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Original research article

GENERAL AND SPECIFIC PHYSICAL ABILITIES OF THE MEMBERS OF A SPECIAL POLICE UNIT

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Abstract. *Tactical or special units are terms used to describe elite military and police tactical teams, trained to perform dangerous missions or tasks with a high risk with which conventional units are unable to cope. Their high physical requirements demand continuous improvement and the maintenance of a certain level of physical fitness and operational performance through simulation of real conditions in training through a variety of polygons and situational scenarios. The purpose of this research was to analyze and evaluate the level of bio-motor abilities between members of the special police units with conventional measurement methods and the specific operational field test TONKA. The sample included 12 members of the special unit of the Slovenian police. The subjects were measured in three phases. The first set of measurements included measurements of physical characteristics, isometric hand strength, and maximal and explosive leg strength. The second set of measurements included measurements of speed and agility that were carried out in full tactical gear. The third set of measurements included a field test, measuring the operational capacity of TONKA. The average age of the members of the police special forces were 30.7 ± 5.35 years, average weight 80.77 ± 4.83 kg, and average height 180.85 ± 4.31 cm, with average body mass index of 24.71 ± 1.58 kg/m^2, average muscle mass of 44.18 ± 3.64 kg, and average body fat percentage of 9.37 ± 1.91%. The average percentage score (AI INDEX) of the operational TONKA test was 74.62 ± 18.99% and the average of the efficiency index (EF INDEX) of TONKA test was 31.12 ± 16.98.*

Key words: *Morphology, motor status, operational performance, field testing, police, tactical officers*

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INTRODUCTION

Tactical or special units are terms used to describe elite military and police tactical teams, trained to perform dangerous missions or tasks with a high risk with which conventional units are unable to cope. Members of the special units must be physically and mentally stable, confident, and brave. Members need to possess adequate tactical knowledge for individual operations or for functioning in small groups, which often operate in a hostile environment (Šalaj & Šalaj, 2011).

These high physical requirements from new and existing members of special units demand continuous improvement and maintaining a certain level of physical fitness (Dawes, 2011). On the basis of these intense physical demands we can describe the members of the special police as "special athletes" (Stephenson, 2008).

Like athletes in their field of sport, applicants for police special units go through a series of tests in the training and selection process. Passing the test represents the start of learning and training of technical tactical skills in order to become full-fledged members of the Special Forces. The vast majority of tests for police officers were designed according to the pattern of military tests. Some foreign units used tests such as the Physical Ability Requirement Evaluation (PARE) and the Police Officer's Physical Ability Test (Popat) (Beck, 2012). The PARE and Popat tests represent the simulation of chasing the suspect. These tests are used only for qualifications and assessment of new recruits in uniformed police and not for members of special units.

However, at the moment there are non-available common standardized tests and norms to assess the tactical, operational, and physical fitness of members of special police units. Currently, the units themselves are responsible for the implementation, development, and evaluation of standards for their physical, tactical, and operational capacity and for prescribing norms for the selection process for new members (Dawes, 2011).

Despite the key role of special units in the treatment of high-risk events, we know very little about the organization and functioning of specialized units. The main reason for this is the lack of research and literature on special units and their activities. Existing resources are available to a limited extent (Klinger & Rojek, 2008). Some morphological characteristics, physiological profiles or studies on the motor abilities of officers, members of special units, were gained through the studies of the Brazilian members of special police units BOPE (Da Luz, de Lucas, & Caputo, 2011), Special Forces SWAT (Dawes, 2011), and of the special forces of the German police (Sperlich et al., 2011)

After reviewing the available literature, we can conclude that it would be very useful if laboratory tests could also be available for determining the specific functional characteristics and abilities that are significantly associated with operational readiness and functional capacity. Physiological tests can assess the overall level of physical condition of the members of the Special Forces and establish guidelines for individualized training programs. The purpose of this research is to analyze and assess the situation of bio-motor abilities of members of the special police units and their specific operational field test TONKA.

METHODS

The sample included 12 members of the special units of the Slovenian police, with a mean age of 30.75 ± 5.35 years, height of 180.85 ± 4.31 cm, and body weight of 80.77 ± 4.83 kg on the day of the measurement. In the dominance of the upper limbs, 11 policemen were right-handed and one left-handed.

The subjects were measured in three phases. The first set of measurements was conducted in the physiological laboratory at Faculty of Sport in regular sport equipment and included measurements of physical characteristics, isometric hand strength, and maximal and explosive leg strength. The second set was carried out at the athletics stadium. In this section, measurements of speed and agility were carried out in full tactical gear. The third set of measurements was carried out on the training grounds of the Special Units. In this part, the field test for measuring operational capacity (TONKA) was executed. During this test we had a mobile device monitoring and measuring functional parameters.

Selected procedures of tests and variables:

Morphological characteristics

Morphological characteristics were measured by anthropometry methods and by electrical bio-impedance. GPM Swiss measurement instruments were used for the anthropometry method. Measurements were carried out by an expert with years of experience, following the prescribed procedures (Lohman, Roche & Martorell, 1988).

