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Published in:
Work

DOI:
[10.3233/WOR-230320](https://doi.org/10.3233/WOR-230320)

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Recommended citation(APA):
Schram, B., Kukić, F., Jankovic, R., Dimitrijević, R., Zigic, G., Orr, R. M., & Koropanovski, N. (2024). Effects of a single-day pre-academy physical test training session on physical fitness scores of police candidates. *Work*, 77(4), 1369-1375. <https://doi.org/10.3233/WOR-230320>

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1 **TITLE: Effects of a Single-Day Pre-Academy Physical Test Training Session on Physical Fitness**
2 **Scores of Police Candidates**

3

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25 **ABSTRACT**

26 BACKGROUND: Concerns are sometimes raised by police applicants undertaking physical
27 fitness testing that they were unfamiliar with the test requirements which in turn negatively
28 impacted their performance. OBJECTIVE: The aim of this study was to investigate the effects
29 of a single day physical test training session on physical fitness scores of police candidates.
30 METHODS: The sample consisted of female police candidates (n=133) who attended a pre-
31 academy training session. On the first day of pre-training, candidates' physical fitness was
32 measured following official assessment day protocols. Measures included maximal handgrip
33 strength, number of push-ups in 10 sec (PU), number of sit-ups in 30 sec (SU), standing long
34 jump (SLJ), Abalakov jump test (AJ), 12 min Cooper running test (CT), and a motor educability
35 test (ME). After the assessment, the overseeing UCIPS staff provided a detailed test skills
36 briefing to candidates (e.g., common mistakes made during testing, how test performance
37 could be improved, etc.). Immediately after the briefing, candidates performed the tests once
38 again. Differences between results were measured using a paired samples t-test with
39 significance set at 0.05. RESULTS: Paired sample t-tests determined significant ($p < 0.001$), large
40 (Rank-Biserial Correlation = 1.00), improvements in physical fitness scores during the second
41 assessment following familiarisation and feedback on test performance. CONCLUSION: Pre-
42 academy training may be effective in improving candidates' physical fitness scores, in most
43 tests, prior to the official assessment for the enrolment to police studies. Thus, to optimise
44 initial candidate scores and opportunities for successful enlistment, police agencies may
45 benefit from providing pre-assessment training.

46

47 **KEYWORDS:** Law enforcement officer, recruit, employment standards, police academy,
48 exercise test, fitness testing.

49 **1. INTRODUCTION**

50 Tactical organisations, inclusive of military and law enforcement, across the world often use
51 physical testing during their recruitment and training process to determine candidate
52 suitability (1). Physical fitness has been shown to be related to a new candidate's injury risk
53 (2) and occupational performance (3), with those who score lower on fitness assessments
54 being at a higher risk of injury (4), and displaying poorer performance in occupationally
55 relevant tasks (REF). These assessments may consist of a variety of assessments including
56 aerobic fitness, strength, agility, flexibility, and power amongst others (5, 6).

57
58 The fitness requirements of a job in the tactical domain are dependent on the occupational
59 profile, with fitness shown to differ between policing units in the same geographical area,
60 likely due to the nature of the work itself (7). Consequently, a battery of fitness assessments
61 is typically created, aimed at ensuring occupationally relevant attributes are considered. For
62 example, in police, grip strength has been associated with pistol marksmanship (8), agility with
63 pursuing offenders (5), and lower body power with jumping over barriers or obstacles (9). This
64 may lead to a variety of assessments being conducted, some of which the recruit may be
65 familiar with, whereas some may be foreign. While research has shown that measures such
66 as the 2.4km run, push-ups, and sit-ups were the most commonly reported in law
67 enforcement, the variation in occupational demands and subsequent lack of consensus on the
68 one best fitness assessment is highlighted a recent review which reported on over 20 different
69 assessments of fitness in tactical organisations (10).

70

71 Tactical organisations recruit from the general population, and consequently there are often
72 a varying range of experience levels with physical training and abilities within those who are

73 recruited (11). This is compounded by the fact that the population pool of age appropriate
74 candidates from which recruits are drawn is shrinking globally and a high percentage of those
75 that remain are afflicted by obesity, inactivity, and other health related problems (2). For
76 example, it is estimated that 80% of adolescents are insufficiently active (12), compounded
77 recently by the COVID-19 pandemic where schools, gyms, and parks were closed for prolonged
78 periods of time (13). Therefore, the situation may develop where an individual is completing
79 what is considered a basic fitness assessment for the first time in a police training academy.

80
81 Due to the high degree of variation, and potential for a lack of familiarity in fitness
82 assessments, it is unclear how much performance may be affected by these factors. The aim
83 of this study was to investigate the effects of a physical fitness assessment training session on
84 subsequent physical fitness test scores of police candidates. The findings of this study could
85 inform the recruitment and training practices of tactical populations.

