Original Article

# Combination of Risk Factors for Metabolic Syndrome in the Military Personnel of the Brazilian Navy

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## Abstract

**Background:** **Cardiovascular diseases are the major cause of death in the population, and metabolic syndrome (MS) is a clinical condition significantly associated with the increase in morbidity and mortality.**

**Objectives:** **To describe the pattern of combination of the risk factors related to the diagnosis of MS in the military personnel of the Brazilian Navy and to identify variables associated with the presence of MS in that population.**

**Methods:** **Cross-sectional study involving 1,383 men (18 to 62 years) assigned to military organizations in the city of Natal, state of Rio Grande do Norte. The criterion proposed by the *International Diabetes Association* was used for the diagnosis of MS. The ratio between observed and expected prevalence and the respective confidence intervals were used to identify the combinations of risk factors that exceeded that expected for the population. Logistic regression was used to identify variables associated with MS.**

**Results:** **The prevalence of MS was 17.6%. Approximately one third of the military personnel studied had two or more risk factors for MS. All specific combinations of risk factors for MS that exceeded the expected prevalence had abdominal obesity as one of its components. In the adjusted analyses, age, smoking and physical activity level remained associated with MS.**

**Conclusions:** **Our findings reinforce the constant presence of abdominal obesity in the phenotype of MS. In addition, our data also support the idea that age, smoking and low level of physical activity are independent variables for the occurrence of MS. (Arq Bras Cardiol 2011;97(6):485-492S)**

**Keywords:** **Risk factors, metabolic syndrome, military personnel, obesity, abdominal/epidemiology, Brazil.**

## Introduction

Several biological risk factors, such as high blood pressure and abdominal obesity[1,2], and behavioral risk factors, such as smoking and sedentary life style[3,4], are associated with the development of cardiovascular diseases (CVD). Although risk factors, in isolation, have a specific impact on health, they are often found in combination in individuals. The combination pattern of those risk factors has been investigated[5-9]. Studies can provide information about the pathophysiological mechanisms involved in cardiovascular disease, in addition to identifying a specific phenotype for the occurrence of a certain clinical condition in a population[8,9].

In the past decade, a clinical condition, metabolic syndrome (MS), has drawn attention to its association with an increase in morbidity and all-cause, specially CVD, mortality[10-13]. Briefly, MS can be defined as a complex disorder represented by a set of cardiovascular risk factors, usually related to central accumulation of fat and insulin resistence[14].

In the Navy setting, some occupational characteristics, such as long work hours, ergonomic problems, and social isolation (training trips), have a negative influence on the health status of individuals[15]. The combination of those aspects seems to contribute to negative changes in the lifestyle of that population[15-17]. It is worth speculating that the occupational factors highlighted might also influence the development of clinical conditions related to a greater cardiovascular risk, such as MS.

This study aimed at assessing the pattern of combination of the risk factors for MS in the military personnel of the Brazilian Navy assigned to the city of Natal, state of Rio Grande do Norte. In addition, this study also tried to identify possible variables associated with the presence of MS in that population.

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## Methods

This is a cross-sectional study designed to assess the prevalence of risk factors for MS in the military personnel of the Brazilian Navy in the city of Natal, state of Rio Grande do Norte. Volunteers of the following military organizations (MOs) were allocated: Third Naval District Command, Naval Hospital of Natal, Coast Guard, Naval Base of Natal, Marine Corps of Natal, major ships in the Northeastern Region (Goiana, Grajaú, Manhães and Graúna patrol vessels), Naval Signal Service, Naval Depot of Natal, Navy Radio Station, and Oceanographic Ship Sirius.

Data were directly collected in the above-cited MOs from July to October 2008, after approval by the Committee of Ethics and Research of the Federal University of Rio Grande do Norte (UFRN) (protocol 176/08). All participants provided written informed consent according to Resolution 196/96 of the National Health Council.

Of a total of approximately 1,800 military individuals assigned to the city of Natal, state of Rio Grande do Norte, 1,581 individuals serving on active duty (87.9%), who were neither on vacation nor on a leave of absence, were recruited. Of those 1,581 individuals, 95 (6%), who were neither present on the assessing days nor fasted adequately for blood withdrawal, were excluded. In addition, all 103 females (6.9% of the total) were excluded. Thus, this study assessed only males (1,383), aged from 18 to 62 years (mean age, 30.7 ± 10.4 years), representing approximately 77% of the total active military personnel.

The volunteers underwent the following evaluations: clinical (body mass, height, waist circumference and blood pressure); blood biochemistry (HDL-cholesterol, triglycerides, and fasting glycemia); and physical activity level (PhA). They were also questioned about the habit of smoking.

