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Original Article

Creating a physical fitness test for soldiers based on the correlations of the results of the special and general physical fitness tests

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Abstract:
The current geopolitical situation in Eastern Europe makes it obligatory for every soldier to be battle-fit and, thus, have good all-around physical fitness. The national armed forces units never had a special physical fitness (SPF) / combat and general physical fitness (GPF) tests, which would take into account the peculiarities of soldiers' combat tasks in each unit and planned workload, which would enable assessing the soldiers' ability to perform the most important tasks during combat, imitating some of the most typical combat tasks, such as moving heavy loads – equipment, protective gear, etc. – going over various obstacles, evacuating the wounded, changing the shooting position, etc. The aim of the study is to develop a general physical fitness test based on the correlations between the control exercises in the GPF test and the control exercises in the SPF test. 57 soldiers participated in the study. 4 field tests were used to test the soldiers participating in the study: 1 adapted special physical fitness test and 3 general physical fitness tests. The analysis of the study results for determining correlations in the SPF and GPF control exercises was carried out using the Pearson and Spearman range correlation coefficients, which showed large effect values between several GPF control exercises and the SPF control exercise march, whereas other SPF test control exercises had medium effect value correlations with some GPF control exercises only. The study showed that it is possible to develop a purposeful GPF test adapted to the peculiarities of a unit, including in it control exercises that can predict the results of the SPF test control exercises.
Kay words: military; soldiers; testing; general physical conditioning; special physical conditioning

Introduction

The soldier's profession and military environment in general, based on the specific army units and positions, is classified as a physically demanding profession, particularly in terms of physical fitness and physical stress resistance (Roberts et al., 2016).

Soldiers' training and battle tasks include such physically demanding trials as long runs and sprints with the change of movement direction, long marches with heavy weights, swimming and climbing, including alpinism (Oderov et al., 2017; Kyröläinen et al., 2018; Vaara et al., 2021). Often soldiers, in imitation of combat field circumstances, have to perform for 16-22 hours a day (Heilbronn et al., 2022), thus creating a high level of stress leading to a decrease in the soldier's work capacity (Conkright et al., 2021).

To determine a person's level of physical conditioning, it is necessary to perform control exercises or tests, as they can be described in sport theory and practice. Control exercises are used to assess physical characteristics and their level. The results of the test and particularly their dynamics also indicate the efficiency of the training process or drawbacks and errors in the training process.

Certain studies showed correlations between body composition, physical tests, and simulated military task performance (Ojanen et al., 2020). In order to achieve more efficient physical adaptation and performance development, more attention should be paid to more progressive and individualized physical training programs divided into phases that continuously improve performance. Without tests, it is impossible to assess the strong and weak sides of a soldier and balance them (Grier et al., 2018; Royer et al., 2018; Robson et al., 2018).

Collection of standardized, unified test results provides the means of regularly obtaining the most recent data on a person's level of physical fitness, work capacity and their development tendencies as one of the most essential indicators (Abele et al., 2015).

Individual qualities are described by the results of the appropriate test (control exercise), while the total fitness is described by the results of the entire test.

Testing is used to determine the following indicators:

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1. physical fitness;
2. special fitness;
3. the functional condition and level of training of the body;
4. impact of physical load on the body;
5. comparison of athletes' fitness in a team;
6. comparison of sporting growth dynamics (Abele et al., 2015).

Regular and ad hoc control are distinguished, and there are also control tests at individual stages. Stage control enables assessing an athlete's condition at each stage, assessing the short-term training effect, evaluating the changes taking place over the long-term training process lasting for several years, during a single year, period or stage.

Regular control is performed to assess an athlete's reaction to short-term loads following the training sessions, as well as training and competition micro-cycles. Ad hoc control is performed to determine the athlete's body's reaction following individual trainings or competitions.

The development of physical fitness standards is often described as a sequence of steps or phases (Reilly et al., 2015).

In the study on developing a physical fitness standard for the Canadian armed forces, a new strategy and methodology were drafted, creating professional tasks for determining minial requirements, called standard development using scenarios. In this methodology, the authors build on the work of a specialist in the field – personal experience of experts in military training, international operations and emergencies, to describe and develop activity standards, providing a criteria-based systematic method, objectively joining the standard with the ability to perform work safely and efficiently.

The study was conducted in three stages. The first stage determined the most demanding tasks to be performed by all the personnel; the second stage included the quantitative assessment of the performance of the defined physically demanding tasks, according to the time of performance, the distance, the load or the activities; and the third stage involved the development of a field test to assess the requirements (Blacklock et al., 2015).

Albeit the steps differ in different studies, the process of developing a physical fitness standard in military context can be summarised using the three principal stages: task analysis, physical requirements analysis and physical fitness test development (Reilly et al., 2015).

The test must be credible, that is, it must show a consequent result on various occasions (the credibility of check and repeated check) or evaluated by various evaluators on the same occasions (mutual credibility). Credibility is usually assessed based on two or more indicators of performance capacity from one and the same group of people, using various measurements (Henriques-Neto et al., 2020).

In military environment, mainly types of tests are used:

1. tests based on testing physical peculiarities – mainly physical fitness tests or general physical fitness tests aiming to reduce health risks and encourage general physical fitness culture. These tests usually measure only one physical characteristic (Hauschild et al., 2016; Robson et al., 2017) and therefore a range of tests is necessary to assess multiple physical capacities/characteristics.

2. tests based on assessing work capacity or special physical fitness tests aiming to determine if soldiers are ready to perform the most physically demanding tasks and service duties at the requisite level. To this purpose, work simulations are used including the replication of various physically demanding tasks from work (for instance, military march). As work simulation replicates with precision the necessary tasks, they have a direct link to the relevance of the content, and they are considered to be face valid; therefore, the tested can see more clearly how a simulation test (that is, simulation) is related to work (Robson et al., 2017).

