

Alessandro Fernandes de Oliveira^a

 <https://orcid.org/0000-0002-2745-1325>

Kevin Alves Barreto^a

 <https://orcid.org/0000-0002-4515-7680>

Américo Pierangeli Costa^a

 <https://orcid.org/0000-0002-2897-9164>

Luiz Guilherme Grossi Porto^a

 <https://orcid.org/0000-0002-6240-1614>

^aFaculdade de Educação Física da Universidade de Brasília, Programa de Pós-Graduação em Educação Física, Grupo de Estudos em Fisiologia e Epidemiologia do Exercício e da Atividade Física (GEAFS). Brasília, DF, Brazil.

Contact:

Luiz Guilherme Grossi Porto

E-mail:

luizporto@unb.br

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Prevalence of cardiometabolic risk factors in Brazilian military firefighters of both sexes

Prevalência de fatores de risco cardiometabólicos em bombeiros militares brasileiros de ambos os sexos

Abstract

Introduction: The high cardiovascular burden of the firefighting profession and the increased prevalence of risk factors for cardiometabolic diseases (RFCD) in the general population requires special attention in this workforce. **Objective:** To investigate the prevalence of RFCD in Brazilian military firefighters of both sexes. **Methods:** In 2023, a cross-sectional study was conducted among 247 firefighters, 27.5% women (36.3 ± 7.2 years) and 72.5% men (41.6 ± 9.1 years), through online, translated, and validated questionnaires. Cardiovascular risk stratification was carried out according to American College of Sports Medicine-ACSM guidelines. **Results:** The most prevalent modifiable RFCD were arterial hypertension (38.5%), hyperglycemia (30.8%), and hypercholesterolemia (20.2%). 75 participants (30.4%) reported not knowing their lipid profile and 58.7% were unable to report whether their blood glucose was within or outside the normal range. Most participants (52.6%) presented high cardiovascular risk, with the proportion being higher among women (73.5%). Only 15.4% of the sample were physically inactive. **Conclusion:** The military firefighters evaluated showed a worryingly high proportion of RFCD, as well as high cardiovascular risk. Our findings support the need for health education and screening, prevention, and treatment strategies for RFCD in these professionals, especially given the intrinsic high cardiovascular risk associated with this profession.

Keywords: Firefighters; Cardiovascular Diseases; Cardiometabolic Risk Factors; Occupational Health.

Resumo

Introdução: A alta sobrecarga cardiovascular da profissão de bombeiro e a elevada prevalência dos fatores de risco para doenças cardiometabólicas (FRDCM) na população em geral orientam atenção especial nesta força de trabalho. **Objetivo:** Descrever a prevalência de FRDCM em bombeiros militares brasileiros de ambos os sexos. **Métodos:** Estudo descritivo, com amostra não probabilística, cuja coleta de dados foi realizada em 2023, por meio do uso de formulário *on-line*, que continha instrumentos traduzidos e validados. A estratificação de risco cardiovascular foi realizada segundo diretrizes do Colégio Americano de Medicina do Esporte – ACSM. **Resultados:** Participaram 247 bombeiros, sendo 72,5% do sexo masculino. Os FRDCM modificáveis mais prevalentes foram: hipertensão arterial (38,5%), hiperglicemia (30,8%) e hipercolesterolemia (20,2%); 30,4% dos participantes relataram desconhecer seu perfil lipídico e 58,7% não souberam reportar se a glicemia estava dentro ou fora da faixa de normalidade. A maioria dos participantes (52,6%) apresentou alto risco cardiovascular, sendo a prevalência maior no sexo feminino (73,5%). Apenas 15,4% eram fisicamente inativos. **Conclusão:** Os bombeiros militares avaliados apresentaram prevalência preocupantemente elevada de FRDCM, assim como de alto risco cardiovascular. Os achados suportam a necessidade de estratégias de educação em saúde e de rastreio, prevenção e tratamento de FRDCM nesses profissionais, especialmente frente ao elevado risco cardiovascular associado a esta ocupação.

Palavras-chave: Bombeiros; Doenças Cardiovasculares; Fatores de Risco Cardiometabólico; Saúde do Trabalhador.

Introduction

The duties of the military firefighter profession are associated with high health risks because they include intense physical and emotional demands, which result in high cardiovascular overload^{1,2}. Evidence shows that during the performance of their duties, professional firefighters can suffer additional increases in heart rate and blood pressure, which are accompanied by changes in blood flow, vascular shear stress, a decrease in plasma volume, an increase in blood viscosity, a procoagulant state, and even low-level myocardial damage and ischemia^{1,3,4}.

In parallel with the characteristics of the profession, which entail a high cardiovascular burden^{1,4}, it is important to consider the global context, in which the most recent estimates from the World Health Organization (WHO), with data from 2019, indicate that, as in 2010, cardiovascular diseases (CVD), especially ischemic heart disease, are still the leading cause of death in the world⁵. Other WHO estimates suggest that by 2030 the number of deaths will be 23.6 million⁶. In Brazil, 30% of deaths are due to CVD⁷. Among firefighters, the situation seems quite similar, despite the great physical and emotional demands inherent in the job^{1,8}.