Venous blood was collected between 8h and 10h, after a 12-hour fasting period. The subjects were instructed neither to perform intense PhA nor to drink alcohol within the 24 hours preceding blood withdrawal. Blood sample analysis was performed by use of automated spectrophotometry with enzyme calorimetry (Wiener Metrolab 2300 autoanalyzer).

The cutoff points referring to the components of MS were defined according to the criteria of the *International Diabetes Federation* (IDF)[18], and the following were considered risk factors for MS: HDL-cholesterol < 40mg/dL; triglycerides ≥ 150 mg/dL; fasting glycemia ≥ 100 mg/dL or the fact of having diabetes; waist circumference ≥ 90 cm, measured at a level midway between the lowest rib and the iliac crest; blood pressure (BP) ≥ 130 mmHg and/or 85 mmHg or the fact of having high blood pressure. A subject with increased waist circumference and at least two other risk factors was considered as having MS.

Blood pressure was measured according to the VI Brazilian Guidelines for Systemic Arterial Hypertension[19]. After a ten-minute rest at the sitting position, three measurements of BP were taken, at one-minute intervals, and the mean of the second and third measures was registered. For that, the properly validated Onrom® HEM-780-E oscillometric device (oscillometric method) was used[20,21].

The PhA level was assessed with the International Physical Activity Questionnaire (IPAQ – short version)[22], properly validated[23] and used in the Brazilian context. The subjects provided information about the frequency and duration of moderate and vigorous PhA in the preceding weak. The PhA level was classified as follows: a) *Active*: vigorous PhA ≥ 3 days/week and ≥ 20 minutes per bout; moderate PhA or walking 5 days/week and ≥ 30 minutes per bout; or a combination resulting in ≥ 5 days/week and ≥ 150 minutes/week (walking + moderate + vigorous); b) *Insufficiently active*: PhA not sufficient to be classified as active; c) *Sedentary*: no PhA lasting more than ten continuous minutes per week. The questionnaire was coordinately applied to groups of 25 to 30 subjects by one of the examiners, who clarified doubts when necessary.

For the purpose of analysis, the military functions/ranks were categorized as follows: senior officers (commodore, commander, and captain); junior officers (ensign, lieutenant junior grade, lieutenant, and lieutenant commander); sergeants and subordinate officers; and midshipmen, seamen, and soldiers.

### Statistical analysis

Statistical analysis comprised the description of the prevalence and its respective confidence intervals (95% CI) for the risk factors in isolation and combination. To assess the pattern of combination of the risk factors, the ratio between observed and expected prevalence (O/E) was calculated for each possible combination. The expected prevalence of a pattern of specific combination of risk factors was calculated based on the individual probability of each risk factor according to its occurrence in the sample studied. For example, the expected prevalence of the combination of simultaneous abdominal obesity (AO), high BP, hypertriglyceridemia (TG) and lack of elevated glycemia (GL) and of low HDL-cholesterol (HDL) is calculated as follows: $pAO \times pBP \times pTG \times (1 - pGL) \times (1 - pHDL)$, where $p$ is the probability (prevalence/100) of the factor in the sample studied. Thus, one could assess which combinations were above or below the expected value, assuming that risk factors occur independently in the population studied[5]. One statistically significant ratio does not include the unit in its confidence interval.

Raw and adjusted logistic regression was used to assess the factors associated with MS. The following categories entered the model as independent variables: age (< 30 years; 30 to 39 years; ≥ 40 years); rank (soldiers, seamen and midshipmen; sergeants and subordinate officers; junior officers; senior officers); smoking (yes/no); and PhA level (inactive, insufficiently active, and active). All analyses were performed with Stata, version 9.0 (STATA Corp., United States), and the significance level adopted was 5%.

## Results

More than half of the sample (53.1%) was under the age of 29 years. Most of the sample was formed by soldiers, seamen and midshipmen, followed by sergeants and subordinate officers. Less than 10% of the sample reported smoking. More than 70% of the sample was classified as active, while only 8.9% reported not performing at least ten minutes of PhA per week. All mean values of the anthropometric and biochemical indicators were within the adequate range and below the cutoff points used for the diagnosis of MS (Table 1).

The most prevalent risk factor in the population studied was the low HDL-cholesterol level, present in 43% of the subjects. Approximately 35% of the subjects studied had abdominal obesity, and the following most prevalent risk factors were high BP, hypertriglyceridemia, and fasting glycemia greater than or equal to 100 mg/dL (Table 2). Figure 1 shows the clear tendency towards an increase in the prevalence of individual risk factors for MS with age increase, except for low HDL-cholesterol level, which remained relatively constant in the age groups. Of the whole sample, 17.6% were diagnosed with MS, which was present in only 1% of the subjects under the age of 20 years and in almost 40% of those aged 40 years or more (Figure 1). Figure 2 shows the prevalence of individual risk factors according to the PhA level, evidencing the decrease in the occurrence of risk factors for MS as PhA levels increase. It is worth noting that most subjects had no risk factor. However, 32% had at least two risk factors for MS (Table 3).

