in those subjects who were diagnosed with the IDF criteria; and higher levels of hemodynamic indicators were also identified in those subjects diagnosed using the IDF criteria.

Figure 1 shows the relative contributions of the five criteria to the diagnosis of MS, according to the NCEP-ATPIII and the IDF. The parameters we assessed included high blood pressure, triglycerides, and HDL cholesterol, which yielded similar results. High fasting glucose levels and large waist circumferences were more prevalent in those subjects diagnosed using the IDF criteria, whereas large waists showed a significant difference ( $p = 0.001$ ).

Table 3 shows the crude and adjusted OR of the variables that were entered into the logistic regression model. The risk of MS, according to the NCEP ATP III criteria, was 2.6 times higher in the individuals who had only a high school education, compared to those with college degrees. Overweight and obese subjects were 12.6 and 43.7 times,

respectively, more likely to develop MS compared with normal-weight individuals.

## DISCUSSION

To the best of the authors' knowledge, this was the first study of MS prevalence of in bank employees. The lack of studies is concerning because MS patients have clinical and laboratory results that strongly indicate other health problems, particularly cardiovascular issues. Additionally, the lack of unanimity of the MS diagnostic criteria should be highlighted because it complicates the comparisons between studies. To narrow this gap, two diagnostic criteria were used in the present investigation; these criteria were established by the NCEP-ATPIII (19) and the IDF (20); the number of cases of MS found using the NCEP-ATPIII and IDF criteria were 86 (17.2% CI<sub>95%</sub> 13.8-20.6) and 113 (22.6% CI<sub>95%</sub> 18.8-26.3), respectively. The prevalence of MS in this study was similar to that found by Felipe-de-Melo et al. (15%) (11) in administrative workers from the Brazilian oil industry but lower than that found in an urban population in the Brazilian capital (29.8%) from our previous study (9). Cavagione (2008) (10) assessed 258 long-haul drivers and observed an MS prevalence 24% using the NCEP-ATP III criteria.

In other countries, we found diverse results for the prevalence of MS in other occupations, including 23.5% in the German chemical industry (21), 10% in different categories of the Spanish population (22), and 8.2% in Taiwanese high-tech workers (23). A Spanish study found that of ten active workers from an automobile company, only one had MS, and managers had a more favorable profile when compared with other workers (24). These



**Table 2** - Biochemical, anthropometric and hemodynamic parameters in the study population, according to the diagnostic criteria and presence of MS.

Variable	NCEP							IDF						
	No (N = 415)			Yes (N = 86)			p-value	No (N = 388)			Yes (N = 113)			p-value
	Mean	SD	Median	Mean	SD	Median		Mean	SD	Median	Mean	SD	Median	
Glucose (md/dL)	84.4	9.0	83	106.4	44.1	92	0.000 <sup>b</sup>	84.1	8.3	83	126.8	51.1	83	0.000 <sup>b</sup>
Insulin mcIU/mL	5.2	3.7	4.1	10.8	8.6	9.4	0.000 <sup>b</sup>	5.7	4.6	4.0	11.0	8.7	7.5	0.000 <sup>b</sup>
Total cholesterol (mg/dL)	190.2	36.1	189	201.2	39.4	198	0.012 <sup>a</sup>	191.5	36.1	188	197.9	44.1	199	0.048 <sup>a</sup>
HDL (mg/dL)	51.1	13.2	48	38.9	7.4	38	0.000 <sup>b</sup>	49.9	13.2	49	39.6	8.9	39	0.000 <sup>b</sup>
LDL (mg/dL)	120.5	55.8	117.2	121.3	34.3	120.8	0.364 <sup>b</sup>	120.9	54.2	117.2	118.4	36.6	120.8	0.326 <sup>b</sup>
VLDL (mg/dL)	21.3	10.8	19.2	37.7	15.7	35.6	0.000 <sup>b</sup>	22.5	11.7	18.4	39.4	18.4	33	0.000 <sup>b</sup>
Triglycerides	107	62.9	94	216.8	136.6	180	0.000 <sup>b</sup>	116.8	78.5	91.5	216.8	139.9	167.5	0.000 <sup>b</sup>
Hs CRP (mg/L)	2.7	5.0	1.4	4.4	4.7	2.7	0.000 <sup>b</sup>	2.9	5.0	1.3	4.0	3.9	2.3	0.000 <sup>b</sup>
Mean blood pressure (mm Hg)	92.9	12.9	92	105.0	12.3	103	0.000 <sup>a</sup>	93.6	12.9	91.2	107.4	13.2	103.5	0.000 <sup>a</sup>
Systolic blood pressure (mm Hg)	123.6	16.5	122	139.7	17.1	138	0.000 <sup>a</sup>	124.7	16.8	121	141.9	19.1	139.3	0.000 <sup>a</sup>
Diastolic blood pressure (mm Hg)	78.3	10.9	77.5	88.1	11.0	86	0.000 <sup>a</sup>	79.0	11.1	76.5	89.3	11.2	86.3	0.000 <sup>a</sup>
Height (m)	1.7	0.1	1.7	1.7	0.1	1.7	0.300 <sup>a</sup>	1.7	0.1	1.7	1.7	0.1	1.7	0.000 <sup>a</sup>
Weight (kg)	70.2	14.4	69.1	87.4	14.5	85.8	0.000 <sup>a</sup>	71.6	15.2	68.2	88.6	12.7	85.6	0.000 <sup>a</sup>
BMI (kg/m <sup>2</sup> )	24.9	4.0	24.4	30.7	4.6	29.7	0.000 <sup>b</sup>	24.7	4.0	24.3	30.0	4.3	29.1	0.000 <sup>b</sup>
WC (cm)	85.8	11.9	85	102.1	9.6	103	0.000 <sup>a</sup>	87.0	12.5	84	103.0	8.9	101	0.000 <sup>a</sup>

