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IMPACT OF PHYSICAL FITNESS ON RECRUITMENT AND ITS ASSOCIATION TO STUDY OUTCOMES OF POLICE STUDENTS

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ABSTRACT

Physical abilities can contribute to good health and performance in police officers. An effective selection followed by an efficient study process can be highly important for police students. This research investigated the impact of physical abilities on recruitment of police students and its association with their study outcomes, grade point average (GPA) and the time to graduate (TG). Lower-back isometric force, vertical and horizontal jumping performance, muscular and aerobic endurance and motor educability of 618 male candidates of police studies were collected and eight years later, the GPA and TG were collected of those who graduated. Discriminate analysis investigated the differences between the candidates who were not selected, the candidates who enrolled but did not graduate, and the candidates who graduated. Correlation analysis investigated the association between the measured physical abilities and the study outcomes. Enrolled candidates compared to non-enrolled candidates were significantly better in the discriminative factor consisting of jumping performance, muscular and aerobic endurance and motor educability. The GPA and TG correlated with muscular endurance of abdominal flexors and aerobic endurance. This may suggest that students with better physical abilities have better chances of entering the academy and tend to have higher study outcomes.

Keywords: Entrance exam; Grade point average; Physical abilities; Police higher education; Study duration.

INTRODUCTION

The majority of police work includes a combination of decision-making and discretion on a daily basis (Birzer, 2003). Sometimes, a police officer can prevent a potential problem by utilising knowledge of social and forensic sciences combined with the information about the suspect, or by acknowledging that physical force may be the only solution (Fahsing & Ask, 2016). In that sense, expertise in decision-making and selection of actions linked to knowledge, technique and skills (or a combination thereof) would be beneficial to police officers. Moreover, as compared with less successful officers, the expert officers tend to perceive better and possess discreet knowledge in specific domains (Fahsing & Ask, 2016). This is the enrolment criteria for police students that have typically been influenced by the university

curricula, which has been developed in order to prepare police students to be expert police officers. Although the study curricula for police students may differ worldwide, two of the globally accepted indicators that reflect the overall success of the study process have been the grade point average (GPA) and time to graduate (TG). The GPA normally represents the pooled mean graduation grade calculated from all completed exams within the curricula (Kuh *et al.*, 2006; York *et al.*, 2015).

Physical fitness is a component part of the educational process of police students, as they also have to be educated in fields such as law, criminalistics and forensic and social sciences. Therefore, the academic success of police students involves a number of exams that constitute the curriculum ranging from specialised motor skills, such as defensive tactics, to various legal and social sciences, such as law and criminalistics. It has been expected of the selected candidates to be successful in the study process, however, not all of them graduate (Nora *et al.*, 2005; Lockie *et al.*, 2019). The scientific data on the reasons for dropping out (or separation) have been scarce although there has been some research from the perspective of physical fitness. For instance, Lockie *et al*. (2019) found that the recruit group who graduated was significantly faster (measured by the 75-yard pursuit run) and had better aerobic endurance (measured by completed shuttles in the multistage fitness test) than those recruits who did not graduate. Moreover, aerobic endurance and age could predict inclusion in the group of police students who were to graduate.

This bears importance because once they have graduated, police students start their careers as officers whose tasks may be highly physically demanding and can be associated with their level of physical abilities (Dawes *et al.* 2018; Orr *et al.*, 2019) or may require various tacit knowledge (Fashing & Ask, 2016). Thus, a police agency should develop recruitment strategies that would select the candidates who were more likely to graduate, and become a policing expert in the field.

The questions arise as to whether physically fitter recruits can have better overall study outcomes, and whether these two dimensions are associated. A review study on non-police population revealed positive associations between physical fitness and academic success (Trudeau & Shephard, 2008), whereby aerobic endurance was a significant predictor of success in mathematics and reading (Castelli *et al.*, 2007). Moreover, Trudeau and Shephard (2008) found that physical activity had positive effects on concentration, memory and classroom behaviour. However, these questions have not been analysed in police education, possibly due to the complexity of the university curriculum coupled with law regulations.