Accordingly, authors (Sharp et al., 2017; Huang et al., 2018; Botta et al., 2022; Blaus et al., 2023) state that the results of the current military fitness often do not correlate to the working requirements of a particular task, especially in what concerns muscular strength, that is, lifting and carrying heavy loads.

Over the last decades, the units of the control exercises for the armed forces of the leading NATO countries and other countries have been reworked with an eye for the applicability of the tests in assessing soldiers' work capacity (Botta et al., 2022; Foulis et al., 2017b; Treweek et al., 2019).

The aim of this study is to develop a general physical fitness test based on determining the mutual relation of control exercises with the combat test control exercises.

Materials and Methods

To determine the correlation between the Great Britain Army Force evaluation test (GBAFET) control exercises and the control exercises of the general physical fitness test, initially simplifying the descriptive statistics of the control exercises, each control exercise was allocated a code/variable, using which the control exercise can be identified in the descriptive part of the results (see Table 1).

4 different tests were performed as part of the study: 3 physical conditioning tests and 1 combat test (see Table 1).

Table 1. Variables of the test exercises and the obtained numerical results

Test exercises	Variables
Great Britain Army Force evaluation test (GBAFET)	
Loaded march 4+2km	y1
Fire & Movement + 15m crawling and 15m sprinting	y2
Casualty Drag - 110kg, 20m	y3
240m Water Can carry 2x22kg	y4
70kg Vehicle Casevac	-
20kg Repeated lift & carry 20x30m	y5
Physical conditioning test Nr. 1 - Physical conditioning test of the National Armed Forces	
Push up for 2min	x31
Sit up for 2min	x32
3000m	x33
Physical conditioning test Nr. 2 - Adapted physical conditioning test of the Great Britain Armed Forces	
Broad Jump	x11
Hex Bar Deadlift	x12
Seated Medicine Ball Throw	x13
5x20 m Shuttle Sprint	x14
Pull Up every 4 sec. - 2x2 sec.	x15
Squats	x16
Physical conditioning test Nr. 3 - Physical conditioning test developed by the study author	
Burpee - 2min	x21
Sit and reach	x22
Plank	x23
Illinois Agility test	x24
Medicine ball throw	x25
Pull up – for men	x26
Power in bent arms – for women	x27
Beep test	x28

During the case study, 57 soldiers were tested (age 31.7 ± 1.9 years, height 181.5 ± 7.2, weight 85.8 ± 11.2), 7 of whom were women. The test was performed in groups of 8-14 soldiers over several months.

The first was the GB Army Force evaluation test (GBAFET). It consists of 6 control exercises, which are to be performed in combat outfit – the uniform, the boots, the web gear, the helmet, the arms, the magazine pouch, the patrol bag, and the backpack. The timespan for the entire test, including the rest time is 160 min. (the total exercise time is 90 min, and the rest between the 1st and 2nd and the 3rd and 4th exercises is 15 min., and between the 2nd and the 3rd, the 4th and the 5th, and the 5th and the 6th is 5 min.) (Blaus et al., 2023).

1st exercise. 4 km march with 40 kg load + 2 km march with 25 kg load (there is a 15-min. pause and backpack change between the exercises, with the performance standard being 4 km – 50 min. + 2 km – 15 min.); the exercise is performed in the following outfit: the uniform, the boots, the web gear, the magazine pouch and the arm – G36, the backpack and the patrol bag (for the 2 km march). The soldiers are allowed to take along a water bottle, which is not included in the total weight. During the march, there is a pacer going along, a soldier travelling with the average speed required to achieve the performance standard. During the exercise, a soldier is allowed to drop behind the pacer for up to 20 m, but at the instructor's warning is to join the group; if the soldier is unable to join the group and receives a third warning, the soldier is disqualified from continuing the exercise. Before the exercise, the soldiers are instructed that they can overcome the pacer.

2nd exercise. Tactical movement 20 x 7,5 m, a zigzag run with taking a shooting position, followed by a 15-m crawl on the belly with elbows and a 15-m run at maximum speed (the performance standard for the 7.5 m run with taking a shooting position is 8 sec., holding the shooting position for 8 sec., and crawling for 15 m followed by a 15-m sprint for 55 sec. each). The run with taking the shooting position is controlled by the instructor, who commands the beginning of the next exercise. The outfit for the exercise is the uniform, the boots, the web gear, the magazine pouch, and the arm – G36. If during the exercise the soldier is unable to perform the 7.5 m run with taking a shooting position in 8 sec., the soldier is disqualified from continuing the exercise (Blaus et al., 2023).

3rd exercise. Evacuating the wounded involves dragging a 110 kg sandbag over the distance of 20 m (performance standard 35 sec.). The outfit for the exercise is the uniform, the boots, the web gear, the magazine pouch, and the arm – G36. A soldier is allowed to change the grip during the exercise.

4th exercise. Carrying a 2 x 22 kg load (water container) over the distance of 240 m, imitating the evacuation of a wounded person on a stretcher (performance standard 4 min.). The outfit for the exercise is the uniform, the boots, the web gear, the magazine pouch, and the arm – G36. During the exercise, the soldier is prohibited from putting the container on the ground, pulling, or pushing it along the ground. If a soldier puts the container on the ground during the exercise, the soldier is disqualified from continuing the exercise.

5th exercise. Standing on a platform in a half-sit-up position, with the legs bent at 90º, a soldier holds a rope with a load with both hands and must raise the 70-kg load by straightening the legs and hold the load with straight legs and a straight back, imitating the evacuation of a wounded person from a vehicle (performance standard 3 sec.). The outfit for the exercise the uniform, the boots, the web gear, the magazine pouch, and the arm – G36. If during the performance of the exercise the soldier drops the load on the ground before 3 sec., the soldier is disqualified from continuing the exercise. Each soldier performs the exercise once.