We measured anthropometric variables ANOL – upper arm circumference, AONMXL – maximum upper arm circumference, AOPL – forearm circumference, AOSL – thigh circumference, AOSLSR – mid-thigh circumference, AOML – calf circumference, ASR – shoulder width, ASM – pelvic width, APKOML – elbow diameter, APLZ – wrist diameter, APKOLL – knee diameter, APSSL – ankle diameter, AKGH – back skin fold, AKGN – triceps skin fold, AKGB – biceps skin fold, AKGP – forearm skin fold, AKGT – abdomen skin fold, AKGPR – chest skin fold, AKGSI – suprailiac skin fold, AKGS – thigh skin fold, and AKGM – calf skin fold. According to the Heath-Carter method (Carter & Heath, 1990) we calculated proportions of ectomorph, mesomorph, and endomorph components. Muscle mass (AMIS) was calculated using Matiegka equation (Matiegka, 1921) The average position in the somato chart was determined with the Somatotype 1.2.5 . software.

Measurements of electrical bio-impedance were performed with the help of the device TANITA TBF-105. We measured body weight, body mass index (BMI, kg/m^2), the proportion of bone mass (AKOSP), the proportion of the absolute bone mass (AKOST), the proportion of fat mass (AIMFATdel), the proportion of absolute fat mass (IMFATmass), and the proportion of body fluids (IMTWBW).

Functional and biochemical parameters

Dinamometry

A hydraulic handgrip dynamometer (Baseline 12-0240) was used to test grip strength (kg). The participants were in a neutral standing position with their non-working shoulder adducted to their trunk and neutrally rotated, with the forearm and wrist in a neutral position (Fess & Moran, 1981). A clear command was given to squeeze the handle as hard as possible and hold it in place and then to relax after 3 seconds. No verbal encouragements were offered during the test. After relaxation, each participant was allowed a 30-second rest period. Following the practice test, three attempts were made from which the mean grip strength was calculated (Mathiowetz, Rennells, & Donahoe, 1985). We used three positions to measure the handgrip strength. The first position was 180° shoulder flexion, the second position was 90° shoulder flexion, and the third position was shoulder adduction. We measured the left and right handgrip strength in all three positions.

Isokinetic testing

Testing was performed by the same experienced examiner in the Laboratory for isokinetic testing at the Faculty of Sport in Ljubljana, Slovenia. The laboratory was air-conditioned, with a room temperature between 22 and 24 °C. Testing was performed between 10 am and 4 pm. The testing session started with a warm-up, consisting of cycling for 6 minutes at a moderate pace (50–100 W), followed by a 15-second stretch of quadriceps and hamstring. All of the participants were given a detailed explanation of the testing procedure, which was also demonstrated to an independent participant not taking part in the study prior to testing (Hadzic, Sattler, Markovic, Veselko, & Dervisevic, 2010). The testing of quadriceps and hamstrings was performed using a Biodex System 3 isokinetic dynamometer (New York, USA). The participants were tested in the seated position. Sliding forward on the seat was prevented by using proper belts that pushed the pelvis downward and backward, without discomfort. Trunk movement was also prevented by using comfortable strapping over the chest area. The thigh of the tested leg was secured by using a special attachment. The participants were instructed not to hold the handles and to keep their arms folded across the chest during testing. We used the lateral femoral condyle as the average axis of rotation of the knee joint and aligned it with the motor axis by using a laser beam, preinstalled into the head of the dynamometer.

We performed a concentric strength testing of the quadriceps (Q) and hamstrings (H) at two testing velocities (60°/s and 180°/s), using 5 and 15 testing repetitions, respectively. Prior to testing each participant performed 2 sub-maximal and 1 maximal repetition at a given velocity. There was no pause between repetitions at the same velocity, but there was a 60-second pause between sets at different velocities. When testing was completed on one side a 3-minute break followed, during which the machine setting was changed to accommodate for the opposite leg. The first leg that was being tested was assigned randomly for each participant. There was no verbal encouragement during the test.

Maximal oxygen consumption

Testing of maximal oxygen consumption was performed twice. The first test was carried out in the physiological laboratory at the Faculty of Sport, University of Ljubljana, under the supervision of an expert with years of experience. Testing of maximal oxygen consumption (VO_{2max}) was performed according to the Nowacki method (Nowacki, 1979). Testing was carried out on the treadmill Hp Cosmos Venus (Germany), where we measured the relative maximum value of VO_{2max} (ml/kg-1/min-1). The measurement of respiratory variables and gas exchange was performed by using the portable telemetry unit K4B (Cosmed, Italy), which was calibrated with a mechanical pump before each test. The second testing of maximal oxygen consumption was carried out on the ground during the performance of a special field test TONKA where we measured the relative value of VO_{2max} (ml/kg-1/min-1). During the test we also measured maximum heart rate (terenSUmax) and average heart rate (terenSUpovp). Maximal oxygen uptake was recorded as the highest VO_2 value obtained for any continuous 1-minute period during the tests. At least two of the following criteria were also required for the attainment of VO_{2max}: a plateau in VO_2 values despite increasing velocity, a respiratory exchange ratio ≥ 1.15 or the attainment of a maximal HR value (HRmax) above 95% of the age-predicted maximum (Esteve-Lanao, San Juan, Earnest, Foster, & Lucia, 2005).

