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Original research article

HAND GRIP SCALING IN DEFINING RISK FACTORS WHEN USING AUTHORIZED PHYSICAL FORCE*

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Abstract. *Police work is done among citizens, quite often in intricate conditions induced by factors of security which may call for an intervention with an extent of communication intensity ranging from low (verbal) to high and exceptionally high and risky (use of lower and severe levels of physical force) to deadly force. The present study aims to place the students of Academy of Criminalistic and Police Studies (ACPS) and active police officers (PO) on a scale within the population in their working environment, in view of the characteristics of basic contractility (maximal muscle force) of the primary manipulatory body organ (the hand) in its essential motor task (flexing all the fingers to produce a grip). The research included 368 respondents: 165 from 10 populations differing in their levels of physical activity and preparedness, while the criterion group of 203 respondents consisted of the ACPS students and PO. The results indicated the existence of four male populations who may be claimed to have significantly higher levels of maximal muscle hand grip force, with respect to the criterion group - PO and the ACPS students (ranging from 26.45 to 83.03 %); five populations had similar levels (from 5.93 to -12.06 %); while one population showed lower force levels (from -25.55 to -26.53 %). The contemporary approach to police higher education design must rest on the utilization of adequate scientific and methodological principles, which will yield the concept defined by the description of the conditions within the system of the environment in which the future police personnel will work.*

Key words: *police, Special Physical Education (SPE), hand grip test, professional risk, muscle force.*

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INTRODUCTION

In order for policing activities to be conducted in the safest possible manner, it is necessary to perform very precise risk assessments with respect to all professional situations encountered by officers authorized with law-enforcement powers (Subošić, & Nikolić, 2007). In particular, it is very important to make an accurate estimate of the likely occurrence of potentially problematic situations (Subošić, Milošević & Kekić, 2008). As authorized officers professionally meet with a population whose individual members can possess physical skills and motor abilities varying in structure and levels (at different public sports events, at special professional situations and so on), it is essential to identify all their potential population characteristics relevant to the police officers in question (Lough & Ryan, 2006; Ashkinazi et al., 2005; Subošić, Vučković & Kekić, 2011; Vučković, Subošić & Kekić, 2011). By a general definition, a system is a distinct functional entity comprising a set of components, their determined attributes, and a set of relations which connect the components and the attributes (Simić, 1990). A system is distinguished by congruity (a system is not a mere sum of its parts, i.e., their accumulation) and hierarchy (a system includes a "subsystem"). Thus, a system is a union of function and structure, as well as of interaction between the entity and its surroundings. This can be illustrated by the relations between the police and citizens (Subošić, 2010), the police and high-risk security situations (Ashkinazi, 2005; Vučković et al., 2011), the police and unfamiliar terrain (Milojković, 2009), or the police and natural or technological disasters and social conditions, especially disturbances (Milojković & Mlađan, 2010). With respect to the research area of Special Physical Education (SPE) aimed at the education of commanding and executive personnel in the police service, it can be maintained that the study subject belongs to the category of *dynamic management systems*. The basic characteristic of such systems is that within them, the transition from the initial condition to another, desired condition, be it transitive and/or final, cannot be instantaneous (Simić, 2010). This characteristic stipulates the category of time as a period within which the desired, targeted change occurs gradually in the characteristics of the system elements. In other words, through a targeted application of a selection of educational and training programs, a qualitative and quantitative transformation is carried out of the desired improvement of the system characteristics, i.e., the motor skills and physical abilities professionally required of the students and/or police officers (Lough & Ryan, 2006; Dopsaj et al., 2007; Dopsaj, Vučković & Vuković, 2011). As humans have biological limitations (innate ontogenetic and philogenetic characteristics), the development of particular physical and motor abilities has its boundaries; in its own right, this facilitates managing the system, that is, enables predictability of hypothetical professional requirements. Police work is done among citizens, in frequently intricate conditions induced by factors of security, climate or geography with a possible extent of communication intensity ranging from low (verbal), to high (use of lower levels of physical force), to exceptionally high and risky (use of severe levels of authorized force), ultimately to deadly force (Ashkinazi et al., 2005, Subošić, 2010). For the officers as the agents authorized by law-enforcement powers, including the right to use force, it is certainly in their best interest to secure the highest level of safety and professional action within their authorization by using their dominant physical abilities (of basic motor status – BMS) and their adequate professionally acquired motor skills (SPE). An essential requirement of a cybernetic approach to decision making and technology in policing is to define all the characteristics of the working environment in which the police operate

