

Effect of specific balance training on balance performance and technical combat skills of male and female police cadets

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Published online: February 28, 2023

(Accepted for publication February 15, 2023)

DOI:10.7752/jpes.2023.02040

Abstract:

The one of the main objectives of training of police cadets is to improve of combat technical skills. *The aim of this study* to improve of combat technical skills of male and female police cadets by means of specific coordination and balance training. *Methods.* The experimental group (male and female cadets) applied specific balance training in physical training during the academic year (September, 2021 – June, 2022). This training included balance exercises with a BOSU ball and specific balance exercises of wrestlers and combat athletes. The control group no applied such exercises in physical training. Simply balance tests to vestibular and balance exam and test with 30 different throws to exam of combat technical skills of cadets were performed. *Results.* In some test cases, significantly ($p \leq 0.05$) best values for male and female cadets, who applied specific balance training, were recorded. There were significant differences ($p \leq 0.05$) in findings of Modified BASS balance test and in test with 30 different throws (quality) in favor of male cadets (experimental group), revealed. A significant differences ($p \leq 0.05$) in test findings as Flamingo balance test (sec), Modified BASS balance test and test with 30 throws (time and quality) in favor of female cadets (experimental group), were identified. *Conclusion.* Specific balance training takes a small-time amount in general physical training and allows you to significantly improve of dynamic balance performance and combat technical skills in police cadets. Were founded that balance training have a higher impact on balance performance and combat technical skills of female police cadets.

Key Words: combat fight techniques; throws; BOSU exercises; balance tests; cadets

Introduction

The police forces performance involves a wide range of activities including use of coercive means, arresting techniques, shooting and physical fitness (Vit et al., 2019). The practices surrounding police training of complex motor skills, including the use of force, varies greatly around the world (Di Nota, & Huhta, 2019). It is known that police officers often perform professional tasks include close combat (Kukić et al., 2019). Unfortunately, a significant number of police cadets and police officers have problems with physical fitness level (Lockie et al., 2018). Police professionals reported that exact information about the composition and effectiveness of police training is sparse today (O'Neill et al., 2019). Investigations reported that the efficiency of professional activity future police officers and employees of law enforcement agencies mostly depends of physical strength and endurance development (Mozolev et al., 2021).

An efficient training process is highly important for police cadets (Kudryavtsev et al., 2018). The overall training program of cadets must consists of 3 hours in the week, including aerobic, plyometrics, body weight, and resistance exercise, and aerobic endurance should be an integral part of the educational process of cadets. Crossfit training techniques to increase the strength and aerobic endurance characteristics of police cadets (Galimova et al., 2018) and military students (Pryimakov et al., 2019) also were recommended. However, besides problem with physical training, significant part of police officers have problems with insufficient knowledge of combat fight techniques, i.e. effective combinations of throws and strikes for most of police cadets and police officers is insufficient.

It's known, that sports wrestling technique is a method of performing a motor task that depends on particular athletes motor properties (Osipov et al., 2017). Thus, speed and quality (accuracy) to apply a throw are

the main indicators of sports wrestling technique. Troyan, (2019) indicated, that feature of the physical training of police officers are trained in professional training programs is the need to master a large volume of combat techniques skills in a relatively short time – 90 hours during the year. Many police cadets do not have time to study combat fight techniques in full. In martial arts almost every movement involves maintenance of balance in a static or dynamic form (Słomka et al., 2019). Hrysomallis, (2011) indicate that the static balance is the skill of sustaining a base of support with minimum movement. Thus, the purposeful development of maintaining a stable balance and coordination abilities have a positive impact on the combat sports performance and quality (Osipov et al., 2021). The balance is fundamental in combat sports, in which the balance is kept against the opponent (Averyanov et al., 2020; Coskun et al., 2019). This is the reason why balance training may be useful for both male and female judo athletes for increasing strength and balance (Serrano-Huete et al., 2021).

The scientific literature review revealed the problem of non-effective training of combat fight techniques in significant part of Russian police cadets (Netbay, & Konovalenko, 2020). Russian police trainers & sports professionals consider that this problem is associated with a low level of coordination abilities and a lack of stable balance in significant part of male and female cadets during of training. We hypothesized that improvement of combat technical skills will be facilitated by specific balance training to develop coordination abilities and maintain a stable static and dynamic body balance in physical training of police cadets. Thus, the aim of this study to improve of combat technical skills of male and female police cadets by means of special coordination and balance training.

