

# BMJ Open Comparative analysis of the health status of military police officers and firefighters: a cross-sectional study in the State of Paraná, Brazil

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## ABSTRACT

**Objectives** To evaluate the health-condition of military police officers and firefighters. To identify risk factors for not being medically ready for duty.

**Design** Cross-sectional study.

**Setting** Data were extracted from medical records during annual periodic health assessments of police officers and firefighters serving with the military police in Paraná, Brazil.

**Participants** 6621 police officers (5927 men and 694 women) and 1347 firefighters (1257 men and 90 women) who underwent health assessments between July 2018 and June 2019 were analysed. Pregnant women were excluded.

**Outcome measures** Data included variables such as sex, age, anthropometric measurements, lifestyle, comorbidities and laboratory tests. Multiple logistic regression was used to estimate the probability of not being medically ready for active duty.

**Results** Overall, police officers had worse health status than firefighters and greater prevalence of overweight and obesity, regardless of sex. Musculoskeletal diseases were the most commonly reported disease by police officers and firefighters of both sexes. Among men, hypertension was the second most prevalent disease, followed by psychiatric diseases and dyslipidaemia. Among women, psychiatric diseases were the second most prevalent. Male police officers  $\geq 40$  years old presented the highest probability of not being considered ready for duty (40.1%). The probability of male police officers between the ages of 31 and 40 not being ready was similar to that for male firefighters  $>40$  years old. There was a higher chance of not being medically ready professionals with diseases such as diabetes mellitus (OR 2.95, 95% CI 1.97 to 5.03), dyslipidaemia (OR 2.65, 95% CI 1.96 to 3.58), hypertension (OR 2.29, 95% CI 1.85 to 4.70), high total cholesterol (OR 2.16, 95% CI 1.93 to 2.42), and heart disease (OR 2.13, 95% CI 1.32 to 3.45).

**Conclusions** There was a high prevalence of chronic diseases and modifiable cardiovascular risk factors among police officers and firefighters. Healthy protective measures should be offered frequently, particularly to police officers at an earlier age.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Few studies have compared the health condition of military police officers and firefighters.
- ⇒ This study included female police officers and firefighters therefore our findings may contribute to research in this subset of the population.
- ⇒ The study used a cross-sectional design, wherein casual relationships could not be inferred from the results.
- ⇒ Our findings may not be generalised to other professional groups.
- ⇒ New fields of research can be developed from the results.

## INTRODUCTION

The public safety sector is essential for the maintenance of social order. The military police in Paraná, South of Brazil, has been responsible for training military police officers and firefighters to fulfil this noble mission for 167 years. Although they are considered to be physically and psychologically fit when they start their careers, these workers are exposed to various work-related risk factors that can cause their physical and mental health to deteriorate.<sup>1,2</sup>

Police work involves long working days and very stressful situations, often in violent areas.<sup>1</sup> Police officers also face unexpected situations that require strength, dexterity and physical fitness.<sup>2</sup> Firefighters face additional risks, when they are exposed to smoke from chemical and biological hazards.<sup>1</sup> Studies have shown that police officers and firefighters have a shorter life expectancy than the general population and high mortality and morbidity, especially due to cardiovascular disease (CVD).<sup>2</sup>

Although firefighters are subjected to physical demands, the prevalence of being overweight and obese among them is similar to the general population. The high prevalence of

CVD risk factors remains a concern since firefighters are called on to exert maximal effort under stressful conditions.<sup>3 4</sup> There is a variable prevalence of cardiovascular risk factors such as hypertension, dyslipidaemia, obesity, diabetes mellitus, smoking and metabolic syndrome among police officers.<sup>5</sup>

Several studies have investigated the health status of police officers and firefighters, focusing primarily on cardiovascular, chronic and psychiatric diseases. However, few have investigated the prevalence of their morbidities with sex and age in that population, or have estimated their risk of having unsuitable health status for their daily work activities. It is imperative that police officers and firefighters attain and maintain physical fitness for both their overall health and ability to perform job tasks safely and effectively. The present study sought to evaluate the health condition of military police officers and firefighters and to identify risk factors for not being medically ready for active duty.<sup>6</sup>

## PARTICIPANTS AND METHODS

### Study design and evaluated population

This observational study investigated the general health status of military police officers and firefighters in Paraná between June 2018 and July 2019. Pregnant women were excluded from the study. A total of 7968 individuals were included: 6621 police officers (5927 men, 694 women) and 1347 firefighters (1257 men, 90 women), which comprised 43.4% of the military police officers and firefighters in Paraná. Participants underwent a medical assessment during the annual health inspections that comprised clinical history, physical examination and laboratory tests. An exercise stress test (ET) on a treadmill was performed by individuals aged 40 years or over. Participants were divided according to sex and age (for males:  $\leq 30$  years old, 31–40 years old and  $\geq 41$  years old; for females:  $\leq 30$  years old and  $\geq 31$  years old) to identify a subset of the study population with the greatest prevalence of chronic diseases. Women were analysed separately because of their biological and behavioural characteristics, highlighting the sex differences in cardiometabolic, obesity and physical performance parameters.