A large-scale study among North American firefighters showed that the prevalence of cardiometabolic risk factors among firefighters was similar to that of the general population⁹, although the prevalence rates were high, and the profession of firefighter is known to have a higher cardiovascular risk⁴. A study carried out in Rio de Janeiro, Brazil, showed that the main causes of death among male military firefighters between 2006 and 2015 were CVD, accounting for 29.7% of deaths¹⁰.

The main risk factors for cardiometabolic diseases (CMD) can be divided into non-modifiable ones, such as age, sex, and family history; and modifiable ones, such as obesity, systemic arterial hypertension (SAH), dyslipidemia, sedentary lifestyle, smoking, and diabetes *mellitus*¹¹.

The findings regarding age are particularly worrying when analyzing the risks of CMD among firefighters, given that the prevalence of hypertension has been shown to be very high among these workers^{12,13}, as well as the fact that there seems to be a trend towards longer career spans, given the changes in pension schemes in different countries¹⁴.

The high cardiovascular burden that comes with being a firefighter and the increased prevalence of CVD risk factors in the general population call for greater attention and care for this population. The international scenario points to a high prevalence of CVD risk factors among firefighters in different countries. A study evaluating more than four thousand North American firefighters identified a high prevalence of obesity, which in turn was associated with a high prevalence of hypertension, dyslipidemia, and hyperglycemia⁹. A similar condition of high proportions of conditions that increase cardiovascular risk has also been reported among Korean firefighters¹⁵. A recent systematic review including firefighters from different regions of the world confirmed this worrying scenario¹⁶.

The aim of this study was therefore to investigate the prevalence of risk factors for CVD in Brazilian military firefighters of both sexes. It is estimated that more detailed knowledge of the cardiometabolic risk scenario among these professionals could be of great value in guiding disease prevention and health promotion actions.

Methods

Study design and context

This is a cross-sectional study carried out between May and June 2023 with Brazilian military firefighters.

Participants

The sample was non-probabilistic, made up of volunteers. The only inclusion criterion was to be working in a Brazilian military firefighting institution, without any medical restrictions for work activities.

The general invitation presenting the survey was published in the partner institution's internal bulletin, as well as sent by e-mail to all active-duty military personnel, thus boosting dissemination to around 5,000 military firefighters of both sexes.

Data collection

Data was collected using a questionnaire on Google Forms. The Informed Consent Form (ICF) was displayed on the initial screen of the electronic form received with the invitation to participate. After signing their agreement, the participants proceeded to fill in the questionnaire.

Due to the low turnout resulting from the initial publication of the survey in the institution's internal bulletin, two extensions were made to the initially planned deadline, and the e-mail strategy was included, which resulted in a significant increase in the number of participants.

There was no electronic lock *a priori* to prevent duplicate answers, inconsistencies or filling in by robots. However, no repeated data was identified, and any inconsistencies were rectified during the preliminary exploratory analysis of the data. Given the diversity of answers and fields on the form, as well as the fact that filling it in was voluntary, we believe that the possibility of robots filling it in, even if possible, is negligible.

All the information collected was self-reported by the participants.

Variables

Socio-demographic data and data on general aspects of health and work were collected. The work regime was classified into three possibilities: 1) 24hx72h scale, used in the standby teams in the barracks and meaning 24h shifts interspersed with 72h of rest; 2) 12hx24h and 12hx72h, for the pre-hospital emergency teams, with 12h work shifts for 24h of rest followed by other 24h shifts and a subsequent 72h off; and 3) expedient, characterized as a daily routine of 8h working on working days.

A cardiovascular risk stratification questionnaire adapted from the American College of Sports Medicine (ACSM) guidelines was used. This questionnaire is divided into three main parts: one which asks about the presence of cardiometabolic risk factors, another about the presence of signs or symptoms suggestive of CMD, and a third part about knowledge of previous diagnoses of CMD, such as diabetes and coronary heart disease. Risk factors include age, family history, smoking, hypertension, hypercholesterolemia, fasting glucose, obesity, and a sedentary lifestyle¹⁷.

Those classified as low risk were younger individuals (men < 45 years old; women < 55 years old) who were asymptomatic and had at most one risk factor present. Those at moderate risk were older (men ≥ 45 years of age; women ≥ 55 years of age) and with two or more risk factors. High risk included all those with any signs or symptoms of CMD or with a previous medical diagnosis of these conditions¹⁷.

For the anthropometric assessment, body weight and height were collected, and the body mass index (BMI) was calculated. Nutritional status was classified according to WHO criteria: less than 18.5 kg/m², underweight; from 18.5 to 24.9 kg/m², eutrophic; from 25.0 to 29.9 kg/m², overweight; from 30.0 to 34.9 kg/m², grade I obesity; from 35.0 to 39.9 kg/m², grade II obesity; equal to or greater than 40 kg/m², grade III obesity¹⁸.

The level of physical activity (PA) was assessed using the International Physical Activity Questionnaire (IPAQ) validated for Portuguese¹⁹, categorizing the participants as active (those who met the minimum PA recommendations for health according to the WHO / ≥ 150 min/week of moderate to vigorous intensity PA; and inactive (those who did not meet the recommended minimum weekly amount)²⁰.

