

Prevalence of metabolic syndrome in metallurgical workers from different shifts

Prevalência de síndrome metabólica em metalúrgicos de diferentes turnos de trabalho

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Keywords

Metabolic syndrome X; Occupational health nursing; Public health nursing; Shift work; Occupational health

Descritores

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Abstract

Objective: To investigate the prevalence of metabolic syndrome in workers from different shifts.

Methods: The population consisted of 93 workers, divided into: first shift (6:00 AM to 2:00 PM), second shift (2:00 PM to 10:00 PM), third shift (10:00 PM to 6:00 AM) and productive shift in administrative hours (7:30 AM to 5:00 PM). The components of the metabolic syndrome were obtained by blood collection in a 12 hour fasting and anthropometric measurements, through the NCEP-ATP III criteria.

Results: Seventy two percent were male, aged between 33 and 38 years. Metabolic syndrome was diagnosed in 26.8% of the sample. The highest prevalence occurred among first shift workers ($p < 0.000$). The HDL-cholesterol, fasting glucose and triglycerides changes were higher in the first shift. There was difference in body weight, body mass index and chronotype ($p = 0.000$), among working shifts.

Conclusion: The prevalence of metabolic syndrome was higher among first shift workers.

Resumo

Objetivo: Verificar a prevalência da síndrome metabólica em trabalhadores de diferentes turnos.

Métodos: A população foi composta por 93 trabalhadores, divididos em: primeiro turno (6h00 às 14h00), segundo turno (14h00 às 22h00), terceiro turno (22h00 às 6h00) e turno produtivo em horário administrativo (7h30 às 17h00). Os componentes da Síndrome Metabólica foram obtidos por meio de coleta de sangue em jejum de 12 horas e medidas antropométricas, pelo critério NCEP-ATP III.

Resultados: 72% eram do sexo masculino, com idades entre 33 e 38 anos. A síndrome metabólica foi diagnóstica em 26,8% da amostra. A maior prevalência da síndrome ocorreu entre os trabalhadores do primeiro turno ($p < 0,000$). As alterações de HDL-colesterol, glicemia em jejum e triglicérides foram maiores no primeiro turno. Houve diferença para massa corporal, índice de massa corporal e cronótipo ($p = 0,000$), entre os turnos de trabalho.

Conclusão: A prevalência da síndrome metabólica foi maior nos trabalhadores do primeiro turno.

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Introduction

Approximately 29.6% of the population of Brazil has a positive diagnosis for metabolic syndrome.⁽¹⁾ Metabolic syndrome is defined by the National Cholesterol Education Program's Adult Treatment Panel III (NCEP-ATP III) as the association of at least three of the following risk factors: abdominal obesity (waist circumference in men ≥ 102 cm and women ≥ 88 cm); fasting hyperglycemia (≥ 110 mg/dL); hypertension (systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥ 85 mmHg); low level of high-density lipoprotein cholesterol (HDL-c) (male < 40 mg/dL and women < 50 mg/dL); and hypertriglyceridemia (≥ 150 mg/dL).⁽²⁾

In addition to the risk factors mentioned above, other factors deserve attention: stress, working during evenings, overweight and excessive workload.⁽³⁾ Thus, working during the evenings can be considered an inducing factor of metabolic syndrome.^(4,5) The explanation for this result is supported by three pillars: (1) not standard meal time and unavailability of means of preparation;⁽⁶⁾ (2) sleep deprivation, causing physiological adaptations that alter eating behavior due to decreased levels of leptin and increased levels of circulating ghrelin;⁽⁷⁾ (3) maladjustment of circadian rhythm, which influences the control of body weight, glycemic control and hormones release.⁽⁸⁾

The aim of this study was to investigate the prevalence of metabolic syndrome among workers in different shifts in a metallurgical industry, and to describe their associated risk factors.

Methods

Descriptive cross-sectional study that included 93 workers from the productive sector of a metallurgical industry of automobile parts in the city of Sorocaba, state of Sao Paulo, southeastern region of Brazil.

The working hours was divided into shifts as follows: first shift (6:00 AM to 2:00 PM), second shift (2:00 PM to 10:00 PM), third shift (10:00 PM to 6:00 AM) and productive shift in administrative hours (7:30 AM to 5:00 PM). We included

29 workers from the first shift, 20 workers from the second shift, 15 workers from the third shift and 29 workers from productive shift in administrative hours. Inclusion criteria were: to be working in a fixed shift for at least 12 months of experience in this shift, lack of medication or prior diagnosis of diabetes. All workers in the productive sector participated in the study.