### Data collection

The participants were military police officers and firefighters performing regular duties who underwent an elective medical assessment during the annual health inspections. Data were collected from standardised electronic health records.

Race category was determined according to the answer given to a standard question on self-declared ethnicity, based on the method used by the Brazilian Institute of Geography and Statistics national census survey which classifies individuals as white, brown, black, yellow or indigenous.<sup>7</sup> A semistructured anamnesis was used to investigate the presence of chronic diseases, such as diabetes mellitus, hypertension, musculoskeletal,

cardiovascular, endocrine, respiratory, neurological and psychiatric diseases, among others. If the answer was yes for any disease, the treatment used was asked. Smoking status was examined in the patient interview.

The International Physical Activity Questionnaire was applied to assess physical activity. It is widely used to estimate the frequency and duration of physical activity levels and has been validated for Brazil.<sup>8</sup> Participants were classified as inactive or insufficiently active if they did no physical activity or less than 150 min per week; as active if they did between 150 and 300 min of moderate physical activity or 75 min of intense activity per week or an equivalent combination; and as highly active if they did more than 300 min per week of moderate to intense activity.<sup>9</sup>

The Alcohol Use Disorders Identification Test–Concise questionnaire was used to assess alcohol consumption. The questionnaire assigns a score on a scale from 0 to 12. For men, a score of 0–3 indicates low risk, 4–5 indicates moderate risk, 6–7 indicates high risk and 8–12 indicates severe risk. For women, a score of 0–2 indicates low risk, 3–5 indicates moderate risk, 6–7 indicates high risk and 8–12 indicates severe risk.<sup>10</sup>

Blood pressure was measured using a portable device (Welch Allyn Tycos DS48 Pocket aneroid sphygmomanometer) attached to the left arm while the participant was in a sitting position and after at least 5 min of rest. Participants were asked to refrain from smoking or consuming caffeine or alcohol for 30 min prior to measurement. They were instructed by a doctor or trained nurse to relax as much as possible and not to talk during the measurement procedure. The arm was supported at heart level and the bladder of the cuff encircled at least 80% of the arm circumference. When the two measurements were divergent, a third measurement was performed and the mean of the measurements was used for statistical analysis.<sup>11</sup> High blood pressure was defined by systolic blood pressure  $\geq 140$  mm Hg and/or diastolic blood pressure  $\geq 90$  mm Hg. Uncontrolled hypertension was defined as systolic blood pressure  $\geq 140$  mm Hg and/or diastolic blood pressure  $\geq 90$  mm Hg in patients taking antihypertensive medications.<sup>12</sup>

Body mass index (BMI) was calculated according to the formula (weight (kg)/height squared ( $m^2$ )). Participants were classified into four categories based on WHO guidelines: low weight ( $< 18.5 \text{ kg}/m^2$ ), normal weight ( $18.5\text{--}24.9 \text{ kg}/m^2$ ), overweight ( $25\text{--}29.9 \text{ kg}/m^2$ ) and obese ( $\geq 30 \text{ kg}/m^2$ ).<sup>13</sup> Waist circumference (WC) was measured horizontally at the midpoint between the lower edge of the ribs and the top of the iliac crest. A  $WC \geq 94$  cm for men or  $\geq 80$  cm for women was considered as a risk factor for metabolic complications.<sup>14</sup>

Participants were considered as not medically ready for duty if the results of their ET were suggestive of ischaemia, cardiac arrhythmia, or if they presented with poor health condition, such as disabling musculoskeletal diseases, uncontrolled hypertension or diabetes mellitus. Whenever necessary, they were referred for specialised medical care.