Blood lactate concentration was measured by the Eppendorf Ebio lactate analyzer (Germany). A sample of 20µl of blood was taken from the hyperemic ear muscles. The accuracy of lactate concentration in fresh blood was ± 0.1 mmol/l-1. The concentration of lactate was measured before laboratory testing (LAmir) and prior to the field operational test of maximal oxygen consumption (Flamir_T), whereas the maximum lactate was measured during the laboratory test (LAmax) and during the field operational test of maximal oxygen consumption (Flamax_T).

Tests of basic and special motor abilities

Basic motor abilities

The counter movement jump (**CMJ, CMJH**) was performed standing straight and executing a vertical jump, beginning with a counter movement down to a knee angle of 90˚. The test was performed with hands held on the hips and with the arm-swing. The test was carried out on the device Optojump, which measured the height of the jump. Each participant executed three CMJ and three CMJH jumps. Breaks between jumps lasted between 60 to 90 seconds to ensure adequate regeneration. The best result was taken for further analysis.

The drop jump (DJ25) test was carried out on the device Optojump, which measured the duration of the contact phase and the height of the jump. The subject jumped from a height of 25 cm. The subjects were given instructions before the start that one foot needs to be in the air in front of the bench with hands to the side. Immediately after their contact with the floor, they had to carry out a quick and maximum vertical propulsion. Each subject carried out 3 drop jumps. Breaks between jumps lasted from 60 to 90 seconds to ensure adequate regeneration. The participants performed the test without arm swings. The best result was recorded for further analysis.

Special motor abilities

Maximum speed test with tactical equipment – 60m sprint with a high start (s60m) was carried out on a tartan athletics track in optimal weather conditions. Time measurements were carried out with an electronic measuring device Brower (USA). The participants ran from a high starting position in their full tactical equipment, which weighed 16.90 kg. The test was carried out twice. Breaks between sprints lasted from 5 to 7 minutes, thus ensuring adequate regeneration. The best result was recorded for further analysis. Running was carried out without their main weapon MP5.

Maximum speed test with tactical equipment and weapon MP5 – 60m sprint with a high start (s60mpuska) was carried out on a tartan athletics track in optimal weather conditions. Time measurements were carried out with an electronic measuring device Brower (USA). The participants ran from a high starting position in their full tactical equipment, including the weapon MP5, which weighed 21.15 kg. The test was carried out twice. The break between sprints lasted from 5 to 7 minutes, thus ensuring adequate regeneration. The best result was recorded for further analysis.

Agility (TtestDpuska, TtestLpuska) was tested with a T-test. The test was carried out on tartan grounds, while time was measured with the Brower electronic device (USA).

The test was performed in full tactical equipment, including an MP5 rifle. Method of application: participant ran as quickly as possible forward to the center cone, then performing 5m of side steps to the right cone, sidestepped 10m to the far left cone, and then sidestepped back to the right to the center cone. After that participant ran backward as quickly as possible to cross the finish line. Time was measured until the participant crossed the finish-start line. Each participant carried out two test runs with the initial movement to the left and, after two repetitions, with the initial movement to the right. The total weight of the equipment was 21.15 kg. The break between iterations was 5 minutes, thus ensuring adequate regeneration. The best result was applied for further analysis.

Specific operational efficiency (TONKA)

Description of tests:

Only one test subject at a time was on the testing grounds. Execution time of the test was measured with a hand stopwatch. The test was conducted in full battle gear, which includes a uniform, shoes, goggles, bulletproof vest, waist belt, Sig Sauer P226 pistol, and MP5 rifle. The weight of the entire equipment was 21.15 kg.

The subject started by running around the entire polygon, with a total length of 530 meters. The 200-meter run was followed by a memory task station 0.1. On this station the participants had to remember the required sequence of five geometric figures, with 5 centimeters in diameter. The time for memorizing the figure sequence was limited to 5 seconds. After this station the participants needed to jump over two obstacles with the height of 2 meters. Then they had to run up to the ladder (5 meters high) and climb it. After that they needed to run for 20 meters to get to the first task.

Task 1:

The first task was carried out with a sniper shooting rifle Blaser R93 Tactical LRS 2 in the prone position. The rifle was located at the shooting site. The test subject shot from a distance of 100 meters at the target – a clay pigeon**, with a diameter of 10 centimeters. Two shots were fired without the possibility of corrective shots. Hits were scored with 10 points, a missed shot with 0 points. The maximum number of points in this task was 20.

Fig. 1 Clay pigeon

Fig. 2 Target Pepper popper

Task 2:

Task 1 was followed by a 10-meter run to the defensive shield. A shield with a weight of 22 kg had to be carried in the battle position up and down the stairs, for a total length of 20 meters, as fast as possible. Immediately after putting down the shield, the shooting task in the prone position with the MP5 gun followed, shooting at a circular target from a distance of 50 meters. The shooter fired 5 shots. Each hit was evaluated from 0 to 10 points. The maximum number of possible points was 50.

