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DOI: 10.5937/bezbednost1902028K
UDK 351.74:613.71/74 (083.132)
Originalni naučni rad
Primljen: 22. 4. 2019. godine
Revizija: 30. 5. 2019. godine
Revizija: 21. 6. 2019. godine
Datum prihvatanja: 4. 6. 2019. godine

The Strategic Approach To An Improvement Of Health-Related Physical Fitness Of Police Officers: An 8-Week Exercise Intervention – Pilot Study[1]

Abstract: *The aim of this study was to investigate the effects of a planned exercise program and lectures followed by a brochure containing the nutrients arranged by quality on measured components of health-related physical fitness.The applied treatments positively affected the restructuring of body composition by reducing the relative amount of fat tissue in the body, local muscular endurance of upper-body, and aerobic endurance.The effects of the treatment depend on the level of control and self-control more than on the length of the treatment, while the level of control (and especially self-control) can be improved by increasing the knowledge about the association of health-related physical fitness and health, with given practical solutions. In that regard, the agencies should provide exercise programs and physical activities for their employees but also develop the strategies for a work-place health promotion that would steer the police officers(POs) and their families towards the involvement in healthy lifestyle.*

[1]This research is part of the National Scientific Project "Effects of applied physical activity on locomotor, metabolic, psychological, social and educational status of the population of the Republic of Serbia", No. ID III 47015, and it is financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia

Keywords: *weight loss, health education, police agencies, occupational health, physical activity.*

Introduction

In so-called industrialized and online societies, where habitual physical activity has been tremendously reduced by technology, the prevalence of various non-communicable diseaseshas increased (Bouchard et al., 2018, pp. 4–8). Increasing prevalence of obesity due to hypokinezia and poor nutrition represents main triggers of health problems related to non-communicable diseases in today's society (Sharkey & Davis, 2008, p. 4).It increases the risk of cardiovascular diseases, diabetes, lowers one's overall quality of life and increases the risk of premature mortality(Ardern et al., 2003; Lee &Skerrett, 2001; Stevens et al., 1998). According to the World Health Organization (WHO), obesity has nearly tripled since 1975, whereby there were around 1.9 billion of overweight adults in 2016, of which 650 million were obese (WHO, 2017).

Although police agencies are the organizations first in the line responsible for security and safety of the society, they were not omitted from aforementioned changes (Kukić et al., 2017; Kukić&Dopsaj, 2016; Sorensen et al., 2000).Some of the tasks performed by police officers (POs) can involve running to catch a suspect, grappling, wrestling and fighting with uncooperative belligerents and carrying injured or unconscious people(Pryor et al., 2012; Sharkey & Davis, 2008, pp. 4–8), often while wearing and carrying external loads (Baran et al., 2018; Carbone et al., 2014). Based on the nature of these tasks and task requirements it is evident that POs need to be physically prepared to perform these duties sufficiently and effectively, and with a reduced risk of injuries (Anderson et al., 2001; Dopsaj et al., 2007; Guffey et al., 2015). In that regard, good physical fitness is a prerequisite for a good health and physical performance of POs(Dawes et al., 2017; Kukić&Dopsaj, 2017).

Conversely, POs spend the majority of time at work conducting duties that are not physically demanding and are often sedentary in nature (e.g. walking, driving, deskwork, sitting in a parked car, etc.) (Garbarino&Magnavita, 2015).This often leads to a reduction of 10 –

32% in a PO's physical performance and increase of body fat (BF), often followed by increased cardiovascular health risksand mortality risk (Kukić et al., 2017; Lagestad et al., 2014; Sorensen et al., 2000; Stevens et al., 1998). Additionally, review studies have shown that components of physical fitness such as body composition and physical abilities are negatively affected as the time spent in service increases (Kukić et al., 2018a; Petersen et al., 2016). This trend partially occurs because POs are expected to conduct physical activity in their leisure time, which can often be filled with other commitments such as family activities, secondary jobs or recovery time. A few studies reported effects of exercise intervention on some physical fitness components of POs(Čvorović et al., 2018b; Demling&DeSanti, 2000; Kukic et al., 2018b), but not on the main ones that are of interest for POs and without a clear and sustainable strategy for the maintenance of physical fitness.