Biases

Considering the nature of the variables being analyzed and the hierarchical system in which the volunteers are inserted, selection bias might occur. To minimize the possibility that subgroups with a higher or lower cardiometabolic risk might have different motivations for participating or refusing, during the research announcement/invitation, emphasis was placed on explaining that everyone’s participation was necessary and welcome, regardless of characteristics such as function, rank, age, sex/gender, among others. It was also made clear that this was independent research, conducted by members of the university with prior evaluation by the Ethics Committee and without any employment links or repercussions. The use of a self-reported information to assess the study variables possibly introduced bias, such as overestimation of the level of PA. To mitigate the occurrence of this type of bias, validated questionnaires appropriate for the study population were used.

Data analysis

Microsoft Excel® 2016 software version 16.0 was used to organize the database. Descriptive statistics were used, expressing the data as mean values and standard deviation, and absolute and relative frequencies were calculated for categorical variables.

Ethical considerations

The project was approved by the Human Research Ethics Committee of the Faculty of Health Sciences of the University of Brasília (CAAE: 80792017.8.0000.0030) on June 16, 2018. Prior authorization from the military corporation in which the study was carried out was obtained. All participants consented to the ICF.

Results

The sample consisted of 247 military firefighters, 27.5% (n= 68) female and 72.5% (n= 179) male. The average age was 36.3 (standard deviation: 7.2 years) among female participants and 41.6 (standard deviation: 9.1) males. Most participants of both sexes were married (71.3%), almost all of whom (92.3%) had at least completed higher education (college degree, specialization, or master’s degree), 71.3% worked in the expedient regime and 43.7% had a BMI within the normal range. Around half of them, 46.6% (n = 115), earned between five and ten minimum wages and 42.1% (n = 104) were the only ones contributing to the family income. More than half of the sample consumed alcohol to some degree, 64.8% (n= 160) (Table 1).

Table 1 Sociodemographic and health characteristics of Brazilian military firefighters, by sex, 2023 (n = 247)

Categorical variable	Female n (%)	Male n (%)	Total n (%)
Marital status			
Single	21 (30.9)	35 (19.6)	56 (22.7)
Married	46 (67.6)	130 (72.6)	176 (71.3)

Continue

Continuation			
Divorced	1 (1.5)	14 (7.8)	15 (6.0)
Education			
High School	-	10 (5.6)	10 (4.1)
College degree - Ongoing	2 (2.9)	7 (3.9)	9 (3.6)
College degree - Complete	33 (48.5)	93 (52)	126 (51)
Specialization	29 (42.7)	59 (32.9)	88 (35.6)
Master's Degree	4 (5.9)	10 (5.6)	14 (5.7)
Work regime			
24h x 72h	10 (14.7)	47 (26.3)	57 (23)
12h x 24h and 12h x 72h	4 (5.9)	10 (5.6)	14 (5.7)
Expedient (8 hours a day)	54 (79.4)	122 (68.1)	176 (71.3)
Average monthly family income			
Up to 5 MW	10 (14.7)	29 (16.2)	39 (15.8)
5 to 10 MW	24 (35.3)	91 (50.8)	115 (46.6)
10 to 15 MW	19 (27.9)	37 (20.7)	56 (22.7)
15 to 20 MW	8 (11.9)	8 (4.5)	16 (6.5)
20 to 25 MW	3 (4.4)	8 (4.5)	11 (4.4)
25 to 30 MW	2 (2.9)	6 (3.3)	8 (3.2)
More than 30 MW	2 (2.9)	-	2 (0.8)
BMI			
Normal	46 (67.6)	62 (34.6)	108 (43.7)
Overweight	17 (25)	88 (49.2)	105 (42.5)
Obesity	5 (7.4)	29 (16.2)	34 (13.8)
Alcohol consumption			
Yes	47 (69.1)	113 (63.1)	160 (64.8)
No	21 (30.9)	66 (36.9)	87 (35.2)

MW: Minimum wage; BMI: Body mass index.

Source: Own elaboration.

The most prevalent risk factors were hypertension (38.5%), age 45 or over in men (33.6%), and hyperglycemia (30.8%) (**Table 2**). However, 30.4% reported not knowing whether they had hypercholesterolemia and more than half, 58.7%, were unable to report whether their blood glucose levels were within or outside the normal range. It is therefore highly likely that these two cardiometabolic risk factors were underestimated. More than half of the military firefighters had a high cardiovascular risk (52.6%), according to the ACSM classification (**Table 3**).

Table 2 Prevalence of cardiovascular risk factors in Brazilian military firefighters, by sex, 2023 (n = 247)

Cardiovascular risk factor (ACSM)	Female n (%)	Male n (%)	n (%)
Age (> 55 years/> 45 years)	-	83 (46.4)	83 (33.6)
Family history	10 (14.7)	25 (14.0)	35 (14.2)
Smoking	1 (1.5)	13 (7.3)	14 (5.7)
Systemic arterial hypertension	19 (27.9)	76 (42.5)	95 (38.5)
Hypercholesterolemia	11 (16.2)	39 (21.8)	50 (20.2)
Hyperglycemia	17 (25.0)	59 (33.0)	76 (30.8)
Obesity	5 (7.4)	29 (16.2)	34 (13.8)
Sedentary lifestyle	9 (13.2)	29 (16.2)	38 (15.4)

ACSM: American College of Sports Medicine.

Source: Own elaboration.