(Simić, 1990; Subošić & Nikolić, 2007; Dopsaj, Vučković & Blagojević, 2007). This should be done in view of placing the police population within their surroundings, after which, in the case of potential deficiencies in the next step, it is possible to define the measures and procedures for potential corrections in the educational system so as to improve the quality of its output effect. In this respect, police education should be fully adjusted to the needs of the society and be successful in contributing to the adaptive response of the national security system to all challenges, risks and threats from organized crime, terrorism, wars, natural and technological accidents or catastrophes, and so on. The hand grip has proved to be a phenotypical characteristic to identify a person genetically predisposed to higher physical abilities at middle and elderly age (Frederiksen et al., 2002). A statistically significant correlation has been established between hand grip strength on the one hand and the quality of life and most daily habits (Tyldesley & Grieve, 2000), overall body strength (Taglione et al., 1999), upper extremity (arm) strength (Ikemoto et al., 2007), anthropometrics (Koley & Kumar, 2009), as well as efficient use of authorized weapons (Vučković & Dopsaj, 2007) on the other hand. Moreover, statistically significant correlations have also been established with the most basic motor skills which dominate the SPE syllabus, such as gripping, punching, throwing, fixing, pushing, striking, blocking strikes, gripping positions at heights, manipulating objects and so on (Ramírez García, Harasymowicz, Aréchiga Viramontes, Alvear Órdenes & Vázquez, 2010; Franchini, Miarka, Matheus & Boscolo Del Vecchio, 2011). The same test has become a standard in the methodology of testing top athletes in various sports and sport disciplines (Ramírez García et al., 2010; Singh, Singh & Singh, 2010), as well as of the general population (Taglione et al., 1999; Frederiksen et al., 2002; Ikemoto et al., 2007).

The aim of this study was to place the students of the Academy of Criminalistic and Police Studies (ACPS), as future highly educated police officials and active police officers, as current agents of the system of national security, on a scale within the population in their working environment, in view of the characteristics of basic contractility (maximal muscle force) of the primary manipulatory body organ (the hand) in its essential motor task (flexing all the fingers to produce a grip). The findings will facilitate scaling ACPS students and general duty police officers in relation to the individuals with various physical characteristics and lifestyles, with respect to physical exercise as a police working environment system. The results will primarily assist the development of the applied scientific methodology in assessment, planning and programming of the work and education systems in the police. In addition, they will also be applicable in the efficiency analysis of high police education syllabi, professional training and development programs, as well as the selection potential of the concept under observation.

THE METHOD

The sample

The study included the following overall sample of healthy adult male population (N=368) from the Republic of Serbia. The first group consisted of different subgroups of participants with respect to a range of fitness levels relative to a variety of physical characteristics (N=165):

1. participants well trained in terms of maximal power and strength (*Power Lift*, N=12, Age=28.25±7.48 yrs, BH=186.52±7.32 cm, BM=96.43±14.93 kg, BMI=27.63±3.36 kg·m^{-2}),
2. participants well trained in terms of combat sports – judoists, wrestlers, and karateists (*Combat Sports*, N=27, Age=25.04±4.51 yrs, BH=178.00±7.45 cm, BM=82.28±14.80 kg, BMI=25.82±2.91 kg·m^{-2}),
3. participants well trained in terms of basic characteristics of muscular power and strength – regular gym workout at least twice a week for longer than 6 months continuously (*Gym Workout*, N=30, Age=29.86±11.38 yrs, BH=183.13±5.37 cm, BM=88.28±8.01 kg, BMI=26.34±2.28 kg·m^{-2}),
4. participants well trained in terms of all motor skills, predominantly power endurance – athletes in sports games where contact with the opponent is allowed – water polo and handball players (*Contact Sports Games*, N=13, Age=22.06±1.37 yrs, BH=193.27±3.94 cm, BM=92.99±5.98 kg, BMI=24.90±1.43 kg·m^{-2}),
5. participants well trained in terms of speed-strength characteristics – sprint, jump and decathlon athletes (*Speed-Strength Sports*, N=15, Age=23.35±1.83 yrs, BH=190.49±4.95 cm, BM=80.50±6.76 kg, BMI=22.17±1.55 kg·m^{-2}),
6. participants well trained in terms of aerobic endurance – football, triathlon, sports orienteering athletes (*Aerobic Endurance Sports*, N=7, Age=23.10±6.01 yrs, BH=182.70±8.90 cm, BM=76.42±9.43 kg, BMI=22.81±0.84 kg·m^{-2}),
7. participants well trained in terms of all motor skills – the students of the Faculty of Sports and Physical Education (*FSPE Students*, N=19, Age=24.31±2.33 yrs, BH=183.44±5.40 cm, BM=82.75±8.88 kg, BMI=24.56±1.94 kg·m^{-2}),
8. participants who exercise regularly with controlled medium intensity general loads (*Recreational Workout*, N=7, Age=33.91±12.38 yrs, BH=177.53±4.69 cm, BM=81.26±7.38 cm, BMI=25.80±2.35 kg·m^{-2}),
9. young and healthy participants who do not exercise regularly – students of different faculties of the University of Belgrade (*Youth Control Group*, N=15, Age=21.58±4.35 yrs, BH=183.75±7.10 cm, BM=86.86±18.99 kg, BMI=25.68±5.04 kg·m^{-2}),
10. adult healthy participants with a predominantly sedentary lifestyle (*Adult Control Group*, N=19, Age=32.59±4.33 yrs, BH=183.94±3.52 cm, BM=85.53±11.03, BMI=25.05±3.58 kg·m^{-2}).