For example, the basic academic studies at the University of Criminal Investigation and Police Studies (UCIPS), Belgrade, Serbia, last four years or eight semesters. There are 40 subjects (10 in each year of study) which in total account for 240 European Credit Transfer and Accumulation System (ECTS). The majority of subjects are from law, social and criminal sciences, while Specialised Physical Education bears 21 ECTS (or 8.75% of total units). If students complete all of the exams on time, they graduate after four years; those who do not keep up with the pace of completing exams in time, have up to eight years to graduate (by law). Thus, students can graduate at different times even though they were recruited the same year, which does not necessarily affect their GPA.

PURPOSE OF STUDY

An effective selection followed by an efficient study process are highly important not only for each police student, but especially for the police agencies, as they are responsible for ensuring

a safe and secure society. Therefore, the primary aim of this retrospective study was to determine the potential impact of the initial level of the physical abilities of police students on the selection process. The secondary goal was to investigate if the tested physical abilities were associated with study outcomes, such as the GPA and the TG.

METHODOLOGY

Research design and ethical compliance

Retrospective data for 618 male candidates applying for admission to the UCIPS were analysed. The selection process was designed as a multi-dimensional positive selection model, consisting of success achieved in previous education (maximum 40 points); health status with the evaluation of psychological structure and personal predispositions (eliminatory test); physical ability assessment (maximum 20 points); general knowledge test (maximum 20 points); and Serbian language test (maximum 20 points) (Dimitrijević *et al*., 2014). As the UCIPS sets a limit to the number of students that can enrol in each year, 152 best-ranked male candidates entered the 2009/2010 academic year. In contrast, 466 male candidates were not accepted and they comprised the non-enrolled group (NE).

Eight years after entering the studies, the 152 candidates were divided into two subsamples. The first subsample included 77 participants who had enrolled but did not graduate (ENG), having dropped out for a variety of reasons not specified in the data. The second subsample included 75 participants who had enrolled and graduated (EG).

All participants and the testing personnel were informed of the aims and the long-term importance of the data collection. Signing an informed consent was a mandatory part of the selection process. The research was conducted in accordance with the conditions of the Declaration of Helsinki, considering the recommendations guiding physicians in biomedical research involving human subjects (Christie, 2000), and with the permission of the Ethics Committee of the Faculty of Sport and Physical Education in Belgrade (Project III47015, Protocol No. 484-2).

Procedures

The candidates were divided into groups so that all assessments could be performed in a single day in accordance with the UCIPS Laboratory standardised procedure for assessing basic physical abilities. A standardised 10-minute running warm-up and 10-minute dynamic stretching protocol preceded the physical ability testing. Following a detailed explanation and demonstration of each test, all participants performed a practice trial followed by two consecutive experimental trials, and the best result was used for further analysis. The rest periods lasted two minutes between consecutive trials and 15 minutes between the two consecutive tests. The test of muscular endurance of the abdominal flexors (sit-ups) and aerobic endurance (Cooper 12-min running test) were performed once.

The same tests, except the CS, were conducted at the third year of studies as part of the examination process within the Specialised Physical Education. These results were compared to those from recruitment day in order to control if the physical fitness of the students from the ENG and EG groups lowered, remained the same or improved during the studies. Regarding the ENG group, only those students who had not dropped-out until the third year completed the test.

Measurements

Muscle force

Using standardised measurement procedures reported in previous research (Dopsaj *et al.*, 2000), maximal isometric force of the back extensors (Fmax_BE) was measured while participants were in the position of isometric dead lift. This involved exerting maximal force by pulling a tensiometric probe with a built-in A/D converter connected to a software system.