The values are given as the means, medians and SDs (standard deviations). N = number of individuals.

a - Student's t-test.

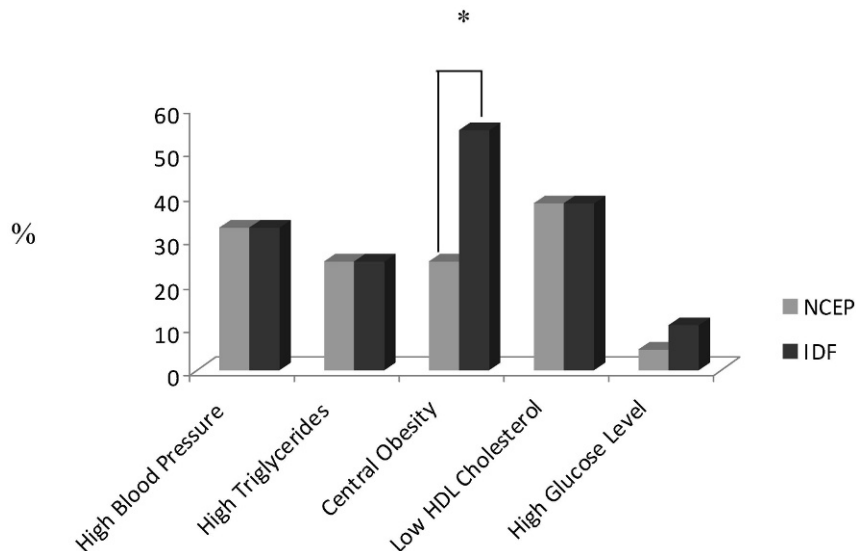
b - Mann-Whitney- U-test.

p<0.05.

results were similar to those found in the present study, which showed a difference in MS rates between the general officers and agency employees using the NCEP-ATPIII criteria. The prevalence of MS was higher in individuals working in agencies, demonstrating that in bank employees, MS might be associated with the nature of their jobs.

Using the IDF criteria, the results indicated that the prevalence of MS varied according to sex: the prevalence was higher in males than females. The IDF criteria for defining central obesity seemed to explain much of this difference: the limits of the NCEP waist circumference were 102 cm for men and 88 cm for women, reflecting different population percentiles compared with the limits set by the IDF criteria, which were 90 cm for males and 80 cm for

females. In particular, men tended to accumulate visceral fat deposits, a condition that increases with age and with increased BMI; this condition is associated with MS (5). Similarly, the rigidity of the cohort, particularly based on the IDF criteria, encompasses most individuals with risk factors for the syndrome. In this study, waist circumference and blood glucose changes appeared more frequently in individuals when the IDF criteria were used as the diagnostic criteria for SM. Similar results were observed by Gündogan (25) in the Mediterranean region of Turkey. Additionally, the distribution of body fat could have strongly influenced metabolic abnormalities in the lipid profiles and glucose levels (26). Our study showed that higher levels of insulin and triglycerides and lower HDL-C



**Figure 1** - Student's T-test \* p=0.001 (the difference between the criteria considered and high waist circumference).