The second group, the criterion groups representing various samples of police officers (N=203), included:

1. general duty police officers as the representatives of the most numerous population of agents authorized by law-enforcement powers (*Police Officers*, N=21, Age=39.55±5.50 yrs, BH=179.33±6.06, BM=83.91±8.88 kg, BMI=26.05±2.03 kg·m^{-2}),
2. ACPS students as prospective senior managers in the police service (*ACPS Students*, N=182, Age=20.22±1.60 yrs, BH=181.69±5.88 cm, BM=80.51±9.49 kg, BMI=24.36± 2.37 kg·m^{-2}).

All of the tests were conducted in compliance with the professional and ethical standards recommended by the American College of Sports Medicine 2006 guidelines (American College of Sports Medicine, 2006). This study applied the *ex post facto* standardized testing procedure and measuring instruments (Hair et al., 1998). In order to measure the levels of basic contractility – maximal muscle force (Sahaly, Vandewalle, Driss & Monod, 2001), the hand grip test was used in accordance with the procedure described earlier (Dopsaj et al., 2007).

Variables

The following variables were used in the study:

1. the maximal value of the measured voluntary muscle force realized by the task – the left hand grip (F_{max}_HG_Left) and the right hand grip (F_{max}_HG_Right); the overall indicator (sum) of the right and the left hand grip strength (F_{max}_R+L) expressed in Newtons (N),
2. the relative value of the measured voluntary muscle force realized by the task – the left and right hand grip, calculated as the relation between the hand grip strength in N with respect to the body mass in kg (F_{rel}_HG_Left, and F_{rel}_HG_Right) expressed in N/kg BM, and the overall indicator (sum) of the relative right and left hand grip strength (F_{rel}_R+L) expressed in N (N/kg BM),
3. the individual score value with respect to the total population tested for each particular variable was calculated in accordance with the procedure described earlier (Dopsaj, Vučković & Blagojević, 2007; Zatsiorsky, 1982). It is expressed in number score points to the second decimal for the following variables: Z_{SCORE}_F_{max}_Left, the score value for the left hand grip F_{max}; Z_{SCORE}_F_{max}_Right, the score value for the right hand grip F_{max}; Z_{SCORE}_F_{rel}_Left, the score value for the left hand grip F_{rel}; Z_{SCORE}_F_{rel}_Right, the score value for the right hand grip F_{rel} and the overall indicator of the right and the left hand grip strength (Z_{SCORE}_R+L).

Thus the measurement was obtained for absolute and relative values of the maximal voluntary isometric muscle force of the hand grip at the basic extremity responsible for the general and specific motor manipulation of the cranial (upper) body parts (Tyldesley & Grieve, 2000). The sample included men in 12 populations differing with respect to the levels of physical activity and fitness. Out of these, 10 belonged to populations with whom, hypothetically, the police officers could come into professional contact, under circumstances bearing the potential risk of using physical force within their authorization.

The multidimensional scale factor method (Dopsaj, Vučković & Blagojević, 2007) was used to unify the position of each population with regard to the same criterion distributed in numerical values from 0 to 100 point numbers (0, as the hypothetical minimum, 50 as the hypothetical mean, and 100 as the hypothetical maximum). Then it was possible to calculate the quantitative numerical attribute of the measured contractile characteristics, i.e., the variables used in order to enable their comparison and subsequent scaling of the populations with respect to the manifested philogenetic potential.

