GENDER DIFFERENCES IN SHORT SPRINT PERFORMANCEWITH AND WITHOUT OCCUPATIONAL LOAD

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Abstract: Maximum acceleration and running speed are significant for police officers in situations where they need to apprehend a running suspect. Most frequently, they have to handle these situations wearing work equipment that weighs equally for both genders. This research aims to determine the differences in maximum acceleration and running speed with equipment of different weight. 35 male and 24 female students from the University of Criminal Investigation and Police Studies took part in the research. The test measured the time needed for a 10m and 20m sprint, as well as a 10m flying start. All tests were performed without additional load, with a duty belt that contained police equipment weighing 5 kg total, as well as a vest weighing 10 kg. The Independent Samples t test found a statistically significant difference within groups in the time of running without occupational load compared to running with the load of 5 kg and 10 kg. Furthermore, the tests with 5 kg and 10 kg loads differed in the first 10m and 20m. All observed variables contained statistically significant differences between female and male students.

Keywords: police, students, occupational loads, physical abilities

INTRODUCTION

The nature of police officers' work entails that they should be adequately physically prepared in order to react efficiently in critical situations. In the moments when it is necessary to assist those in danger, or apprehend a suspect, it is of utmost importance to react quickly. Such incidents may occur suddenly, when officers who are, for instance, on foot patrol, might need to invest their maximum physical

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effort so as to change their pace from a slow walk into a sprint, and arrest an offender (Anderson, Plecas & Segger, 2001; Koedijk et al., 2020). Understandably, the occupational effectiveness of police officers largely depends on their ability to perform these tasks (Strating, Bakker, Dijkstra, Lemmink & Groothoff, 2010; Crawley, Sherman, Crawley & Cosio-Lima, 2015). Therefore, physical abilities are recognized as a vital component when resolving critical incidents, such as attempting to detain a fleeing suspect, overpowering those resisting arrest, handcuffing, crowd control, etc.

Resolving a critical incident can be divided into three main parts: getting to the problem, controlling the problem and removing the problem (Anderson et al., 2001). The tasks of the first part (getting to the problem) can vary from safety checks, arriving to the place of incident (e.g. a traffic accident), or, in quite a few cases, to catching up to the suspect. During the chase, police officers mostly run at the maximum or almost maximum speed, with possible sudden changes in direction, within the range of 5 to 350 meters. Apart from these situations, acceleration and running speed are also significant in the moments when it is necessary to reach a cover as soon as possible (Anderson et al., 2001, Dawes et al., 2015). For abovementioned reasons, not only do the physical ability tests closely imitate potential scenarios that might occur on duty, with the aim of monitoring the level of police officers' physical abilities, but they also represent a strategy for improving the job-related physical fitness (Strating et al., 2010; Jackson & Wilson, 2013; Orr et al., 2019).

The equipment police officers carry during worktime is there to aid the resolving of critical incidents. Besides applying physical force, officers have at their disposal a police baton, handcuffs, or even firearms (Arlov, Ivanović & Janković, 2015). Sudden changes in the intensity of police work (e.g. when one needs to quickly run out of a car and apprehend a suspect) are very physically demanding, and consequently lead to higher injury rates than in the public sector, thus police officers carry protective gear that can weigh even up to 40 kg (Dawes et al., 2015). On the one hand, this equipment can make detaining a suspect easier, or increase safety; however, on the other, it can decelerate the movement and decrease the mobility of police officers (Dawes et al., 2015; Orr et al., 2019).

Regardless of the differences in morphological characteristics and motor abilities, when doing police work, duties performed by male and female police officers do not differ (Kukic et al., 2020). Men are taller and heavier than women, with a higher level of motor abilities, especially force and strength, and hence female officers may be required to carry relatively heavier loads than male officers (Dopsaj et al., 2010; Kukic et al., 2020). Aside from detaining a possibly much heavier suspect, female officers, as well as lighter male officers, are also expected to overcome a larger relative resistance (Baran, Dulla, Orr, Dawes & Pope, 2018, Lockie et al., 2018).

Determining the level of physical readiness of police officers is very important, inasmuch as adequate tests and testing procedures can ascertain what physical performances are related to the work efficiency of police officers (Strating et al., 2010; Jackson & Wilson, 2013). The equipment police officers carry decreases the speed of their movement, as well as their mobility; however, the higher their physical readiness, the lower the negative impact of occupational load (Orr et al., 2019). That being the case, appropriate ways of testing may serve to provide information regarding the level of physical abilities, and later even ways to further develop and establish the abilities relevant to the efficiency of police officers' work. The aim of this study was to determine the differences in the maximum acceleration and running speed in a short sprint distances, in both female and male students carrying loads of different weight.

METHODS

Participants

59 third year undergraduate students of the University of Criminal Investigation and Police Studies in Belgrade took part in the research, 24 of whom were female students (FS), while 35 were male students (MS). The basic descriptive data of their morphological characteristics are shown in Table 1.

