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Original Research Article

Differences in Muscle Strength Among Members of Selected Security Forces

Miroslav Ligday[1], Tomáš Kozák[2*], Stanislava Ivanová[2], Viktória Vilimová[3], Kristína Němá[1]

[1] University of Presov, Faculty of Sports, Department of Educology of Sports, Presov 08001, Slovakia
[2] University of Presov, Faculty of Sports, Department Sports Kinanthropology, Presov 08001, Slovakia
[3] Student of University of Presov, Faculty of Sports, Presov 08001, Slovakia
*Correspondence: tomas.kozak@smail.unipo.sk

Abstract

Background: Security personnel are required to maintain high levels of physical fitness to perform demanding operational tasks. Muscle strength is essential for interventions, rescue operations, and work in hazardous environments. The aim of this study was to analyze differences in muscle strength among members of the police force, municipal police, and fire service of the Slovak Republic. **Methods:** The research sample consisted of 15 male members of security forces (n=5 per group). Body height and weight were measured using a stadiometer and digital scale. Muscle strength was assessed using four standardized tests: standing long jump, 30-second sit-up test, 30-second push-up test, and bent-arm hang. **Results:** Across all tests, members of the fire service demonstrated the highest performance. Compared with firefighters, municipal police officers achieved 18.75–37.78% lower median values, and police force members showed 2.22–35.14% lower performance depending on the test. Firefighters reached the longest jump distance (240 cm), highest sit-up performance (37 reps), most push-ups (45 reps), and longest bent-arm hang duration (37 s). Municipal police reached the lowest values in most indicators, particularly in push-ups and sit-ups. **Conclusions:** The findings indicate significant differences in muscle strength between security units. Firefighters consistently outperformed both police groups, reflecting the physically demanding nature of their occupation. The lower values observed in the Police Force and especially the Municipal Police emphasize the need for targeted physical conditioning programs aligned with operational requirements.

Keywords: police force, municipal police, fire service, strength abilities

Introduction

Muscle strength, defined as the ability of the musculoskeletal system to overcome, resist, or maintain the effect of external forces, represents a fundamental component of physical fitness in security practice [1]. Maximal strength is critical for lifting heavy loads and overcoming resistance from opponents, explosive strength enables rapid interventions, and muscular endurance is necessary for maintaining performance during prolonged operations. Thus, muscle strength forms an essential pillar of operational readiness among security personnel [2]. Moreover, research indicates that higher muscle mass and strength levels are associated with reduced injury risk and enhanced operational performance, further highlighting the importance of developing muscular capacity in these professions [3]. Physical fitness is widely recognized as a prerequisite for safe and

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effective performance in high-demand public safety professions [4]. Firefighters generally demonstrate substantially higher levels of muscular strength than the general population [5], while police officers typically achieve average to slightly above-average levels, which may be insufficient given the physically demanding and often dangerous nature of police work [6]. Assessing muscular strength as part of comprehensive fitness test batteries is therefore essential, as it supports tasks such as rescues, operational interventions, and physical confrontations [7]. Nevertheless, physical preparedness varies notably across units, influenced by task-specific demands and the quality and frequency of physical training [8]. Members of security forces in the Slovak Republic operate within the framework described in the Security Strategy, which positions them as integral components of the national defense and security system [9]. Their operational effectiveness depends not only on organizational coordination but also on the physical preparedness of personnel, which directly influences performance in demanding and often unpredictable situations [10]. Members of the national police force routinely face high physical demands involving interventions, operational actions, and work under stressful conditions, including interactions with aggressive individuals [11]. Municipal police officers, in contrast, focus on maintaining public order, ensuring traffic safety, enforcing local regulations, and cooperating with the police force in crime prevention and emergency support [12]. Firefighters represent one of the most physically demanding professions, requiring sudden deployment, work in life-threatening conditions, manipulation of heavy equipment, and navigation of hazardous environments such as extreme heat, smoke, collapsed structures, or contaminated areas. Consequently, they must possess exceptional strength, endurance, reaction time, coordination, and resilience [13]. Given these considerations, the aim of this study is to analyze differences in muscle strength among members of the police force, municipal police, and fire service of the Slovak Republic, depending on their assignment to specific units. To address this aim, the study formulates the following research question: How does the level of muscular strength differ between police force, municipal police, and firefighters?

Material and Methods

Research sample

The research sample consisted of 15 male members of security forces aged 27–54 years (Table 1). The sample included active members of three security services in Slovak Republic, with five respondents representing each unit (Police Force, Municipal Police, Fire and Rescue Service). All participants were active-duty personnel, forming a relatively homogeneous group in terms of occupational demands and required physical fitness.

Participants were included based on the following criteria:

- active service in one of the three security services (Police Force, Municipal Police, Fire Service),
- current operational assignment,
- absence of musculoskeletal injuries or conditions.