Muscular power of lower limbs

Lower-body power in the horizontal plane was assessed indirectly by a standing long jump (SLJ) test following the procedures of Pihlainen *et al*. (2018). Participants were instructed to jump as far as possible from the marked line with both feet, with no restrictions placed on the degree of arm swing or countermovement used. The distance from the starting to the landing point at the heel contact was measured in centimetres with 1cm measurement precision (Markovic *et al.*, 2007).

The Abalakow vertical jump test (ABL), consisting of a countermovement jump with arm swing and expressed as jumping height in centimetres, was used to indirectly measure the lower-body power in the vertical plane (Markovic & Jaric, 2004). Participants were instructed to jump as high as possible after performing a preceding countermovement with arm swing. Bending the knees and hips was not allowed during the flight phase of the jump. The test was conducted on a contact platform (Contact plate, Globus, Codogne, Italy; accuracy ± 0.001 second) that records flight time (t).

Upper-body muscular endurance and power

The muscular endurance of abdominal and hip flexors was assessed using a variation of the traditional sit-up (SU) test (each sit-up=contact between the opposite knee and elbow) wherein participants completed as many alternate rotations of the upper body as possible within 30 seconds (Dimitrijević *et al.*, 2014).

The repetitive power of the arm extensors was assessed using the maximum number of push-ups (PU) performed within 10 seconds. The initial position was with the body prone, arms extended, hands positioned at shoulder width, and only the feet and palms touching the floor (Ebben *et al*., 2011).

Aerobic endurance

General aerobic endurance was assessed using the 12-minute Cooper running test (RUN), whereby the participants were required to cover the longest possible distance in 12 minutes. This was shown to be a valid test ($r=0.93$, $p<0.001$) estimator of maximal oxygen consumption (Bandyopadhyay, 2015). The participants ran around the 230m long circuit track marked at every five metres for the required time.

Motor educability

Motor educability was assessed by the contraction and stretching test (CS). The aim of the CS test was to estimate the participant's ability to comprehend and learn complex motor tasks (Kolarević *et al.*, 2014). In the test, the participant lay supine on the mat, with his legs and arms fully extended and the arms above the head at shoulder width. The participant then flexed the hip and knee of one leg so that the whole foot made contact with the ground and continued to flex until the foot and the knee of the opposite leg (still extended) were in the same line. While

holding this position, the participant turned to the side of the extended leg and after reaching the lateral position, he flexed the whole body (trunk, arms, and legs) simultaneously, and assumed a position with open palms on each side of the head, elbows on the upper knees and feet in a dorsiflexed position. The participant then extended the whole body at once, returning to the initial position, and repeated the entire movement with the other side of the body.

The participant performed 24 consecutive alternate whole-body flexions and extensions, 12 on each side. The requirement was to perform as fast as possible, while each incorrect repetition was recorded as an error and the result was expressed as the total number of errors (err).

Study outcomes

The GPA of the police students who graduated was calculated as the average grade derived from a total number of exams that students completed within the curriculum. The higher GPA reflected higher success of the police students. The TG was presented in the number of months that police students needed to graduate. Generally, the UCIPS curriculum predicts that all subjects will be lectured and examined within four years, with ten months per year divided into two semesters. During the additional four years provided by law for completing the studies, only exams were organised for the students. The police students who graduated at the end of the 8^{th} semester were the most efficient students, and those who needed additional time were less efficient.

Analysis of data

Descriptive statistics (mean±standard deviation) were calculated for each variable. A standardised multivariate score and the centroid location of each group were defined using a discriminant analysis that indicated the impact of physical fitness on the recruitment process. The Pearson's correlation analysis was used to establish associations between investigated physical abilities and the EG group study outcomes. Statistical significance was set at $p<0.05$. Effect sizes were calculated for the correlation coefficients according to Sullivan and Feinn (2012) as small ($r=0.2$ to 0.49), medium ($r=0.50$ to 0.79), and large ($r>0.8$). A paired sample t-test was applied to determine the changes in physical abilities of the ENG and the NG after three years of study. All statistical analyses were conducted using the SPSS for Windows, Release 11.5.0 (Copyright by SPSS Inc., 1989-2002, Chicago, IL).