Statistical analyses

Firstly, all of the results were analyzed using the basic descriptive statistic method which yielded: the mean value – MEAN and standard deviation – SD. The model of the dependence between the original and overall variables F_{max} and F_{rel}, and the score values of the distribution was defined by a linear regression analysis, using the general form of the equation $y = ab^x$. The differences between the variables on a general level were established by a multivariate analysis of variance – MANOVA (12 samples with 8 variables each), while the differences between single variables across the groups were determined by a one-way analysis of variance – ANOVA. A Bonferroni test was used to establish the variance in single variables across group pairs (Hair, Anderson, Tatham & Black, 1998).

All normative criteria were expressed in points and were defined in seven class categories of strength levels as: superior (over 83.33 score points), excellent (66.67 to 83.32 score points), very good (58.33 to 66.66 score points), average (41.67 to 58.32 score points), below-average (33.33 to 41.66 score points), low (16.67 to 33.32 score points), and poor (less than 16.66 score points), in accordance with metrological criteria in sports science (Zatsiorsky, 1982). Statistical difference was defined at the probability of 95% for $p \leq 0.05$. All of the data processing was done in Excel 2003 (Microsoft®Office Excel 2003) and SPSS Statistics 17.0.

THE RESULTS

Table 1 gives all basic descriptive variable indicators of the studied populations.

Table 1. Basic descriptive variable indicators of the studied populations.

Sample Population		F_{max}_HG_L (N)	F_{rel}_HG_L (N/kg)	Z_{SCORE}_F_{max}_L (Score number)	Z_{SCORE}_F_{rel}_L (Score Number)	F_{max}_HG_R (N)	F_{rel}_HG_R (N/kg)	Z_{SCORE}_F_{max}_R (Score Number)	Z_{SCORE}_F_{rel}_R (Score Number)
Power Lift	Mean ± SD	805.40± 62.29	8.476± 0.962	87.87± 0.751	71.25± 15.41	832.42± 62.16	8.754± 0.934	83.53± 10.14	65.71± 13.47
Combat Sports	Mean ± SD	584.03± 105.54	7.188± 1.147	49.67± 18.21	50.63± 18.36	618.78± 134.86	7.615± 1.444	48.68± 21.99	49.28± 2083
Gym Workout	Mean ± SD	688.93± 79.35	7.825± 0.789	67.77± 13.69	60.83± 12.63	736.16± 81.86	8.361± 0.828	67.73± 13.23	60.02± 11.95
Contact Sports Games	Mean ± SD	641.12± 77.93	6.927± 0.968	59.52± 13.45	46.46± 15.49	710.02± 99.63	7.661± 1.140	63.56± 16.25	49.94± 16.44
Speed-Strength Sports	Mean ± SD	622.99± 73.90	7.805± 1.255	56.39± 12.75	60.51± 20.09	711.09± 81.86	8.889± 1.267	63.74± 13.35	67.66± 18.29
Aerobic Endurance Sports	Mean ± SD	540.05± 137.72	7.001± 0.981	42.08± 23.77	47.66± 15.70	575.22± 139.17	7.467± 1.035	41.57± 22.70	47.14± 14.94
FSPE Students	Mean ± SD	567.51± 86.13	6.851± 0.683	46.81± 14.86	45.25± 10.94	607.41± 111.39	7.324± 0.922	46.83± 18.17	45.07± 13.30
Recreational Workout	Mean ± SD	566.32± 61.16	6.977± 0.798	46.61± 10.56	47.26± 12.77	598.28± 86.01	7.382± 1.232	45.34± 14.03	45.91± 17.77
Youth Control Group	Mean ± SD	496.71± 78.83	5.925± 1.361	34.60± 13.60	30.42± 21.79	536.47± 61.00	6.395± 1.265	35.25± 9.95	31.68± 18.26
Adult Control Group	Mean ± SD	560.73± 109.09	6.570± 1.064	45.64± 18.83	40.74± 17.04	634.33± 101.11	7.477± 1.176	51.22± 16.49	47.28± 16.97
Police Officers	Mean ± SD	580.65± 72.85	6.966± 0.964	49.08± 12.57	47.10± 15.43	594.61± 83.56	7.167± 1.329	44.74± 13.63	42.81± 19.18
ACPS Students	Mean ± SD	571.14± 80.85	7.137± 0.950	47.44± 13.95	49.82± 15.20	611.73± 84.23	7.650± 1.036	47.53± 13.74	49.78± 14.95
Total Sample (N=468)	Mean ± SD	585.97± 96.58	7.148± 1.041	49.99± 16.67	50.00± 16.67	628.47± 103.34	7.672± 1.154	50.26± 16.84	50.10± 16.66

Table 2 gives the ANOVA results, which can be indicative of the existence of a general statistically significant difference in all hand grip muscle force characteristics among the different populations.

