CARDIORESPIRATORY AND NEUROMUSCULAR FITNESS OF FEDERAL HIGHWAY POLICE OFFICERS

APTIDÃO CARDIORRESPIRATÓRIA E NEUROMUSCULAR DE POLICIAIS RODOVIÁRIOS FEDERAIS

APTITUD CARDIORESPIRATORIA Y NEUROMUSCULAR DE POLICÍAS DE SEGURIDAD VIAL FEDERALES

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ABSTRACT

Introduction: Higher levels of physical fitness are associated with better quality of life and indicators of health and performance in police forces. Objective: This study aims to describe and evaluate the level of cardiorespiratory and neuromuscular fitness of a national sample of federal highway patrol officers. Methods: Cross-sectional study with data from 6212 agents of the Federal Highway Police. Endpoints were as follows: abdominal resistance (AR); upper limb muscular resistance (ULMR); upper limb muscle strength (ULMS) and cardiorespiratory fitness (CF). The following independent variables were included: sex; age; geographic region of posting and participation in the Institutional Physical Education Program (PEPI). The linear regression model was used to test the association between endpoints and independent variables. Results: The highest proportion of police officers obtained an excellent score for neuromuscular endpoints (AR: 63.9% men, 69.6% women, ULMR: 68.8% men, 61.8% women, ULMS: 22.2% men, 40% women). In CF, the highest percentage of scores was average and good (respectively, 30.6% and 43.0% for men, 39.1% and 39.2% for women). Male officers were fitter than female officers, except for the ULMS endpoint. There was a decrease in fitness levels for all endpoints according to age. Police officers from the northern region were fitter than in the other regions. Police officers who were not registered in the IPEPI were fitter than those registered. Conclusion: Federal Highway Patrol officers have good levels of fitness, which declines with age. Level of Evidence III; Study of nonconsecutive patients; without consistently applied “gold” reference standard.

Keywords: Police; Physical fitness; Physical endurance; Muscle strength; Health.

RESUMO

Introdução: Maiores níveis de aptidão física estão associados à melhor qualidade de vida e indicadores de saúde e desempenho nas forças policiais. Objetivo: Este estudo visa descrever e avaliar o nível de aptidão cardiorrespiratória e neuromuscular de uma amostra nacional de policiais rodoviários federais. Métodos: Estudo transversal, com dados de 6.212 agentes da Polícia Rodoviária Federal. Como desfechos, consideraram-se: resistência abdominal (RA); resistência muscular de membros superiores (RMMS); força muscular de membros superiores (FMMS) e aptidão cardiorrespiratória (AC). Foram incluídas as seguintes variáveis independentes: sexo; idade; região geográfica de exercício do cargo e participação no Programa de Educação Física Institucional (PEFI). O modelo de regressão linear foi utilizado para testar a associação entre desfechos e variáveis independentes. Resultados: A maior proporção dos policiais obteve conceito excelente para desfechos neuromusculares (RA: 63.9% homens, 69.6% mulheres; RMMS: 68.8% homens, 61.8% mulheres; FMMS: 22.2% homens, 40% mulheres). Na AC, maior percentual foi dos conceitos médio e bom (respectivamente, 30.6% e 43.0% para homens, 39.1% e 39.2% para mulheres). Os policiais do sexo masculino foram mais aptos do que os do sexo feminino, exceto para o desfecho de FMMS. Houve queda de aptidão em todos os desfechos conforme a idade. Os policiais da região norte foram mais aptos em comparação com as demais regiões. Os policiais não inscritos no PEFI foram mais aptos em comparação com os inscritos. Conclusão: Os Policiais Rodoviários Federais têm bons níveis de aptidão física, que declina com a idade. Nível de evidência III; Estudo de pacientes não consecutivos; sem padrão de referência “ouro” aplicado uniformemente.

Descritores: Polícia; Aptidão física; Resistência física; Força muscular; Saúde.