Data collection occurred in the medical clinic of the industry, during their working shift hours. First, we evaluated the workers from the first shift and productive shift; then, the second shift, finally the third shift. Evaluations of metabolic components and blood pressure were performed by a nurse technician. The questionnaires were answered by the workers. Anthropometric evaluations were conducted by a professional of physical education, who had experience with this type of measurements.

The waist circumference was measured at the midpoint between the iliac crest and the lower costal margin, using a metal anthropometric tape of Sanny® brand with 0.1 cm accuracy.⁽²⁾ The body weight and height were measured with barefoot workers in light clothing, using a digital Sanny® scale brand with 0.1kg of accuracy, and the Sanny® stadiometer brand with 0.1cm accuracy.

A venous blood sample was collected after 12 hours of fasting and abstinence of exercise and alcohol. The measures included triglycerides, HDL-c and glucose. The material was analyzed by a Reference clinical laboratory in the city. The metabolic components were determined using the automatic biochemical analyzer Konelab® 60i (Thermo Electron Corporation, Wiener lab group, Rosario, Argentina).

Blood pressure was measured by auscultation through two measures, in the sitting position after 5 minutes of rest, as recommended by NCEP-ATP III using aneroid sphygmomanometer Tycos® brand.⁽²⁾

The Pittsburgh Sleep Quality Index Questionnaire (PSQI)⁽⁹⁾ was used to assess the characteristics of sleep patterns and quantify the individual's sleep quality. The final score defines that the results > 5 represent poor sleep quality.

To classify chronotype, we used the Horne and Ostber questionnaire,⁽¹⁰⁾ adapted.⁽¹¹⁾ Scores above 58 classify individuals as morning types, below 42

as afternoon types and 42-58, as intermediate or in-different types.

The level of physical activity was analyzed through the International Physical Activity Questionnaire (IPAQ).⁽¹²⁾ The instrument presents the results as the following categories: sedentary, insufficiently active, insufficiently active A, insufficiently active B, active and very active.

Data such as gender, age, marital status, education, alcohol consumption, smoking, working hours, position and level of job satisfaction, were quantified through the identification form. The level of absenteeism (missing working days) and the quality of the parts produced were collected with the help of the coordinators of the productive sector.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS Inc., Chicago, Illinois, USA), version 15.0. To verify the normal distribution assumption, we used the nonparametric test of Shapiro-Wilk. To compare the prevalence of the metabolic syndrome among shifts, we used the chi-square test. To compare the risk factors that characterize metabolic syndrome, we used the Kruskal-Wallis test. As for multiple comparisons between the risk factors per shift, the Mann-Whitney U test was used. General and between shifts comparisons for the variables mass, body mass index and chronotype were made by analysis of variance (ANOVA) and Tukey

post-hoc. The significance level for all statistical tests was $\alpha = 0.05$.

The development of the study met national and international standards of ethics in research involving human subjects.

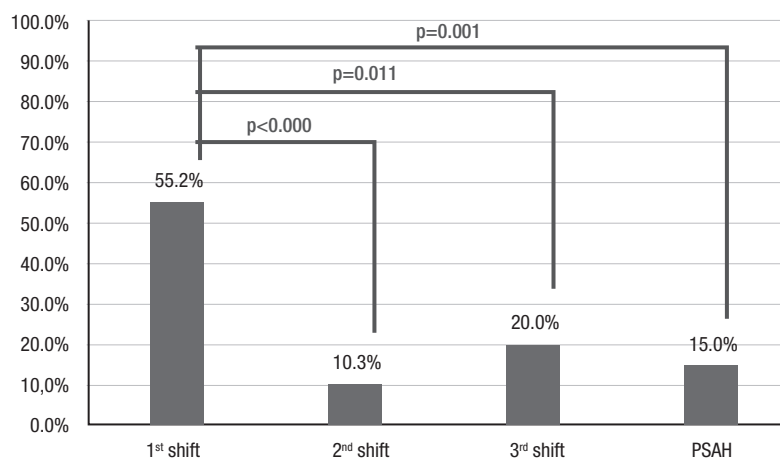
Results

The study included 93 workers, aged between 33 and 38 years. Regarding marital status, 65 workers (70.0%) were married, 23 (25.0%) were single and 12 (5.0%) were separated or other. Participants had completed high school, as it was required by the industry. As to gender, 67 subjects (72.0%) were male. No stratification of the sample was performed by gender, as the shift presented low quantity of women.

The diagnosis of metabolic syndrome occurred in 26.8% of the study population and was higher among first shift workers (Figure 1).

The comparison between the components (systolic and diastolic blood pressure, triglycerides, HDL-c, fasting glucose and waist circumference), which characterize the metabolic syndrome, is presented in table 1.