Table 2. ANOVA results – Differences between the populations with respect to the variables indicating hand grip muscle force characteristics.

Tests of Between-Participant Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Observed variables	F_{max}_HG_Left	1174582.71	11	106780.25	15.31	0.000
	F_{rel}_HG_Left	73.65	11	6.69	7.06	0.000
	F_{rel}_HG_Left_kg	0.77	11	0.07	7.06	0.000
	Z_{SCORE}_F_{max}_Left	34974.82	11	3179.53	15.30	0.000
	Z_{SCORE}_F_{rel}_Left	18863.39	11	1714.85	7.05	0.000
	F_{max}_HG_Right	1304705.61	11	118609.60	14.69	0.000
	F_{rel}_HG_Right	84.51	11	7.68	6.51	0.000
	F_{rel}_HG_Right_kg	0.88	11	0.08	6.50	0.000
	Z_{SCORE}_F_{max}_Right	34608.98	11	3146.27	14.66	0.000
	Z_{SCORE}_F_{rel}_Right	17583.34	11	1598.48	6.51	0.000

Graph 1 presents the score point ordering of the studied populations, where the results are expressed as the mean F_{max} score of both hands (Z_{SCORE}_F_{max}_Left + Z_{SCORE}_F_{max}_Right / 2). It was shown that:

- superior strength levels were found in
  - participants well trained in regard to maximal power and strength – *Power Lift* (85.63 points),
- excellent strength levels were found in
  - participants who worked out regularly – *Gym Workout* (at least twice a week for longer than 6 months continuously) (66.71 points),
- very good strength levels were found in
  - participants well trained in terms of all motor skills, predominantly power endurance – *Contact Sports Games* (61.43 points),
  - participants well trained in terms of speed-strength characteristics – *Speed-Strength Sports* (59.95 points),
- average strength levels were found in
  - participants well trained in terms of combat sports – *Combat Sports* (49.56 points),
  - participants well trained in terms of all motor skills – *FSPE Students* (47.85 points),
  - *ACPS Students* as prospective senior managers in the police service (47.41 points),
  - general duty *Police Officers* as the representatives of the most numerous population of agents authorized with law-enforcement powers (46.78 points),
  - participants who exercise regularly with controlled medium intensity general loads – *Recreational Workout* (45.62 points),
  - the control group of adult healthy participants with a predominantly sedentary lifestyle – *Adult Control Group* (45.14 points),

  - participants well trained in terms of aerobic endurance – *Aerobic Endurance Sports* (41.69 points),
- below-average strength levels were found in
  - young and healthy participants who do not exercise regularly – *Youth Control Group* (34.83 points).

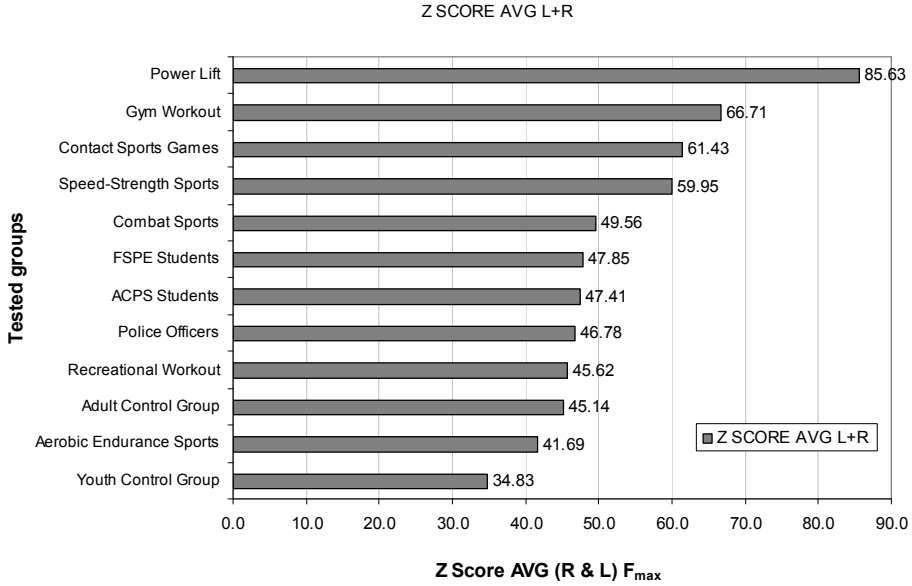
No participants from the sample tested in this study had either low or poor hand grip strength.