Table 4 shows the observed and expected prevalence for each possible combination of risk factors for MS. It is worth noting the pattern of combination including all risk factors, whose prevalence was 20 times greater than that expected if the factors were independent (random occurrence). In addition, six other patterns of combination of risk factors for MS had prevalence greater than that expected, and abdominal obesity was a factor common to all of them (Table 4).

Table 5 shows the variables associated with MS. In raw analysis, a strong positive association with age group and military rank was found. Because of the low prevalence of MS in subjects under the age of 20 years, that age category was grouped with the one immediately above. In addition, the PhA level was inversely associated with the presence of MS in both adjusted and raw analyses. In adjusted analysis, the association between MS and military rank lost significance, while smoking showed a positive association with MS.

## Discussion

The present study aimed at assessing the pattern of combination of risk factors for MS in the Brazilian Navy personnel. In addition, it also attempted to identify possible variables associated with MS in that population. The main findings were as follows: a) ~30% of the sample had two or more risk factors for MS; b) several combinations of risk factors for MS exceeded the expected prevalence, and abdominal obesity was the common factor to all; c) age, smoking, and low PhA level were associated with the presence of MS.

The analysis of the pattern of combination evidenced that 32% of the subjects studied showed no risk factor for MS, while one third of the subjects had at least two risk factors. When investigating similar risk factors in the Framingham Offspring Study (HDL-cholesterol, triglycerides, fasting glycemia, body mass index, and BP), but using different criteria (lowest HDL-cholesterol quintile and highest quintile for the others), Wilson et al[12] have reported similar results: 33% of the men showed no risk factor for MS, while 37% showed at least two risk factors. In a large survey

**Table 1 – Characteristics of the sample studied (n = 1,383)**

| Variables | n | % |
|---|---|---|
| Age group (years) | | |
| < 20 | 236 | 17.1 |
| 20 to 29 | 475 | 34.3 |
| 30 to 39 | 283 | 20.5 |
| ≥ 40 | 389 | 28.1 |
| Rank | | |
| Soldiers and seamen | 764 | 56.2 |
| Sergeants and subordinate officers | 486 | 35.8 |
| Junior officers | 76 | 5.6 |
| Senior officers | 33 | 2.4 |
| Smoking | | |
| No | 1,249 | 90.3 |
| Yes | 134 | 9.7 |
| Physical activity level | | |
| Active | 964 | 70.9 |
| Insufficiently active | 275 | 20.2 |
| Sedentary | 120 | 8.9 |
| | **Mean** | **Standard deviation** |
| Abdominal circumference (cm) | 86.4 | 10.8 |
| HDL-Cholesterol (mg/dL) | 41.8 | 9.5 |
| Glycemia (mg/dL) | 79.3 | 17.7 |
| Triglycerides (mg/dL) | 111.7 | 100.7 |
| Blood pressure (mmHg) | | |
| Systolic | 118.6 | 13.7 |
| Diastolic | 76.0 | 11.4 |

**Table 2 – Prevalence of risk factors for the diagnosis of metabolic syndrome in the military personnel of the Brazilian Navy assigned to the city of Natal, state of Rio Grande do Norte**

| Risk factors | n | % (95%CI) |
|---|---|---|
| Abdominal obesity (waist ≥ 90cm) | 478 | 34.6 (32.1-37.1) |
| Low HDL-Cholesterol (< 40mg/dL) | 596 | 43.1 (40.5-45.7) |
| High fasting glycemia (≥ 100mg/dL) | 91 | 6.6 (5.3-8.0) |
| High triglycerides (≥ 150 mg/dL) | 267 | 19.3 (17.3-21.4) |
| High blood pressure (≥ 130 and/or 85 mmHg) | 364 | 26.3 (24.0-28.7) |

*95%CI – 95% confidence interval.*

carried out in China, Gu et al[6] have reported that 55% of the men assessed had two or more risk factors for CVD, although that cannot be compared with this study, because of the indicators selected [dyslipidemia, systemic arterial hypertension (SAH), diabetes, smoking, and obesity]. The relevance of identifying individuals who accumulate more risk factors is clear when prospective studies have evidenced that the risk of having CVD or stroke or of dying increases as more risk factors are aggregated[7,9].