Task 3:

The second task was followed by running over two longitudinally positioned Swedish benches and stopping at the end on a transversely placed bench, which was 30 centimeters wide. Standing on the transversely placed bench, the test subject had to fire 4 shots with an MP5 rifle from a distance of 20 meters at the target Pepper popper (PP). Hits were evaluated with 10 points, a missed shot with 0 points. The maximum number of points was 40. After that we ran to the fourth task.

Task 4:

In task 4 it was necessary to pass 19 car tires. The subject had to stop and stand up on the last tire with both feet. Standing on the car tire, the test subject had 3 shots to shoot sideways with an MP5 gun at 3 PP targets from a distance of 20 meters. Hits were evaluated with 10 points, missed shots with 0 points. The maximum number of points was 30. After that we ran to the fifth task.

Fig. 3 Circular target.

Fig. 4 PT-2 target.

Task 5:

The task consisted of 4 runs around 2 stakes. At the second stake, when the subjects were facing the target, they always performed a single MP5 rifle shot at a target PT-2. The first run was carried out for a distance of 30 meters, the second run for a 63-meter distance, the third for 69 meters, and the fourth run for a distance of 75 meters. A total of 4 shots were fired, from which hits were valued using points from 0 to 5. The first shot was fired from a distance of 40 meters, the second shot from a distance of 37 meters, the third shot from a distance of 34 meters, and the fourth shot was carried out from a distance of 31 meters from the target. The maximum score was 20. After that we ran to the sixth task.

Task 6:

The task was performed by running up and around a tree on a hill with a 30° slope and back downhill to the stake which marked the shooting spot. At the marked place a single shot was fired with a Sig Sauer P226 gun at a PP target. Running up and downhill around the tree with brief stops for shooting was carried out 3 times with a total of 3 shots fired in task 6. The first shot was fired from a distance of 23 meters, the second shot from a distance of 20 meters, and the third shot was fired from a distance of 18 meters. Hits were evaluated with 10 points, missed shots with 0 points. The maximum score was 30. After that we ran to the seventh task.

Task 7:

In task 7 we shot at 5 targets which represented geometric symbols of 20 centimeters in diameter from the memory task station 0.1 from the beginning of the test. The shots were fired with a Sig Sauer P226 gun. The objective of the task was to hit the geometric shapes in the exact order they had to remember at the memory station 0.1. Each hit of the target with the geometrical figure in the correct sequence brought 10 points. If you missed the first shot, you missed the sequence and the task was scored with 0 points. If you hit the first three shots in the correct order, and missed the sequence in the last two shots, the task was scored with 30 points. The maximum number of points was 50. The last shot was followed by a sprint around the second half of the polygon in which the subjects had to jump over two 2-meter-high obstacles. We ran around the shooting yard up the stairs, finishing the test at the starting point.

Table 1 Scoring at the shooting stations

Task	Number of shots in a task	Weapon	Maximum number of points
Task 1	2	Blazer R93 LRS Tactical 2	20
Task 2	5	MP5	50
Task 3	4	MP5	40
Task 4	3	MP5	30
Task 5	4	MP5	20
Task 6	3	Sig Sauer P226	30
Task 7	5	Sig Sauer P226	50
Total 7	26		240

Evaluation of the TONKA field test

First the efficiency percentage of each individual task was calculated as follows: Number of achieved points*100)/Number of maximum possible points in a task. After that the calculation of the average efficiency percentage of all the tasks gave us the TONKA accuracy index (AI INDEX). Then the final efficiency index of the TONKA field test (EF INDEX) was calculated, which represents the final success rate of the special field test. The EF INDEX was calculated with the maximum TONKA test heart rate and the total TONKA field test time divided by the Tonka Accuracy index calculated before:

$$EF\ INDEX = \frac{\mathrm{HRmaxT} \times \mathrm{ttest(min)}}{TONKA\ AI\ INDEX}$$

It is evident from the equation that the result of the index is inversely proportional to the product; in other words the lower the index, the better the test result.