Graph 2 displays the score point difference for the mean F_{max} score of both hands ($Z_{SCORE}\_F_{max}\_Left + Z_{SCORE}\_F_{max}\_Right / 2$), so as to show the sufficiency or the deficiency in the levels of the measured contractile ability with respect to the sample populations. The results are displayed as percentage differences in score points calculated as the mean F_{max} score of both hands:

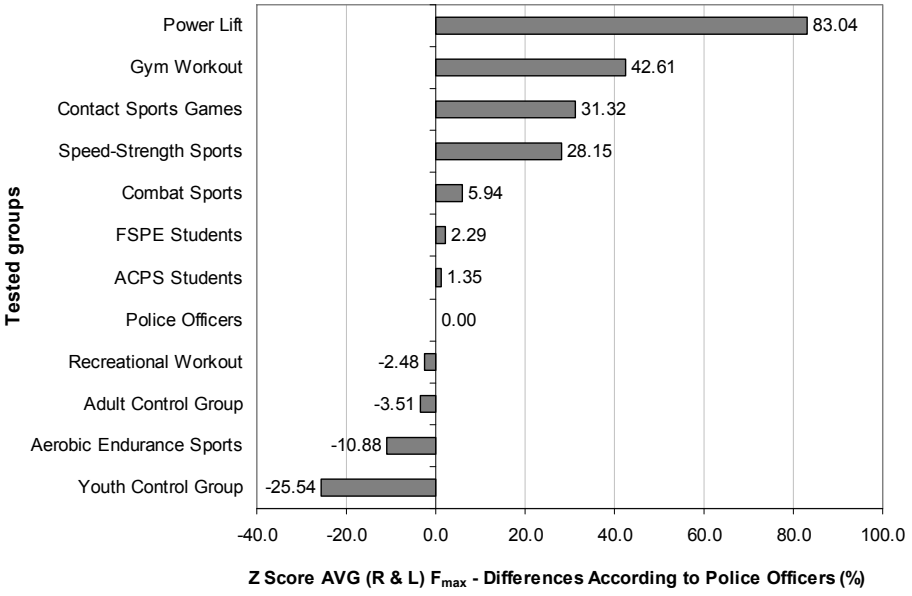
- the population classified as having superior strength levels (Power Lift) had by 83.03 and 80.62% better hand grip contractile ability compared to the criterion population of ACPS and general duty police officers (statistically significant improvement at: t=11.331, p=0.000 and t=8.312, p=0.000, respectively),
- the population classified as having excellent strength levels (Gym Workout) had by 42.60 and 40.71% better contractile ability compared to the criterion population of ACPS and general duty police officers (statistically significant improvement at: t=6.712, p=0.000 and t=4.616, p=0.000, respectively),
- the populations classified as having very good strength levels had a by 31.31 and 29.77% (Contact Sports Games) and 28.14 and 26.45% (Speed-Strength Sports) better contractile ability compared to the criterion population of ACPS and general duty police officers (statistically significant improvement at: t=2.089, p=0.045 and t=2.025, p=0.048 vs t=2.355, p=0.016 and t=2.103, p=0.023, respectively),
- the populations classified as having average strength levels had a, by 5.93 and 4.53% (Combat Sports) and 2.29 and 0.93% (FSPE Students), better but statistically non-significant contractile ability compared to the criterion population of ACPS and general duty police officers (statistically non-significant at: t=0.486, p=0.315 and t=0.505, p=0.308 vs t=0.909, p=0.187 and t=0.530, p=0.299, respectively), while the following populations showed lower levels and also a statistically non-significant contractile ability than the criterion population: by -2.48 and -3.78% (Recreational Workout), -3.51 and -4.79% (Adult Control Group), as well as -10.89 and -12.06% (Aerobic Endurance Sports) (statistically non-significant at: t=0.443, p=0.335 and t=0.249, p=0.403 vs t=1.378, p=0.093 and t=1.029, p=0.156 vs t=0.512, p=0.313 and t=0.413, p=0.345, respectively),
- the population classified as having below-average strength levels (Youth Control Group) had by -25.55 an -26.53% statistically significant lower levels of contractile ability than the criterion populations (t=3.930, p=0.001 and t=3.199, p=0.002, respectively).