Table 1. Research sample

Security forces	n	Age (years)	Body height (m)	Body weight (kg)	BMI (kg/m2)
		Med±QD (Min/Max)			
Police force	5	37.00±2.50 (29.00/54.00)	1.77±4.50 (1.70/1.85)	94.00±7.50 (72.00/95.00)	27.80±0.85 (24.90/30.30)

Municipal police	5	39.00±4.50 (35.00/54.00)	1.80±2.50 (1.73/1.83)	94.00±8.50 (73.00/95.00)	28.10±2.05 (22.5/31.40)
Fire service	5	32.00±2.50 (27.00/50.00)	1.83±0.05 (1.70/1.84)	84.00±1.00 (76.00/88.00)	25.40±1.95 (22.70/29.40)

Med- Median, QD- Quartile Deviation, Min-minimum, Max-maximum

Methods

Firstly, body height was measured using an ADE MZ10021 stadiometer (ADE GermanyGmbH, Germany), and body weight was assessed using the digital scale Hyundai OVET 739 (Hyundai Electronics, South Korea). Secondly, muscle strength was measured by following tests:

1. The standing long jump test: measures the explosive power of the lower body. The participant stands behind a marked starting line with their feet shoulder-width apart. From a standing position, they bend their knees, swing their arms backward, and then jump forward as far as possible, landing on both feet. The test is performed twice, and the longest jump is recorded to the nearest centimeter [14].

2. The sit-up test: evaluates abdominal muscle strength and endurance. The participant lies on a mat with their feet 30 cm apart, knees bent at a 90-degree angle, and hands placed behind the neck. A partner holds the participant's feet to prevent them from lifting off the ground. Upon the start signal, the participant performs sit- ups, ensuring that their elbows touch their knees during the upward movement and that their back fully returns to the mat during the downward movement. The total number of correctly performed sit-ups within 30 seconds is recorded [14].

3. The 30-second push-up test: evaluates muscle strength of upper limbs. From the front-leaning rest position with the hands fully extended and shoulder-width apart, with feet together, the examinee lowers the body by flexing the arms to the down position, where the chest must touch the ground. The total number of correctly performed repetitions during a 30-second interval is recorded [15].

4. Bent-arm hang: evaluates the muscle endurance of shoulder girdle and back muscles. The tested participant tried to hold onto the 2.5 diameter metal bar in the pull-up position, for as long as possible. The grip width matched that of the shoulders. The chin was kept above the bar level. The tested participant was taken up to the required position and when participant was ready to start the time started. The chin was not allowed to touch the bar during the test. The tested participant was verbally supported. The test was finished at the moment when the chin sank under the bar level. The result was measured with accuracy of 0.1 s [14].

The median was used as a measure of central tendency, and the quartile deviation as a measure of variability. Descriptive analysis was performed using SPSS Statistics 20.0 software (IBM, Armonk, USA).

Ethical Approval

Participants were informed and consented to the purpose and procedures of testing, which was conducted in accordance with the ethical standards of the Declaration of Helsinki [10]. The research was approved by the ethics committee of the University of Presov (ECUP042025PO).

Results

Table 2. Muscle strength among members of selected security forces

Security forces	n	Standing long jump test (cm)	The sit-up test (reps)	The 30-second push up test (reps)	Bent-arm hang (s)
		Med±QD (Min/Max)			
Police force	5	194.00±14.25 (181.00/231.00)	35.00±2.25 (27.00/40.00)	44.00±6.75 (26.00/45.00)	24.00±0.75 (16.00/44.00)
Municipal police	5	195.00±6.00 (181.00/228.00)	31.0±2.63 (26.00/40.00)	28.00±4.13 (20.00/36.00)	28.00±5.63 (19.00/44.00)
Fire service	5	240.00±5.63 (212.00/250.00)	37.00±2.63 (30.00/39.00)	45.00±4.13 (31.00/49.00)	37.00±3.75 (31.00/43.00)

Med- Median, QD- Quartile Deviation, Min-minimum, Max-maximum, reps-repetitions

In the percentage comparison of median values, the best results in the standing long jump test were achieved by members of the fire service. Members of the municipal police lagged behind on average by 18.75%, while the results of the police force were 19.17% lower compared to the fire service. In the sit-up test, the highest performance was again observed in members of the service. The police force had results 5.41% lower, whereas the municipal police scored 16.22% lower. In the 30-second push-up test, the best results were once more recorded among the fire service. The police force achieved a median 2.22% lower, while the municipal police had results 37.78% lower. In the bent-arm hang test, the highest results were also achieved by members of the fire service. The municipal police had values 24.33% lower, and the police force showed the lowest median, with a 35.14% difference compared to the fire service.

Discussion

The results indicate substantial differences in muscular strength levels among members of the police force, municipal police, and the fire service. The strength-related performance tests showed that the highest levels of physical capability were demonstrated by members of the fire service, particularly in the pull-up hold and standing long jump tests. The performance of the police force and municipal police officers was more balanced. However, considerable inter-individual variability was observed within each group, suggesting heterogeneous levels of physical preparedness even among personnel within the same unit. These differences can be interpreted considering occupational demands. Firefighters routinely handle heavy equipment, carry loads, and operate in physically extreme conditions, all of which require high levels of muscular strength and overall physical conditioning. In contrast, members of the police force—particularly municipal police officers—engage more frequently in administrative or less physically demanding tasks, which may contribute to lower performance across several tested parameters.