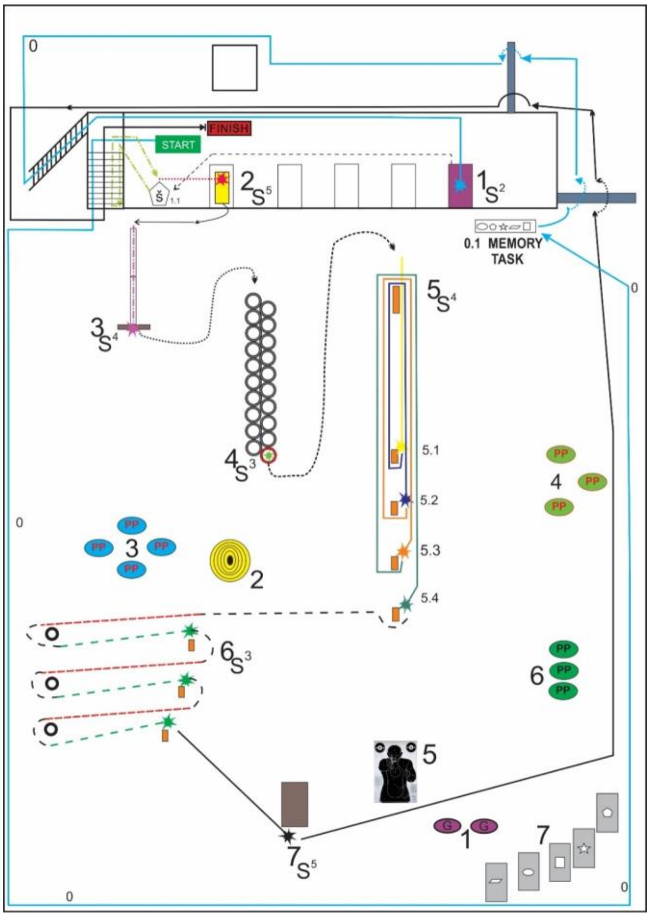

Fig. 5 Polygon of special TONKA field test

Legend: 5 – target of the same numbered station, – Shield , – 5-Task number / S^x – Number of shots in the task, – Shooting spot inside of the task, – Target Pepper popper , – Round target, – Clay pigeon target, – Targets with geometry symbols, – PT-2 target, – Jump over an obstacle, – Obstacle, – Running on an uphill slope of 30°, – Running downhill and shooting, – Stake, – Ladder.

Statistical methods

SPSS 21.0 software was used to analyze the results, along with the method of descriptive statistics to describe the status of the Slovenian police special forces (SPSF) with mean values, standard deviation, minimum, and maximum. To compare the differences with other groups in the discussion, we used the T-test for independent samples. The results are shown as the difference of mean values (ASdiff) with a confidence intervals of 95% CI.

RESULTS

Table 2 The morphological profile of Slovenian police Special Forces

Variable	Mean	Std. Deviation	Minimum	Maximum
Age	30.75	5.35	24.00	42.00
Weight (kg)	80.77	4.83	73.10	89.30
Height (cm)	180.85	4.31	173.30	190.10
BMI (kg/m^2)	24.71	1.58	22.00	27.90
AMIS (kg)	44.18	3.64	38.00	52.10
AMISP (%)	49.41	1.75	46.40	51.80
IMFATmass (kg)	7.58	1.66	4.50	9.70
AIMFATdel (%)	9.37	1.91	5.70	12.40
AKOST (kg)	12.79	1.14	10.60	14.80
AKOSP (%)	15.83	1.20	13.40	17.70
IMTWBW (%)	53.46	3.17	49.60	59.60

BMI – Body mass Index, AMIS – muscle mass calculated after Matiegka, AMISP – Muscle mass in %, IMFATmass – fat mass in kg by impedance, AIMFATdel – fat mass in % by impedance, AKOST – bone mass in kg by impedance, AKOSP – bone mass in % by impedance, IMTWBW – total body water in % by impedance

Table 3 The anthropometrical profile and somatotype of Slovenian police Special Forces

	Variable	Mean	SD	Minimum	Maximum
Circumferences (cm)	AONL	32.35	3.60	26.0	37.4
	AONMXL	38.70	6.30	32.7	57.3
	AOPL	29.09	1.25	26.0	30.8
	AOSL	60.49	1.91	57.7	64.7
	AOSLSR	57.94	1.86	55.0	61.6
	AOML	40.10	1.77	36.8	43.3
Width (cm)	ASR	41.46	1.54	39.2	43.7
	ASM	27.90	1.23	25.6	29.4
Diameter (cm)	APKOML	7.33	0.40	6.6	7.8
	APLZ	5.88	0.29	5.3	6.3
	APKOLL	10.01	0.39	9.2	10.6
	APSSL	7.45	0.44	7.0	8.3
Skin fold thickness (mm)	AKGH	10.97	2.54	7.6	16.4
	AKGN	5.53	1.86	3.2	10.0
	AKGB	3.60	0.98	2.2	6.0
	AKGP	4.38	0.72	3.6	5.4
	AKGT	13.97	5.21	8.2	24.2
	AKGPR	8.27	4.02	5.4	20.0
	AKGSI	9.80	3.07	5.4	16.2
	AKGS	11.40	3.21	7.4	18.2
	AKGM	6.57	1.94	4.2	9.2
Somatotype	AEKTO	2.06	0.78	0.7	3.3
	AMEZO	5.44	1.15	3.4	7.7
	AENDO	2.60	0.58	1.8	3.9

AONL – relaxed arm circumference, AONMXL – flexed arm circumference, AOPL – forearm circumference, AOSL – thigh circumference, AOSLSR – mid-thigh circumference, AOML – calf circumference, ASR – shoulder width, ASM – pelvic width, APKOML – elbow diameter, APLZ – wrist diameter, APKOLL – knee diameter, APSSL – ankle diameter, AKGH – subscapular skin fold, AKGN – triceps skin fold, AKGB – biceps skin fold, AKGP – forearm skin fold, AKGT – abdominal skin fold, AKGPR – chest skin fold, AKGSI – suprailiac skin fold, AKGS – thigh skin fold, AKGM – calf skin fold, AEKTO – ectomorph component, AMEZO – mesomorph component, AENDO – endomorph component

In Table 2 we can see that the members of the SPSF are on average 30.75 (± 5.35) years old, with a mean body weight of 80.77 (± 4.83) kg, and with a mean height of 180.85 (± 4.31) cm. On average, their body mass index value is 24.71 (± 1.58) and the average percentage of muscle mass is 49.41% (± 1.75).