If, on the one hand, knowing how many risk factors occur simultaneously is important, on the other, investigating how they combine can provide subsidies for interventions. Knowing the existence of a more prevalent clinical pattern can support more specific actions for both the treatment and prevention of chronic degenerative diseases of cardiovascular etiology. Thus the present study identified several combinations occurring more frequently than it would be expected if the risk factors were independent from one another (if they occurred randomly). Of the 16 possibilities of combination, including at least three risk factors, seven showed higher prevalence than expected, and abdominal obesity was a common condition to all. In a similar study with a large Japanese population over the age of 40 years (41,819 men and 77,593 women), Aizawa et al[8] have reported that almost all combinations with at least three of the five components of the MS diagnosis occurred at a frequency over the one expected, indicating, similarly to this study, that a combination of risk factors occurred, and that such combination does not seem to be casual.

**Table 3 – Simultaneity of risk factors for the diagnosis of metabolic syndrome in the military personnel of the Brazilian Navy assigned to the city of Natal, state of Rio Grande do Norte**

| Risk factors | n | % (95%CI) |
|---|---|---|
| 0 | 441 | 31.9 (29.4-34.4) |
| 1 | 451 | 32.6 (30.1-35.2) |
| 2 | 220 | 15.9 (14.0-17.9) |
| 3 | 193 | 14.0 (12.2-15.9) |
| 4 | 64 | 4.6 (3.6-5.9) |
| 5 | 14 | 1.0 (0.5-1.7) |

*95%CI – 95% confidence interval.*

In our study, central obesity was the most common factor in the combinations, with a greater prevalence than expected, which seems to confirm its importance in the phenotype of MS. This suggests that, more than a coincidence, abdominal obesity is closely related to the other risk factors. Although the causal mechanisms that directly link central obesity to MS have not been completely clarified, the contribution of central obesity to the changes in MS occurs considerably because of the altered secretion of biologically active substances derived from adipocytes (adipokines), such as interleukin-6 (IL-6), tumor necrosis factor alpha (TNF-α), and plasminogen activator inhibitor type-1 (PAI-1)[24], favoring insulin resistance and associated cardiometabolic risk factors[25],