Table 3 shows the defined simple mathematical dependence models for F_{max} and F_{rel} for the left and the right hand grip separately, as well as the mean values of F_{max} and F_{rel} for the left and the right hand together (x value) with the scores of the total population sample (y value). The method applied ensured absolute prediction accuracy for the original (raw) data so that the determination coefficient (R^2) for each defined model was 1.00, i.e., 100% (Table 3). The mathematical models used enabled placement prediction for a sample participant (by simply entering their results of the hand grip contractile ability

into the formula – *x* value) with respect to the measured ability of the total population of the hypothetical working environment (*y* value). Thus the sample of participants could be placed on a 0 to 100 scale showing the measured ability.



Graph 1. Score point ordering for the mean $Z_{SCORE}\_F_{max}\_Left + Z_{SCORE}\_F_{max}\_Right$ in the sample populations.



Graph 2. Score point difference for the mean $Z_{SCORE}\_F_{max}\_Left + Z_{SCORE}\_F_{max}\_Right$.

Table 3. Prediction equations of the defined dependence models for raw contractility variables (F_{max} and F_{rel} for the left and right hand grip, and F_{max} and F_{rel} L+R hand grip) with score values.

Hand	Characteristic	General Score Model prediction equation	Prediction accuracy
Left hand grip	F_{max} (N)	y = 0.1730x - 51.4979	R^2 = 1.00
	F_{rel} (N/kg)	y = 16.0879x - 65.1161	R^2 = 1.00
Right hand grip	F_{max} (N)	y = 0.1632x - 52.4102	R^2 = 1.00
	F_{rel} (N/kg)	y = 14.4603x - 60.9317	R^2 = 1.00
R+L hand grip	F_{max} (N)	y = 0.0862x - 54.6486	R^2 = 1.00
	F_{rel} (N/kg)	y = 7.9074x - 67.1865	R^2 = 1.00

DISCUSSION

The ever-accelerating development of hardware, software, and information technologies affecting technical support, management systems, training methods, or work technology is obvious in every field of maintaining security through all relevant agencies, public, military, or specialized (Charman, Savage & Cope, 1999; Deschamps, Paganon-Badinier, Marchand & Merle, 2003; Lough & Ryan, 2006, Milojković, 2009; Dopsaj et al., 2007; Vučković & Dopsaj, 2007). However, the long-defined principle that preventive action is the best security measure is still the prevailing concept in policing (Subošić, 2010). Partly, such preventive measures are expressed through adequate selection, physical and professional training, maintaining specific fitness levels, and general preparedness of police officers to apply their authorized powers in circumstances inducing physical contact with other persons, or other high risk security situations (Deschamps et al. 2003; Subošić, Milošević & Kekić, 2008; Ashkinazi et al., 2005; Subošić, Vučković & Kekić, 2011; Vučković, Subošić & Kekić, 2011).

The results of this study indicated that there were as many as four male populations that can be claimed to have statistically significant levels of more developed maximal muscle force (of hand grip) than the tested sample of police officers and ACPS students in the range between 26.45 and 83.03 % (Table 1 and Graph 1). All the populations were characterized by a high level of physical activities and training aimed at developing contractile abilities with respect to maximal force and strength, speed-strength and strength endurance.

Besides, it was determined that there were four populations with indicators of a maximal force similar to the criterion group (in the range between 5.93 and -13.06 %): the participants with top training in combat sports, well trained in terms of all motor skills, participants who trained recreationally, who did aerobic endurance training or those in the adult control group with a sedentary lifestyle.

The only population with significantly lower criterion indicators (ranging from -25.55 to -26.53 %) included the participants from the young population who did not exercise regularly.

Firstly, the results point to the fact that systematic and regular exercise programmed to develop physical abilities is important for adequate physical preparedness in ACPS and police officers is the way to provide better placement as compared to their working environment.