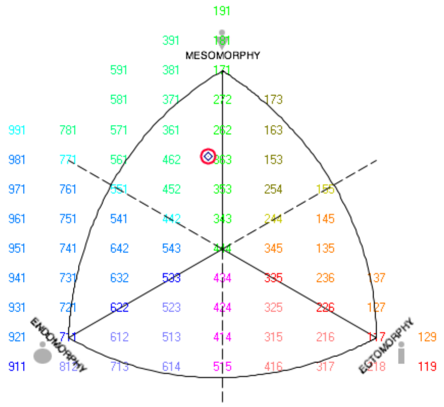

Fig. 6 Somatochart placement of Slovenian police Special Forces

From Table 3 we can see that the members of the Special Unit have the most developed mesomorph component (5.44 ± 1.15), followed by endomorph component (2.6 ± 0.58) and ectomorph component (2.06 ± 0.78). The positioning in the somatotype chart can be seen from the data in Table 4. Figure 6 shows that the Slovenian police Special Unit belongs to the group of balanced mesomorphs.

Table 4 Hand grip strength and isokinetic knee strength of Slovenian police Special Forces

Variable	Mean	SD	Minimum	Maximum
HGDG (kg)	57.80	7.21	47.63	72.57
HGDP (kg)	54.39	8.31	40.82	68.95
HGDD (kg)	58.36	8.89	45.36	72.57
HGLG (kg)	58.78	5.50	49.90	68.95
HGLP (kg)	53.68	5.14	44.91	63.50
HGLD (kg)	56.89	9.15	45.36	76.20
QL60 (Nm/kg)	2.79	0.40	2.36	3.72
QR60 (Nm/kg)	2.80	0.36	2.47	3.61
HL60 (Nm/kg)	1.42	0.16	1.09	1.61
HR60 (Nm/kg)	1.54	0.17	1.30	1.80
QL180 (Nm/kg)	1.91	0.26	1.58	2.48
QR180 (Nm/kg)	1.91	0.23	1.51	2.24
HL180 (Nm/kg)	1.08	0.16	.84	1.37
HR180 (Nm/kg)	1.12	0.15	.88	1.40
HQRL	0.52	0.08	.40	.64
HQRR	0.55	0.07	.43	.67

HGDG – right arm 180° shoulder flexion hand grip strength, HGDP – right arm 90° shoulder flexion hand grip strength, HGDD – right arm shoulder adduction hand grip strength, HGLG – left arm 180° shoulder flexion hand grip strength, HGLP – left arm 90° shoulder flexion hand grip strength, HGLD – left arm shoulder adduction hand grip strength, Q – quadriceps, H – hamstring, L – left knee, R – right knee, 60 – 60°/s testing velocity, 180 – 180°/s testing velocity, HQRL – left knee hamstring to quadriceps ratio, HQRR – right knee hamstring to quadriceps ratio

Table 4 reveals that the isokinetic test data are shown as isokinetic torque measurements per kilogram of body weight in Nm/kg. From the data we can see that the SPSF have a better intramuscular relationship between quadriceps and hamstrings on their right leg (0.55 ± 0.07) than on their left leg (00.52 ± 0.08). The data on the intramuscular ratio indicate a general weakness in the hamstring muscles.

Table 5 Physiological profile during the Nowacki treadmill and special TONKA test of Slovenian police Special Forces

Variable	Mean	SD	Minimum	Maximum
VO_{2max} (ml/kg/min)	57.04	3.53	50.13	60.58
LAmir (mmol/l)	1.61	0.48	1.00	2.50
LAmax (mmol/l)	7.92	2.03	4.60	11.80
VO_{2max} T (ml/kg/min)	46.76	10.77	29.99	65.99
HR_{max}T test N=9	185.78	9.15	173.00	198.00
HRavrg_T N=9	168.22	11.83	149.00	181.00
Flamir_T (mmol/l) N=7	1.93	0.68	1.30	3.20
Flamax_T (mmol/l) N=7	8.21	2.23	6.10	13.00

VO_{2max} – maximum aerobic capacity on treadmill test, LAmir – lactate level before treadmill test, LAmax – maximum lactate level during treadmill test, VO_{2max}T – maximum aerobic capacity during TONKA test, HR_{max}T – maximum heart rate during TONKA test, HRavrg_T – average heart rate during TONKA test, Flamir_T – lactate level before TONKA test, Flamax_T – maximum lactate level during TONKA test