87 **2. METHODS**

88 The sample consisted of the entire group of 133 female police candidates (mean 18.6 ± 0.4
89 years, height 170.1 ± 0.3 cm, weight 64.9 ± 5.8 kg, and body mass index 22.4 ± 1.9 kg/m²) who
90 were attending pre-academy training at the University of Criminal Investigation and Police
91 Studies (UCIPS) in Belgrade, Serbia. Within the university study program, specialised physical
92 education forms approximately 10% of the content. Typically, the physical assessment form
93 part of the selection process into the UCIPS in conjunction with previous education, health
94 status, a general knowledge and language test. The individual results of the physical
95 assessments for successful candidates are then used to inform individualised, 8-week training
96 programs to maintain or enhance fitness attributes which were deemed to be deficient.

97

98 During the pre-academy training, the standardised fitness assessments were conducted and
99 scored as they would be as part of the academy training and included measures of muscular
100 strength, muscular endurance, lower limb power, aerobic fitness, and a motor educability test.
101 These fitness assessments include 1) grip strength (measured through a hand held
102 dynamometer), 2) the maximal number of push ups in 10 seconds, 3) the maximal number of
103 sit ups in 30 seconds, 4) a standing long jump (for horizontal plane power), 5) the Abalakow
104 Jump Test (for vertical plane power), 6) contraction and stretching test (a motor educability
105 test) and 7) the 12 min Cooper running test (for aerobic fitness). Each assessment was
106 explained in detail, demonstrated, and practiced by the candidates before their first
107 assessment. Each of these assessments have been used previously in this population and have
108 been described in previous studies (14) but will be briefly revised here.

109

110 ***Grip Strength:***

111 Candidates grip strength was recorded with a handheld dynamometer where they were
112 instructed to grip and squeeze with as much force as possible. The maximal output (in
113 decanewtons (DaN)) was recorded.

114 ***Push-ups:***

115 Upper body power was assessed using the number of push-ups completed in 10 seconds.
116 Candidates began the assessment in the prone position, with elbows fully extended and hands
117 shoulder width apart, and the number of full completed repetitions were recorded.

118 ***Sit-ups:***

119 The number of sit-up repetitions completed in a 30 second period was conducted to assess
120 trunk endurance. The SUs started and finished with their backs on mats, legs bent at 90

121 degrees, fingers entwined on the occipital bone, and elbows open to touch the floor. They
122 could not move their hands or fingers from the occipital bone. The sit-up movement was
123 naturalized by allowing slight elbow motions. Swinging was prohibited. A fellow participant
124 tightly secured her feet flat on the ground. Each repeat ended with both shoulder blades
125 touching the ground before the next one began. Hips and fingers have to stay on the ground
126 during the test. The top applicants had to touch their legs with their chests. Non-compliant
127 repetitions were ignored.

128 ***Standing Long Jump:***

129 The standing long jump is an assessment of lower body power in the horizontal plane whereby
130 candidates jump as far as possible over a marked line. Individuals are given no restrictions on
131 arm swing or countermovement strategy prior to jumping and the distance from the starting
132 line to the point of heel contact is recorded to the nearest 1cm.

133 ***Abalokow Jump Test:***

134 To assess lower body power in the vertical plane, the Abalokow Jump Test was administered.
135 The maximum height was reported from a countermovement jump on a contact platform
136 which recorded flight time (Contact Plate, Globus, Codogne, Italy).

137 ***Motor Educability Test:***

138 The candidates ability to comprehend and learn complex motor tasks was assessed through
139 the contraction and stretching test (15). The candidates were instructed to adopt 24 different
140 whole-body flexion and extension positions (12 on each side) as quickly as possible and each
141 incorrect repetition was recorded as an error.

142 ***12 min Cooper Test:***

143 Aerobic endurance was assessed with the 12-minute Cooper run test. The distance covered in
144 12 minutes of running around a 230m track by each candidate was recorded to the nearest
145 10cm.

146

147 In this group, immediately after the completion of the assessments, staff who are responsible
148 for conducting the physical fitness assessments provided a detailed briefing including
149 feedback based on previous experience on specific mistakes and/or deficiencies in performing
150 the tests along with making individual recommendations for candidates. Examples of typical
151 mistakes in performing each assessment along with relevant recommendations for improving
152 performance are found in Table 1.

153

154 *Table 1 here*

155

156 At the completion of this skills briefing, the assessments were conducted again except for the
157 12 min Cooper running test, due to the effect that fatigue would have on subsequent
158 performance. Results from the first attempt at the assessments was then compared to the
159 results of the second assessment.