Material & methods

This scientific work was performed on male and female cadets of the Siberian Law Institute of the MIA of Russia (Krasnoyarsk, Russia). Young male (n=30) and female (n=18) cadets without significant differences between groups in any anthropometric characteristics, age, grade and time of training (mean age: 19.24±0.41 years old, mean height of males: 178.63±7.44 cm, mean height of females: 166.32±8.49 cm, mean weight of males: 79.42±6.53 kg, mean weight of females: 54.37±5.29 kg) were randomly divided into two equal groups (each group was composed of male (n=15) and female (n=9) cadets). All male and female cadets had similar physical fitness profile and combat technical skills before the start stage of the study (September, 2021). All cadets had at least 180 minutes: combat fight technique (100 min) + physical training (80 min) per week, for six months before the start of investigation. All cadets were informed about the aim of this scientific work and gave written informed consent to participate in this scientific work. The study was carried out in accordance with the Declaration of Helsinki 2008.

The physical training program (90 hours during the academic year) was applied to all participants. The control group applied the standard program of physical training of police cadets. About 40% of total training time was spent to physical development (development of muscle strength, speed, aerobic endurance). About 50% of total training time was spent to study and improve combat technical skills (different combinations of throws, punches and kicks, painful techniques, sparring with opponents). About 10% of total training time was spent to development of coordination and flexibility and control testing (physical fitness tests and combat fight technique exams). Each training included warm-up (15–20 min), main part (studying of combat fight technique and improving combat technical skills during the 45–50 min) and final part (strength and endurance fitness training during 15–20 min).

The experimental group applied a specific structure of physical training during the investigation (September, 2021 – June, 2022). In warm-up and final part were applied specific exercises that help to increase of coordination abilities and balance control. The original balance trainer ball BOSU 72-10850 (USA) was used for balance training. The BOSU balance exercises were: Static Awareness Balance (Participant stay upright on the dome with the feet hip-distance apart, hands by the sides with palms facing forward and focus on a focal point on the floor or wall directly ahead, than participant close both eyes and hold the position); Walk Ups (Participant stay upright on the dome with the feet hip-distance apart, hands by the sides with palms facing forward. In this position participant to walk up and down on the dome, thus only one foot is on the dome instead of two); Lateral Walks Overs (Participant to stand next to the dome with the feet hip-distance apart. In this position participant to walk the right foot on top, followed the left, and to exit the dome on the other side); Standing Abduction Toe Taps (Participant stay upright on the dome with the feet hip-distance apart and place the arms into an athletic position in front of the body with a 90-degree bend at the elbows. In this position participant to lift the right foot off the dome and tap the foot on the side of the dome, than return to center and repeat with the left leg.). Each specific balance exercise lasted for 30 seconds. The full set (2 min) included performing all the BOSU balance exercises. The sets number was 5 (overall training time is 10 min). In main part of each training were applied specific balance training exercises of wrestlers and combat athletes: break balance of the opponent standing on one leg (pushing) and pushing the opponent of zone out (body drop the opponent on the mat). Each participant completed the training task for 20 seconds, then took a self-defensive posture and defended for 20 seconds. Total time of such exercises was 10-12 minutes per training. After, participants applied

two roll (forward roll – back roll) and then to apply a throw (Tsuru-Goshi or Ippon-seoi-Nage) in full speed. Total time of this exercise was 5-8 minutes per training.

Specific balance tests: Flamingo balance test (FBT), Modified BASS balance Test of dynamic balance (MBT) and Fukuda stepping test (FST) to evaluate the static and dynamic body balance of participants were applied in this study. Each participant completed these tests 3 times and best score was considered as total test result.

Static balance has measured by using FBT. In this test the participant is standing on his preferred foot, bends his free leg backwards and grips the back of the foot with hand on the same side, standing like a flamingo. The participant keeps balance by holding the instructor's hand then the stopwatch started as the instructor lets go. The stopwatch is stopped each time when the participant loses balance, either by falling off the beam or letting go the foot behind being held. The total number of falls should be counted in one minute of balancing (no must more than 15 falls in the first 30 seconds in testing).