6th exercise. 20 x 30 (2 x 15 m) repeated raising and carrying of a 20 kg load (sandbag) (performance standard 14 min.). During the exercise, a soldier lowers the 20-kg load with both hands from a platform raised at 1.5 m and puts it on the ground, then with both hands puts it on the shoulder and walks with it for 30 m. Returning to the platform, the soldier puts the load on the platform with both hands, etc. The outfit for the exercise the uniform, the boots, the web gear, and the magazine pouch. During the exercise, the soldier is warned when 7 min. have passed, with the following warnings after each successive minute.

Physical conditioning test Nr. 1 – a physical conditioning test of the National Armed Forces, to be performed by every soldier once a year. The test consists of 3 control exercises, which are performed in sports clothing and footwear. The time criterion for all the tests including the rest time is 60 min. (the total time of the control exercises is up to 20 min., with undetermined rest and transition times, preferably under 15 min., between the exercises).

1st exercise. *Push-ups*. The initial position (IP) is prone plank, with palms of the hands parallel. Moving the elbows back, with the upper arms and the body constituting a line, bend the arms and exhale. Straighten the arms and inhale. Performance time is 2 minutes. The soldier must try to make as many repetitions as possible. Methodological notes: the arms must be bent in the elbows up to 90º. The arms must be straightened after the exercise is performed. Rest is taken in the plank position, by transferring the weight to the legs without changing the arm position.

2nd exercise. *Sit-ups*. IP lying on the back, with legs bent at least 90º, the foot placed flat on the ground, the arms bent and crossed in front and the hands resting against the shoulders. Raise the upper body to the sitting position and exhale. Return to the IP and inhale.

3rd exercise. *Running on terrain.* The distance is 3000 m. Performance time is unlimited. Methodological notes: following the NAF physical conditioning test, women must run the distance of 1500 m, but in order to assess all the tests participants equally, it was decided that women also run 3000 m.

Physical conditioning test Nr. 2 – a physical conditioning test of the GB Armed Forces consists of 6 control exercises performed in sports clothing and footwear. The time for performing the test, including the rest, is 60 min. (the total time for the control exercises is 35 min., with a 5-min. pause or transition between the exercises).

1st exercise. *Standing long jump or broad jump* (explosive strength exercise). Soldiers are allowed to make 2 training jumps if needed and 2 registered jumps, with the farthest jump being registered.

2nd exercise. *Hex bar deadlift* (maximum strength exercise). Soldiers perform 2-3 training lifts before the exercise, deciding with which weight they would work during the control exercise. The soldiers can lift the weight 1-10 times during the control exercise.

3rd exercise. *Seated medicine ball throw* (explosive strength exercise). IP – seated with straight legs, with the back supported against the wall, and the stuffed ball held with both hands against the chest. The soldiers are allowed to make 2 training throws if necessary and 2 registered throws, with the farthest one being considered.

4th exercise. *5 x 20 m shuttle run* (anaerobic endurance and movement coordination exercise). IP – lying prone facing in the direction of the run, hands raised and fingers at the starting line. Soldiers are allowed to make one training run and 2 registered runs, with the fastest run considered.

5th exercise. *Pull-ups on the horizontal bar (4 sec.)* (power endurance exercise). During the exercise, soldiers perform the maximum number of repetitions without a time limit, making each exercise on the instructor counting 1, 2 – bend the arms, and 3, 4 – straighten the arms (Blaus et al., 2023).

6th exercise. *Squats* (lower body endurance exercise). During the exercise, soldiers perform the maximum number of repetitions without a time limit. IP – feet shoulder width apart, hands straight in front. The legs are bent in the knees to a 90° angle, followed by straightening the knees and returning to the IP, with as many repetitions as possible. During the exercise, it is allowed to take rest for 2 sec. in the IP. The exercise is included in the set of control exercises depending on the weather conditions: in deep snow, the exercise can be substituted for a 2-km run around the stadium. The exercise is taken from the Chinese AF set of PC control exercises (Blaus et al., 2023).

Physical conditioning test Nr. 3 – a physical conditioning test developed by the study author consists of 7 control exercises performed in sport clothing and footwear. Physical conditioning pilot test was performed in a gym. The time criterion for all the tests including the rest time is 60 min (the total time for the control exercises is 30 min., with a 5-min. rest and transition to the next exercise).

1st exercise. *Burpee* (power endurance exercise). IP – standing, arms down. 1 – squat with hands on the ground; 2 – plank position after a jump, arms straight; 3 – bend the arms; 4 – straighten the arms; 5 – with a jump, take the squatting position with hands on the ground; 6 – jumping up, straighten, arms above; land to the IP. Methodological notes: during the exercise, the soldiers determine the pace and the rest, if necessary. Rest is possible only in the IP.

2nd exercise. – *Plank* (static strength endurance exercise). IP – prone with support on the hands, the hands parallel to each other, and the palms turned to the floor. The soldiers must hold the IP statically. Methodological notes: the SP must be held for the maximum length of time, with no time limit. During the exercise, a soldier can receive 1 warning on inappropriate body position. After the second warning, the soldier is disqualified from further performing the exercise, and time is stopped.

3rd exercise. *Illinois Agility test* (anaerobic endurance and movement coordination exercise). IP – prone position with the head at the starting line, the arms bent at the sides, the hands at the shoulders and the elbow not touching the ground. After the "start" signal, a soldier stands up and runs 10 m forward, around a cone, then returns. This is followed by a *zigzag run* between four cones. The soldier runs further 10 m forward, around a cone, then back, crossing the finish line. Methodological notes: if necessary, soldiers can make 1 training run and 2 registered runs. The best time is registered.

4th exercise. *Throwing a medicine ball over the head* (explosive strength exercise). IP – standing with the back against the direction in which the ball is to be thrown, the feet shoulder width apart, the heels at the starting line, and the stuffed ball raised in straight arms. Moving the stuffed ball forward and down between the legs, simultaneously bending the legs, the ball is to be thrown upwards and backwards over the head. Methodological notes: after the stuffed ball is thrown, the soldier is allowed to "fall" behind the line. If necessary, soldiers can make 1 training throw and 2 registered throws. The best throw is registered.