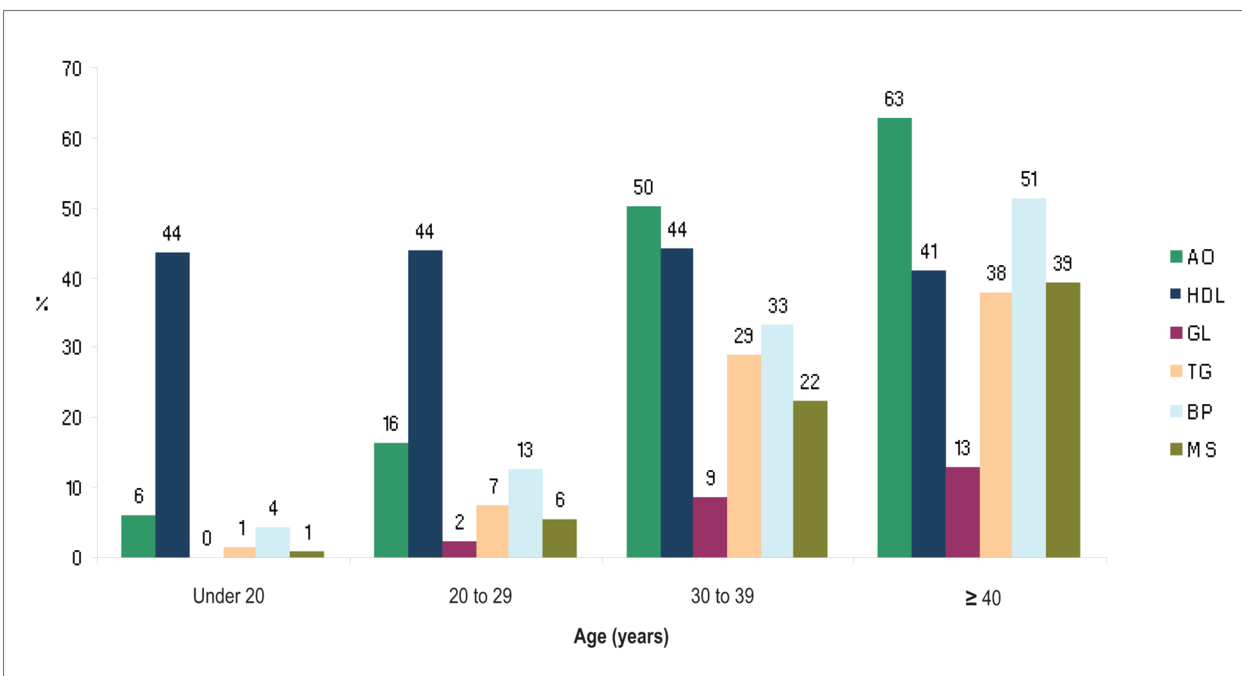


**Figure 1 –** *Prevalence of risk factors and metabolic syndrome according to age group. AO – abdominal obesity ≥ 90 cm; HDL – HDL-cholesterol < 40 mg/dL; GL – fasting glycemia ≥ 100 mg/dL; TG – triglycerides ≥ 150 mg/dL; BP – systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥ 85 mmHg; MS – metabolic syndrome (presence of AO and at least two other risk factors).*

**Table 4 – Pattern of combination of risk factors for the diagnosis of metabolic syndrome in the military personnel of the Brazilian Navy assigned to the city of Natal, state of Rio Grande do Norte**

| Nº of risk factors | AO | HDL | GL | TG | BP | PO | PE | PO/PE (IC95%) |
|---|---|---|---|---|---|---|---|---|
| 5 | + | + | + | + | + | 1 | 0.0 | 20.1 (10.93-33.56)* |
| 4 | + | + | + | + | - | 0.4 | 0.1 | 2.9 (0.85-6.14) |
| 4 | + | + | + | - | + | 0.3 | 0.2 | 1.4 (0.38-3.53) |
| 4 | + | + | - | + | + | 3.2 | 0.7 | 4.5 (3.26-6.03)* |
| 4 | + | - | + | + | + | 0.7 | 0.1 | 10.6 (4.57-19.0)* |
| 4 | - | + | + | + | + | 0.1 | 0.1 | 1.1 (0.19-5.56) |
| 3 | + | - | + | - | + | 0.9 | 0.3 | 3.3 (1.82-5.85)* |
| 3 | + | - | + | + | - | 0.1 | 0.2 | 0.5 (0.09-2.89) |
| 3 | - | + | + | - | + | 0.3 | 0.4 | 0.8 (0.20-1.86) |
| 3 | + | - | - | + | + | 3.1 | 0.9 | 3.3 (2.41-4.49)* |
| 3 | - | + | - | + | + | 0.8 | 1.3 | 0.6 (0.30-1.06) |
| 3 | + | + | - | - | + | 4.1 | 3.0 | 1.4 (1.05-1.81)* |
| 3 | + | + | - | + | - | 3.6 | 2.0 | 1.8 (1.35-2.41)* |
| 3 | + | + | + | - | - | 0.2 | 0.6 | 0.3 (0.07-1.08) |
| 3 | - | + | + | + | - | 0.4 | 0.3 | 1.5 (0.59-3.53) |
| 3 | - | - | + | + | + | 0.3 | 0.1 | 2.4 (0.64-6.02) |

*AO – abdominal obesity ≥ 90 cm; HDL – HDL-cholesterol < 40 mg/dL; GL – fasting glycemia ≥ 100 mg/dL; TG – triglycerides ≥ 150 mg/dL; BP – systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥ 85 mmHg; PO – prevalence observed; PE – prevalence expected; PO/PE – ratio between prevalence observed and expected; 95%CI – 95% confidence interval; * – combinations with a higher frequency than that expected for the independent occurrence of risk factors.*

**Table 5 – Analysis of the factors associated with metabolic syndrome in the military personnel of the Brazilian Navy assigned to the city of Natal, state of Rio Grande do Norte**

| Variables | Metabolic Syndrome | | Raw | | Adjusted* | |
|---|---|---|---|---|---|---|
| | n | (%) | OR (95%CI) | p - value | OR (95%CI) | p - value |
| Age group (years) | | | | < 0.001† | | <0.001† |
| < 30 | 28 | 3.9 | 1 | | 1 | |
| 30 to 39 | 63 | 22.3 | 6.98 (4.36-11.18) | | 8.02 (4.40-14.61) | |
| ≥ 40 | 153 | 39.3 | 15.81 (10.29-24.29) | | 18.27 (10.13-32.94) | |
| Rank | | | | < 0.001† | | 0.51† |
| Soldiers and seamen | 57 | 7.5 | 1 | | 1 | |
| Sergeants and subordinate officers | 147 | 30.2 | 5.38 (3.86-7.45) | | 0.72 (0.45-1.17) | |
| Junior officers | 17 | 22.4 | 3.57 (1.95-6.53) | | 0.93 (0.45-1.90) | |
| Senior officers | 14 | 42.4 | 9.14 (4.35-19.18) | | 0.97 (0.42-2.26) | |
| Smoking | | | | 0.131 | | 0.028 |
| No | 214 | 17.1 | 1 | | 1 | |
| Yes | 30 | 22.4 | 1.40 (0.91-2.15) | | 1.75 (1.06-2.89) | |
| Physical activity level | | | | < 0.001† | | <0.001† |
| Active | 131 | 13.4 | 1 | | 1 | |
| Insufficiently active | 69 | 24.6 | 2.12 (1.53-2.94) | | 1.48 (1.03-2.14) | |
| Sedentary | 44 | 35.8 | 3.61 (2.39-5.45) | | 2.20 (1.39-3.50) | |