The MBT can be used to be standardised balance test that incorporates both static and dynamic tasks. This test is performed with the participant standing on the start marker with their right foot and looking straight ahead. A metronome (Cherub WSM-330BK, China) gives an audio cue every second to ease time orientation for the participant. Instructed to jump to the following marker (marker 1), the subject is allowed to take a brief look at the goal marker, jump, and then land on the ball of the left foot covering the marker.

They must keep their eyes looking straight ahead while maintaining the position for a maximum of 5-seconds before advancing to marker 2. The 5-second stance is counted aloud by the instructor to further facilitate time orientation of the participant. All markers are to be jumped to with alternating feet in the numbered order. A successful performance consists of hopping to each tape mark without touching the floor with the heel or any other part of the body, and holding a static position on each tape mark for 5 seconds without exposing the tape mark. Each successful landing earns the participant 5 points. Each second the participant holds a steady position; they are rewarded with another 1 point; meaning a total of 100 points are possible for the entire test (every balance fault results in a loss of 1 point per second).

The FST is one balance and vestibular test that may be performed during a vestibular and balance exam. All participants used FST (100 steps in place) with closed eyes and hold arms outstretched directly in front. After stepping, we determined how much participant rotated or displacement to one side or the other. The angle of rotation ($^{\circ}$) and distance of displacement (cm) from the starting point was determined.

To exam of participants combat technical skills level a test with 30 different throws was applied. After adequate warm-up, all cadets completed 10 throws Tsuru-Goshi, 10 throws O-soto-Gari and 10 throws Ippon-seoi-Nage at a fast pace. Each participant performed throws in left natural posture (15 throws) and right natural posture (15 throws). The total time to complete throws and quality (accuracy) to apply throws were estimated (all test procedure was recorded on video). Quality rating scale were: 5 points if the throw is executed without loss of balance and with the opponent falling on the back; 4 scores points if the throw is executed with small loss of balance or no loss of balance, but with the opponent falling on the side; 3 points if the throw is executed with small loss of balance and with the opponent falling on the side; 2 points if the throw is executed with loss of balance and with the opponent falling on the side; 1 points if the throw is made with a significant loss of balance and falling on the opponent. The test subject must score at least 90 points to get an assessment - satisfactory; at least 120 points to get an assessment - good; more than 120 points to get an assessment – excellent.

Statistical analysis in this scientific work was carried out using SPSS 18.0 (SPSS Inc., Chicago, USA). The data were examined for normality assumptions and the existence of extreme scores before analysis. Shapiro-Wilk test was used to analyses data normality and homoscedasticity of variance was verified with the Levene's test. Independent t-Student test to compare static and dynamic body balance and combat technical skills indicators between groups. Data were expressed as the mean \pm standard deviation (SD) for each group. Values of $p \leq 0.05$ were considered significant for this investigation.

Results

The general dynamics of findings shows an increase of test performance for all studied participants (male and female cadets). However, in some test cases, significantly ($p \leq 0.05$) best values for male and female cadets, who applied specific balance training, were recorded.

No statistically significant differences in test findings between male cadets in the start of this study (September, 2021) were registered (Table 1). However, in the final stage of this study (June, 2022), significant differences in some results of male cadets were found. Thus, a significant difference ($p \leq 0.05$) in findings of MBT and in test with 30 throws (quality) in favor of male cadets (Experimental group) was revealed. In other test cases: FBT, FST and test with 30 throws (time) there were no significant differences in total findings between male cadets (Table 1).

Table 1. The overall findings of male cadet's combat technical skills and balance performance during the investigation.