### Laboratory assessment

Blood samples were collected by venepuncture after 12 hours of fasting. Total cholesterol and triglycerides were determined by colorimetric assay, and glucose by the hexokinase method. Total cholesterol and triglycerides serum levels were considered ideal if they were <200 mg/dL and <150 mg/dL, respectively.<sup>15</sup> A glucose serum level <99 mg/dL was considered normal.<sup>16</sup> Uncontrolled diabetes was defined by fasting plasma glucose >130 mg/dL in patients taking antidiabetic medications.<sup>16</sup>

### Cardiorespiratory assessment

Participants aged 40 years old or older without a history of CVD were monitored by a cardiologist while they underwent an ET on a treadmill. Participants were instructed to avoid exhausting activities in the 24 hours prior to the examination, and to eat light food, and not to smoke or drink coffee in the 3 hours prior to the examination. Electrodes were placed on the chest and attached to an ECG machine. Resting ECG, heart rate and blood pressure were measured prior to starting the exercise regimen. Once no limiting factors were detected on the baseline ECG, the participant was placed on a treadmill with a protocol designed to increase in intervals during the exercise. Blood pressure and heart rate were monitored throughout, and the participant was monitored for any developing symptoms, such as chest pain, shortness of breath, dizziness or extreme fatigue.

The most common protocol used for treadmill exercise stress testing was the Bruce protocol. This protocol is divided into successive 3-min stages, which requires the patient to walk faster and at a steeper gradient. The testing protocol could be adjusted according to the participant's tolerance, aiming for 6–12 min of exercise duration.<sup>17</sup> The Ellestad protocol for treadmill testing has a fixed inclination of 10% and a velocity of 1.7 mph for 3 min, 3 mph for 2 min, 4 mph for 2 min and finally 5 mph for 3 min.<sup>18</sup> Oxygen consumption was estimated by the formula (male:  $VO_2=1.11 \times (60-0.55 \times \text{age})$ ; female:  $VO_2=1.11 \times (48-0.37 \times \text{age})$ ).

Participants were questioned about any symptoms that they experienced during exercise. All participants were monitored closely during the recovery period until their heart rate and ECG were back to baseline. Indications for terminating the test were: participant request due to severe symptoms (ie, chest pain, shortness of breath or fatigue), severe exercise-induced hypotension or hypertension, horizontal or down sloping ST depression  $\geq 1$  mm or ST-segment elevation, new bundle branch block, atrioventricular block, ventricular arrhythmia, reaching maximal heart rate or completing all stages.

### Statement of patient and public involvement

Participants were not involved in the design, conduction or analysis of this study. The results will be shared with the participants and the general population through the publication of this article.

### Statistical analysis

Data are shown as mean $\pm$ SD, median (minimum and maximum values) or percentages. An independent samples Student's t test was used to compare continuous variables, while Fisher's exact test or the  $\chi^2$  test was used to compare categorical variables. For the univariate and multivariate analysis, logistic regression models were adjusted for factors associated with the results of the clinical assessment (ready or not ready). Variables with  $p < 0.05$  in the univariate analysis were included in the multivariate model. Interaction was assessed for firefighters/police officers and each variable was considered for the multivariate model. If present, the interaction term was included in the model adjusted for other variables. The Wald test was used to assess statistical significance. The OR for not being medically ready for active duties and 95% CI are shown. The Kolmogorov-Smirnov normality test was used to examine whether variables were normally distributed and two-sided  $p < 0.05$  were considered statistically significant. Data were analysed using Stata V.14.1 StataCorp LP.

### RESULTS

Among the 6621 police officers, 74.1% declared themselves as white, 20.3% as brown (mixed heritage) and 4.6% as black, while among the 1347 firefighters, 78.8% declared themselves as white, 15.9% as brown (mixed heritage) and 3.4% as black. Regarding rank, 12.4% of all individuals held the rank of officer and 87.6% were privates. **Table 1** shows the general, clinical, and laboratory characteristics of the police officers and firefighters by sex. Both male and female police officers were significantly older, had longer length of service and higher BMI and WC than firefighters. Systolic and diastolic blood pressure was significantly higher in male police officers than in male firefighters. In addition, the prevalence of overweight and obesity was greater among police officers than firefighters of both sexes. A significantly higher percentage of police officers had WC above the ideal, whereas a significantly higher percentage of firefighters was within the ideal BMI range.

Musculoskeletal diseases were the most commonly self-reported diseases in all groups. In men, hypertension was the second most prevalent disease, followed by psychiatric diseases and dyslipidaemia. Among women, psychiatric diseases were the second most prevalent.