*OR – odds ratio; 95%CI – 95% confidence interval; * – OR adjusted for all variables of the model; †p-value for trend.*

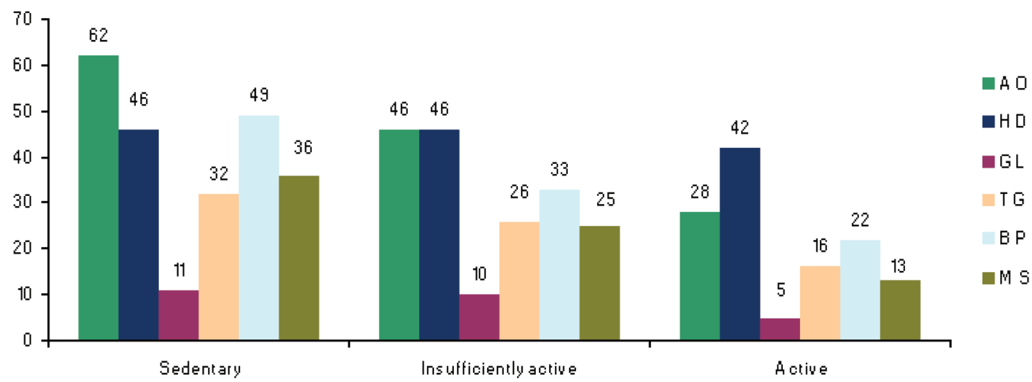


**Figure 2 –** *Prevalence of risk factors and metabolic syndrome according to the physical activity level; AO – abdominal obesity ≥ 90 cm; HDL – HDL-cholesterol < 40 mg/dL; GL – fasting glycemia ≥ 100 mg/dL; TG – triglycerides ≥ 150 mg/dL; BP – systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥ 85 mmHg; MS – metabolic syndrome (presence of AO and at least two other risk factors).*

thus potentiating an atherogenic, prothrombotic and inflammatory profile[24-27].

Although insulin resistance is known to be a key factor for the occurrence of several cardiometabolic abnormalities (dyslipidemia, SAH, atherosclerosis, non-alcoholic liver steatosis)[25], the most prevalent clustering of the metabolic abnormalities associated with MS has been evidenced in individuals with abdominal obesity. Thus, in fact, central obesity seems to be a marker of dysmetabolic state and a partial cause of MS[26].

Regarding the prevalence of MS in our sample, it is difficult to compare with other studies, because of the lack of uniform criteria and cutoff points for the definition of that clinical condition[28]. Thus, when assessing the impact of different cutoff points in the prevalence of MS, Barbosa et al[29] have reported that more conservative criteria of waist circumference – 84 and 88 cm for women and men, respectively – provided more effective conditions to identify subjects with diabetes *mellitus* and obesity in the city of Salvador, state of Bahia. In addition, those authors have also reported that the criterion of the *National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults – Adult Treatment Panel III* (NCEP-ATP III) tended to underestimate the prevalence of MS in that population. Thus, in the present study, we chose to consider the International Diabetes Federation (IDF) definition of MS.

Analyzing the possible variables associated with MS, only age, smoking and PhA level maintained the association in the adjusted model. Although supposedly associated with both socioeconomic factors and the profile of occupational demands, the variable military rank lost significance after adjusting for age and the other variables. In fact, there is evidence supporting the inverse relation between PhA and MS[30]. In addition, prospective studies have reported the protective effect of PhA on the development of that condition[31,32]. In Brazil, however, studies assessing that association have reported controversial results. Doro et al[33], assessing a sample of 1,330 Japanese-Brazilians, have found no association between the PhA level (leisure, work, and movement) and MS. In the cohort of Pelotas, state of Rio Grande do Sul, of 1982, the effect of behavioral and sociodemographic variables was investigated, and only family income and educational level were statistically associated with MS, as compared with behavioral variables, such as smoking, alcohol consumption, fat ingestion, and PhA[34]. Our findings might have resulted from the high PhA levels of our sample. In fact, part of the military functions includes physical exercises and occupational PhA as a daily task, contributing to a better physical health profile and, thus, lower cardiovascular risk.