RESULTS

The descriptive parameters for the entrance exam physical abilities, the GPA and the TG are shown in Table 1. The matrix structure of the circuit variables in the separate discriminant function established two factors, discriminant Factor 1 (DF1) consisting of six statistically significant variables: PU, SU, SLJ, CS, RUN and ABL and discriminant Factor 2 (DF2) including only Fmax_BE (Table 2). The results showed that centroid positions of the study groups differed significantly only relative to the first discriminant function (Figure 1). The precision of the procedure and the applied measurement methodology were highly reliable as the DF1 explained 91.6% of the common variance of the overall system of five physical variables, while the DF2 explained 8.4% of the common variance. The subsequent reverse verification, using discriminant analysis for group classification, showed that 75.4% of all participants were classified correctly.

Table 1. **DESCRIPTIVE PARAMETERS OF PHYSICAL ABILITIES AT ENTERANCE EXAM, GPA AND TG.**

Physical abilities	**NON-ENROLLED** (n=466) Mean±SD	**NOT GRADUATED** (n=77) Mean±SD	**ENROLLED & GRADUATED** (N=75) Mean±SD
Fmax_BE (DN)	144.44±21.19	147.34±20.41	143.83±21.72
ABL (cm)	44.10±5.05	45.32±4.64	46.29±4.77
SLJ (cm)	222.01±19.12	229.13±14.74	231.96±17.89
PU (no)	10.92±2.187	11.97±1.49	11.84±1.56
SU (no)	24.71±3.53	26.00±4.00	26.62±3.38
CS (err)	8.85±5.97	6.64±5.12	6.36±4.35
RUN (m)	2602.89±294.68	2675.18±256.05	2754.50±246.58
TG (month)			59.69±14.28
GPA (score)			7.44±0.53

Fmax_BE=Maximal isometric force of the back extensors; ABL=Abalakow vertical jump; SLJ=Standing Long Jump; PU=Push-ups; SU=Sit-ups; CS=Contraction and stretching; RUN=12-minute Cooper running test; TG=Time to graduate; GPA=Average grade

Table 2. **RESULTS OF DISCRIMINANT ANALYSIS**

Variables	**Discriminant Factor 1**	**Discriminant Factor 2**
ABL (cm)	0.512*	0.238
SLJ (cm)	0.657*	-0.006
PU (no)	0.664*	-0.587
SU (no)	0.662*	0.112
CS (err)	-0.579*	0.230
RUN (m)	0.566*	0.346
Fmax_BE (DN)	0.053	-0.490*
Variance (%)	91.6	8.4
CC	0.292	0.920

*Highest absolute correlation between each variable and any discriminant function
ABL=Abalakow vertical jump; SLJ=Standing Long Jump; PU=Push-ups; SU=Sit-ups; CS=Contraction and stretching;
RUN=12-minute Cooper running test; Fmax_BE=Maximal isometric force of the back extensors; CC= canonical correlation.

Figure 1 reports the position of each group's centroid position (multiple Z-score) in relation to the separate canonical discriminant functions, with the same quantitative characteristics (the numerical value of the group centroid). The group centroids were significantly differently positioned relative to DF1 that was not the case with DF2.