Morbidities, except for musculoskeletal diseases, were significantly more prevalent among male police officers than among male firefighters while there was no difference in the prevalence of comorbidities between female police officers and female firefighters. The most widely used medications were antihypertensive drugs and antidepressants while smoking was more prevalent among police officers than firefighters. Regarding the laboratory assessment, a significantly higher percentage of male police officers had fasting glucose, total cholesterol

**Table 1** General, clinical and laboratory characteristics of police officers and firefighters, according to sex

	Male			Female		
	Police officers (N=5927)	Firefighters (N=1257)	P value*	Police officers (N=694)	Firefighters (N=90)	P value*
Age (years)	37.6±7.8	36.5±8.2	<0.001	32.7±6.5	29±4.2	<0.001
Length of service (years)	13.5±8.9	12.5±9.6	<0.001	7.6±6.7	4.2±4.5	<0.001
Weight (kg)	85.2±12.3	82.3±11.6	<0.001	65.6±10.6	62.3±6.5	<0.001
BMI (kg/m <sup>2</sup> )	27.6±3.6	26.6±3.3	<0.001	24.2±3.4	22.8±1.9	<0.001
BMI<18.5%	0.1	0.2	<0.001	1.4	0.0	<0.001
18.5–24.9%	23.2	33.5	<0.001	64.1	91.1	<0.001
25–29.9%	54.6	51.4	<0.001	28.4	8.9	<0.001
≥30 %	22.0	15.0	<0.001	6.1	0.0	<0.001
Waist circumference (cm)	93.9±10	90.4±9.5	<0.001	78.6±9.8	74.4±5.8	<0.001
Normal %	51.0	67.6	<0.001	59.8	82.2	<0.001
Increased %*	49.0	32.4	<0.001	40.2	17.8	<0.001
SBP (mm Hg)	122.3±12.1	120.7±10.8	<0.001	112.8±11.3	111.3±8.8	0.150
DBP (mm Hg)	78.7±9.1	77.6±8.6	<0.001	72.4±8.8	71±7.5	0.099
Musculoskeletal diseases %	9.4	9.9	0.686	6.5	6.7	0.872
Systemic hypertension %	8.4	5.0	<0.001	2.4	0.0	0.264
Psychiatric diseases %	3.8	2.0	0.002	6.2	3.3	0.396
Dyslipidaemia %	3.4	1.6	0.001	0.72	0.0	0.917
Diabetes mellitus %	1.5	0.72	0.034	0.9	0.0	0.548
Antihypertensives %†	6.9	3.7	<0.001	2.2	2.2	0.970
Antidepressants %	2.8	1.6	0.015	5.2	2.2	0.218
Smoking %	8.4	5.0	<0.001	5.6	1.1	0.115
Glucose>99 mg/dL %	12.4	10.2	0.044	4.3	1.2	0.267
Total cholesterol>190 mg/ dL %	53.1	49.4	0.025	41.9	40.5	0.889
Triglycerides>150 mg/ dL %	38.8	27.2	<0.001	15.1	14.3	0.973

\*Increased waist circumference=males ≥94 cm and females ≥80 cm.

†Antihypertensives: ACE inhibitor, diuretic, beta blocker or calcium channel blocker.

BMI, body mass index; DBP, diastolic blood pressure; SBP, systolic blood pressure.

and triglyceride serum levels above the normal range in comparison to male firefighters.

Table 2 shows the clinical and laboratory characteristics of male police officers and male firefighters by age group, in an attempt to identify a subset of the population with the highest prevalence of risk factors for CVD chronic diseases. Increased WC was more prevalent among police officers in all age groups. Musculoskeletal diseases were the most prevalent disorder in police officers and firefighters in all age groups, without statistically significant differences between them. The prevalence of hypertension was significantly greater among police officers ≥31 years old while psychiatric diseases, dyslipidaemia and

diabetes mellitus were more prevalent among police officers >40 years old with their prevalence increasing with age. Excessive alcohol consumption was more frequent among firefighters >40 years old. Police officers did significantly less physical activity than firefighters in all age groups. Cardiac arrhythmia, the abnormality most frequently detected by the ET, was significantly more prevalent among police officers than among firefighters >40 years old. Finally, a significantly greater number of police officers than firefighters were considered to not be medically ready for duty across all age groups.

All of the clinical characteristics were similar between female police officers and female firefighters ≤30 years

**Table 2** Univariate analysis of clinical and laboratory data for male police officers and male firefighters by age group