Some aspects should be considered when interpreting the data of the present study. First, the comparison of the prevalence of MS found in our study with that of population-based studies should be cautiously performed, because the age profile and mainly the PhA level of the active military personnel differ from those of the general population. Another important point is the criteria used to define MS, because that choice has a direct impact on the prevalence of MS. In addition, the present study has been designed to answer several research questions, and other important variables related to MS, such as dietary behavior and alcohol consumption, could not be assessed, representing a partial limitation of the present study. It is worth noting the large size of the sample investigated, which represented more than three quarters of the study population, reducing the possibility of systematic sampling errors, thus allowing generalizations for that population group – the active military personnel of the Brazilian Navy. In addition, the quality of data collection and laboratory analyses reinforces the internal validity of the study.

Finally, it is worth emphasizing that the risk factors for MS clustered in the subjects studied and that abdominal obesity was the most prevalent risk factor in the combinations occurring more frequently than expected. Considering that the mission of the Brazilian Navy is to "*prepare and employ the Naval Power, to contribute to the defense of the Nation*", the cardiometabolic health of active military personnel was expected to be more favorable than that of the general population. Therefore, preventive and/or therapeutic programs focused on cardiovascular and metabolic health are required, because one third of the military personnel assessed showed two or more risk factors for MS, especially the less active ones.

**Potential Conflict of Interest**

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

**Sources of Funding**

There were no external funding sources for this study.

**Study Association**

This study is not associated with any post-graduation program.

## References

1. Williams B. The year in hypertension. J Am Coll Cardiol. 2008;51(18):1803-17.
2. Zhang C, Rexrode KM, van Dam RM, Li TY, Hu FB. Abdominal obesity and the risk of all-cause, cardiovascular, and cancer mortality: sixteen years of follow-up in US women. Circulation. 2008;117(13):1658-67.
3. Lipton R, Cunradi C, Chen MJ. Smoking and all-cause mortality among a cohort of urban transit operators. J Urban Health. 2008;85(5):759-65.
4. Lollgen H, Bockenhoff A, Knapp G. Physical activity and all-cause mortality: an updated meta-analysis with different intensity categories. Int J Sports Med. 2009;30(3):213-24.
5. Schuit AJ, van Loon AJ, Tijhuis M, Ocke M. Clustering of lifestyle risk factors in a general adult population. Prev Med. 2002;35(3):219-24.
6. Gu D, Gupta A, Muntner P, Hu S, Duan X, Chen J, et al. Prevalence of cardiovascular disease risk factor clustering among the adult population of China: results from the International Collaborative Study of Cardiovascular Disease in Asia (InterAsia). Circulation. 2005;112(5):658-65.
7. Yusuf HR, Giles WH, Croft JB, Anda RF, Casper ML. Impact of multiple risk factor profiles on determining cardiovascular disease risk. Prev Med. 1998;27(1):1-9.
8. Aizawa Y, Kamimura N, Watanabe H, Aizawa Y, Makiyama Y, Usuda Y, et al. Cardiovascular risk factors are really linked in the metabolic syndrome: This phenomenon suggests clustering rather than coincidence. Int J Cardiol. 2006;109(2):213-8.
9. Wilson PWF, Kannel WB, Silbershatz H, D'Agostino RB. Clustering of metabolic factors and coronary heart disease. Arch Intern Med. 1999;159(10):1104-9.
10. Lakka H-M, Laaksonen DE, Lakka TA, Niskanen LK, Kumpusalo E, Tuomilehto J, et al. The metabolic syndrome and total and cardiovascular disease mortality in middle-aged men. JAMA. 2002;288(21):2709-16.
11. Katzmarzyk PT, Church TS, Janssen I, Ross R, Blair SN. Metabolic syndrome, obesity, and mortality. Diabetes Care. 2005;28(2):391-7.
12. Wilson PWF, D'Agostino RB, Parise H, Sullivan L, Meigs JB. Metabolic syndrome as a precursor of cardiovascular disease and type 2 diabetes mellitus. Circulation. 2005;112(20):3066-72.
13. Zambon S, Zanoni S, Romanato G, Chiara Corti M, Noale M, Sartori L, et al. Metabolic syndrome and all-cause and cardiovascular mortality in an Italian elderly population. Diabetes Care. 2009;32(1):153-9.
14. Brandão AP, Brandão AA, Nogueira AR, Suplicy H, Guimarães JI, Oliveira JEP / Sociedade Brasileira de Cardiologia. I Diretriz brasileira de diagnóstico e tratamento da síndrome metabólica. Arq Bras Cardiol. 2005;84(supl. 1):3-28.
15. Silva M, Santana VS. Ocupação e mortalidade na Marinha do Brasil. Rev Saúde Pública. 2004;38(5):709-15.
16. Coggon D, Wield G. Mortality of Army cooks. Scand J Work Environ Health. 1993;19(2):85-8.
17. Dalager NA, Kang HK. Mortality among Army Chemical Corps Vietnam veterans. Am J Ind Med. 1997;31(6):719-26.
18. Alberti KG, Zimmet P, Shaw J. The metabolic syndrome: a new worldwide definition. Lancet. 2005;366(9491):1059-62.
19. Brandão AA, Rodrigues CI, Consolim-Colombo F, Plavnik FL, Malachias MV, Kohlmann Jr O, et al. / Sociedade Brasileira de Cardiologia, Sociedde Brasileira de Hipertensão. VI Diretrizes brasileiras de hipertensão. Arq Bras Cardiol. 2010;95(1 supl):1-51.
20. El Feghali RN, Topouchian JA, Pannier BM, El Assaad HA, Asmar RG. Validation of the OMRON M7 (HEM-780-E) blood pressure measuring device in a population requiring large cuff use according to the International Protocol of the European Society of Hypertension. Blood Press Monit. 2007;12(3):173-8.
21. Coleman A, Steel S, Freeman P, de Greeff A, Shennan A. Validation of the Omron M7 (HEM-780-E) oscillometric blood pressure monitoring device according to the British Hypertension Society protocol. Blood Press Monit. 2008;13(1):49-54.
22. Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc. 2003;35(8):1381-95.
23. Matsudo S, Araújo T, Matsudo V, Andrade D, Andrade E, Oliveira LC, et al. Questionário Internacional de Atividade Física (IPAQ): estudo de validade e reprodutibilidade no Brasil. Rev Bras Ativ Fis Saude. 2001;6(2):5-18.
24. Despres J-P, Lemieux I. Abdominal obesity and metabolic syndrome. Nature. 2006;444(7121):881-7.
25. Jornayvaz FR, Samuel VT, Shulman GI. The role of muscle insulin resistance in the pathogenesis of atherogenic dyslipidemia and nonalcoholic fatty liver disease associated with the metabolic syndrome. Annu Rev Nutr. 2010;30:273-90.
26. Despres J-P, Lemieux I, Bergeron J, Pibarot P, Mathieu P, Larose E, et al. Abdominal obesity and the metabolic syndrome: contribution to global cardiometabolic risk. Arterioscler Thromb Vasc Biol. 2008;28(6):1039-49.
27. Mathieu P, Poirier P, Pibarot P, Lemieux I, Despres J-P. Visceral obesity: the link among inflammation, hypertension, and cardiovascular disease. Hypertension. 2009;53(4):577-84.