Multiple comparisons were performed by the Mann-Whitney U test, and the first shift showed a statistically significant difference from other shifts,



PSAH – Productive shift in administrative hours

Figure 1. Comparison of positive diagnosis of metabolic syndrome among working shifts (Chi-square test)

Table 1. Comparison of median values and interquartile ranges for the variables among working shifts

Variable	First shift n = 29	Second shift n = 29	Third shift n = 15	PSAH n = 20	p-value
Systolic blood pressure	120 (110-130)	110 (110-120)	120 (110-140)	110 (100-135)	0.537
Diastolic blood pressure	80 (80-80)	80 (75-80)	80 (70-90)	80 (72-80)	0.639
Triglycerides	152.0 (151.0-153.5)	126.0 (124.0-130.0)	125.0(120.0-142.0)	144.0(142.2-148.8)	0.000*
Waist circumference	94.0 (90.0-100.5)	91.0 (85.5-100.5)	95.5 (92.0-110.0)	93.0 (84.5-98.4)	0.135
HDL-Cholesterol	39.0 (37.0-47.5)	50.0 (50.0-56.0)	50.0 (45.0-51.0)	45.0 (42.3- 51.8)	0.000*
Fasting glucose	103.0 (101.0-105.0)	84.0 (81.0-85.0)	91.0 (90.0-92.0)	94.5 (91.3-97.3)	0.000*

*Kruskal-Wallis non-parametric test

Table 2. Absolute and relative values of the modifiable risk factors and variables associated with work

Variables	Shift			
	First n=29 n (%)	Second n=29 n (%)	Third n=15 n (%)	PSAH n=20 n (%)
Smoking	14 (48.3)	3 (10.3)	4 (26.7)	10 (50.0)
Sedentarism	12 (41.4)	9 (31.0)	5 (33.3)	13 (65.0)
Alcoholism	16 (55.2)	4 (13.8)	2 (13.3)	15 (75.0)
Job dissatisfaction	27 (93.1)	-	1 (6.7)	14 (70.0)
Absenteeism	24 (82.8)	5 (17.2)	2 (13.3)	16 (80.0)
Poor quality of the parts produced	28 (96.6)	2 (6.9)	3 (20.0)	20 (100.0)

PSAH – Productive shift in administrative hours

for the three variables (triglycerides, HDL-cholesterol and fasting glucose), with $p < 0.001$. The second shift showed a statistically significant difference from the third shift when comparing HDL-c ($p = 0.027$) and fasting glucose ($p < 0.001$); and the production shift in administrative hours for the three variables ($p < 0.005$). Between the third shift and productive shift in administrative hours, the difference was only for triglycerides ($p = 0.001$).

The poor sleep quality was found in many first shift workers (69.0%) as well as in third shift workers (86.7%). In the other groups, the prevalence was inversely, as 55.2% workers of the second shift and 60.0% of the production shift in administrative hour had good sleep quality.

Some modifiable risk factors were more prevalent among first shift workers (Table 2).

As for the chronotype, 58.6% of workers of the first shift were classified as moderately morning types, 13.8% were definitely morning types and 27.6% were indifferent types (nor afternoon neither morning). The indifferent chronotype were more frequent in workers from second and third shifts. As for the productive shift in administrative hour, the highest prevalence was for moderately morning type.

According to ANOVA test, the third shift (85.0 ± 12.2) had higher values of body mass (kg) and significant difference when comparing the first

shift (74.7 ± 10.7), with $p = 0.040$. For the overall classification of chronotype, there was a significant difference when comparing the first shift with the others: first shift (62.2 ± 7.2), second shift (54.0 ± 8.4), third shift (56.7 ± 8.5) and productive shift in administrative hours (59.8 ± 9.3), with $p = 0.003$.

Discussion

The limitation of the study was the cross-sectional design since it does not allow the establishment of cause and effect relationships. Our results showed higher prevalence of metabolic syndrome among first shift workers when compared to other shifts. The first shift of the assessed industry presented some evening shift characteristics (reduction in total sleep duration), as people woke up between 3:30 AM and 4:00 AM., since all depended on public transportation to go to work. This result is in line with other studies that showed high prevalence of metabolic syndrome in evening workers. In addition, such occurrence is highlighted when comparing evening workers to morning workers who have never worked in the evening.^(4,5)

Most of the workers of the first and third shifts had poor sleep quality. Importantly, workers of the first shift declared sleeping in the public transportation, in the route between the residence and the

industry. People who sleep less may suffer physiological adaptations, which are able to change eating behavior. Thus, the reduction in total sleep duration is associated with decreased serum leptin levels and increased circulating ghrelin increases hunger and food intake.^(7,13,14)