Depending on the nature of tasks that POs are potentially required to do while on duty, they may need to have developed different type of physical fitness.Firefighters and SWAT teams would need a well-developed performance-related physical fitness(Anderson et al., 2001; Dawes et al., 2014; Maupin et al., 2018), while administrative officers would need a good health-related physical fitness (Kukić&Dopsaj, 2016, 2017).However, studies have shown that certain components of physical fitness are highly associated to both, health and performance related physical fitness (Anderson et al., 2001; Arvey et al., 1992; Dawes et al., 2014). In that regard, Hauschild et al. (2017) conducted a review study on fitness tests and occupational tasks and found that upper-body muscular endurance and aerobic endurance are particularly relevant when assessing health status of POs. Since the percent of body fat (PBF) has been negatively associated to healthand performance(Dawes et al., 2014; Ma et al., 2011; Violanti et al., 2017)it is also considered to be one of the main pillars of health-related physical fitness (Riebe et al., 2018, pp. 66–79).

To our knowledge, there is a significant gap in scientific data on developing strategies for improvement of physical fitness of POs.In that regard, this pilot study contributes by providing an initial data on impact of an organized eight-week exercise program followed bylectures anda brochure about the healthy eating on components of health-related physical fitness. Thus, the aim of this study was to

investigate the effects of a planned exercise program and lectures followed by a brochure on measured components of health-related physical fitness.It was hypothesized that investigated components of health-related physical fitness would change under the influence of the applied intervention.

Materials and methods

A longitudinal observational study design with a stratified sample of convenience has been applied to investigate the effects of an 8-week exercise program followed by a brochure (Kukić et al., 2019b) and lectures on health-related physical fitness of POs. Only overweight and obese POs were called through the employee emailing system to join the losing weight course organised by theTraining section of police sports education center. Only healthy POs who met the enrolment criteria were tested at the beginning of the course – test, and at the end of the course – re-test.

Participants

Fourteen male POs with BMI > 27.5 kg/m^2,age = 33.45 ± 6.09 years, body height (BH) = 172.71 ± 7.26 cm, and body mass(BM) = 109.86 ± 14.84 kgwere included in an organized training program for eight weeks.The participants were recruited systematically, through an employee mailing system that we used to announce the eligibility criteria for engaging into the exercise program. The criteria were BMI > 27.5 kg/m^2, a signed written consent that a participant is healthy and participates on its own responsibility and a written medical approval signed by a doctor of medicine that the participant is fit to join the exercise program that may contain light to moderately high intensities. All participants were briefed about the purpose of the study and their results were included onlyif they signed a written informed consent about the use of data in research purposes. This research was carried out in accordance with the conditions of declaration of Helsinki, recommendations guiding physicians in biomedical research involving human subjects (Christie, 2000).

Health-related physical fitness

Four basic measures of POs' health-related physical fitness were analyzed, consisting of relative amount of ballast component of body composition, upper-body local muscular endurance and aerobic endurance. The relative amount of ballast tissue was assessed using an InBody 720 machine (Biospace, Co., Ltd, Seoul,Korea), following the procedures previously explained in studies (Kukić&Dopsaj, 2017; Kukic et al., 2018b) and expressed as the percentage of body fat (PBF). The upper-body local muscular endurance was measured by a 1-minut push-up (PU) and 1-minut sit-up (SU) test according to previously explained procedures (Čvorović et al., 2018a). The aerobic endurance was measured using an incremental multi-stage 20m shuttle-run test on an indoor rubber matt, following the procedures recently explained in research (Kukic et al., 2018b).

Training plan strategies

Training intervention was mostly related to safe and healthy weight loss as a primary training goal, followed by aerobic capacity development and local muscular endurance. After initial assessment, the training plan was developed trying to fulfill the requirements of this specific group of trainees. The main form of training delivery was in group classes, but following individual capabilities based on assessment results. A 2-hour training session was performed five times per week. During the training session participants had one break of 5 – 10 minutes for recovery and refreshment.Trainingswere conducted in the afternoon (16:00 – 18:00) in outdoor and indoor conditions. The first four weeks were mostly directed on postural control and movement efficiency and aerobic training of low intensity but high in volume, while strength training was mostly related to local muscular endurance and core stability. After this, in weeks 5 – 8, the volume was decreased but intensity was increased targeting VO_2max development as a part of cardiorespiratory fitness, and hypertrophy as a part of strength development strategies. The basic information about applied training methods and program design strategies after initial assessment are presented in Table 1.

Table 1. Applied assessment and exercise strategies.