160

161 **2.1 Statistical Analysis:**

162 Descriptive statistics for each assessment were calculated and initial and subsequent
163 assessment results were compared using the Statistical Package for the Social Sciences (SPSS,
164 Version 27). To determine the most appropriate test, normality was assessed through visual
165 inspection of histograms and the Kolmogorov-Smirnov test, and if found to be normally
166 distributed, paired samples t tests were utilised, otherwise Wilcoxon Signed Rank tests were

167 used. Mean differences and 95% confidence intervals were calculated for paired samples t
168 tests, while mean differences and Z scores reported for Wilcoxon Signed Rank tests.
169 Significance was set at 0.05.

170

171 **3. RESULTS**

172 The initial and subsequent results of each assessment are displayed in Table 2. A positive
173 change was seen in all measures in the subsequent assessment with significant improvements
174 in grip strength (0.6 DaN, 95% CI = [0.1,1.2]), push ups (0.6 repetitions, Z = 5.3), sit ups (4
175 repetitions, Z = 9.4), standing long jump (5.5 cm, Z = 5.6), Abalakov jump test (3.9 cm, Z = 7.5)
176 and a decrease in errors in the motor educability test (10.1 fewer errors, 95% CI [9.3, 10.9]).

177

178 *Table 2 here*

179

180 **4. DISCUSSION**

181 The aim of this investigation was to determine whether a physical test training session would
182 affect the physical fitness test scores of police candidates. This study suggests that
183 performance in fitness assessments may be improved immediately with identification of
184 typical errors and individualised suggestions to improve performance. The results suggest that
185 performance on many common fitness assessments used in tactical organisation may not be
186 representative of an individual's true ability, particularly if they do not fully understand the
187 assessment and the optimal way to complete them.

188

189 Minimal research exists which assess the effects of familiarisation on fitness assessments
190 alone. Previous research has shown that both familiarisation and customised exercise

191 programs over five weeks improved performance in a wildland firefighter fitness test, a circuit
192 consisting of four sequential tasks (16). Likewise, training and familiarisation has shown
193 improvements in fitness tests for correctional officers (17) and physical abilities tests in
194 Nuclear Power Emergency Service Maintainers (18), however minimal investigations have
195 assessed familiarisation alone. Studies in paediatric populations have found that repeated
196 familiarisation sessions were required to stabilise the consistency of fitness measures including
197 a vertical jump and long jump, and at least three practice sessions were required to improve
198 performance in co-ordination tasks (19). This finding was contradicted in the study by Moir et
199 al. (20) who found familiarisation sessions were not required to stabilise the reliability of
200 loaded and unloaded vertical jumps in adult males or in the athletes profiled in the study by
201 Nibali et al. (21) who proposed that it was due to the vertical jump being similar to many
202 athletic tasks.

203
204 The results from this group generally suggest limited exposure to athletic tasks. As a group,
205 the mean result of the Coopers Run test would be considered 'average' (22), the grip strength
206 'above average' with a result in the 75th percentile (23), the push ups would be 'poor' (24), the
207 sit ups would be 'below average' (25), the standing long jump would be 'poor' (26), and the
208 vertical jump would be considered 'poor' (27). Within the UCIPS, there is an internal scoring
209 system for the fitness results based on previous results which reflect that of the literature
210 whereby the Coopers Run test would be considered 'above poor', the grip strength results
211 'satisfactory', and the remainder all classified as 'poor'. Generally, it has been proposed that
212 greater familiarisation is required for non-specific testing (28) and therefore familiarisation
213 may be more beneficial in a population which is relatively unfamiliar with physical activity, as
214 evident by this groups initial results.

215

216 Other factors identified as having the potential to affect performance in fitness tests include
217 anxiety and nervousness about having to perform in front of peers and being ranked
218 hierarchically, which has been perceived to affect performance (29). This relationship
219 between arousal and performance is displayed in the Yerkes Dodson curve whereby there is
220 an optimal level of arousal for maximal performance (30). While performance is known to
221 increase as physiological or mental arousal increases, excessive levels of arousal can evoke
222 anxiety which is associated with a detrimental effect on performance. Candidates who are
223 over-aroused during their physical assessments may therefore not be performing to their full
224 capability.

225

226 There are some limitations to this study which need to be acknowledged, in particular the
227 effect which learning may have played on the results and that the entire group were females.
228 Learning may have played a role in the improvement in results found in the second
229 assessment, however the fact that the individuals demonstrated significant improvements
230 might suggest otherwise. Previous research has highlighted that familiarisation sessions allow
231 subjects to improve performance in physical assessments such as knee extension strength (31)
232 and anaerobic cycle ergometry (32), which are thought to not be the result of learning.
233 Additionally, some research has shown that, provided attempts are within 48 hours of each
234 other, such as was done in this study, that these familiarisation sessions avoid the effects of
235 learning (19). Given that the group was all female, this may limit the translation of these
236 findings to males unless further research is done. Furthermore, these were relatively simple
237 assessments, further research should examine the effect of an individual's understanding of
238 more complex tasks, such as marksmanship, utilising both males and females. Consequently,

239 given the simple study design, future research should utilise a control group in order to
240 determine the true effects of learning and to enable causal claims to be made regarding the
241 improvement of test results within this population.