Table 3 Classification of cardiovascular risk in Brazilian military firefighters according to pre-participation risk stratification ACSM criteria, by sex, 2023 (n = 247)

Cardiovascular risk	Female n (%)	Male n (%)	Total n (%)
Low risk	10 (14.7)	53 (29.6)	63 (25.5)
Moderate risk	8 (11.8)	46 (26.0)	54 (21.9)
High risk	50 (73.5)	80 (44.7)	130 (52.6)

ACSM: American College of Sports Medicine.

Source: Own elaboration.

The prevalence of signs and symptoms suggestive of CMD or pulmonary disease among military firefighters was higher in females, except for claudication, which was more prevalent in males (**Table 4**). The prevalence of previously diagnosed metabolic disease was also higher in females (**Table 5**).

Table 4 Prevalence of signs and symptoms suggestive of cardiometabolic or pulmonary disease in Brazilian military firefighters, according to pre-participation risk stratification ACSM criteria and sex, 2023 (n= 247)

Signs/Symptoms	Female n (%)	Male n (%)	Total n (%)
Chest pain or discomfort	20 (29.4)	30 (16.8)	50 (20.2)
Dyspnea, shortness of breath	22 (32.4)	26 (14.5)	48 (19.4)
Dizziness, fainting	31 (45.6)	31 (17.3)	62 (25.1)
Edema, swelling of the ankle	14 (20.6)	7 (3.9)	21 (8.5)
Tachycardia, palpitations	14 (20.6)	19 (10.6)	33 (13.4)
Claudication, leg pain when walking	1 (1.5)	4 (2.2)	5 (2.0)

Continue

Continuation			
Heart murmur	2 (2.9)	2 (1.1)	4 (1.6)
Tiredness, fatigue	7 (10.3)	6 (3.4)	13 (5.3)

ACSM: American College of Sports Medicine.

Source: Own elaboration.

Table 5 Previous diagnoses of diseases in Brazilian military firefighters, according to pre-participation risk stratification ACSM criteria and sex (n= 247)

Illness	Female n (%)	Male n (%)	Total n (%)
Cardiac	1 (1.5)	6 (3.4)	7 (2.8)
Vascular	-	1 (0.6)	1 (0.4)
Pulmonary	5 (7.4)	8 (4.5)	13 (5.3)
Metabolic	10 (14.7)	9 (5.0)	19 (7.7)
Renal	-	3 (1.7)	3 (1.2)
Hepatic	2 (2.9)	5 (2.8)	7 (2.8)
Other	12 (17.6)	24 (13.4)	36 (14.6)

ACSM: American College of Sports Medicine.

Source: Own elaboration.

Discussion

This study found a high prevalence of cardiometabolic risk factors, as well as a worrying proportion of firefighters classified as being at high cardiovascular risk, especially females. The findings corroborate those of previous studies, in the sense that firefighters have high proportions of cardiometabolic risk factors, often like those of the general population, although they perform very different activities and are known to have a higher cardiovascular risk¹².

In this scenario, the high proportions of firefighters in the overweight range (overweight + obesity) and reporting systemic arterial hypertension stand out, which again confirms previous findings^{12,21}. In these cases, the proportion of overweight male firefighters is almost twice as high as that of females, as is the proportion of hypertension. A new finding worth highlighting is that, despite the lower prevalence of cardiometabolic risk factors in females and the lower average age, the proportion of those with high cardiovascular risk was higher than in males, which can be explained by the greater presence of reports of signs and symptoms suggestive of CMD, as well as a previous diagnosis of diseases associated with higher cardiovascular risk. It is also important to mention that, despite the fact that most of the sample was not working exclusive shifts for those directly involved in rescue or emergency activities, which is a distinguishing feature of the sample in this study, the findings are very worrying in view of the high physical and emotional demands characteristic of the profession^{2,4}, in which everyone can be called upon at any time.

The findings of this study have important practical implications, whether for the workers involved in this profession, for the health services of military fire departments in Brazil, or for society, in the sense that they contribute to understanding the cardiometabolic risk scenario in a large category of workers with high social importance. Better knowledge of the distribution of cardiometabolic risk factors in this category can contribute to the implementation of training strategies aimed at self-care, the possible improvement of

routine occupational assessments, which can incorporate strategies for even earlier identification of more prevalent risk factors, firefighters belonging to groups with a higher risk of greater illness, as well as an understanding of the differences found between the sexes.

About the high prevalence of cardiometabolic risk factors, especially obesity and hypertension, the findings of this study are consistent with what has been found in firefighters in other countries. A study of 417 firefighters in France found that the most common cardiovascular risk factors were overweight and obesity (62.1%) and hypertension (27.8%)²². American firefighters followed from 2015 to 2018 showed a 48% prevalence of overweight and 36% of obesity. In addition, among male and female firefighters with obesity, 81% and 58% had high blood pressure levels, respectively. Being in a higher BMI category was significantly associated, regardless of age, with a higher prevalence of all the CVD risk factors examined in male firefighters, including high blood pressure, high cholesterol, high triglycerides, and high blood glucose. Among normal-weight female firefighters, 25% had high blood pressure and 0% had high blood glucose, while obese firefighters had a prevalence of 57% and 11%, respectively⁹.

In Quebec, Canada, a study of female firefighters, also using online questionnaires and with a similar average age (38.2, standard deviation 9.9 years) and risk stratification approach to the present study, showed that around 11% were at moderate risk and 65% at high risk of CVD, according to the ACSM²³. It should be noted that these results were very similar to those reported here.