RESUMEN

Introducción: Las mayores niveles de aptitud física están asociadas a la mejor calidad de vida e indicadores de salud y desempeño en las fuerzas policiales. Objetivo: Este estudio tiene el objetivo de describir y evaluar el nivel de aptitud cardiorrespiratoria y neuromuscular de una muestra nacional de policías de seguridad vial federales. Métodos: Estudio transversal con datos de 6.212 agentes de la Policía de Seguridad Vial Federal. Como resultado, se consideraron: resistencia abdominal (RA); resistencia muscular de miembros superiores (RMMS); fuerza muscular de miembros superiores (FMMS) y aptitud cardiorrespiratoria (AC). Se incluyeron las siguientes variables independientes: sexo; edad; región geográfica de ejercicio del cargo y participación en el Programa de Educación Física Institucional (PEFI). El modelo de regresión lineal se utilizó para probar la asociación entre resultados y variables independientes. Resultados: La mayor proporción de los policías obtuvo concepto excelente para resultados neuromusculares (RA: 63.9% hombres, 69.6% mujeres; RMMS: 68.8% hombres, 61.8% mujeres; FMMS: 22.2% hombres, 40.0% mujeres). En la AC, el
were obliged to participate in the PFT. Must participate in the annual health programs of the public service, practice of physical activity outside the work environment. FHP personnel individual Performance (AIP); and (III) perform selected specific activities, PFT 2016, as long as there was no medical contraindication. However, extracted from the FHPD database and analyzed while maintaining the by a specific national commission. All data from the present study were regional authorities and subsequently tabulated in a single document regionalized schedules. The PFT is performed annually, according to regionalized schedules. An observational study was conducted based on retrospective data the National Commission and later received by electronic mail. The PFT 2016 tests were conducted in the 5 regions of Brazil (North, South, Northeast, Southeast, and Central-West) and the majority of those evaluated were tested at appropriate locations in their work cities. The tests were applied by regional committees composed of police officers, at least one of whom should have graduated in physical education, and was previously trained to perform standardized procedures. The physical evaluations consisted of 4 tests in the following order: (I) 1-minute sit ups; (II) 1-minute push-ups; (III) pull-ups/isometric tests on a fixed bar; and (IV) 12-minute run/walk test. The tests were conducted between March and June 2016, according to the schedule defined by each State. The registration and input of data were done by the evaluators themselves, in each region, using a pre-formatted worksheet provided by the PFT National Commission. The latter was then responsible for gathering all national data. The database included name, registration, sex, age, participation in IPEP, and the results of physical tests. For the purpose of this manuscript, information about these data was requested from the National Commission and later received by electronic mail. 1-minute Sit-Ups - Abdominal Muscle Resistance The abdominal resistance (RM) was measured with the use of a protocol described in previous studies that assessed physical fitness among police officers12,13. The individual started the test in supine position on a mat, with knees flexed at 90° and the feet flat on the ground with the heels together. The arms were crossed on the trunk, with hands resting on the opposite shoulders. Once in position, the individual flexed the trunk, raising the shoulders until the elbows touched the upper portion of the knees, and returned to the initial position. During the test, each candidate received help from an evaluated colleague, who exerted pressure on the feet in order to keep the feet of the evaluated on the
ground during the entire exercise. On a verbal command from the evaluator, the timer was started and the participant began the test. The individuals were instructed to perform the maximum possible number of abdominal sit-ups in 1 minute.

One-minute Push-Ups - Upper Limb Muscle Resistance

The upper limb muscle strength (ULMR) of the FHP was measured using a protocol commonly used in this population\(^{9,11,20}\). The male participants started the test in ventral decubitus, with hands and toes on the floor, elbows extended, palms facing forward, shoulders aligned, legs joined, spine erect. With respect to the female participants, only the number of ground supports of the initial position was different from the men, with the procedure performed with hands, knees, and toes on the floor. On a verbal command from the evaluator, the participant performed the push-ups so that the elbows passed the shoulder line, bringing the thorax close to the floor, and then extending them back to the starting position. The officers continued to execute as many repetitions as they could within 1 minute. Participants were allowed to rest in straight-arm position, while keeping their spine erect and allotted time was not exhausted. The test was terminated when the subject was unable to perform the exercise with proper technique or when the allotted time expired.