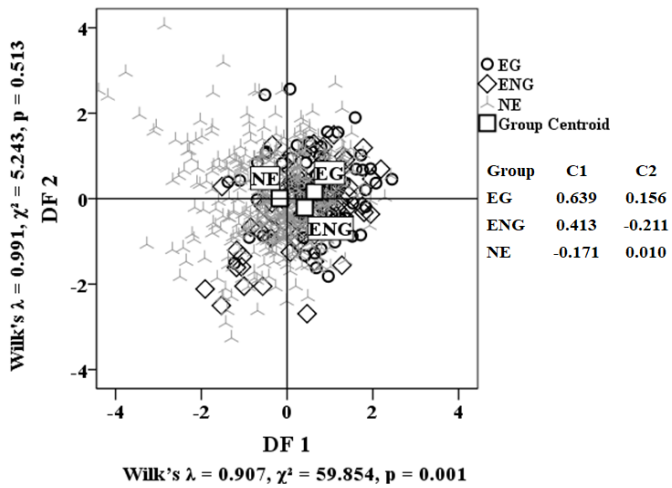

Figure 1. **CENTROID POSITION RELATIVE TO SEPARATE CANONICAL DISCRIMINANT FUNCTIONS**

Pearson's correlation coefficient analysis revealed no significant association for most of the tested physical abilities (Table 3). The only significant correlations of a small magnitude occurred between the TG and RUN, and between the GPA and SU.

Table 3. **PEARSON'S CORRELATION ANALYSIS**

Variables	Grade-point Average (GPA)	Time to graduate (TG)
Fmax_BE (DN)	-0.172	0.119
ABL (cm)	0.197	-0.137
SLJ (cm)	0.182	-0.166
PU (no)	0.172	-0.048
SU (no)	0.229*	-0.160
CS (err)	-0.111	-0.165
RUN (m)	0.031	-0.238*

*p<0.05; Fmax_BE=Maximal isometric force of the back extensors; ABL=Abalakow vertical jump; SLJ=Standing Long Jump; PU=Push-ups; SU=Sit-ups; CS=Contraction and stretching; RUN=12-minute Cooper running test

Table 4 shows the results of the t-test that compared the level of physical fitness measures from the recruitment to these measures obtained at the end of the third year of study. The EG group significantly improved the Fmax_BE and SU, while other physical abilities remained unchanged. The SLJ and the RUN were close to reaching significance, indicating the trend of increment in these two performance measures. The ENG group performed significantly higher in the Fmax_BE, but lower in the PU. Other abilities remained unchanged, with negative trends in the ABL and SU.

Table 4. **PAIRED SAMPLE t-TEST**

Variables	ENROLLED & GRADUATED (EG)		ENROLLED & NOT GRADUATED (ENG)	
	Mean diff.	p-Value	Mean diff.	p-Value
Fmax_BE	33.39	0.000	27.86	0.000
ABL	-0.28	0.700	-0.80	0.465
SLJ	4.52	0.063	2.75	0.475
PU	0.28	0.189	-0.55	0.046
SU	2.03	0.000	-0.15	0.847
RUN	63.57	0.051	0.00	1.000

Fmax_BE=Maximal isometric force of the back extensors; ABL=Abalakow vertical jump; SLJ=Standing Long Jump; PU=Push-ups; SU=Sit-ups; RUN=12-minute Cooper running test

DISCUSSION

The results of this study suggested that police students whose overall physical fitness was good on recruitment day were more likely to graduate at the UCIPS. The discriminant analysis revealed that police students from the EG group were superior in ABL, SLJ, PU, SU, CS, and RUN, as they positioned differently to the NE (non-enrolled) and ENG groups. The position of the centroids relative to DF2 was not significantly different between the groups and the EG group was positioned the highest.

Given the difference in positioning of the groups relative to DF1, it seems that the recruitment procedure was precise for the physical fitness. A small shared portion of variance between the SU and GPA, as well as between the RUN and TG is not causative, especially bearing in mind that multiple different factors (such as intellectual capacities) influences the academic outcomes far more than physical abilities does. In that sense, it would not be appropriate to talk about physical fitness as predictor of the GPA, even though correlation analysis provides an insight as to what physical abilities physical education teachers should pay attention.

In comparison to the current study, Lockie *et al.* (2019) investigated the reasons for the discontinuation of studies at police academy and found that aerobic endurance was lower in recruits who left the police academy due to physical fitness failure or injuries. The authors of this research concluded that improving aerobic endurance prior to entering the police academy was highly important, as this could influence the chances of successful graduation. This was supported by the results from this study, which may indicate that aerobic endurance can be a

relatively precise and sensitive indicator and predictor of progression throughout the police academy.