Targeted abilities	Assessment	Program design	Applied methods
Mobility & flexibility	Overhead squat according to functional movement screening (FMS), Seat and ReachTest.	Focus on identified weaknesses, mainly on movement efficiency and recommended range of motion.	Short static and targeted dynamic warm-up (at the beginning of session), Static stretching and triggering during the cool-down phase.
Cardiorespiratory fitness	Multi-stage 20-m shuttle-run test	Focus on development of VO_2max and targeting a fat depot as energy source for exercise.	Pace walking, Walk/Run, Jogging, Tempo running, Fartlek, Intervals.
Strength development	1-minute Push-Up test, 1-minute Sit-Up test.	Postural control, Gradual strength development, Hypertrophy, Annual fitness test related.	Body weight, Circuit training, High intensity interval training (strength endurance oriented), High intensity functional training (job task related), Resistance training.

Apart from regular training sessions, two times a week the participants had 30-minute lectures about healthy lifestyle, weight-loss strategies, proper nutrition, maintaining healthy weight throughout the lifespan, etc.In addition, the participants were provided with a food brochure developed based on the glycemic index and glycemic load of the nutrients (Kukić et al., 2019a). In short, nutrients were divided into low, medium and high glycemic index foods and colored green, yellow and red, respectively. A photo, caloric value and glycemic index were provided for each nutrient and participants were able to schedule which nutrient they would eat on a particular day in the week (Kukić et al., 2019b). The participants were advised to choose only from the green pages of the brochure.

Statistics

Descriptive statistics for means and standard deviation (SD) were calculated at the beginning of an 8-week training program and at the end. The effects of the applied training program were analysed using a Paired sample t-test, with significance level set at $p < 0.05$. The relative effects were also expressed in relation to initial values (%). The magnitude of these effects was calculated using a Cohen's effect size (ES) formula: ES = (M2 – M1)/S, whereM1 and M2 are the means at test and retest and S is a standard deviation of either group. The magnitudes of ES were defined as small = 0.2, moderate = 0.5, large = 0.8 and verylarge = 1.3(Sullivan &Feinn, 2012).

Results

The descriptive statistics at the start and after the applied experimental procedure for body composition and physical abilities, along with corresponding t-test results with the effect size of the applied training program is shown in Table 2. All measured components of physical fitness showed significant improvement, with a small to large ES of the applied training program. A large amount of the total MD in BM occurred due to reduction in BF (-4.15 kg), which resulted in a small ES of training on PBF. Among physical abilities, the highest improvement occurred in PU and SU, while small increase occurred in VO_2max.

Table 2. Descriptive statistics and paired sample t-test results.

Variables	Test		Retest		Paired samples t-test				
							95% CID		
	Mean	SD	Mean	SD	t	MD	Lower	Upper	ES
BM (kg)	109.86	14.84	104.71	14.01	-4.98	-5.14†	-7.37	-2.91	-0.3
PBF (%)	40.61	6.27	38.07	6.49	-5.90	-2.53†	-3.46	-1.61	-0.4
PU (No)	11.14	9.35	21.00	10.21	7.44	9.86†	6.99	12.72	1.1
SU (No)	19.64	6.63	31.93	6.59	9.11	12.29†	9.37	15.20	1.9
VO_2max ($ml/kg/min^2$)	22.91	3.26	24.56	3.54	2.78	1.65*	0.37	2.93	0.5

*Significant at $p < 0.05$, †Significant at $p < 0.001$, SD – standard deviation, MD – mean difference, CID – confidence interval of difference.

Considering the relative changes in components of health-related physical fitness, physical abilities improved more than body composition, with PU and SU being improved 14.27 and 10.08 times more than PBF (Figure 1).

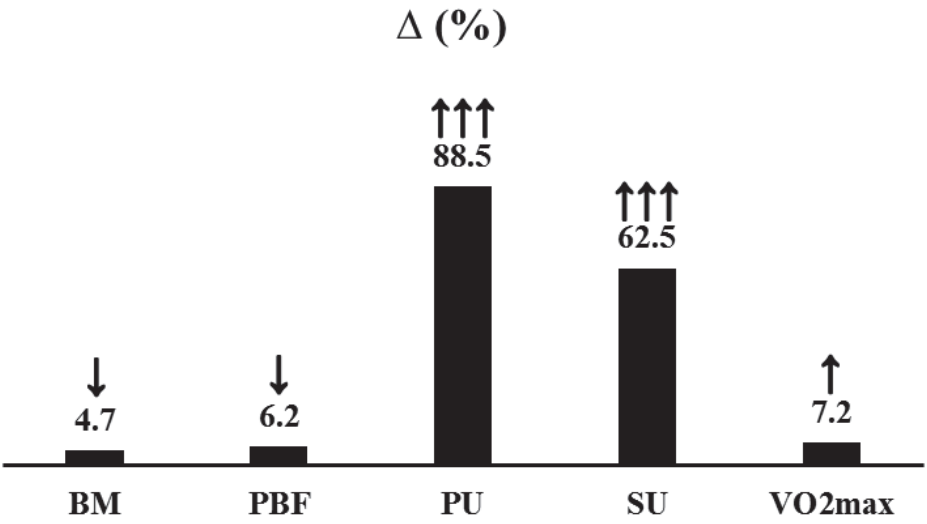

Figure 1.Relative mean changes (Δ) in components of health-related physical fitness and corresponding ES.