September, 2021			
Tests	Control group	Experimental group	$p \leq$
FBT (falls)	0.97±0.31	1.06±0.25	0.316909
FBT (sec)	51.29±9.91	50.33±11.61	0.506166
FST (°)	31.06±2.44	31.52±2.18	0.213145
FST (cm)	45.59±5.48	46.64±6.92	0.339793
MBT (points)	71.85±12.08	72.15±10.25	0.455166
Throws (time)	1.44±0.27	1.54±0.30	0.322847
Throws (quality)	96.80±8.71	96.86±10.08	0.972685
June, 2022			
FBT (falls)	0.48±0.20	0.46±0.21	0.779810
FBT (sec)	65.42±14.10	67.38±13.34	0.126769
FST (°)	27.73±3.42	27.03±4.25	0.215337
FST (cm)	37.80±6.26	37.44±8.04	0.819495
MBT (points)	82.61±9.44	86.30±11.37	0.048236*
Throws (time)	1.25±0.12	1.22±0.09	0.339861
Throws (quality)	122.39±11.86	126.13±14.88	0.045409*

*Note: * – $p \leq 0.05$ – (level of significance)*

We are not found significant differences in test findings between female cadets in the start of the study (September, 2021). In the final of this study significant differences in some test cases results were revealed (June, 2022). Significant differences ($p \leq 0.05$) in such test findings as FBT (sec), MBT and test with 30 throws (time and quality) in favor of female cadets (Experimental group), who applied special balance trainings, were identified. In other test cases: FBT (falls) and FST there was no significant differences in total values between female cadets (Table 2).

Table 2. The overall findings of female cadets combat technical skills and balance performance during the investigation.

September, 2021			
Tests	Control group	Experimental group	$p \leq$
FBT (falls)	2.13±0.22	2.10±0.26	0.759723
FBT (sec)	34.04±8.33	34.88±9.25	0.596997
FST (°)	38.56±2.17	38.29±2.06	0.338802
FST (cm)	39.08±4.98	40.46±3.49	0.441742
MBT (points)	69.36±9.12	68.73±10.35	0.390777
Throws (time)	2.04±0.26	1.58±0.32	0.625753
Throws (quality)	78.46±7.47	78.26±6.93	0.946214
June, 2022			
FBT (falls)	1.18±0.18	1.12±0.15	0.394179
FBT (sec)	44.05±12.41	47.38±13.04	0.034672*
FST (°)	33.45±3.09	32.96±2.35	0.354056
FST (cm)	33.96±3.76	33.23±4.41	0.665206
MBT (points)	76.22±11.56	81.53±9.08	0.010461*
Throws (time)	1.55±0.30	1.32±0.24	0.049208*
Throws (quality)	100.93±15.56	106.95±13.71	0.009118*

*Note: * – $p \leq 0.05$ – (level of significance)*

Discussion

The major findings obtained in this scientific work were: some balance and combat technical skills indicators were significantly better in Experimental group compared to Control group; the positive effect of specific balance training on balance and combat technique performance was significantly higher in female cadets (Experimental group) compared to females (Control group). Thus, we are fully confirmed our hypothesis about improvement of combat technical skills by means of specific balance training regarding female cadets and partially confirmed our hypothesis regarding the male cadets.

A scientific literature review shown that most investigations in the field is focused on the physical fitness of future police officers, i.e. a forced increase in muscle strength and increase in endurance characteristics (Kukić et al., 2019). It was show, that developing upper-body strength and aerobic fitness may be beneficial to police officers to perform better in job-specific tasks (Lockie et al., 2018). Problems of coordination abilities and balance development, and connection of stable balance with the level of technical combat skills are neglected in physical training of police cadets. Increasing of strength and functional abilities takes up a large amount of

training time for police cadets. Police cadets are simply limited in training time to improve their coordination abilities and stable balance.

We are investigated that significant impact of special balance training on participants' technical combat skills was revealed by using 15–20% of general training time in physical training of police cadets. A large positive impact is possible because police cadets don't need to know a large amount of different wrestling techniques. Professional training program of future police officers assume the effective use of 3–4 different throws in combat. In this case, is possible to effectively use a training time to develop coordination and stable balance in police cadets. It can be emphasized that specific balance exercises do not take a large time amount of general training time and can be applied by male and female cadets. We found a positive impact of such trainings only on quality to apply throws in male cadets (Experimental group) in this study. It cannot be excluded high initial level of physical fitness and technical wrestling skills of the investigated cadets. However, it's known, that it is possible to increase body balance due to increased development of muscular strength. The size and weight of participants, in particular shoulder girth and hip girth, have a significant impact on the ability to maintain a stable balance (Bučinel et al., 2019). This data can explain the lack of significant differences between male cadets in most test cases at the final of this investigation. Note, the impact of specific balance training among female cadets was more significant.