Similarly, Shusko *et al.* (2017) reported that baseline push-ups and 1.5-mile run-time showed the best ability to predict successful academy graduation in police recruits. Considering that the baseline aerobic endurance and muscular endurance probably resulted from the amount and type of pre-academy physical activity and exercise, one may argue that the recruits who had better aerobic endurance had spent more time conducting endurance training. Moreover, as dominant recruits were also more likely to graduate and less likely to become injured or drop-out, it may be contended that they persisted in maintaining their physical fitness throughout the academy. This persistence in physical training may also be suggested to have translated to perseverance in the studies of other subjects as well.

Additionally, police students who had better aerobic and muscular endurance might be more resilient and have faster recovery from physical training, which could allow them to have better focus on studying and lower risk of injuries (Knapik *et al.*, 2001; Deuster & Silverman, 2013; Silverman and Deuster, 2014). The present correlation (Table 3) and t-test (Table 4) analysis also seemed to strongly support this notion. Small correlations occurred between physical abilities and academic outcomes, while those who graduated tended to improve, while those who did not, remained the same or, although not significantly, their physical abilities declined.

Several studies that investigated associations between the components of physical fitness and academic outcomes of pre-university populations showed a positive association between these variables (Castelli *et al.*, 2007; Trudeau and Shephard, 2008; Du Toit *et al.*, 2011). Castelli *et al.* (2007) found that aerobic fitness and upper body muscular endurance (push-ups and curl-ups) correlated with academic achievement. More importantly, their regression analysis revealed that aerobic endurance was a significant predictor of success in mathematics and reading. Castelli *et al.* (2007) noted that, although not measured, motivation could be one of the reasons for these interactions because cognitive functions were shown to be associated with the attainment of aerobic fitness.

Moreover, Trudeau and Shephard (2008) reviewed a considerable number of studies (cross-sectional and quasi-experimental) on associations between physical activity and academic performance, and found that physical activity had a positive effect on concentration, memory and classroom behaviour. Du Toit *et al.* (2011) found significant correlations between sit-ups, standing long jump, and strength and academic outcomes, which they argued reflected the orientation towards the overall achievement among motivated learners. Considering this, although the present results revealed a low correlation coefficient, they indicated the same pattern as the associations from the above-mentioned studies. Thus, the results suggest that greater initial levels of a range of physical abilities may be an important factor in estimating police students' final study outcomes.

Finally, following the reasoning based on the results of this study, better fitness levels helped police students to reach high academic outcomes that may improve their future work performance in a highly demanding profession. They may become both more resilient to operational stressors (shift work, working alone at night, over-time demands, risk of injury) and more open to psychological, intellectual and emotional demands of modern policing.

PRACTICAL APPLICATION

A better understanding of the relationship between initial physical abilities and study outcomes may be useful for police academies to improve the recruitment process and the physical education curricula. Furthermore, it would allow strength and conditioning specialists working with police students to be more precise in planning physical preparation of the students. Finally, the results from this study suggest that similar research could be conducted on non-police students as physical fitness and physical activity seem to be positively associated with academic outcomes.

CONCLUSIONS AND LIMITATIONS

Given the sample size, sex bias, and magnitude of correlations, the results should be interpreted within the context of certain limitations. Concerning the latter, although the results that indicated a small correlation between the GPA and the number of SU performed, as well as between the RUN and the TG are indicative but they are also inconclusive, as other physical abilities did not correlate to any indicators of the study process. One may argue that there was no association between the level of initial physical abilities and study outcomes, such as the GPA and the TG. Considering the results from other studies on associations between physical fitness and academic outcomes, as well as the discrimination and correlation analyses from the current study, it seems that the same pattern may be responsible for achievement in both physical fitness and academic endeavours. Further research is needed to determine what these patterns are.

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