5th exercise (for men). *Pull-ups* from a vertical hanging position on a horizontal bar (power endurance exercise for the upper body). Methodological notes: the exercise is registered if during the pull-up the chin is raised over the bar. Each soldier performs the maximum number of repetitions according to his physical conditioning. During the exercise, the soldier cannot swing or perform additional body movements.

6th exercise (for women). *Hanging from the bar with bent arms* (static strength endurance exercise). IP is a vertical hanging position with the arms bent on a bar, the hands gripping the bar from above, and the chin above the bar without touching it. Every soldier holds for the maximum time according to her physical conditioning. During the exercise, the soldier is allowed to receive 1 warning on inappropriate body position. On the 2nd warning, the time is stopped, the soldier is disqualified from further performance of the exercise, and time is stopped.

7th exercise. *Beep test* (aerobic endurance exercise). This test involves uninterrupted running between two lines at 20-m distance from each other. The pace is determined by a sound signal, the beep. The participants stand behind the line, facing the second line, and start running on hearing the signal. After a minute, the pace increases. Methodological notes: while performing the exercise, the soldier can receive 2 warnings for not crossing the second line on time (the soldier is ~ 1 m from the line). On the 3rd warning, the soldier is disqualified from further performance of the exercise and the current level is registered. The soldier who has not received the warning performs the exercise until deciding to quit.

Results

The GBAFET control test – vehicle Casevac – was taken out of the further mathematical statistic calculations, because during the performance of the control exercise it was not determined whether the participants have to perform the exercise to their last and because all the participants demonstrated a positive (passed) result under the assessment criteria: 3 sec, without continuing the exercise further. All the participants showed the same results – 3 sec., which did not allow to determine the correlation of the combat test control exercise with the physical fitness test control exercises.

To determine the correlation of the GBAFET control exercises with the physical fitness test control exercises, a normal data distribution check was performed. It has to be mentioned that the essential aspect of the selection (soldiers employed in the test) is correspondence to the general whole, that is the selection results should show normal distribution. Data correspondence to normal distribution was checked using the following methods:

1. Absolute value asymmetric and excess indicators were compared to their standard errors (see Table 2). If the mentioned absolute values exceed their standard errors, the variable data do not correspond to normal distribution. Correspondence to normal distribution means that the selection is sufficiently representative of the whole;

2. Using the Kolmogorov-Smirnov (Lilliefors test modification) criteria (see Table 3). When *Sig.* ≤ .05, the distribution significantly deviates from the norm;
3. Using the Shapiro-Wilk test criteria (see Table 3).

Table 2. Asymmetric and Excess test indicators of the control exercise scale data

Control exercise	A	SES	E	SEK
y1	**-.846**	.337	.190	.662
y2	-.276	.337	-.439	.662
y3	-.250	.322	**-.702**	.634
y4	-.208	.319	**-1.039**	.628
y5	**-1.453**	.316	**1.500**	.623
x11	**-.442**	.316	-.461	.623
x12	-.253	.316	.043	.623
x13	**-.709**	.316	-.239	.623
x14	**.607**	.316	-.502	.623
x15	**-.375**	.316	-.024	.623
x16	**.679**	.316	-.283	.623
x21	**-.404**	.316	-.364	.623
x22	**-.330**	.316	.242	.623
x23	.228	.316	-.555	.623
x24	.268	.316	**-.638**	.623
x25	**-.688**	.316	-.363	.623
x26	-.031	.316	-.439	.623
x27	**1.894**	.794	**3.871**	1.587
x28	**.483**	.316	.144	.623
x31	-.178	.316	**-.901**	.623
x32	-.290	.316	**-.717**	.623
x33	**.933**	.316	**.689**	.623

As can be seen from Table 2, the values gained from the control exercises indicate that the majority of the exercise results do not satisfy the requirements of the normal distribution (highlighted).

Kolmogorov-Smirnov and Shapiro-Wilk test criteria's assessment results are somewhat better (highlighted values correspond), but they still show that the selection does not provide sufficiently good correspondence to the general whole (see Table 3), which can be explained by the fact that, out of all the field test participants (n-57), 7 were females from S-1, S-2 and S-3 age group, and 50 were male soldiers from V-1, V-2, V-3 and V-4 age group, as well as by the fact that the participants physical fitness ranged from good to excellent. These difference in gender, age and physical fitness creates a greater probability that the group is not going to be uniform, creating a greater variation in the field tests results. It should also be noted that the tests were performed over several months, and the soldiers' physical fitness have varied in the meantime, based on the type and regularity of the daily physical activities, trainings outside of their service time and various health issues.

Table 3. Assessment of the correspondence of the control exercise data scale to normal distribution

	Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
Control exercise	Statistic	df	Sig.	Statistic	df	Sig.
y1	.134	50	.025	.924	50	.003
y2	.115	50	**.094**	.975	50	**.356**
y3	.105	55	**.196**	.938	55	.007
y4	.121	56	.040	.961	56	**.067**
y5	.202	57	.000	.829	57	.000
x11	.107	57	**.099**	.969	57	**.148**
x12	.158	57	.001	.954	57	.030
x13	.131	57	.016	.940	57	.007
x14	.137	57	.009	.941	57	.008
x15	.136	57	.011	.948	57	.016
x16	.130	57	.018	.942	57	.008

x21	.129	57	.019	.972	57	**.201**
x22	.075	57	**.200***	.979	57	**.442**
x23	.089	57	**.200***	.980	57	**.485**
x24	.078	57	**.200***	.977	57	**.356**
x25	.105	57	**.181**	.937	57	.005
x26	.082	57	**.200***	.963	57	**.079**
x27	.245	7	**.200***	.777	7	.024
x28	.127	57	.024	.964	57	**.084**
x31	.090	57	**.200***	.970	57	**.165**
x32	.077	57	**.200***	.970	57	**.165**
x33	.109	57	**.087**	.934	57	.004

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

To compare deviations between various groups of samples (exercises), variation coefficient $v = \frac{s}{\bar{X}} \cdot 100$ was used, where s- is standard deviation and $\bar{X}$ – average value. The range of the numerical results (variation coefficient) is shown in Table 4.