Table 1, Basic data of participants morphological characteristics

Gender	Variables	Mean	SD	Min	Max
FS (N = 24)	BH (cm)	170.25	3.10	166.00	177.00
	BM (kg)	61.93	5.35	52.00	74.00
	BMI (kg/m^2)	21.37	1.90	18.90	25.90
MS (N = 35)	BH (cm)	183.63	5.26	171.00	194.00
	BM (kg)	84.91	6.77	70.00	103.00
	BMI (kg/m^2)	25.17	1.46	21.60	28.50

Procedure

After a detailed explanation of the manner of testing, as well as an appropriately conducted standard warm-up, the participants were instructed to run 20 meters from a standing start as fast as possible. In the test, the time of running the first 10 meters, then the second 10 meters, and finally the total time needed to run 20 meters were measured. Given that the 20-meter running test is similar to the 30-meter one, its reliability is undeniable (Mirkov, Nedeljkovic, Kukolj, Ugarkovic & Jaric, 2008). The test was conducted three times. The participants first ran in their sportswear, then carrying a standard police duty belt with a gun and a spare unloaded magazine, a baton, and handcuffs. The total weight of this belt with equipment was 5 kg. The third test was conducted with a vest weighing 10 kg. This type of load (the 10 kg vest) had been defined in some earlier works as the occupational load for police officers (Orr et al., 2019; Kukuc et al., 2020). Each test was conducted after an appropriate active rest, when the participants were able to display their maximum score.

The time was measured with the help of a computer system designed for physical ability testing (*Physical ability test 02)*, consisting of a measure acquisition device, application software, and running sensor (UNO-LEX, NS, Serbia). Photocells were set in such a manner that cutting the ray of the first one started the chronometer, whereas the moment of cutting the ray of the second one stopped it, in order to gain the information for the first 10 meters. Simultaneously, the measurement of the second 10 meters commenced, whereas going through the third sensor led to obtaining the final result. The test observed the results of running in all sections (first 10 m, second 10 m, and total 20 m) without load (10m1, 10m2 and 20m), with a police belt (PB10m1, PB10m2 and PB20m), and with a vest (V10m1, V10m2 and V20m).

Statistics

All data were analyzed by using descriptive indicators in order to calculate the basic parameters of a central tendency: arithmetic mean (Mean) and standard deviation (SD). The existence of differences was determined by the independent samples t-test (Hair, Anderson, Tatham & Black, 1998). Statistic procedure was conducted using Statistical Package for Social Sciences (IBM, SPSS Statistics 20). The significance level was set at $p < 0.05$.

RESULTS

The descriptive parameters for the time needed to run 10 m, 20 m, and 10 m flying start, together with the differences between FS and MS are shown in Table 2.

Table 2, Results of descriptive statistics and differences between the results achieved by FS and MS

Variables	FS		MS		t-test		
	Mean	SD	Mean	SD	Mean difference	Lower bound	Upper bound
10m1 (s)	2.159	0.087	1.930	0.117	0.229*	0.173	0.285
10m2 (s)	1.654	0.096	1.422	0.093	0.231*	0.182	0.281
20m (s)	3.813	0.158	3.353	0.185	0.46*	0.368	0.553
PB10m1 (s)	2.312	0.127	2.046	0.147	0.266*	0.192	0.339
PB10m2 (s)	1.719	0.120	1.451	0.112	0.269*	0.208	0.330
PB20m (s)	4.031	0.216	3.497	0.240	0.534*	0.412	0.657
V10m1 (s)	2.379	0.150	2.044	0.123	0.335*	0.264	0.407
V10m2 (s)	1.883	0.157	1.537	0.118	0.346*	0.274	0.418
V20m (s)	4.261	0.277	3.580	0.229	0.681*	0.549	0.814

*Significant at $p < 0.05$

The existence of statistically significant difference within the groups in the time of running without load, compared to the running with 5 kg and 10 kg load (police belts and vests), as well as the differences in the time of running with load for the first 10 m, second 10 m, and total 20 m are shown in Table 3, Table 4, and Table 5, respectively.

Table 3, The differences in first 10 m for FS and MS without and defined load

Gender	Test		Mean Difference (s)	95% Confidence Interval for Difference	
				Lower Bound	Upper Bound
FS	10m1	PB10m1	-0.153*	-0.214	-0.092
		V10m1	-0.220*	-0.028	-0.152
	PB10m1	V10m1	-0.067	-0.165	0.032
MS	10m1	PB10m1	-0.116*	-0.167	-0.065
		V10m1	-0.113*	-0.159	-0.067
	PB10m1	V10m1	-0.003	-0.050	0.056

*Significant at $p < 0.05$

Table 4, *The differences in second 10 m for FS and MS with and without defined load*

Gender	Test		Mean Difference (s)	95% Confidence Interval for Difference	
				Lower Bound	Upper Bound
FS	10m2	PB10m2	-0.066*	-0.109	-0.022
		V10m2	-0.229*	-0.287	-0.170
	PB10m2	V10m2	-0.163*	-0.235	-0.092
MS	10m2	PB10m2	-0.034*	-0.071	0.015
		V10m2	-0.117*	-0.154	-0.074
	PB10m2	V10m2	-0.083*	-0.127	-0.045