In this study, the proportion of signs and symptoms suggestive of CMD among female firefighters was higher than among male. Self-reported chest pain, according to the Cardiovascular Statistics - Brazil 2021, can be related to cardiovascular problems and obstruction of the heart's arteries and was more prevalent in women than in men in all the studies described⁷. In women, the most significant traditional risk factors for CVD include systemic arterial hypertension, dyslipidemia, diabetes mellitus, smoking, obesity, and a sedentary lifestyle²⁴. The prevalence of these risk factors has been increasing, even in younger women and, when associated gender-specific risk factors, they contribute to an increase in morbidity and mortality²⁴.

The high prevalence of risk factors in military firefighters is worrying, given that firefighters can exert maximum effort under stressful conditions. In this context, the high prevalence rates observed here, in both sexes, would already be worrying in the general population. Among firefighters, the concern is even greater, since the higher cardiovascular risk in these professionals may be related to their work activities¹.

According to Vigitel 2023, the frequency of being overweight in Brazil in 2022 was 61.4%, and this was higher among males (63.4%) than females (59.6%). Obese adults accounted for 24.3% of the population interviewed, which was similar for females (24.8%) and males (23.8%). For the total population and for women, the frequency of obesity was lower among those with more schooling. In the Federal District, 60.3% of adults were overweight, 62.4% males and 58.6% of females; while 21.9% were obese, 16.9% males and 26.2% females²⁵. In this study, the prevalence of overweight and obesity was lower than in the general population and, as in the population as a whole, there was a higher prevalence in males than in females. Compared to data stratified by sex and age group²⁵, the findings presented here indicate a lower prevalence of obesity in this group of military firefighters, especially in females (7.4% vs. 27.4%). In males, the difference also favored firefighters, but to a lesser extent (16.2% vs. 26.5%). A lower prevalence of overweight among firefighters compared to the general population is desirable and expected, given the physical demands of the profession⁸. However, considering the demands of the job and the known harm to health cardiovascular associated with obesity²⁶, prevalences of 7.4% and 16.2% among female and male firefighters, respectively, with such a low average age, cannot be underestimated.

In the United States, a survey of firefighters found that 49% of male participants were overweight and 37% were obese. Among female firefighters, 39% were overweight and 27% were obese⁹. In Espírito Santo, Brazil, a high prevalence of overweight (48.7%) and obesity (11%) was reported among male firefighters²⁶. A study previously carried out in the Federal District reported that 54.3% of male firefighters were overweight and 14.7% were obese²¹. In the current study, the prevalence rates were lower than those found in fire departments in other studies, and only slightly higher than those reported among firefighters in the Federal District (14.7% vs. 16.2%).

Obesity is an independent risk factor for CVD. An accumulation of excess adiposity leads to various pro-inflammatory effects on the vascular system, including dysregulation of adipocyte tissue and decreased sensitivity to insulin. These conditions can cause endothelial dysfunction, which is further linked to atherosclerosis, hypertension and hyperlipidemia²⁷. Obesity has also been associated with a twofold increased risk of left ventricular hypertrophy in firefighters²⁸.

SAH is a chronic non-communicable disease characterized by persistent elevation of blood pressure (BP), i.e. systolic BP (SBP) greater than or equal to 140 mmHg and/or diastolic BP (DBP) greater than or equal to 90 mmHg²⁹.

A study carried out in Pará, Brazil, found that only 23.5% of the military firefighters surveyed had systemic BP within the normal range³⁰. An American study, which used lower diagnostic values for SAH: SBP > 130 mmHg and DBP > 80 mmHg, reported that in the 20-29 age group, 45% of male firefighters were hypertensive and 11% of females had SAH. These figures increased to 77% and 79%, respectively, in the 50 to 59 age group, showing that at older ages, the prevalence of SAH in women is similar to that in men¹².

Because it is often an asymptomatic and silent disease, hypertension tends to progress with structural and/or functional changes in target organs such as the brain, heart, kidneys, and vessels and has an independent, linear, and continuous association with CVD, chronic disease, and premature death. Increased BP contributes directly or indirectly to 50% of CVD deaths²⁹. In this study, hypertension was the most prevalent risk factor for CVD in both men and women.

Another risk factor for CVD that has increased in prevalence in recent years is dyslipidemia³¹. When total cholesterol is greater than or equal to 200 mg/dL, it is considered high. High cholesterol was found in 22.98% of military firefighters in the state of Espírito Santo²⁶. In the United States, there was an increase in cholesterol values from 9% to 14% in a five-year follow-up of a group of firefighters³². In the current study, cholesterol was high in 20.2% of the sample, which is highly worrying in this population, given the association between high total cholesterol values and the risk of CVD^{33,34}.

The 2019 Brazilian National Health Survey (PNS) revealed that 7.5% of people had never had a blood test to measure cholesterol and triglycerides, of which 4.4% were female and 11.0% male³¹. In this study, 30.4% of the participants were unaware of their cholesterol levels. This finding is worrying given the recognized role of cholesterol in the formation of atheromatous plaques, which increases the risk of CVD³³, especially in a profession with a high cardiometabolic risk. There's no way of thinking about prevention when you don't know the problem exists.