Table 4. Range of the exercises' numerical results (variation coefficient)

Variable	**y1**	**y2**	**y3**	**y4**	**y5**			
v (%)	2,3	5,7	7,1	4,0	2,7			
Variable	**x11**	**x12**	**x13**	**x14**	**x15**	**x16**		
v (%)	10,7	19,3	18,1	7,0	50,0	44,0		
Variable	**x21**	**x22**	**x23**	**x24**	**x25**	**x26**	**x27**	**x28**
v (%)	19,1	79,0	38,8	7,0	17,1	57,5	116,9	30,5
Variable	**x31**	**x32**	**x33**					
v (%)	25,0	20,4	15,0					

Comparing the range of numerical results of the GBAFET control exercises and the range of the numerical results of the GPF test control exercises, we can see that variation coefficients are lower (see Table 4). This can be explained by the fact that the control exercises are complex, consisting of numerous separate physical activities (creeping-running-crawling, lifting-carrying-walking, etc.) and the weaker performance of a single physical activity is compensated by the better performance of another physical activity within the same control exercise. It should also be mentioned that, before performing the GBAFET, the soldiers knew the assessment criteria of each control exercise – the result to demonstrate in order to obtain positive evaluation, "passed." Albeit it was determined before each of the control exercises that the exercise is to be performed with maximum effort to demonstrate as high result as possible, by achieving this positive assessment/result the soldier would save his/her efforts, thinking of the next exercise, and might cease to perform the control exercise prematurely, before showing the maximum positive results; this would lead to the participants' results being more or less grouped around the positive assessment or "pass." The only exception was the control exercise Casevac, before the performance of which it was set that the participants could stop performing the exercise upon passing it (3 sec.). Based on the above, we can suggest that an assessment scale with several levels provides a greater range of numerical results, which could be the reason for the relatively high range of numerical results of the GPF test control exercises.

The range of numerical results of the GPF test control exercises shows that individual exercises (x15, x16, x26, x27) have a very wide range of results. Strength endurance exercise for the upper body of the Physical Fitness Test Nr. 2 x15 and the authors' PFT strength endurance exercises for the upper body x26 and x27 range of results can be explained by the fact that individual male soldiers, mainly from v-1 age group (aged 18-27) and female soldiers do not use this exercise in their training process, as well as indicating that, before the NAF service, they did not do the exercise, therefore its performance was difficult for them. Likewise, it should be mentioned that for soldiers with higher body weight these exercises are more challenging and present greater difficulties as compared to such upper body strength endurance exercises as bending the arms and performing the plank, as indicated by another researcher, too (Aandstad, 2019). A very wide range of numerical results of physical fitness test Nr. 3 control exercise x27 can be explained by the fact that the sample was very small (7 females), and the data is not sufficient for making an informed conclusion.

In the assessment criteria for the physical fitness test Nr. 2 control exercise x15, it is indicated that, in this control exercise, the progress of results for each soldier is evaluated, rather than the maximum number of repetitions on each occasion the test was performed, which, in our opinion, is not a motivating criterion for the soldiers who are better prepared for performing the exercise. In our case, it was determined for the soldiers that the exercise is to be performed for the maximum result, making as many repetitions as possible.

Physical Fitness Test Nr. 2 includes a strength endurance exercise for the lower body x16, where the range of results can be explained by the fact that there was no time limit set for performing the exercise, with the assessment criterion being the number of repetitions, thus creating differing motivation for performing the control exercise among the test participants. Albeit the control exercise in the test was to be performed as the final exercise, many test participants acknowledged that they stopped performing the exercise not because they were tired, but because they would have muscle ache the next day, which is characteristic of performing strength conditioning exercises, and that they would find it hard to perform their service duties. Yet other test participants would do the control exercise to exhaustion and without thinking of possible leg muscle ache.

Physical Fitness Test Nr. 3 control exercise x22 had a range of positive and negative probability results at small medium values. In analysing, we see that the widest range can be found in strength endurance exercises. This means that the sample was not uncontroversial and needs to be substantially amplified to make well-funded conclusions in relation to the general whole. A correlation analysis of the GBAFET and GPF test control exercise was performed to test the correlation between variables y1 - y5 (GBAFET control exercises) and x11 - x33 (GPF test control exercises), as well as to answer the research question: *"Can GPF control exercise results be used to predict SPF control exercise results?".*

A summary of the results which reflects a numerical correlation tendency between the GBAFET control exercises and the general physical fitness test control exercises are represented in Table 5 and Table 6.

The GBAFET test y1 control exercise, in making calculations using the Pearson correlation coefficient and the Spearman correlation coefficient, demonstrated a large effect correlation value with 7 GPF control exercises. 2 Physical Fitness Test Nr. 2 control exercises x-11 (r = -0.48 p < .001/ r_s = -0.49, p < .001), which is an explosive strength control exercise for the lower part of the body, and x-14 (r = 0.45, p = .001/ r_s = 0.42, p = .002), which is a speed endurance control exercise. 3 Physical Fitness Test Nr. 3 control exercises x-23 (r = -0.42, p = .002/ r_s = -0.37, p = .007), static strength endurance control exercise for the core muscles, x-24 (r = 0.48, p < .001/r_s = 0.46, p = .001), speed endurance and movement coordination control exercises and x-28 (r = -0.59, p < .001), aerobic endurance control exercise and 2 Physical Fitness Test Nr. 1 control exercises x-31 (r = -0.55, p < .001/r_s = -0.55, p < .001), strength endurance control exercise for the upper part of the body and x-33 (r = 0.52, p < .001/r_s(57) = 0.59, p < .001), aerobic endurance control exercise (see Table 5 and Table 6)

The GBAFET y1 control exercise, in making calculations using the Pearson correlation coefficient and the Spearman correlation coefficient, demonstrated medium effect correlation value with 4 GPF control exercises - 2 Physical Fitness test Nr. 2 control exercises, x-14 (r_s = 0.42, p = .002), which is a speed endurance control exercise, and x-16 (r = -0.37, p = .008), which is a speed endurance control exercise for the lower body. 1 Physical Fitness Test Nr. 3 control exercise x-21 (r = -0.42, p = .002/r_s = -0.37, p = .007), which is a combined strength endurance control exercise for the upper and lower body correlated with 1 Physical Fitness Test Nr. 1 control exercise x-32 (r = -0.40, p = .004/r_s = -0.38, p = .007), which is a strength endurance control exercise for the stomach muscles (see Table 5 and Table 6).