Because unified national physical fitness standards for all branches of the security sector do not exist in Slovakia, we compared our findings with military and firefighter standards employed in Slovakia and the Czech Republic. These standards represent the minimum physical requirements for professional soldiers and thus offer a suitable point of reference [3,5,12].

Explosive lower-body strength was assessed using the standing long jump test. Firefighters achieved the best results, followed by municipal police officers and the police force. When compared with reference values minimum entrance requirements for the fire service set at 160–165 cm, our participants met or exceeded these thresholds. The mean

jump distance of firefighters surpassed the minimum requirement by 77.5 cm (47.7 %), municipal police officers by 32.5 cm (20.0 %), and police force members by 31.5 cm (19.4 %). These findings are consistent with Marins et al. [6], who reported average horizontal-jump values of 216.1 cm (range 180–245 cm) in police fitness assessments, and with Marins et al. [16], who reported 209.5 ± 26.0 cm in Brazilian federal highway police officers. Firefighters in our study clearly outperformed these international reference values, while police participants achieved slightly lower, yet still above-minimum, results.

Dynamic strength of the abdominal musculature and hip flexors was assessed using a sit-up test. Firefighters again achieved the highest scores. Although our protocol employed a shorter time limit, approximate comparison with the 1-minute test is feasible based on the repetition-to-time ratio. For the relevant age category, minimum requirements range from 34–39 sit-ups per minute. The mean values obtained in our sample of municipal police: 31, police force: 35, firefighters: 37—suggest above-average dynamic strength of the trunk musculature. Marins et al. [6] similarly highlighted the relevance of trunk and upper-body endurance, reporting 60-second sit-up performance ranging from 28.0 to 60.3 repetitions, with an average of 40.5. Comparable results were reported by Chizewski et al. [17] for firefighters (31.4±6.1 sit-ups), demonstrating that our firefighters slightly exceeded these international averages.

Upper-body muscular strength was evaluated using the 30-second push-up test, which is also part of the Czech Armed Forces' fitness screening for recruits. Firefighters demonstrated the best performance, followed by the police force (−2.22 %), and municipal police officers (−37.78 %). When compared with reference values (19–21 push-ups) for the relevant age category, all groups exhibited above-average physical preparedness. Firefighters' mean performance exceeded the standard by 25 repetitions (125 %), police force members by 24 (120 %), and municipal police officers by 8 (40 %). Results from Chizewski et al. [17] reported 41.9±12.4 push-ups in firefighters, while Marins et al. [16] reported 32.2±11.1 push-ups in Brazilian police officers per minute, confirming that our participants performed above these international averages. However, results from Boyce et al. [18] showed higher maximal upper-body strength among police officers (96.3±20.9 kg) than firefighters (93.4±18.9 kg). Upper-body strength and endurance were strongly correlated with firefighting performance in the Firefighting Physical Ability Test (FPAT). These findings highlight the critical importance of upper-body function for successful task execution among firefighters [19].

The bent-arm hang test served as an indicator of upper-body and trunk strength and is commonly used in fitness assessments for female applicants. In our study, firefighters achieved a mean hold time of 37 s, municipal police officers 28 seconds, and the police force 24 seconds. For men, pull-ups (3–4 correct repetitions for the given age group) are typically used to evaluate the ability to lift one's body weight in a controlled manner. Nevertheless, Sax van der Weyden et al. [20] note that the pull-up hold also provides reliable measurement of upper-body strength and capacity in men and is included in the Tactics-Specific Fitness Test (SORT) for SWAT operators, where participants averaged 47.1±8.4 seconds. In addition, grip strength represents an important complementary indicator of upper-body fitness. It has been shown to correlate with task performance and injury risk in police recruits, with lower grip strength associated with higher failure rates in tactical assessments, further underscoring the relevance of upper-body strength testing for operational effectiveness [21].

Limitations of the study

The main shortcoming of presented research is the size of research sample, which limits the generalizability of the findings. Moreover, subsequent research should employ longitudinal and multifactorial designs to determine the current fitness levels more comprehensively. Additionally, in following research is necessary to consider service time of each participant.

Conclusions

The present study analyzed differences in muscle strength among members of the police force, municipal police, and fire Service of the Slovak Republic. Across all assessed tests—standing long jump, sit-ups, push-ups, and bent-arm hang—the highest performance levels were consistently recorded among members of the fire service. Their superior results likely reflect the demanding nature of their professional duties, which require high levels of explosive power, muscular endurance, and overall physical robustness. In contrast, members of the police force and municipal police demonstrated lower strength parameters, with the Municipal Police showing the weakest performance in most indicators.

Future recommendations

Based on the findings, we recommend regular monitoring of strength parameters across security units to identify deficits and track physical fitness. Incorporating occupation-specific conditioning programs: targeting explosive lower-body strength, abdominal muscle strength and endurance, and upper-body muscular strength and endurance - would help align fitness levels with real operational demands. Systematic integration of these targeted training routines into the workflow could enhance performance efficiency and reduce injury risk among personnel.

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