	Male					
	Age≤30 years		Age 31–40 years		Age>40 years	
	Police officers (n=1307)	Firefighters (n=361)	Police officers (n=2336)	Firefighters (n=459)	Police officers (n=2284)	Firefighters (n=437)
LoS (years)	4±2.5	3.6±2.7*	10±5.7	9.1±6.2**	22.5±5	23.4±5**
BMI (kg/m <sup>2</sup> )	26.3±3.3	25.6±2.8***	27.4±3.3	26.4±3***	28.4±3.7	27.7±3.7***
WC≥94 cm (n, %)	374 (28.6)	57 (15.8) ***	1088 (46.6)	128 (27.9) ***	1442 (63.1)	222 (50.8) ***
Musculoskeletal disease (n, %)	76 (5.8)	18 (5)	232 (9.9)	55 (12)	252 (11)	51 (11.7)
Systemic hypertension (n, %)	16 (1.2)	4 (1.1)	101 (4.3)	8 (1.7) **	382 (16.7)	51 (11.7) **
Psychiatric diseases (n, %)	23 (1.8)	2 (0.6)	89 (3.8)	12 (2.6)	116 (5.1)	11 (2.5) *
Dyslipidaemia (n, %)	6 (0.5)	1 (0.3)	53 (2.3)	5 (1.1)	141 (6.2)	14 (3.2) *
Diabetes mellitus (n, %)	1 (0.1)	0 (0)	10 (0.4)	0 (0)	80 (3.5)	9 (2.1) *
CVD (n, %)	5 (0.4)	2 (0.6)	17 (0.7)	6 (1.3)	44 (1.9)	7 (1.6)
Smoking (n, %)	98 (7.5)	16 (4.4)	188 (8.1)	20 (4.4) **	214 (9.4)	27 (6.2) *
Alcohol consumption (n, %) <sup>†</sup>	114 (8.7)	33 (9.1)	232 (9.9)	48 (10.5)	308 (13.5)	69 (15.8) *
PA<150 min/week (n, %)	342 (26.2)	32 (8.9) ***	739 (31.6)	67 (14.6) ***	801 (35.1)	113 (25.9) ***
PA≥150 min/week (n, %)	442 (33.8)	148 (41) ***	888 (38)	211 (46) ***	963 (42.2)	221 (50.6) ***
PA≥300 min/week (n, %)	523 (40)	181 (50.1) ***	709 (30.4)	181 (39.4) ***	520 (22.8)	103 (23.6) ***
Laboratory tests						
Gluc. >99mg/dL (n, %)	37 (3.0)	9 (2.6)	161 (7.2)	22 (5.2)	503 (22.8)	89 (21.4)
TC>190mg/dL (n, %)	462 (37.7)	110 (33.2)	1199 (54.6)	209 (50.2)	131 (60.2)	249 (61.8)
TG>150mg/dL (n, %)	285 (23.0)	46 (13.7) ***	860 (38.9)	114 (27.0) ***	1039 (47.5)	156 (38.5) **
Exercise stress test						
Ischaemia	0 (0)	0 (0)	6 (2.2)	3 (5.2)	90 (4.3)	21 (5.2)
Arrhythmia (n, %)	0 (0)	0 (0)	19 (6.9)	2 (3.5)	171 (8.2)	16 (4) **
High blood pressure (n, %)	0 (0)	0 (0)	9 (3.3)	4 (6.9)	120 (5.8)	15 (3.7)
Conclusion not ready (n, %)	236 (18.1)	34 (9.4) ***	662 (28.3)	68 (14.8) ***	904 (39.6)	128 (29.3) ***

\*\*p<0.05; \*\*p<0.01; \*\*\*p<0.001.  
<sup>†</sup>Excessive consumption of alcoholic beverages: Alcohol Use Disorders Identification Test–Concise score≥4.  
 BMI, body mass index; CVD, cardiovascular disease; Gluc, fasting glucose; LoS, length of service; PA, physical activity; TC, total cholesterol; TG, triglycerides; WC, waist circumference.

old, save for physical activity. Female police officers >30 years old had longer length of service, higher BMI and higher WC. There was no significant difference in the prevalence of not being ready for duty between female police officers and female firefighters (table 3).

After adjusting the multivariate model for predicting unhealthy conditions and using the explanatory variables of police officer/firefighter, sex and age, the probability of these workers being considered as not ready for active duty could be estimated (table 4).

The multivariate logistic regression model included the explanatory variables shown in table 5. The best health profiles were found among female firefighters while the worst health profiles were found among male firefighters ≥40 years old and male police officers ≥30 years old. Furthermore, male police officers >40 years old presented the highest probability of not being medically ready for active duty.