Table 5. Statistically significant correlation between variables

		x11	x13	x14	x16	x21	x23	x24
y1	Pearson Correlation	-.48*		.45**	-.37**	-.42**	-.48**	.48**
	Sig. (2-tailed)	**.000**		**.001**	**.000**	**.002**	**.000**	**.000**
y2	Pearson Correlation		.28*					
	Sig. (2-tailed)		**.046**					
y3	Pearson Correlation					-.33*		
	Sig. (2-tailed)					**.013**		
y4	Pearson Correlation					-.26*		
	Sig. (2-tailed)					**.050**		

**. Correlation is significant at the .01 level (2-tailed).
*. Correlation is significant at the .05 level (2-tailed).

Table 5. Statistically significant correlation between variables (continuation)

		x25	x26	x28	x31	x32	x33
y1	Pearson Correlation				-.55**	-.40**	.52**
	Sig. (2-tailed)				**.000**	**.004**	**.000**
y2	Pearson Correlation	.29*	.30**				
	Sig. (2-tailed)	**.042**	**.034**				
y5	Pearson Correlation			-.35**			
	Sig. (2-tailed)			**.008**			

**. Correlation is significant at the .01 level (2-tailed).
*. Correlation is significant at the .05 level (2-tailed).

Table 5. Statistically significant correlation between variables (continuation)

		x11	x13	x14	x21	x23	x24	x28
y1	Spearman's rho Correlation Coefficient	-.49**		.42**	-.37**	-.43**	.46**	-.59**
	Sig. (2-tailed)	**.000**		**.002**	**.007**	**.002**	**.001**	**.000**
y2	Spearman's rho Correlation Coefficient		-.28*		-.36**			-.30*
	Sig. (2-tailed)		**.035**		**.007**			**.026**
y5	Spearman's rho Correlation Coefficient							-.33*
	Sig. (2-tailed)							**.012**

**. Correlation is significant at the .01 level (2-tailed).
*. Correlation is significant at the .05 level (2-tailed).

Table 5. Statistically significant correlation between variables (continuation)

		x31	x32	x33
y1	Spearman's rho Correlation Coefficient	-.59**	-.55**	-.38**
	Sig. (2-tailed)	**.000**	**.000**	**.007**
y3	Spearman's rho Correlation Coefficient		-.33*	
	Sig. (2-tailed)		**.012**	

**. Correlation is significant at the .01 level (2-tailed).
*. Correlation is significant at the .05 level (2-tailed).

The GBAFET y2 control exercise, in performing calculations using the Pearson correlation coefficient and the Spearman correlation coefficient, demonstrated medium effect value with 3 GPF test control exercises - Physical Fitness Test Nr. 2 control exercise x13 (r_s = -0.28, p =.035), which is an explosive strength control exercise for the upper body, and 2 Physical Fitness Test Nr. 3 control exercises x-25 (r = 0.29, p = .042), which is an explosive strength control exercise, as well as x-26 (r = 0.30, p = .034), a strength endurance control exercise for the upper body (see Table 5 and Table 6).

The GBAFET y3 control exercise, in performing calculations using the Pearson correlation coefficient and the Spearman correlation coefficient, demonstrated medium effect value with 4 GPF test control – Physical Fitness Test Nr. 2 control exercise x13 (r_s = -0.28, p =.035), 2 Physical Fitness Test Nr. 3 control exercises x-21 (r = -0.33, p = .013/r_s = -0.36, p =.007), which is a combined strength endurance exercise for the upper and lower body, and x-28 (r_s = -0.30, p =.026), which is an aerobic control exercise, and Physical Fitness Test Nr. 1 control exercise x-32 (r_s = -0.34, p =.010), which is a strength endurance control exercise for the stomach muscles (see Table 5 and Table 6). The GBAFET y4 in performing calculations using the Pearson correlation coefficient and the Spearman correlation coefficient, demonstrated medium effect value only with Physical Fitness Test Nr. 3 control exercise x-21 (r = -0.26, p = .050), a combined strength endurance exercise for the upper and lower body.

In turn, SPF test y5 control exercise, in performing calculations using the Pearson correlation coefficient and the Spearman correlation coefficient, demonstrated medium effect correlation value with only 1 GPF test control exercise, Physical Fitness Test Nr. 3 control exercise x-28 (r = -0.35, p = .008/r = -0.33, p = .012), which is an aerobic endurance control exercise, whereas the mutual correlations between the other control exercises are insignificant, with a small effect value.

A summary of the GBAFET and GPF control exercises effect sizes is give in Table 6.