Table 6 Basic and special motor abilities of Slovenian police Special Forces

Variable	Mean	SD	Minimum	Maximum
CMJ (cm)	37.73	4.95	29.40	45.00
CMJH (cm)	45.58	7.10	35.60	55.50
DJ25 (cm)	31.82	3.07	26.50	36.50
DJ_CT (ms)	218.17	29.05	178.00	276.00
60m (s) N=11	9.17	0.44	8.53	10.20
60m_puska (s) N=11	9.42	0.43	8.80	10.36
TtestDpuska (s) N=11	9.08	0.35	8.61	9.79
TtestLpuska (s) N=11	8.99	0.39	8.51	9.80
TONKA AI INDEX (%)	74.62	18.99	23.81	94.71
ttestt N=9 (min)	10.85	1.11	9.29	12.49
EF INDEX N=9	31.12	16.98	19.35	73.63

CMJ – counter movement jump height, CMJH – counter movement jump with hands height, DJ25 – drop jump from 25 cm, DJ_CT – drop jump contact time, 60m – 60 m sprint, 60m_puska – 60 m sprint with a rifle, TtestDpuska – agility T-test to the right with rifle, TtestLpuska – agility T-test to the left with rifle, TONKA AI INDEX – % of the score of special field test, ttestt – time of special TONKA field test, EF INDEX – efficiency index of the TONKA field test

DISCUSSION

According to the obtained data we can compare the SPSF's average age of 30.75 (± 5.35) years with the data published by Sperlich et al. (2011) on a sample of 120 members of the German police special forces aged 28.9 (± 5.20). The members of the SPSF and German police special forces are not statistically different in age values (ASdiff 1.85 years, 95% CI -1.27-4.97) (Table 7). The age of the members of special units may be an important factor, as, according to Gallagher et al. (1996) muscle mass decreases with age, which significantly reduces maximum physical efficiency (Fitzgerald et al., 1986; Harman & Frykman, 1992). The SPSF and German special forces do not differ in body height of 183.3 (± 6.2) cm (ASdiff 2.45 cm, 95% CI -1.18-6.08) and body mass index of 24.23 (± 6.2) kg/m^2 (ASdiff 0.51 kg/m^2, 95% CI -1.47-0.45). The values of muscle mass, according to a study carried out by Da Luz et al. (2011) on a sample of 9 members of the special unit of the Brazilian police forces (BOPE) with 33.9 (± 4.0) kg, were statistically significantly higher for the SPSF (ASdiff 6.03 kg, 95% CI 2.81-9.25). Comparing the amount of fat mass of the BOPE special unit, which is 12.7 (± 4.5) kg, we can see that the value is lower for the SPSF, but not statistically different (ASdiff 5.12 kg, 95% CI 2.81-8.06).

Table 7 T-test of some morphological and physiological characteristics of the SPSF with other Special Forces studies

Study	Variable	Mean	SD	Asdiff	-95% CI	95% CI
Dawes, 2011 (n=21)	AGE	37.76	6.2	7.01	**2.65**	**11.37**
	Weight (kg)	90.41	15.19	9.64	**0.39**	**18.89**
	Height (cm)	179.86	8.2	-0.99	-6.21	4.23
	BMI (kg/m^2)	28.65	3.79	3.94	**1.59**	**6.29**
	VO_{2max} (ml/kg/min)	45.36	1.72	-11.7	**-13.54**	**-9.82**
Sperlich et al., 2011 (n=120)	AGE	28.90	5.20	1.85	-1.27	4.97
	Height (cm)	183.30	6.20	2.45	-1.18	6.08
	BMI (kg/m^2)	24.23	6.20	0.51	-1.47	0.45
	VO_{2max} (ml/kg/min)	57.40	4.30	0.36	-2.89	2.17
Da Luz et al., 2011 (n=9)	AGE	38.00	5.70	7.25	**2.17**	**12.33**
	Weight (kg)	77.20	9.10	-3.57	-9.99	2.85
	Height (cm)	175.20	4.00	-5.65	**-9.51**	**-1.79**
	FM (kg)	12.70	4.50	5.13	**2.19**	**8.07**
	SMM (kg)	33.90	4.00	10.28	**-13.78**	**-6.78**
	BMI (kg/m^2)	25.10	2.30	0.39	-1.38	2.16
Simpson, Gray, & Florida-James 2006 (n=10)	VO_{2max} (ml/kg/min)	55.00	4.00	-2.04	-5.39	1.31

Brazilian and Slovenian special forces vary in somatotype. Brazilian SWAT members dominate in endo-mesomorph types with an Endomorph component of 3.46 (± 1.05), Mesomorph component of 4.69 (± 1.0), and Ectomorph component of 26.2 (± 1.5), while balanced mesomorph types prevail in the SPSF, as we can see from Table 3.

If we compare the values of maximal aerobic capacity (VO_{2max}), we can see that, in comparison with German special units with 57.4 (± 4.3) ml/min/kg, the SPSF are very similar and not statistically different in VO_{2max} values (ASdiff 0.36 ml/min/kg, 95% CI -2.89- 2.17). According to the study of Simpson et al. (2006), SPSF members also have a similar VO_{2max} compared to a special parachute unit of the British Army with a value of 55 (± 4) ml/min/kg (ASdiff 2.04 ml/min/kg, 95% CI -1.23-5.31). As we mentioned before, members of special units can be called special athletes. Their maximal aerobic capacity can be compared to the results of top male rowers, who have, according to a research conducted by Mikulić (2008), an average VO_{2max} value of 58.4 (± 3.9) ml/kg/min, which indicates the superior fitness of SPSF.