Discussion

The main findings of this study suggest that the hypothesis was true, as an 8-week exercise intervention followed by a lecturing programme and a food brochure may be an effective strategy for improvement of health-related physical fitness of POs.The applied treatments positively affected the reduction in BM and restructuring of body composition by reducing the amount of ballast tissue. Furthermore, local muscular endurance of upper-body drastically improved, while the effects were smaller on an aerobic endurance, suggesting that the neural component of muscular contraction was affected more than theoxidative pathway of metabolic system.

All participants reduced BM, while only one increased PBF by 0.21%. Although this participant reduced a total amount of fat by 0.8 kg, it accounted for only a third of the total reduction in BM, indicating that the majority of the reduction in BM occurred due to the loss of body water.According to the body characteristics of this particular participant at the beginning of the study,his BMI was in obesity class II and PBF ranked in the lowest part of very poor and he

had undergone a fat removal surgery prior the study. It is well known that the ratio between the extracellular and intracellular water is increased among excessively obese population(Mazariegos et al., 1992). This ratio significantly decreases after the surgical intervention for body weight reduction on account of both water compartments(Mazariegos et al., 1992). Moreover, the first phase of body weight reduction occurs due to an initial depletion of glycogen depotwhich is also associated with a negative fluid balance(Müller et al., 2016). Since the implementation of this 8-week intervention was called a weight loss course and participants were required to report their results to their superior officers, they could intentionally undertake the restrictive diet a few days prior to the final measurements. Although weekly requirements that would increase the level of control between the trainings and during the weekend were planned and proposed, they were not strictly implemented in this pilot study. Therefore, it may be possible that some participants were losing weight during the week but gaining it over the weekend, which might be the reason why the ES of the treatment on PBF was relatively small. The losing-gaining pattern of behaviour could potentially increase the probability of restrictive fasting the last few days of the treatment, falsely believing that it would increase the effects of the treatment on body fat reduction.

In contrast, Čvorović et al. (2018) investigated the effects of a 12-week exercise program followed by a 500-kcal caloric deficit in controlled environment and found that moderate relative changes in BM (-11.45%) occurred due to a large ES of an applied treatment on PBF (-20.70%, $p< 0.001$). Furthermore, a study conducted on female police officers (Kukic et al., 2018b), consisting of a 4-week exercise program and lecturing once a week about healthy eating and physical activity habits showed very small effects of the treatment on BM (-1.14% , $p = 0.005$), but moderate effects on PBF (-5.26%, $p = 0.001$). However, the fluctuations in participants' BM were monitored over the weekend and the warning for exclusion was given if BM increased. The observational analysis of the aforementioned comparisonleads to two mainconclusions:1)implementation of well-crafted exercise interventions positively affects the restructuring of body composition by reducing the PBF; 2) the magnitude of the applied program highly

depends on the level of control of factors such as the amount and quality of food intake, especially during the weekend.

Considering the effects of the applied treatment on physical abilities, PU and SU tests indicate large and very large improvements in upper-body local muscular endurance, while small improvement occurred in aerobic endurance. The explanations for large improvements in PU and SU may lie partially in the fact that participants reduced BM and thereby also the load that needs to be lifted, but largely in improvements that are based on neuromuscular activity (Cormie et al., 2011; Haff& Triplett, 2015, pp. 8–10). The participants of this study initially performed 11 PU and 20 SUon average, which corresponds to an anaerobic lactic metabolic system (Blagojević et al., 2016, p. 166; Haff& Triplett, 2015, p. 88). Since these were their maximal efforts, the majority of strength training that was afterwards applied during the study could be consideredas ananaerobic lactic type of training.The early phase of this type of training (e.g. 1 – 4 weeks) is characterized by the neural adaptations, which are fundamental for the expression of muscular strength, power and performance(Haff& Triplett, 2015, p. 88). On the other side, given the sample's body composition characteristics and that the initial maximal oxygen uptake was poor for a healthy population, the desired load of aerobic training was more based on the volume, rather than on the intensity (Haff& Triplett, 2015, p. 119). Moreover, at early stages of the training for obese trainees, the adaptations are reflected in improved movement efficiency due to better neuromuscular activities of synergists and antagonists, followed by a small improvement in aerobic power (Haff& Triplett, 2015, p. 122).Based on the results, we would strongly encourage implementation of short-term strategies for improvements in physical abilities of overweight and obese POs as it positively affects neuro-muscular adaptations. However, longer periods of involvement in exercise programs are needed for more profound effects on cardiovascular fitness as well as on body composition.