The main non-modifiable risk factors associated with not being medically ready for duty were: being a police officer (OR 1.50, 95% CI 1.27 to 1.77), being male aged 31–40 years (OR 2.03, 95% CI 1.43 to 2.89), and being ≥40 years old (OR 2.55 95% CI 1.79 to 3.62). Moreover, the following modifiable risk factors were identified: high WC (OR 1.63, 95% CI 1.45 to 1.83), physical inactivity (OR 1.67, 95% CI 1.44 to 1.93), smoking (OR 1.75, 95% CI 1.45 to 2.12) and excessive consumption of alcohol (OR 1.44, 95% CI 1.22 to 1.70). The medical conditions associated with not being medically ready for duty were hypertension (OR 2.29, 95% CI 1.85 to 4.70), dyslipidaemia (OR 2.65, 95% CI 1.96 to 3.58), diabetes mellitus (OR 2.95, 95% CI 1.97 to 5.03), heart disease (OR 2.13, 95% CI 1.32 to 3.45), psychiatric diseases (OR 1.33, 95% CI 1.02 to 1.74) and high serum levels of total cholesterol (OR 2.16, 95% CI 1.93 to 2.42) (figure 1).

**Table 3** Univariate analysis of clinical and laboratory data for female police officers and female firefighters by age group

	Female			
	Age≤30 years		Age>30 years	
	Police officers (n=299)	Firefighters (n=57)	Police officers (n=395)	Firefighters (n=33)
LoS (years)	3.4±2.6	3.5±3.2	10.9±7.1	5.4±6.1***
BMI (kg/m <sup>2</sup> )	23.4±2.9	22.8±1.8	24.8±3.6	22.7±2.1***
WC≥80 cm (n, %)	82 (27.4)	10 (17.5)	197 (49.9)	6 (18.2)***
Musculoskeletal disease (n, %)	13 (4.4)	5 (8.8)	32 (8.1)	1 (3)
SH (n, %)	2 (0.7)	0 (0)	15 (3.8)	0 (0)
Psychiatric diseases (n, %)	10 (3.3)	1 (1.8)	33 (8.4)	2 (6.1)
Dyslipidaemia (n, %)	2 (0.7)	0 (0)	3 (0.8)	0 (0)
Diabetes mellitus (n, %)	1 (0.3)	0 (0)	1 (0.3)	0 (0)
Heart disease (n, %)	0 (0)	0 (0)	2 (0.5)	0 (0)
Smoking (n, %)	13 (4.4)	0 (0)	26 (6.6)	1 (3)
Alcohol consumption (n, %) †	12 (4)	3 (5.3)	12 (3)	1 (3)
PA<150 min/week (n, %)	76 (25.4)	2 (3.5)***	117 (29.6)	4 (12.1)
PA≥150 min/week (n, %)	93 (31.1)	25 (43.9)***	138 (34.9)	14 (42.4)
PA≥300 min/week (n, %)	130 (43.5)	30 (52.6)***	140 (35.4)	15 (45.5)
Laboratory tests				
Gluc. >99 mg/dL (n, %)	4 (1.4)	1 (1.8)	14 (4.8)	28 (100)
TC>190 mg/dL (n, %)	116 (39.9)	23 (42.6)	116 (38.9)	10 (35.7)
TG>150 mg/dL (n, %)	42 (14.4)	8 (14.8)	40 (13.8)	3 (10.7)
Exercise stress test				
Ischaemia (n, %)	0 (0)	0 (0)	8 (8)	0 (0)
Arrhythmia (n, %)	0 (0)	0 (0)	1 (1)	1 (50)*
High blood pressure (n, %)	0 (0)	0 (0)	4 (4)	0 (0)
Conclusion not ready (n, %)	36 (12)	5 (8.8)	69 (17.5)	3 (9.1)

\*\*p<0.05; \*\*\*p<0.001.  
†Excessive consumption of alcoholic beverages: AUDIT-C score≥3.  
BMI, body mass index; Gluc, fasting glucose; Los, length of service; PA, physical activity; SH, systemic hypertension; TC, total cholesterol; TG, triglycerides; WC, waist circumference.

## DISCUSSION

This is the largest study of the epidemiological profile of military police officers and firefighters in Paraná. The probability of male police officers between the ages of 31 and 40 not being ready was similar to that of male firefighters >40 years old, indicating that the health condition of male police officers deteriorates earlier. Our findings indicate that the priority for regular medical assessment should be given to this subset of male police officers >30 years old and firefighters >40 years old, who in some cases already had increased WC, diabetes mellitus, CVD and dyslipidaemia, in order to facilitate access to healthcare interventions and to stimulate healthy daily habits.

Several modifiable risk factors for CVD were observed, including increased WC, obesity, physical inactivity and smoking. They were more common among participants over 30 years old, which suggests that in addition to ageing, work-related risk factors may play a central role

in the deterioration of health condition.<sup>2–5</sup> This finding underlies the need for better planning and investment in prevention and early diagnosis in this population. Furthermore, behaviour interventions to encourage healthy habits should be implemented in order to help to modify the profile of chronic diseases.