**Table 3** - Logistic regression analysis, including the crude and adjusted OR for MS according to the NCEP-diagnosed employees of a state bank in Vitória/ES.

Variable	Category	p-value	NCEP OR Crude/CI	NCEP OR Adjusted/CI
Age (years)	<30	0.004	1	1
	31 to 40		2.91(0.835-10.176)	1.97(0.478-8.129)
	41 to 50		3.86(1.490-10.018)	1.65(0.531-5.177)
	>50		5.66(2.066-15.545)	2.52(0.747-8.562)
Education	High school	0.011	2.79(1.383-5.664)	2.60(1.112-6.113)
	College		1.67(0.859-3.243)	2.18(1.019-4.696)
	Graduate school		1	1
Marital status	Single	0.005	1	1
	Married/Living together		3.20(1.543-6.650)	2.04(0.842-4.971)
	Separated/ Divorced/Widowed		2.74(1.044-7.193)	1.84(0.564-6.062)
Position	Agency	0.034	1.65(1.036-2.693)	1.39(0.780-2.504)
	General direction		1	1
BMI	Normal weight	0.000	1	1
	Overweight		12.29(4.736-31.926)	12.63(4.802-33.265)
	Obesity		43.33(16.235-115.681)	43.69(16.056-118.885)

The odds ratios were adjusted in a logistic regression analysis for other variables in the table, with 95% confidence intervals for the presence of MS according to the NCEP ATP III criteria. OR=odds ratio; CI=confidence interval.

levels were found in individuals with MS. Changes in the lipid metabolism of subjects with insulin resistance (IR) are triggered by excessive levels of circulating fatty acids that are derived from visceral adipose tissue in the liver, which increases the production of triglycerides and lowers HDL-C. These excessive levels of circulating fatty acids also affect insulin sensitivity in muscle tissue by inhibiting glucose uptake. Hyperglycemia and excessive fatty acids can both result in hyperinsulinemia (27).

In our study, the high percentage of hypertensive subjects (32.5%) was remarkable. A population study in Vitoria-ES, Brazil, indicated a prevalence of hypertension 38% (28), which was higher than the 25% to 30% estimated prevalence in the adult Brazilian population (29). In the 1990s, a study of state bank employees in Rio de Janeiro, Brazil, estimated hypertension prevalence as 18.3% in the subjects. The subjects were the same ages as those in this study; the prevalence of hypertension was higher in males (22.3%) than females (12.6%) ( $p<0.001$ ), and the prevalence increased with age (30).

Chronic inflammation plasma markers are associated with risk for coronary artery disease; hsCRP has been the most studied marker (31), and in our study, it was higher in the individuals with MS. This result was similar to that of another study of various professional categories (10). Studies conducted in apparently healthy young adults have shown the potential of hsCRP in predicting future coronary events and its role as an important marker for this purpose (32-33), which demonstrates that individuals with MS have additional risk factors for CVD.

Social determinants are strongly correlated with MS, but the contribution of these determinants has not been fully elucidated. For example, individuals with higher education levels and greater access to information have greater opportunities in the labor market and, consequently, higher purchasing power; these individuals usually have a lower prevalence of MS (34). However, in our study, the individuals who had college degrees had a higher prevalence of MS compared with those who had only completed high school. This finding can be explained by the high rates of overweight and obesity found in populations with higher education levels. Thus, the increased

adiposity in both low-income individuals and those with higher education levels supports the hypothesis that obesity could be a causative factor for MS in this population. Obesity has appeared to be a risk factor for MS because obese individuals have a 43.3 times higher risk of developing MS compared with normal-weight subjects. The population in this study showed a high prevalence of overweight (36.9%) and obesity (17.9%), which might be related to the physical inactivity that is also prevalent in this group, as well as the sedentary type of work performed by the subjects. A 1994 epidemiological study of bank employees in Rio de Janeiro has already demonstrated the rates of overweight and obesity in this population: 27.8% and 6.4%, respectively (35). Our results showed a large number of workers with MS and high levels of PCR; therefore, these subjects had increased risks of developing cardiovascular disease, although they did not have low education levels. In the studied population, obesity emerged as a risk factor for MS, and it should be the subject of further research. Furthermore, these findings support the need for programs to promote employee health, to facilitate the monitoring of the magnitude and temporal trends of these factors and to assess the actions that are directed toward this population group.

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## AUTHOR CONTRIBUTIONS

All of the authors participated appropriately in the study conception and design, data acquisition, analysis and interpretation, and the final approval of the published version.

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