High cholesterol is a risk factor for the formation of atherosclerotic plaque, which begins with aggression against the vascular endothelium and, as this becomes more fragile, contributes to plaque instability, rupture, and ultimately thrombosis, which leads to the occurrence of an acute cardiovascular event³⁴. In this way, identifying asymptomatic individuals who are more predisposed is crucial for effective prevention, with the correct definition of individual therapeutic goals, which is absolutely necessary for members of a profession with a high cardiometabolic risk.

Among all the risk factors for the development of atherosclerotic disease, diabetes *mellitus* is one of the most damaging^{33,34}. The frequency of diabetes in Brazil in 2023 was 10.2%. As with hypertension and dyslipidemia, women had a higher proportion of reported diabetes diagnoses than men (11.1% vs. 9.1%)²⁵. A study in Canada with female firefighters reported a prevalence of 3%²³. In the present study, more than half of the participants were unable to say whether their blood glucose levels were within or outside the normal range, a fact which may hinder screening for health risk factors and early diagnosis of diabetes, preventing more effective disease prevention measures, as in the case of lack of knowledge of dyslipidemia.

In Brazil, 9.3% of adults smoke, and the prevalence is higher in males (11.7%) than in females (7.2%)²⁵. Smoking was a cardiovascular risk factor with a low prevalence in this study.

This survey found a low prevalence of inactive participants (15.4%). When categorizing by sex, 13.2% of female and 16.2% of male firefighters were classified as inactive according to the IPAQ (< 600 MET/week). The low prevalence found may be related to the very nature of the profession. This professional activity is classified in the Compendium of Physical Activities as a profession with vigorous intensity work activities ranging from 6.8 to 9.0 MET³⁵. In a Brazilian study evaluating the intensity of PA performed by military firefighters while fighting forest fires, it was observed that firefighters performed more than 110 minutes of vigorous intensity (>76% and < 94% of the maximum heart rate predicted for their age) and more than 30 minutes of very vigorous intensity (>= 94% of the maximum heart rate)³⁶.

A cross-sectional censitary study among military personnel from a fire department battalion in the state of Minas Gerais, Brazil, which investigated levels PA using the IPAQ short version, revealed a higher prevalence of physical inactivity than that observed in this study. Of the 202 participants in the study, 70.3% were physically active and 29.7% insufficiently active³⁷. Even though the numbers observed were higher than in this study, the prevalence of inactivity was still lower than that observed in the Brazilian population³¹. It is known that a sedentary lifestyle is directly related to risk factors for CVD¹². Despite the low prevalence of physical inactivity, more than half of the military firefighters had a high cardiovascular risk (52.6%), making the occupational risk of the profession more evident. However, this does not diminish the importance of practicing PA, as it seems to be inversely associated with occupational stress and serves as an important mitigating factor of occupational stress in firefighters³⁸. A study, in Greece, with 430 firefighters aged between 21 and 60 investigated the association between PA and occupational stress. Using logistic regression models with multivariable adjustment, it was found that firefighters who exercised had a 50% lower risk of occupational stress and, using a categorical model, it was shown that each hour per week of increased PA by firefighters was associated with a 16% lower risk of occupational stress after adjusting for age, education, smoking, and BMI³⁸. This evidence demonstrates the indirect effect of PA on factors directly related to cardiovascular health, such as occupational stress among firefighters.

It is important to recognize the limitations of this work. Firstly, the non-probabilistic nature of the sample, which could lead to selection bias. The low proportion of respondents also limits the external validity of the findings. The relatively short time taken to publicize the survey is one of the possible explanations for the low response rate. Self-reported answers may constitute response bias and have affected the validity of the results, in addition to the impossibility of debating the answers³⁹. BMI has limited capacity to distinguish between fat mass and fat-free mass, which can lead to incorrect classification of obesity using this index. However, BMI is accepted worldwide for estimating the prevalence of obesity and has even been validated for use among firefighters, without overestimation occurring, both in Brazil and abroad⁴⁰. Another important limitation of our study concerns the high percentage of respondents who reported not knowing their lipid profile and blood glucose values (30.4% and 58.7%, respectively). There may have been an underestimation of the estimated prevalence of both risk factors and the proportion of those with a moderate level of cardiovascular risk.

Conclusion

The most prevalent risk factors among the firefighters taking part in the study were hypertension, age 45 or over in males, and hyperglycemia. Most of the participants were unable to report whether their cholesterol and blood glucose levels were within or outside the normal range, and these risk factors may have been underestimated. More than half were at high risk of CVD, and the proportion of signs and symptoms suggestive of CVD in women was higher than in men.

Military firefighters, together with health professionals, should consider a comprehensive program that addresses screening, prevention, counseling, education, and treatment of prevalent cardiometabolic risk factors, since this class of workers is routinely exposed to greater cardiovascular risk. These efforts should be instituted early in the firefighter's career, as aging is associated with worsening cardiometabolic health, and many firefighters remain operationally active throughout their careers.