Similar to our findings, Nogueira *et al* found a prevalence of 54.3% for overweight and 14.7% for obesity in a study that investigated the relationship between cardiorespiratory fitness and body composition in 4237 Brazilian firefighters in the Federal District.<sup>19</sup> Damacena *et al* recently reported that the prevalence of obesity was 10.99% among male firefighters (N=892) and that there was an overall high prevalence of overweight of 48.65%. Recent online survey of 2398 female career firefighters, one may consider female firefighters to have been successful in overcoming the occupational risks, such as a challenging nutritional environment, inconsistent schedules, limited

**Table 4** Univariate and multivariate logistic regression model for explanatory variables

Variable	Classification	Not ready	P value*	P value†	OR	95% CI
Firefighter/police officer	Firefighter (ref.)	17.7%				
	Police officer	28.8%	<0.001	<0.001	1.50	1.27 to 1.77
Sex and age group	Female≤30 years (ref.)	11.5%				
	Female>30 years	16.8%	0.036	0.597	1.12	0.73 to 1.74
	Male≤30 years	16.2%	0.027	0.024	1.52	1.06 to 2.19
	Male 31–40 years	26.1%	<0.001	<0.001	2.03	1.43 to 2.89
	Male>40 years	37.9%	<0.001	<0.001	2.55	1.79 to 3.62
Waist circumference	Normal (ref.)	18.8%				
	Increased‡	36.7%	<0.001	<0.001	1.63	1.45 to 1.83
Physical activity	300 min/week (ref.)	19.2%				
	≥150 min/week	26.8%	<0.001	<0.001	1.31	1.14 to 1.51
	<150 min/week	35.6%	<0.001	<0.001	1.67	1.44 to 1.93
Smoking	No (ref.)	25.8%				
	Yes	41.1%	<0.001	<0.001	1.75	1.45 to 2.12
Alcohol consumption	Low risk (ref.)	25.4%				
	Moderate to severe risk §	39.8%	<0.001	<0.001	1.44	1.22 to 1.70
Hypertension	No (ref.)	24.5%				
	Yes	57.5%	<0.001	<0.001	2.29	1.88 to 2.79
Dyslipidaemia	No (ref.)	25.9%				
	Yes	60.9%	<0.001	<0.001	2.65	1.96 to 3.58
Diabetes mellitus	No (ref.)	26.4%				
	Yes	66.7%	<0.001	<0.001	2.95	1.85 to 4.70
Heart disease	No (ref.)	26.7%				
	Yes	49.4%	<0.001	0.002	2.13	1.32 to 3.45
Psychiatric diseases	No (ref.)	26.6%				
	Yes	35.8%	<0.001	0.039	1.33	1.02 to 1.74
Total cholesterol	≤190 mg/dL (ref.)	18.2%				
	>190 mg/dL	36.1%	<0.001	<0.001	2.16	1.93 to 2.42

\*Univariate logistical regression model and Wald test,  $p < 0.05$ .

†Multivariate logistical regression model and Wald test,  $p < 0.05$ .

‡Women ≥80 cm; men ≥94 cm.

§Excessive consumption of alcoholic beverages: Alcohol Use Disorders Identification Test–Concise score ≥4 (men), ≥3 (women).

Ref., Reference group.

time for fitness and the metabolic impact of shift work, that expose firefighters to increased risk of obesity.<sup>20 21</sup> Although females still represent a small percentage of the police force and firefighting service, they are an integral part of the workforce and medical attention tailored to their specific needs may lead to better health outcomes.

A study that investigated the prevalence of metabolic syndrome and its risk factors among 10 348 Chinese police officers, found a high prevalence of hypertriglyceridaemia (40.8%), hypertension (38.2%) and abdominal obesity (25.7%).<sup>22</sup> In our study, total cholesterol, triglycerides and glucose serum levels were above the ideal range in a large number of police officers and firefighters of both sexes and all age groups, but particularly among male police

officers, suggesting a greater risk for metabolic diseases in this population. The analysis by age group revealed that the prevalence of obesity and high WC increased with age. The association of weight status and increased risk for atherosclerotic CVD was greater among older firefighters highlighting the aging-related increase in CVD risk, and that additional screening may be necessary among older firefighters to ensure that they are healthy enough to continue with the strenuous and stressful work of firefighting.<sup>23</sup> Low levels of physical activity, unhealthy eating habits, demanding jobs, sleep disorders and stress, which are common during the course of a police officer's or firefighter's working life, may also help to explain the high prevalence of CVD in these populations.<sup>24 25</sup>

**Table 5** Probability of a police officer or firefighter being classified as not ready for duty

Profile			Probability of not being ready*
Profession	Sex	Age (years)	
Firefighter	Female	≤30	7.0%
Firefighter	Female	>30	10.1%
Firefighter	Male	≤30	10.3%
Police officer	Female	≤30	12.4%
Firefighter	Male	31–40	17.1%
Police officer	Female	>30	17.4%
Police officer	Male	≤30	17.8%
Firefighter	Male	>40	26.3%
Police officer	Male	31–40	27.9%
Police officer	Male	>40	40.1%

\*Multivariate logistic regression model.