Pull-Ups/isometry of elbow on fixed bar - Upper Limb Muscle Strength

The upper limb muscle strength (ULMS) was measured according to a published protocol\(^{21}\). Men started in a position of suspension, with elbows extended and hands in prone position (palms of the hands forward). The body was elevated until the chin passed over the bar. After each lift, the officer returned to the initial position with arms fully extended and the body in suspension. The final score was the total number of lifts until exhaustion. The female candidates performed flexion of the elbows without external assistance, with feet in prone position, passing the line of the chin above the top line of the fixed bar, and maintaining isometry for the maximum time possible. The total time in isometry was recorded for later classification. This test was not required to be performed by the police officers, being the only optional test within the PFT in the year 2016.

Twelve-minute run/walk test

Cardiopulmonary fitness was measured with the 12-minute run/walk test, and maximum oxygen consumption (\(\text{VO}_2\text{max}\) in mL.kg\(^{-1}\).min\(^{-1}\)) was estimated from the value of the distance covered according to the following previously validated equation \((r = 0.91)\)^{22}: \(\text{VO}_2\text{max} = \text{Distance} - 504 / 44.78\). Among the different indirect field tests for the \(\text{VO}_2\text{max}\) prediction, Cooper’s 12-minute run test is the most popular and requires only a tape measure to determine the distance travelled in 12 minutes. This test aims at running or walking the longest distance possible on a track in 12 minutes. At the signal of the evaluator, the officer should run or walk the maximum distance during 12 minutes, on a track demarcated every 50 m, with the final result recorded as the next mark passed by the officer. Lastly, the classification established by a table in the PFT Public Notice\(^{18}\) was carried out. The table is the same used for the general population\(^{22}\). The distance covered in Cooper’s test showed a significant correlation with directly measured \(\text{VO}_2\text{max}\) \((r = 0.93, p <0.001)\)^{23}.

Independent variables

Independent variables related to sex (male or female), age (in complete years), geographic region of occupation (North, Northeast, Midwest, Southeast and South) and participation in the IPEP were included. As an operational decision, the age variable was categorized in decades (≤ 29 years, 30-39 years, 40-49 years, ≥ 50 years).

Statistical analyses

For the associations between outcomes and independent variables, the averages and respective 95% confidence intervals for each measure of physical fitness and the extracted independent variables of interest were estimated. To test the association, linear regressions were used, based on the type of independent variable. For nominal independent categorical variables (sex, region, and IPEP) the \(p\)-value was estimated for heterogeneity, while for the ordinal variable (age) the \(p\)-value was estimated for linear trend. For the specific independent variable of geographic region, statistical differences were also calculated using the Bonferroni post hoc test. The descriptive analyses were stratified by sex. In addition, because the ULMS test was different according to sex, the association of this outcome with independent variables was also performed in a stratified manner.

RESULTS

The characteristics of the sample according to sex are shown in Table 1. The largest proportion of the sample was between 30 and 39 years of age; 51.1% were men and 57.2% were women. With respect to the region of greatest predominance of FHP participants in the PFT, the sex distribution in the Northeast comprised 29.1% men and 29.8% women. It should be emphasized that the majority of policemen were registered in the IPEP (76.3% men and 84.2% women).

According to the supplemental classification tables used by the PFT\(^{18}\) in regard to physical fitness, most of the male policemen evaluated in Cooper’s 12-minute run test were classified as good (43%), while female officers were classified similarly as fair (39.2%) and good (39.1%). In the abdominal resistance test, an excellent classification predominated for both sexes (63.6% of males and 69.6% of females). In the ULMS test using push-ups, the majority of men and women were classified as excellent (68.8% and 61.8%, respectively). In the pull-ups/isometry test, both male and female officers were predominantly in the 10-percentage point decile (22.2% and 40%, respectively).

The associations between outcomes and independent variables are shown in Table 2. The results show that men have higher cardiorespiratory fitness, abdominal strength, and ULMR. Officers of the Northern region were more able in all outcomes, and officers of the Northeast region had the worst results of physical fitness in all tests performed. There was no difference between the regions in the assessment of ULMS for females. Officers not registered in the IPEP seem to be more qualified to the region of greatest predominance of FHP participants in the PFT, sex distribution in the Northeast comprised 29.1% men and 29.8% women. It should be emphasized that the majority of policemen were registered in the IPEP (76.3% men and 84.2% women).