*Significant at $p < 0.05$

Table 5, *The differences in 20 m for FS and MS with and without defined load*

Gender	Test		Mean Difference (s)	95% Confidence Interval for Difference	
				Lower Bound	Upper Bound
FS	20m	PB20m	-0.218*	-0.293	-0.143
		V20m	-0.448*	-0.529	-0.367
	PB20m	V20m	-0.230*	-0.347	-0.112
MS	20m	PB20m	-0.158*	-0.218	-0.098
		V20m	-0.236*	-0.290	-0.182
	PB20m	V20m	-0.077*	-0.137	-0.018

*Significant at $p < 0.05$

DISSCUSION

The test results determined that variables 10m1,PB10m1 and V10m1 for FS had statistically significantly better results with all types of load, the differences becoming more prominent as the load increased (Table 2). Upon observing the total 20 m sprint time, it could be seen that the difference between FS and MS in sportswear was 13.72%, with a duty belt 15.27%, and with a vest 19.29%. The study found that, compared to the sports equipment, both FS and MStook statistically significantly longer running time in the first 10 m with a belt by 6.62% and 5.67%, whereas with a vest it was by 9.25% and 5.58%, respectively. In both gender groups between PB10m1 and V10m1, no statistically significant differences were found (Table 3). The difference between 10m2 compared to PB10m2 and V10m2 in FS was 3.78% and 12.16%, whereas in MS it was 2.37% and 7.49%. In 10 m flying start, a statistically significant difference was observed between PB10m2 and V10m2, which was 8.71% for FS, and 5.60% for MS (Table 4). The subsequent total 20 m running time statistically differed between 20m and PB20m, between 20 and V20m, as well as between PB20m and V20m, amounting to 5.42%, 10.53% and 5.40% for FS, and 4.53%, 6.62% and 2.18% for MS, respectively.

The results of this research are similar to the study of Orr (2019), which found that physical abilities, especially lower-body power, upper-body and trunk endurance, as well as aerobic fitness, are related to running speed, especially in officers wearing occupational load. What is more, the results of the study found that carrying a 10 kg vest statistically significantly increased the time of performing Illinois

agility test by almost 5%. Also, a strong connection found between vertical jump and sprint performance tests at the distances of 5 m, 10 m, and 15 m, shows that it is preferable to additionally apply the training methods that may improve lower-body power, potentially leading to enhancing sprint speeds over short distances (Dawes et al., 2015). In regrade, the results of our study showed that load increase affects FS more than MS. The results of these findings could be explained by the fact that men, on average, have a higher level of general physical abilities compared to women, viewed from the aspects of speed, strength, and endurance (Dopsaj et al., 2010), enabling them to perform better in sprint with load tests. Apart from physical abilities, the efficiency of movement with load can also be affected by morphological characteristics. Body composition is strongly related to the efficiency in the running speed both with and without 10 kg load, hence leading to a presumption that better results could be achieved by increasing skeletal muscle mass and reducing fat mass (Kukic et al., 2020). The occupational load carried by police officers may also have an impact on the results of physical ability tests. The study that corroborates this was conducted by Koedijk (2020), and its goal was to investigate the influence of wearing a police uniform on performance, using the Physical Competence Test (PCT). The difference in weight between the sportswear condition and the police uniform condition was about 9.5 kg. In this study, it took about 14 seconds more to perform the PCT in a uniform; i.e. the efficiency decreased by approximately 7.5%. Furthermore, the participants indicated a higher perceived exertion (RPE) after completing the PCT in a police uniform by approximately 17%. It was concluded that the decreased efficiency in the PCT, followed by the increased values of RPE, was in all likelihood caused by the diminished mobility, additional load, and heat.

The findings of this study showed that different weight of the equipment did not affect the time needed to run the first 10 m. As it was presumed carrying a police duty belt with the equipment weighing 5 kg diminishes the mobility of a participant similarly to a 10 kg vest. At the start, the participants attempted to fasten the equipment (they frequently held the baton or gun), as opposed to the vest, which they did not hold, since it clung to the body. Once they achieved certain speed, the participants did not need to fasten the equipment, thus the manner of running the second 10 m was identical, which, given the larger weight of the equipment, negatively affected the time needed to run 10 m flying start, and consequently the total 20 m.

CONCLUSION

The aim of this research was to investigate the differences in maximum acceleration and running speed between the FS and MS who performed the test first in sportswear, then with a police duty belt and 5 kg equipment, and finally with a 10 kg vest. The results of the study showed that MS had statistically significantly better results, compared to FS. It can be concluded that the load increase had a higher negative impact on the sprint performance of the FS. Based on these results, we can assume that there is a need for new studies that would ascertain the impact of occupational load on the results of standard physical ability assessment tests. That studies should potentially lead to new protocols, testing standards, as well as to determining adequate norms for police officers' physical abilities.

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