Because, objective and reliable measurement should be considered paramount in evidence-based police training of defensive and control tactics (O'Neill et al., 2019), special tests to exam the combat techniques performance and combat skills of the police cadets are required. We can offer knowledge about the control of combat technique skills (test with 30 different throws) to exam of the police cadets and officers. This test allows police instructors to accurately exam the level of combat technical skills (ability to quick apply a throw) in practitioners.

Usually, police cadets perform special coordination balance exercises at the beginning of training session (warm up). However, Eken et al., (2020) showed that the use of different warm-up protocols does not significant effect on the level of balance of athletes. The Experimental group performed specific coordination and balance exercises in warm up, main part and final part of training in the present study. We have received a significant ($p \leq 0.05$) positive impact associated with an increase in quality of performance of combat technical skills for male cadets and quality of combat technical skills and time of combat technique performance for female cadets (Experimental group), relative to findings of cadets (Control group), who hasn't applied specific balance training in physical training program. These findings allow recommending specific balance training in physical training program of police cadets, to improve the quality of combat technical skills.

The overall findings of balance tests showed that all participants initially had the normal range of vestibular function. We founded that the mean range within participants is $< 32^\circ$ deviation (male cadets) and $< 39^\circ$ deviation (female cadets) in the start stage of this study (September, 2021), and $< 28^\circ$ deviation (male cadets) and $< 34^\circ$ deviation (female cadets) in the final stage of this study (June, 2022). All participants didn't exceed the normal range for FST (100 steps) during the study. The mean range of distance of displacement for participants is 46 cm for male cadets and 40 cm for female cadets in September, 2021, and 37 cm for male and 33 cm for female cadets in June, 2022. We didn't find any significant differences in the FST values (rotation and displacement) between the groups. The MBT seems simple to perform for healthy young people. We founded more modest values of MBT (mean < 91 point) in male and female cadets in this investigation. It should be emphasized that participants, who applied specific balance training, demonstrated higher values of MBT in the June, 2022.

Is known, that not all physical training programs that are effective for male cadets will be equally effective for female cadets (Osipov et al., 2021). Lockie et al., (2020) investigate that female cadets will generally be less physically fit. Training instructors should ideally implement individualized physical training programmes for this sample. Martinez, & Abel, (2021) presented date that female cadets demonstrated higher performance in physical fitness tests (1.5-mile run, 1 repetition maximum bench press, sit-up repetitions, push-up repetitions, and 300-m run) compared to male counterparts. However, research of physical fitness profile of women (aged 17–19) shows that coordination abilities are not a significant factor in the basic physical status of young women (Osipov et al., 2020). It is known, that the one from the important preconditions for optimal performance of all physical activities is a good quality of balance of young women (Korvas, 2019). Female participants of both groups, who applied different physical training programs, showed improved test findings in the June, 2022. However, female cadets (Experimental group), who had a larger amount of coordination and stable balance training, showed higher and significant ($p \leq 0.05$) test findings associated with maintaining a stable balance and combat technical skills. These findings allow recommending specific balance training in physical training program of female cadets.

We tried to avoid possible limitations related to the participants' number, age, gender and physical condition of all participants in our research. However, there were some difficulties with matching up a sufficient number of similar participants especially in the females group. Thereby, further research with a large number of different-sex participants is needed. Also, we should note that relatively compliant opponents were used for

training and testing of combat technical skills to maintain the safety of cadets. However, future police officers will likely face more combative and noncompliant opponents in the field. It is not yet known how combat fight skill performance during the training will generalize to dynamic field encounters.

Conclusions

The possibility of improving the technical combat skills of male and female police cadets, who applied the specific balance training has been shown in this study. Such specific balance training take a small-time amount in general physical training and allows you to significantly improve of dynamic balance performance and combat technical skills in police cadets. Was founded that balance trainings have a higher impact on balance performance and combat technical skills of female cadets. Thus, this training program can be applied in physical training law enforcement officers, especially police and military female cadets.

Conflicts of interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Gratitude

The authors thank the police cadets, instructors, and administration of the Siberian Law Institute of the MIA of Russia for their participation in research and dedication to their profession. Also, authors thank the anonymous reviewers for their careful reading of our manuscript and their comments and suggestions.

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