Finally, there was a decrease in physical fitness according to the categories of age for all tests performed. Figure 1 shows the decrease in the components of physical fitness, measured according to age (presented as continuous numerical variables).

DISCUSSION

The present FHP study, using data collected in different regions of Brazil, is the first of its kind when considering the population evaluated and sample size. Moreover, it sought to provide knowledge regarding the physical fitness of FHP personnel. As a main finding, it is noteworthy that the participants presented a cardiorespiratory fitness that varied from fair to good according to reference population values; ULMR and strength were excellent, males were superior to females regarding ratings of physical fitness, and a decline in physical fitness with age was observed. Moreover, in this population, officers from the Northern region...
Table 2. Description of the sample, according to gender, of Federal Highway Police, Brazil, 2016. n=6212.

Table 2. Association between the measures of physical fitness and variables of interest in the Federal Highway Police, Brazil, 2016. n=6212.

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jumping obstacles, using strength in struggling with suspects, and transporting heavy equipment. Several studies have found a strong correlation between components of physical fitness, particularly strength and muscle power and cardiorespiratory fitness, and performance in occupational police tasks\(^8,\text{12}\). In this context, a recent study using regression analysis showed that the results of the aerobic, ULMR, and trunk test, as well as muscle power, were the best predictors for the time of completion in a police occupational fitness test\(^12\). Thus, the development of programs of aerobic exercise and strength within the institutional framework is recommended to minimize physical deficiencies.

Interestingly, data from the present study indicate that police officers from the Northern region demonstrated better results in different components of physical fitness, except in muscle strength among women. This region may have stood out because this is where newly trained police officers are placed, as confirmed by a specific statistical test (data not shown). These results corroborate a study carried out with entrants in the Brazilian Armed Forces in different regions, who presented good cardiorespiratory fitness (51.1 mL/kg/min) estimated by the same test\(^16\). Moreover, in the same study, the Northeast region, as in the present study, achieved the lowest levels of aerobic capacity among the 5 regions studied. We suggest specific investigations for this population in order to understand this association.

The data from the present study identified differences in physical fitness among police officers who were not participating in the program to encourage the practice of physical activity in the IPEP; however, those who participate in the program had lower physical fitness. Due to the cross-sectional design of the study, the lack of more information in the database, and control for possible confounding factors for this association, the present study cannot suggest that the program is not effective in increasing or maintaining the levels of physical fitness of the FHP. As a possible interpretation, one can suggest that police officers not included in the program are more qualified than those registered in the institutional program. These data corroborate a study with FHP from a police station in the south of Brazil, in which police officers participating in a health program presented concerning physical fitness results\(^19\).

**Figure 1.** Linear regression analysis of the measures of physical fitness according to age in Federal Highway Police, Brazil, 2016. n=6212.
It should be emphasized that this was the first study to assess the cardiovascular and neuromuscular fitness of FHP personnel with a nationally representative sample. The large sample size increases the possibility of generalizing these results to other police forces. However, some limitations should be noted. First, the authors were limited to physical fitness data supplied by the FHPD, without access to anthropometric data, for example. However, it is known that cardiorespiratory and neuromuscular fitness are independent predictors of risk of death from all causes, which reinforces the relevance of the findings of the present study. In addition, the evaluations were performed by different teams in each region, and in locations (athletic tracks) with uneven surfaces and subject to climate differences in each region, which decreases the standardization of procedures. On the other hand, Normative Instruction 66/2016 of the FHPD lists all standards and procedures to be followed by the testers and participants in the process of implementation and evaluation of the PFT. Considering the cross-sectional design of this study, new studies should employ a longitudinal design in order to identify the relationship of physical fitness with the time in the police force, as well as its secular trend.

CONCLUSION

Our results showed that the majority of police officers have fair and good cardiorespiratory fitness, and excellent neuromuscular fitness compared to reference population values. Male Federal Highway Police officers possess higher cardiorespiratory and neuromuscular fitness than do female officers. There was a decline in neuromuscular fitness with age, with values close to one repetition every 2 years. For cardiorespiratory fitness, the decline is close to 3.5 mL/kg/min with every 10 years of age. In addition, police officers in service in the northern region of Brazil, as well as officers non-registered in the IPEP were the fittest.

All authors declare no potential conflict of interest related to this article.

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