28. Alberti KG, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. Circulation. 2009;120(16):1640-5.

29. Barbosa PJB, Lessa I, Almeida Filho N, Magalhães LBNC, Araújo J. Critério de obesidade central em população brasileira: impacto sobre a síndrome metabólica. Arq Bras Cardiol. 2006;87(4):407-14.

30. Wijndaele K, Duvigneaud N, Matton L, Duquet W, Delecluse C, Thomis M, et al. Sedentary behaviour, physical activity and a continuous metabolic syndrome risk score in adults. Eur J Clin Nutr. 2009;63(3):421-9.

31. Broekhuizen LN, Boekholdt SM, Arsenault BJ, Despres JP, Stroes ES, Kastelein JJ, et al. Physical activity, metabolic syndrome, and coronary risk: the EPIC-Norfolk prospective population study.Eur J Cardiovasc Prev Rehabil. 2011;18(2):209-17.

32. Ekelund U, Brage S, Franks PW, Hennings S, Emms S, Wareham NJ. Physical activity energy expenditure predicts progression toward the metabolic syndrome independently of aerobic fitness in middle-aged healthy Caucasians: the Medical Research Council Ely Study. Diabetes Care. 2005;28(5):1195-200.

33. Doro AR, Gimeno SGA, Hirai AT, Franco LJ, Ferreira SRG. Análise da associação de atividade física à síndrome metabólica em estudo populacional de nipo-brasileiros. Arq Bras Endocrinol Metabol. 2006;50(6):1066-74.

34. da Silveira VM, Horta BL, Gigante DP, Azevedo Junior MR. Metabolic syndrome in the 1982 Pelotas cohort: effect of contemporary lifestyle and socioeconomic status. Arq Bras Endocrinol Metabol. 2010;54(4):390-7.