Table 6. Correlation results

No.	Variables	Spearman and Pearson correlation coefficient, statistical significance	Effect size
1.	y1 - x11	$r(57) = -0.48, p < .001$	large
2.	y1 - x11	$r_s(57) = -0.49, p < .001$	large

3.	y1 - x14	$r(57) = 0.45, p = .001$	large
4.	y1 - x14	$r_s(57) = 0.42, p = .002$	medium
5.	y1 - x16	$r(57) = -0.37, p = .008$	medium
6.	y1 - x21	$r(57) = -0.42, p = .002$	medium
7.	y1 - x21	$r_s(57) = -0.37, p = .007$	medium
8.	y1 - x23	$r(57) = -0.48, p < .001$	large
9.	y1 - x23	$r_s(57) = -0.43, p = .002$	large
10.	y1 - x24	$r(57) = 0.48, p < .001$	large
11.	y1 - x24	$r_s(57) = 0.46, p = .001$	large
12.	y1 - x28	$r_s(57) = -0.59, p < .001$	large
913.	y1 - x31	$r(57) = -0.55, p < .001$	large
14.	y1 - x31	$r_s(57) = -0.55, p < .001$	large
15.	y1 - x32	$r(57) = -0.40, p = .004$	medium
16.	y1 - x32	$r_s(57) = -0.38, p = .007$	medium
17.	y1 - x33	$r(57) = 0.52, p < .001$	large
18.	y1 - x33	$r_s(57) = 0.59, p < .001$	large
19.	y2 – x13	$r(57) = 0.28, p = .046$	medium
20.	y2 – x25	$r(57) = 0.29, p = .042$	medium
21.	y2 – x26	$r(57) = 0.30, p = .034$	medium
22.	y3 – x13	$r_s(57) = -0.28, p = .035$	medium
23.	y3 - x21	$r(57) = -0.33, p = .013$	medium
24.	y3 - x21	$r_s(57) = -0.36, p = .007$	medium
25.	y3 - x28	$r_s(57) = -0.30, p = .026$	medium
26.	y3 – x32	$r_s(57) = -0.34$, p =.010	medium
27.	y4 - x21	$r(57) = -0.26, p = .050$	medium
28.	y5 - x28	$r(57) = -0.35, p = .008$	medium
29.	y5 - x28	$r_s(57) = -0.33, p = .012$	medium

r- Pearson Correlation Coefficient
r_s - Spearman's rho Correlation Coefficient

Discussion

An analysis of the GBAFET and the GPF test control exercises correlation was performed in order to test the correlation between variables y1 - y5 (GB AF combat/ SPF test control exercises) and x11 - x33 (GPF test control exercises) and also to answer the research question: "Can the GPF control exercises be used to predict the results of the SPF control exercises?".

As can be seen in Table 6, the GBAFET y1 control exercise (march with weight 4km with 40kg + 2km with 25kg), which is a combined aerobic endurance and strength endurance control exercise, can be replaced with GPF test control exercises x11, x14, x23, x24, x28, x31 and x33, which show a great effect value. Of these control exercises, the closest correlation is shown by control exercises x28 (r_s = -0.59) and x33 (r_s = 0.59/ r = 0.52), which are aerobic endurance control exercises. Of the remaining 5 control exercises that show a great effect value, 2 are speed endurance and movement coordination control exercises x14 and x24, one is a strength endurance control exercise for the upper body x31, one is an explosive strength control exercise for the lower body x11 and one is a static strength endurance control exercise x23.

While individual studies show an insignificant correlation between the march and various GPF aerobic endurance tests (Hauschild et al., 2016; Stocker & Leo, 2020) on the whole, it can be concluded that the SPF control exercise march (y1) can be replaced by several GPF aerobic endurance control exercise or strength endurance control exercises, which showed the closest correlations. The NAF GPF control exercises on the whole include an aerobic endurance control exercise – 3000 m run (x33), which shows equivalence with another aerobic endurance control exercise – 20 m beep test (x28). Beep test is included in individual armed forces, schools and sports GPF control exercise sets, replacing the classical aerobic endurance control exercise 1500-3000 m run outdoors or on the stadium. This control exercise in sets of control exercises is included for important reasons:

1. The control exercise is recognised as being a valid aerobic power measurement test (Mayorga-Vega et al., 2015; Armstrong & Welsman, 2018; Tomkinson et al., 2019);
2. The exercise can be done indoors, and thus it is not subject to the weather, which is important in northern countries and countries with unpredictable weather.

In turn, due to the weather conditions, the aerobic endurance and strength endurance control exercise included in the British Armed Force GPF x16 – squats for the maximal results, show only a medium value effect, which can be explained by the above-mentioned motivation of the soldiers.

The strength endurance control exercise for the upper body – bending and strengthening the arms in the plank position x31, as well as the static strength endurance control exercise plank x23 have close correlations with the SPF control exercise y1 – the physical characteristic or their manifestations required for performing a march. During the march, moving with various weights, such as backpacks, strength endurance in the upper body is one of the most important factors for showing high results. Another important factor is the endurance of the body's core muscles in moving various weights, which also reduces the risk of injury and forms the correct body posture (Roy et al., 2010; Tingelstad et al., 2016). In turn, explosive strength in the legs' muscles, speed endurance and movement coordination in various previous studies (Solomonson et al., 2016) is mostly related to the ability to perform other military tasks, such as overcoming obstacle courses, changing the shooting position and taking shelter in response to the opponent's fire.

The GBAFET y2 control exercise (fire and movement 20x7,5m or zigzag run with taking a shooting position = 15m crawl on the elbows = 15m max fast run) is a combined speed strength, speed endurance and movement coordination control exercise, which can be replaced by the GPF test control exercises x13, x25 and x26, which show a medium effect value. Out of these control exercises, the closest correlation is shown by control exercise x26 (r = 0.30), which is a strength endurance control exercise for the upper body, and also equivalent medium close correlations are shown by the explosive strength control exercises x25 (r = 0.29) and x13 (r = 0.28) (see Table 5).

On the whole, it can be concluded that the GBAFET control exercise fire and movement + crawl _ maximum run (y2) can be replaced by the GPF strength endurance control exercises for the upper body or the explosive strength control exercises for the upper and lower body, but, because the performance of y2 control exercise involves multiple and as fast as possible changes of the body position (lying, standing and crawling), we believe that the primary replacement for the exercise is the GPF control exercise x25 – throwing a rubber ball over the head and backwards, which test/determines manifestations of the explosive strength of the upper and lower body muscles. In turn, the inclusion of the strength endurance control exercise for the upper body, bar pull-ups (x15) should be considered, because this control exercise is included in the sets of the GPF control exercises for the NAF and various forces in numerous countries, replacing the control exercises – bending and straightening the arms in the plank position. Currently, the NAF GPF test includes the strength endurance exercises for the stomach muscles – lowering and raising the upper body (x32) and the strength endurance control exercise for the upper body – bending and strengthening the arms in the plank position (x31), while the control exercise bar pull-ups (x15) was considered to be physically hard and inappropriate for soldiers with a higher body weight index and for females, as also stated in another study (Aandstad, 2019).