During the realization of this study, especially in the beginning,it was noticed that most of the participants desired to lose ballast weight, however they did not comprehend the impact of the treatment on their health. The most common motive in this specific

case was the participants' awareness that with the existing body composition they cannot pass the annual physical fitness test, but their awareness about the current health condition and potential risks related to bad body composition and low fitness level was very low. After a few lectures on the importance of body composition, physical activity and healthy eating habits, our observation was that the participants became more responsible in their approach to the treatment. Although the effects of the lectures on shifting the perception were not statistically tested in this study, the inclusion of education seemed to play an important role in shifting participant's mindset. Therefore, health promotion should be permanently promoted at the level of the entire police population. In that regard, a regular body composition check-up could be a pre-screening tool for identifying the nutritional status, while physical activities should be incorporated into workplace policies and ethics. This should be reinforced by well crafted health promotion strategies that would help employees and their families to develop healthy habits.

Study limitations

Although it was organized with a strong scientific background, this study was not without certain limitations. The main limitation was the inability to monitor the diet after training activities, especially during the weekends when the majority of participants was travelling to their hometowns. The sample of the study was relatively small and did not include female POs. Furthermore, the effects of the lectures were not tested, so conclusions cannot be made based on the quantitative analysis. In addition, training could be enhanced withthe application of modern technologies by monitoring physiological indices, such as heart rate, blood pressure, sugar level, sleep quality, calories, etc.

Conclusion

This pilot study applied an innovative approach in dealing with components of physical fitness of POs, because we incorporated the education about the association between health and body composition, exercise and healthy eating. Based on the results, it could be concluded

that the application of the 8-week exercise program together with lectures is an effective approach in improvement of physical fitness and health of obese POs.The improvements inPU (88.5%%, $p<0.001$), SU (62.5%, $p< 0.001$) and RU (7.5%, $p< 0.05$) were higher than those inBM (4.7%, $p< 0.001$) and PBF (6.2%, $p< 0.001$), whereby repetitive muscular endurance improved the most. The effects of the conducted lectures on the shift of the perception about the effects of the treatment from losing body weigh per se to improving health are inconclusive, but very indicative and should be defined in the future. It seems that the effects of the treatment depend on the level of control and self-control more than on the length of the treatment, while the level of control (especially self-control) can be improved by increasing the knowledge about the association of health-related physical fitness and health, with given practical solutions. In that regard, the agencies should provide exercise programs and physical activities for their employees but also develop the strategies for a work-place health promotion that would steer the POs and their families towards the involvement in healthy lifestyle.

Acknowledgments

This research is part of the National Scientific Project “Effects of applied physical activity on locomotor, metabolic, psychological, social and educational status of the population of the Republic of Serbia”, No. ID III 47015, and it is financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

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Стратешки приступ унапређењу физичке припремљености која је у складу са стандардом за добро здравље полицајаца: осмонедељна интервенција – пилот студија

Резиме: *Циљ ове студије био је да испита ефекте планираног вежбања и исхране праћене брошуром у којој се налазе намирнице поређане по квалитету на измерене компоненте физичке припремљености која је у складу са стандардом за добро здравље. Примењени третмани имали су позитиван утицај на реструктуру телесног састава умањењем релативне количине масног ткива, као и на побољшање мишићне издржљивости горњег дела тела и аеробне издржљивости. Ефекти третмана више зависе од нивоа контроле и самоконторле него од трајања примењеног третмана, док ниво контроле (посебно самоконтроле) може бити побољшан увећањем знања о повезаности физичке припремљености и здравља, уз дата практична решења. С тим у вези, полицијске агенције би требало да обезбеде програме вежбања и физичке активности за своје запослене, али би такође требало да развију стратегије за промоције здравље на радном месту које би усмеравале полицајце и њихове породице ка укључење у здрав начин живота.*

Кључне речи: *губљење тежине, здравствено образовање, полицијске агенције, здравље на радном месту, физичка активност.*