The studied industry had a cafeteria, however, workers complained about the quality of the served food and many chose to bring their own lunch box, frozen foods, savory or sweet. Workers from the first and third shifts reported that they often drank coffee to stay “awake”, and it was always accompanied by treats. Shift workers are more vulnerable to poor diet due to the unavailability of food preparation facilities, so they usually opted for fast food preparation, which has high fat contents. It is also common for workers to “eat” at work, in order to stay awake.⁽¹⁵⁾

Most of first shift workers had higher levels of sedentarism. There are consistent reports about the relationship between high levels of sedentary lifestyles and the positive diagnosis of metabolic syndrome.^(7,16) This association is easily explained, since physical exercise increases the available glucose-mediated insulin, decreases glucose intolerance, improves insulin sensitivity, reduces blood glucose, lowers blood pressure levels and increases the ability of the muscle tissue in consuming fatty acids, causing thereby a confrontation of factors that lead to metabolic syndrome.⁽¹⁷⁾

Smoking and alcohol consumption showed high frequency among first shift workers and productive shift in administrative hours. There were reports from first shift workers that this habit was intended to “forget about work.” Smoking helps maintain wakefulness.⁽¹⁸⁾ Alcohol use is also associated as a way to address sleep problems, however, this can be a risk factor for alcoholism. Heavy consumption of alcohol is associated with abdominal obesity, hypertension, hypertriglyceridemia, hyperglycemia, type 2 diabetes mellitus and the positive diagnosis of metabolic syndrome.⁽¹⁹⁾ Thus, smoking and alcohol consumption are risk factors for metabolic syndrome in evening workers.^(14,16,17)

First shift workers had a high rate of dissatisfaction with work and, according to their reports,

it was associated to salary issues and career plan. Job satisfaction can be a source of health, but the job dissatisfaction can lead to impairments in physical, social and mental health and cause problems at work.⁽²⁰⁾

First shift workers had high levels of absenteeism. Study involving workers in the United States showed that 30.2% of the sample was diagnosed with metabolic syndrome, and this showed higher rates of absenteeism compared to healthy subjects.⁽²¹⁾ Thus, the syndrome is also associated with the industry’s productivity level.

The level of disapproval of finished products by first shift workers was 96.6%, thus, almost all delivered production was rejected by customers. Product quality is associated to customer satisfaction, because a satisfied customer keeps buying, on the other hand, a dissatisfied client will terminate business relationships with the industry, as well as adding negative value to the product to other customers.⁽²²⁾

As for the variables that characterize metabolic syndrome, the results showed that the first shift showed a statistically significant difference from other shifts to the variables triglycerides, HDL-c and fasting glucose. These changes are commonly found in the literature.^(7,14)

Most workers in the first shift were classified as moderately morning types or definitely morning types, not being evening or morning types. In addition, there was significant difference when comparing the chronotype score between shifts. It can be said that first shift workers were in proper working hours with their chronotype. Thus, the workers would have a protective effect related to shift work, considering the results from chronotypes, the ideal would be to work in the first shift (6:00 AM to 2:00 PM).⁽²³⁾ However, the first shift had a higher prevalence of metabolic syndrome when compared to the others. We found no studies that exclusively addressed the chronotype and metabolic syndrome to confront the results of this study.

The third shift presented the highest values of body weight showing significant difference when compared to the first shift. However, the metabolic syndrome was not observed among workers of the third shift, perhaps because they presented a higher

level of physical exercise. Regular practice of physical activity contributes to the control and reduction of body mass and prevention of metabolic diseases. This practice can also help synchronization of circadian rhythms of shift workers.⁽⁷⁾

In short, we found in the study population, increased prevalence of metabolic syndrome. This result may be due to the presence of certain risk factors, such as: poor sleep quality, poor diet, sedentarism, alcohol consumption and smoking. In addition, the metabolic syndrome may be associated with some variables related to work, such as absenteeism, low quality of the parts produced and job dissatisfaction. Such association was also found in a study conducted with adult workers in the USA.⁽²¹⁾ The use of chronotype score for the choice of working hours was not considered a preventive factor of metabolic syndrome. Thus, our findings were consistent with results found in several studies.

There were more positive diagnosis of metabolic syndrome among first shift of workers, contrary to what the literature indicates. Metabolic syndrome can change the productivity and the reputation of the industry in the economic market, causing financial losses. Therefore, it requires special attention for all shift workers, not only for the evening shift, as advocated in several studies.

Conclusion

The prevalence of metabolic syndrome was higher among first shift workers. This result may be associated with poor sleep quality, poor diet, sedentarism, alcohol consumption, smoking, absenteeism and job dissatisfaction.

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Moreno E; De Martino MMF and Costa RF declare contribution to the project design, development of research, data interpretation, writing, critical review and final approval of the version to be published.

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