The duties performed by police officers and firefighters were associated with musculoskeletal disorders, particularly lower back pain, suggesting the need for preventive measures and ergonomic control programmes in the workplace.<sup>26–28</sup>

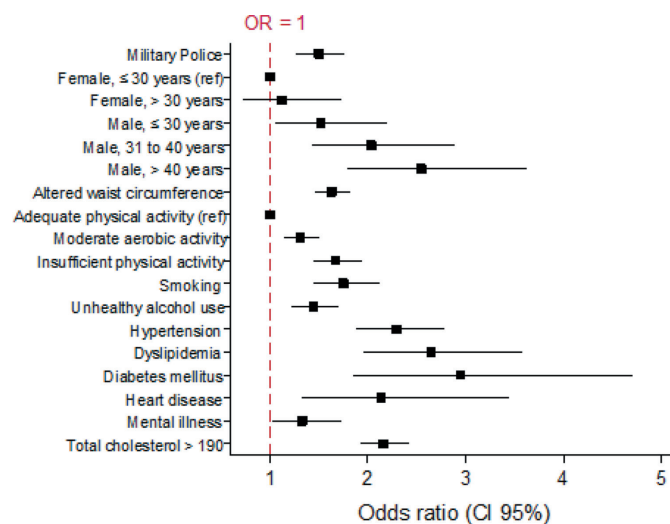
A study by Han *et al* compared the prevalence of chronic diseases among 860 221 public-sector workers in South Korea and found that police officers had a significantly higher risk for angina *pectoris*, acute myocardial infarction and cerebrovascular disease, while firefighters were more susceptible to post-traumatic stress disorders.<sup>1</sup> In the present study, psychiatric diseases were more prevalent among police officers, particularly among women over 30 years old. The close correlation between occupational stress and mental illness has been observed in previous studies.<sup>29 30</sup> The different instruments used for work-related psychological assessments in these studies

prevent comparison of these findings. Although police officers and firefighters reported that they were receiving psychiatric treatment, this may not reflect the true prevalence of this health issue, as some participants may have omitted this information for fear of stigmatisation. The overall prevalence of smoking among police officers and firefighters was lower than in the general population in the state of Paraná which is 11.3%.<sup>31</sup> The high prevalence of mental diseases, alcoholism, smoking and substance abuse among police officers and firefighters highlights not only the need for better medical assessment to ensure timely diagnosis and treatment, but also the need for public policies to promote preventive health measures.

The present study has certain limitations that must be mentioned. First, the cross-sectional design does not allow causal relationship between risk factors and comorbidities to be established. Nevertheless, the study population was recruited after a thorough medical assessment to ensure that healthy candidates are accepted in the police and firefighting services. In addition, the study population underwent an elective medical assessment and had not requested a medical examination of their own accord. The fact that only the serum levels of total cholesterol were measured, and not high-density lipoprotein or low-density lipoprotein, prevented a more detailed assessment of CVD risk.

Furthermore, the low number of women (11.7% of police officers and 7.2% of firefighters) underpowered the statistical analysis of this subgroup of workers. Lastly, the specific nature of the study population does not allow for the generalisation of the findings to other populations.

Long-term longitudinal studies are needed to understand the effect of the different activities carried out by police officers and firefighters on their health status. The identification of the causes of the deterioration of their health condition may allow for the adoption of prompt interventions to prevent disease evolution and promote both physical and mental health.



**Figure 1** Multivariate logistic regression analysis of characteristics associated with not being medically ready for duty. Ref, reference.

## CONCLUSIONS

Our study highlights the need for regular medical assessments and follow-ups of police officers and firefighters, as well as for the promotion of preventive healthcare. These measures need to be offered earlier and more frequently for police officers. The health condition of female police officers and firefighters should not be neglected as they are exposed to the same work-related risk factors as men and, consequently, may also present a high prevalence of CVD risk factors and chronic diseases. It should be stressed that the police officers and firefighters included in this study were working under normal conditions and were unaware of their medical status. This scenario may adversely affect both the workers' own health and the health of others when they are performing their duties.

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