Next, the results of this study proved the existence of a scientific methodology and its statistics which could make it possible to calculate, classify and define the up-to-date scaling of police officers' general physical preparedness with respect to the professional risks of their working environment. Certainly, physical abilities belong to a multidimensional category, which means that in order to provide professional risk assessment it is necessary to use the data on other physical properties, that is, general and specific motor skills such as energy potential, force and strength indicators of various muscle groups, different aspects of speed and dexterity, Special Physical Education skills, special police skills, etc. (Charman, Savage & Cope, 1999; Ashkinazi et al., 2005).

Thirdly, this study is significant for the potential of the applied scientific methodology, which can be used to evaluate the efficiency of the models in the present or future system of education, training and professional development of police officers. Namely, after the initial model has placed a police officer within the environment and the education and training model has been implemented, a re-test of physical abilities can provide an insight into the direction and intensity of the induced change in the placement on the working environment population scale. The given numerical value, providing quantitative scaling of the current level of the officer's physical preparedness, is the absolute parameter, while the numerical difference between the current and the initial positions is the measure of how efficient the applied training model has been.

CONCLUSIONS

A great number of studies have established the importance of physical preparedness in police officers at executive or command positions, in view of more effective and efficient resolution of specific ordinary or extraordinary security situations in varied working environments realized in space which can be confined or exposed, in an open urban area, or unfamiliar rural terrain (Vučković, & Dopsaj 2007, Charman, Savage & Cope, 1999; Vučković, Subošić & Kekić, 2011). In the circumstances of fighting against organized crime, civil unrest or terrorism, police officers often encounter situations where perpetrators focus their aggression on agents authorized with law-enforcement powers who are trying to prevent them, rather than on the civilian bystanders at the crime scene. It is then that the issues arising from inadequate degree of training, inexperience in estimating the problem situation, poor stress management, lack of professionalism and tact in the first contact, lack of self-initiative, security, self-confidence and mutual trust among police officials accumulate towards failure to adhere fully to the basic principles of using physical force, even when legal requirements have been justified. Moreover, this heightens the concern for their own safety, which increases drastically, particularly in cases of inadequate general and specific physical preparedness in police officers. Finally, such issues do not contribute to building trust and good relationships between the police and the citizens. Therefore, one of the key responses to the above-mentioned issues lies in modern, socially responsible high education of the police force, their professional training and further development. Such a concept assumes an undauntedly transformed and permanently innovative approach to producing high-quality police force, ready to provide an adequate response to all the requirements arising from contemporary social conditions and prospective tasks lying ahead.

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GRADACIJA SNAGE STISKA RUKE U DEFINISANJU FAKTORA RIZIKA PRILIKOM UPOTREBE DOZVOLJENIH FIZIČKIH MERA

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Svoj rad policija mora vršiti među civilima, često u složenim okolnostima na koje utiču bezbednosni faktori koji mogu zahtevati intervenciju koja po svom intenzitetu može biti u rasponu od niskih vrednosti (verbalna opomena) do visokih i irazito visokih (upotreba različitih nivoa fizičke sile) pa sve do smrtonosne sile. Ovo istraživanje kao cilj ima da na skali predstavi studente Akademije za kriminalistiku i policijske studije (ACPS) i već aktivne članove policije (PO) u okviru populacije u njihovom radnom okruženju, u pogledu karakteristika osnovne kontrakcije (maksimalne snage mišića) i primarnog manipulatornog organa tela (ruke) prilikom osnovnog motoričkog zadatka (savijanje svih prstiju kako bi se neki predmet uhvatio). U istraživanje je uključeno 368 ispitanika: 165 iz 10 populacija koje se razlikuju u nivoima fizičke aktivnosti i spremnosti, dok su kontrolnu grupu od 203 ispitanika činili student ACPS i PO. Rezultati ukazuju na postojanje četiri muške populacije za koje se može reći da imaju značajno veće nivoe maksimlanog stiska ruke, u poređenju sa kontrolnom gruppm - PO i studenti ACPS (u rasponu od 26.45 do 83.03 %); pet populacija bilo je na sličnom nivou (od 5.93 do -12.06 %); dok je jedna populacija imala niže vrednosti snage (od -25.55 do -26.53 %). Savremeni pristup organizaciji višeg obrazovanja policijskih snaga mora se bazirati na adekvatnim naučnim i metodološkim principima, koji će nas dovesti do koncepta koji je definisan opisom uslova u okviru sistema okruženja u kome će budući policijski službenici raditi.

Ključne reči: *policija, specijalno fizičko obrazovanje (SPE), test snage stiska ruke, profesionalni rizik, snaga mišića.*