The GBAFET y3 control exercise Casualty drag (dragging a 110kg heavy sandbag over the distance of 20 m), which is a combined speed strength, speed endurance and strength endurance control exercise, can be replaced with the GPF control exercises x13, x21, x28 and x32, which show a medium effect value. Of these control exercises, the closest negative correlation is shown by control exercise x21 (r_s = -0.36/ r = -0.33), which is a combined strength endurance exercise for the upper and lower body, and a somewhat worse negative correlation is shown for control exercise x32 (r_s = -0.34), which is a strength endurance control exercise for the stomach muscles – raising and lowering the upper body. Control exercise x32, when performing calculations using the Spearman range correlation coefficient, showed a medium value effect with SPF y3 control exercise, while when making calculations using the Pearson correlation coefficient, the results showed a lesser effect value. Likewise, it should be noted that both control exercise correlations have a negative/minus value, meaning that, when the results of one control exercise decrease, the results of the other control exercise increase, which is not contradictory in this case, because both of the GPF test results were determined, counting the number of repetitions of the exercise during a given time period (2 min.).

Overall, it can be concluded that the GBAFET control exercise Casualty drag (y3) can be replaced by the GPF control exercises x21 or x32.

The GBAFET y4 control exercise Water Can Carry, imitating evacuation in a litter (carrying a 2X22kg heavy water can over 240m), which is a strength endurance exercise, when the correlation was calculated using the Pearson correlation and the Spearman range correlation coefficient, showed a medium effect value with one of the GPF exercises only, x21 burpee test (description of the exercise: initial position standing with arms down, 1 – squatting with hands on the ground, taking a squatting position; 2 – the plank position, arms straight; 3 – the plank position with the arms bent; 4 - the plank position, arms straight; 5 – squatting; 6 – a hop, arms over the head, going back to the initial position). GPF control exercise x21 is a combined control exercise, which can test several physical characteristics and their manifestations; during the exercise, the body position should be changed (standing, squatting, plank), taking various exercise performance position and loading all the greatest body muscle groups, which in the study by another author is mentioned as an important factor (Yamashita, 2023). Other authors (Foulis et al., 2017a; 24. Stocker & Leo, 2020; Tingelstad et al., 2016; Chassé et al., 2019) in their studies note close correlations between various casualty evacuation SPF tests and strength endurance, explosive strength and aerobic endurance control exercises. Our studies showed close correlations, with the calculations using the Pearson correlation and the Sperman range correlation coefficients, between the GPF control exercise x27 hanging at the bar with bent arms (r = -0.47 / r_s = -0.42), which is a static strength endurance control exercise for the upper body, but, one should bear in mind the fact that the set of the GPF control exercises included a strength endurance control exercise for females, replacing the strength endurance control exercise for the upper body x26 – bar pull-ups for males, the exercise was performed by only 7 participants. Therefore, the credibility of the control exercise results is negligible.

Overall, it can be concluded that the GBAFET control exercise Water Can Carry (y4) can be replaced by the GPF control exercise x21.

The GBAFET y5 control exercise – repeated lifting and carrying weight (20 x 30m with a 20kg weight (sandbag)), which is an aerobic endurance and strength endurance control exercise was subjected to calculations using the Pearson correlation and the Spearman range correlation coefficients and showed a medium effect value with only one of the GPF control exercise x28 – "beep test" ($r = -0.35$ / $r_s = -0.33$), which is an aerobic endurance control exercise.

In our study, strength endurance exercises show weak correlations with the SPF test y5 control exercise, which is also observed by other authors (Carstairs et al., 2016; Hydren et al., 2017) in their studies, while looking for correlations between strength endurance control exercises and various tasks involving repeated lifting and carrying heavy loads.

Overall, it can be concluded that the GBAFET control exercise – repeated lifting and carrying a load (y5) can be replaced by the GPF control exercise x28.

The GBAFET control exercise Casevac (lifting out a 70kg weight and holding it with straight legs and straight back for 3 sec), which is a maximum strength test, was not subjected to mathematical statistical calculations, because all the participants performing the control exercise (n-57) completed the requirements of the control exercise, holding a 70kg weight for 3 sec. Based on the studies of other authors (Hydren et al., 2017; Poser et al., 2019), the SPF control exercise would have to be replaced by the GPF control exercise lifting from the ground, because both control exercise test the maximum strength.

Conclusion

The aim of the study was to develop a general physical fitness test based on determining the correlation between the control exercises of the general physical fitness test and those of a combat test (GBAFET).

The initial analysis of the results after determining the correlation between the GBAFET and the GPF control exercises shows that the GPF control exercises that can be used for predicting the results of the GBAFET control exercises best are:

1. control exercises – x28 and x33 (aerobic endurance);
2. control exercise - x25 (explosive strength);
3. control exercise – x21 (strength endurance for the upper and lower body);
4. control exercise – x32 (strength endurance for the stomach muscles);
5. control exercise – x12 (max strength).

However, one should also bear in mind the fact that a field test had many additional circumstances, which were not singled out (gender, age, prior physical fitness, etc.) and which have a substantial influence on the results of the control exercises. Likewise, it should be born in mind that for certain control exercises the assessment criteria was not motivating enough, and the maximum ability of each participant was not manifested, which is an important factor in determining the correlations between the GBAFET and the GPF control exercises. Likewise, it should be noted that the performance of each control exercise is also influenced by its technical performance and prior experience. To minimize the impact of the above factors, a greater sample would be required. In this case, we can only point to a tendency that can be related to the general whole.

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