242

243 **5. CONCLUSION**

244 With a decline in the physical activity levels of the population from which tactical personnel
245 are drawn, it is important that adequate training around physical assessments is conducted.
246 Staff responsible for training and assessing physical fitness within tactical organisations should
247 acknowledge that incoming recruits may not have a great understanding of the physical
248 assessments, and this might limit their performance. This study highlights to organisations
249 which conduct physical assessments, that the initial result recorded in an assessment may not
250 be a true representation of a candidates physical ability, and that appropriate levels of
251 instruction and training may be required to reflect their ability.

252

253 **ETHICAL APPROVAL**

254 This research was conducted in accordance with the conditions of the Declaration of Helsinki,
255 and with the permission of the Ethics Committee of the University of Criminal Investigation
256 and Police Studies (IRB No. 440/2).

257 **INFORMED CONSENT**

258 All candidates consented to their de-identified data being used in their investigation.

259 **ACKNOWLEDGEMENTS**

260 The authors would like to acknowledge the candidates who participated in this project.

261 **FUNDING**

262 Not applicable

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354 **Tables and captions:**

355 *Table 1: Errors identified in assessment performance and prompts to improve performance. (Note - translated to English*
 356 *from Serbian)*

Test	Mistakes or/and deficiencies in performing	Recommendations for better performance
Grip Strength	<ul style="list-style-type: none"> • Incorrect grip of the device • Not concentrating fully during the assessment 	<ul style="list-style-type: none"> • Grip the device so that the lower handle is across all phalanges of the fingers and the upper handle is at the root of the thumb • Squeeze as hard as you can as if you want to crush something
Push ups	<ul style="list-style-type: none"> • Long pauses in the up position • Slowing down excessively in the down position. 	<ul style="list-style-type: none"> • Go down as fast as possible with minimal periods of motionlessness • Do not rest, raise and lower without rest
Sit ups	<ul style="list-style-type: none"> • Breath holding at the beginning • Loss of control or a notable slowing down of the movement when lowering to the mat • Pausing in the upper and/or lower position 	<ul style="list-style-type: none"> • Breathing from the first repetition so that the exhalation will be in the upper position • Actively and quickly lower to the mat under muscular control • Do not pause in the upper and/or lower position
Standing long jump	<ul style="list-style-type: none"> • Increased stiffness of the whole body a few seconds before jump • Insufficiently or excessively lowering into the half-squat position • Pausing in the half-squat position • Weak arm swing and hip pull • Insufficient vertical flight component • Moving or sitting back on landing 	<ul style="list-style-type: none"> • The whole body should be relaxed in the starting position • Lowering to the half-squat position should be quick, and move as quickly as possible to the leg extension phase without pause • Arms should be swung forward as strongly as possible and hips pushed forward in the flight phase • If you cannot stay in place after landing, roll forward
Motor Educability Test	<ul style="list-style-type: none"> • Not keeping the feet flat on the floor • Lifting the hips before rolling onto the side. • Not maintaining contact of feet together or elbows to knees. • Incomplete extension of the arms 	<ul style="list-style-type: none"> • Try to transition from each position rhythmically. • Complete as fast as possible • Don't hold any single position. • Continuous breathing.
Abalakow jump test (CMJ)	<ul style="list-style-type: none"> • Insufficiently or excessively lowering into the half-squat position • Descending too slowly into the half-squat position • Pausing in the half-squat position • Weak arm swing 	<ul style="list-style-type: none"> • The whole body should be relaxed in starting position • Lowering to the half-squat position should be quick, and move as quickly as possible to the leg extension phase • Arms should be swung up and as high as possible with the jump

358 *Table 2: Results of the initial and subsequent fitness assessments*

Activity	Test 1	Test 2	p Value
Grip Strength (DaN)	34.2±4.9	34.8±5.2	0.45
Push-ups (repetitions)	1.4±2.3	2.0±2.6	<0.001
Sit-ups (repetitions)	14.5±4.0	18.5±3.6	<0.001
Standing Long Jump (cm)	145.7±24.2	151.2±24.3	<0.001
Abalakow Jump Test (cm)	22.5±8.1	26.4±5.1	<0.001
Motor Educability Test (number of mistakes)	20.5±5.3	10.4±6.0	<0.001
Coopers Run Test (m)	1964.9±319	-	-
Total Score	3.5±2.8	5.6±3.0	<0.001

359

ACCEPTED

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