Physiological and morphological characteristics are important factors that affect the operational capacity (Šimenko, Čoh, Škof, Zorec, & Milić, 2014). Therefore, special units have to train as closely as possible to real conditions in their training through a variety of polygons and situational scenarios to acquire specific knowledge and experience Klinger et al., 2008; McGill et al., 2013). According to Dawes (2011), the units are themselves responsible for the implementation, development, and evaluation of the standards of their physical, tactical, and operational capacity. They also keep and prescribe norms for the selection process of new members. One such operational test is a 2-mile backpack run test, which was used by Simpson et al. (2006) on a sample of 10 members of the special military parachute units, which illustrates the operational capability of troops.

When comparing the time length of the tests, we can see that the two tests significantly differ (ASdiff 238 s, 95% CI 180.71-295.29), as the TONKA test is shorter with an average time of 651 (± 66.6) s compared to a 2-mile backpack run test with 889 (± 61) s. However, when we compare physiological strains, the two tests show some similarities, as the average heart rate (ASdiff 7.78 b/min, 95% CI -16.67-1.11) and maximum heart rate (ASdiff 0.22 b/min, 95% CI -7.27-6.83) do not statistically differ. The tested subjects in both tests are significantly different in maximal lactate concentration (ASdiff 2.79 mmol/l, 95% CI 1.15-4.43), which could be an indicator of the better physical fitness of the SPSF or greater difficulty of the TONKA test.

The operational capacity in relation to the nature of work of special units in their real working environment presents an intervention of special units in a variety of the most complex security tasks, which may include hostage rescues, high-risk arrests, terrorist threats, and exposure to snipers or armed suspects (Klinger et al., 2008; Williams & Westall, 2003). Therefore, Special Units need a wide range of motor skills, with a special focus on strength, speed, and agility (Šimenko, Čoh, & Žvan, 2015). The operational TONKA test includes all of the above, with stations and tasks which have to be carried out in full battle gear. The test subjects use a gun, rifle, and sniper rifle and carry a shield, while sprinting, running, climbing, jumping, and performing disbalanced positions and mental tasks. On this polygon police officers are closer to their real situations and acquire specific knowledge and experience for their actual needs in interventions. Results and comparisons confirm the suitability of the selection procedure and high-quality sports programs used by commanding personnel of the SPSF for providing a high level of physical fitness (Šimenko et al., 2015; Zorec, 2009), which is the basis for specialized training and precise use of firearms (Bohinc & Vodičar, 2014).

CONCLUSION

The main goal of the study was to show that, comparing the gathered data of our SPSF with available data from elite sports and studies investigating police and army Special Forces, the Slovenian Police Special Forces have an appropriate morphological and physiological profile. The training process with the operational TONKA test could play a key factor in improving operational performance in specialty units, because it covers their main motor and special firearms tasks. That is the reason why the TONKA test presents a reliable method of training of the police Special Forces.

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OPŠTE I SPECIFIČNE SPOSOBNOSTI ČLANOVA SPECIJALNIH POLICIJSKIH JEDINICA

Taktičke odnosno specijalne jedinice predstavljaju termine koji opisuju elitne vojničke i policijske grupe, trenirane za izvođenje opasnih misija odnosno zadataka velikog rizika, sa kojim se obične jedinice nisu sposobne suočiti. Njihov visok stepen fizičke pripremljenosti zahteva neprekidno unapređenje i održavanje određenog nivoa fizičke pripremljenosti te operativnih performansi putem simulacije realnih uslova koja se vrši unutar treninga pomoću raznih poligona i situacijskih scenarija. Cilj istraživanja je bio u analizi i evaluaciji nivoa bio-motričkih sposobnosti članova specijalne policijske jedinice konvencionalnim merskim metodama i specifičnim operativnim terenskim testom TONKA. Uzorak je obuhvatio 12 članova specijalne jedinice slovenačke policije. Subjekti su mereni u tri faze. Prva faza merenja je obuhvatila merenje fizičkih karakteristika, izometrijske snage ruku i maksimalne eksplozivne snage nogu. Druga faza merenja je obuhvatala merenje brzine i izdržljivosti u punoj bojnoj opremi. Treća faza merenja je obuhvatila test na terenu, gde je izmeren operativni kapacitet TONKE. Prosečna starost testiranih članova policijske specijalne jedinice bila je 30.7 ± 5.35 godina, prosečna težina 80.77 ± 4.83 kg i prosečna visina 180.85 ± 4.31 cm, sa prosečnim indeksom telesne mase 24.71 ± 1.58 kg/m2. Izmerena prosečna mišićna masa je bila 44.18 ± 3.64 kg, dok je procenat masnoće od celokupne telesne težine bio 9.37 ± 1.91%. Prosečni rezultat (AI INDEKS) operativnog sistema TONKA bio je 74.62 ± 18.99 % dok je prosečni indeks efikasnosti (EF INDEKS) testa TONKA bio 31.12 ± 16.98.

Ključne reči: *morfologija, status motorike, operativna performansa, terensko testiranje, policija, specijalne jedinice.*