References

1. Smith DL, DeBlois JP, Kales SN, Horn GP. Cardiovascular strain of firefighting and the risk of sudden cardiac events. *Exerc Sport Sci Rev*. 2016 Jul;44(3):90-7. <https://doi.org/10.1249/JES.0000000000000081>
2. Soteriades ES, Smith DL, Tsismenakis AJ, Baur DM, Kales SN. Cardiovascular disease in US firefighters: a systematic review. *Cardiol Rev*. 2011;19(4):202-15. <https://doi.org/10.1097/CRD.0b013e318215c105>
3. Hunter AL, Shah AS, Langrish JP, Raftis JB, Lucking AJ, Brittan M, et al. Fire simulation and cardiovascular health in firefighters. *Circulation*. 2017 Apr;135(14):1284-95. <https://doi.org/10.1161/CIRCULATIONAHA.116.025711>
4. Kales SN, Smith DL. Firefighting and the Heart: implications for Prevention. *Circulation*. 2017 Apr;135(14):1296-9. <https://doi.org/10.1161/CIRCULATIONAHA.117.027018>
5. World Health Organization. Leading causes of death and disability 2000-2019: a visual summary. Geneva: World Health Organization; 2021 [cited 2024 Mar 30]. Available from: <https://www.who.int/data/stories/leading-causes-of-death-and-disability-2000-2019-a-visual-summary>
6. World Health Organization. About cardiovascular diseases, 2019. Geneva: World Health Organization; 2019 [cited 2023 Dec 19]. Available from: [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds))
7. Oliveira GM, Brant LC, Polanczyk CA, Malta DC, Biolo A, Nascimento BR, et al. Estatística cardiovascular - Brasil 2021. *Arq Bras Cardiol*. 2022 Jan;118(1):115-373. <https://doi.org/10.36660/abc.20211012>
8. Smith DL, Barr DA, Kales SN. Extreme sacrifice: sudden cardiac death in the US Fire Service. *Extrem Physiol Med*. 2013 Feb;2(1):6. <https://doi.org/10.1186/2046-7648-2-6>
9. Bode ED, Mathias KC, Stewart DF, Moffatt SM, Jack K, Smith DL. Cardiovascular disease risk factors by BMI and age in United States firefighters. *Obesity (Silver Spring)*. 2021 Jul;29(7):1186-94. <https://doi.org/10.1002/oby.23175>
10. Coelho S, Miura R, Rocha L, Aires M, Aires S, Barroso M. Mortalidade em bombeiros militares do Estado do Rio de Janeiro - Brasil: análise de período de dez anos. *FLAMMAE*. 2020;6(16):89-104. <https://doi.org/10.17648/2359-4837/flammae.v6n16.p89-104>
11. Précoma DB, Oliveira GM, Simão AF, Dutra OP, Coelho-Filho OR, Izar MC, et al. Updated cardiovascular prevention guideline of the Brazilian Society of Cardiology - 2019. *Arq Bras Cardiol*. 2019 out;13(4):787-891. <https://doi.org/10.5935/abc.20190204>
12. Khaja SU, Mathias KC, Bode ED, Stewart DF, Jack K, Moffatt SM, et al. Hypertension in the United States Fire Service. *Int J Environ Res Public Health*. 2021 May;18(10):5432. <https://doi.org/10.3390/ijerph18105432>
13. Kales SN, Tsismenakis AJ, Zhang C, Soteriades ES. Blood pressure in firefighters, police officers, and other emergency responders. *Am J Hypertens*. 2009 Jan;22(1):11-20. <https://doi.org/10.1038/ajh.2008.296>
14. Nogueira RM, Saint-Martin DR, Barreto KA, Soares EMK, Smith DL, Molina GE, et al. Longitudinal changes in cardiorespiratory fitness among firefighters based on a fixed 12.0 MET standard and an age-adjusted fitness standard. *Work*. 2023;76(2):821-9. <https://doi.org/10.3233/WOR-220608>
15. Lee W, Kim J. Prevalence of metabolic syndrome and related factors in Korean career firefighters in comparisons with other occupational groups. *J Occup Environ Med*. 2017 Apr;59(4):384-8. <https://doi.org/10.1097/JOM.0000000000000956>
16. Beckett A, Scott JR, Chater AM, Ferrandino L, Aldous JW. The Prevalence of metabolic syndrome and its components in firefighters: a systematic review and meta-analysis. *Int J Environ Res Public Health*. 2023 Sep;20(19):6814. <https://doi.org/10.3390/ijerph20196814>
17. American College of Sport Medicine. Diretrizes do ACSM para o teste de esforço e sua prescrição. 9th ed. Rio de Janeiro: Guanabara Koogan; 2014. 268 p.
18. World Health Organization. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. *World Health Organ Tech Rep Ser*. 1995;854:1-452.
19. Matsudo S, Araujo T, Matsudo V, Andrade D, Andrade E, Oliveira L, et al. Questionário Internacional de Atividade Física (IPAQ): estudo de validade e reprodutibilidade no Brasil. *Rev Bras Ativid Fisica Saude*. 2001;6(2):5-18.
20. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*. 2020 Dec;54(24):1451-62. <https://doi.org/10.1136/bjsports-2020-102955>
21. Nogueira EC, Porto LG, Nogueira RM, Martins WR, Fonseca RM, Lunardi CC, et al. Body composition is strongly associated with cardiorespiratory fitness in a large brazilian military Firefighter Cohort: the Brazilian firefighters study. *J Strength Cond Res*. 2016 Jan;30(1):33-8. <https://doi.org/10.1519/JSC.0000000000001039>

22. Savall A, Charles R, Trombert B, Fontana L, Roche F, Pelissier C. Prevalence of cardiovascular risk factors in a population of French firefighters. *Arch Environ Occup Health*. 2021;76(1):45-51. <https://doi.org/10.1080/19338244.2020.1779017>
23. Gendron P, Lajoie C, Laurencelle L, Trudeau F. Cardiovascular disease risk in female firefighters. *Occup Med (Lond)*. 2018 Aug;68(6):412-4. <https://doi.org/10.1093/occmed/kqy074>
24. Oliveira GM, Almeida MC, Marques-Santos C, Costa ME, Carvalho RC, Freire CM, et al. Posicionamento sobre a saúde cardiovascular nas mulheres - 2022. *Arq Bras Cardiol*. 2022 Nov;119(5):815-82. <https://doi.org/10.36660/abc.20220734>
25. Ministério da Saúde (BR). Vigitel Brasil 2023: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico: estimativas sobre frequência e distribuição sociodemográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito Federal em 2023. Brasília, DF: Ministério da Saúde; 2023.
26. Damacena FC, Batista TJ, Ayres LR, Zandonade E, Sampaio KN. Obesity prevalence in Brazilian firefighters and the association of central obesity with personal, occupational and cardiovascular risk factors: a cross-sectional study. *BMJ Open*. 2020 Mar;10(3):e032933. <https://doi.org/10.1136/bmjopen-2019-032933>
27. Soteriades ES, Hauser R, Kawachi I, Liarokapis D, Christiani DC, Kales SN. Obesity and cardiovascular disease risk factors in firefighters: a prospective cohort study. *Obes Res*. 2005 Oct;13(10):1756-63. <https://doi.org/10.1038/oby.2005.214>
28. Smith DL, Haller JM, Korre M, Fehling PC, Sampani K, Porto LG, et al. Pathoanatomic findings associated with duty-related cardiac death in US firefighters: a case-control study. *J Am Heart Assoc*. 2018 Sep;7(18):e009446. <https://doi.org/10.1161/JAHA.118.009446>
29. Barroso W, Rodrigues C, Bortolotto L, Mota-Gomes M, Brandão A, Feitosa A, et al. Diretrizes Brasileiras de Hipertensão Arterial - 2020. *Arq Bras Cardiol*. 2021;116(3):516-658. <https://doi.org/10.36660/abc.20201238>
30. Araújo IKF, Cunha KC. Hábitos alimentares e estado nutricional dos bombeiros militares de Belém, Pará, Brasil. *Rev Bras Nutr Esp*. 2021;15(91):113-27.
31. Instituto Brasileiro de Geografia e Estatística. Coordenação de Trabalho e Rendimento, Ministério da Saúde (BR). Pesquisa nacional de saúde: 2019: percepção do estado de saúde, estilos de vida, doenças crônicas e saúde bucal: Brasil e grandes regiões. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2021.
32. Mathias KC, Bode ED, Stewart DF, Smith DL. Changes in firefighter weight and cardiovascular disease risk factors over five years. *Med Sci Sports Exerc*. 2020 Nov;52(11):2476-82. <https://doi.org/10.1249/MSS.0000000000002398>
33. Jebari-Benslaïman S, Galicia-García U, Larrea-Sebal A, Olaetxea JR, Alloza I, Vandembroeck K, et al. Pathophysiology of atherosclerosis. *Int J Mol Sci*. 2022 Mar;23(6):3346. <https://doi.org/10.3390/ijms23063346>
34. Valente LJ. Influência do uso de estatinas sobre a regressão/estabilização da placa de ateroma [dissertation]. Covilhã, Portugal: Universidade da Beira Interior; 2019.
35. Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett DR Jr, Tudor-Locke C, et al. 2011 Compendium of physical activities: a second update of codes and MET values. *Med Sci Sports Exerc*. 2011 Aug;43(8):1575-81. <https://doi.org/10.1249/MSS.0b013e31821ece12>
36. Saint-Martin DR, Segedi LC, Soares ED, Nogueira RM, Cruz CJ, Fontana KE, et al. Nível de atividade física e sobrecarga cardiovascular em bombeiros militares durante combate a incêndio florestal: um estudo exploratório. *Rev Bras Saude Ocup*. 2020;45:e16. <https://doi.org/10.1590/2317-6369000037718>
37. Jesus B, Reis L, Silva I, Carreiro D, Coutinho L, Ricardo L, et al. Relação entre nível de atividade física, condições de saúde e ocupacionais entre bombeiros militares. *Rev Univ Vale Rio Verde*. 2015;13(1):77-86. <http://periodicos.unincor.br/index.php/revistaunincor/article/view/1841>
38. Soteriades ES, Vogazianos P, Tozzi F, Antoniadou A, Economidou EC, Psalta L, et al. Exercise and occupational stress among firefighters. *Int J Environ Res Public Health*. 2022 Apr;19(9):4986. <https://doi.org/10.3390/ijerph19094986>
39. Mota RC, Siqueira JS, Fernandes RD. Validade do autorrelato de hipertensão arterial em trabalhadores. *Cad Saude Colet*. 2023;31(2):e31020421. <https://doi.org/10.1590/1414-462x202331020421>
40. Porto LG, Nogueira RM, Nogueira EC, Molina GE, Farioli A, Junqueira LF Jr, et al. Agreement between BMI and body fat obesity definitions in a physically active population. *Arch Endocrinol Metab*. 2016;60(6):515-25. <https://doi.org/10.1590/2359-3997000000220>

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