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WHICH MOTOR ABILITIES HAVE THE HIGHEST IMPACT ON WORKING PERFORMANCE OF SLOVENIAN SOLDIERS?

1. INTRODUCTION

Soldiers are expected to maintain a high degree of physical readiness as operational demands can degrade motor performance (Nindl, Barnes, Alemany, Frykman, Shippee and Friedl, 2007). Motor abilities are those psychosomatic dimensions that determine motor efficiency and performance of motor tasks (Šturm and Strojnik, 1994). Certain level of motor abilities is important for efficient performing of each day's tasks in the modern military. The motor abilities of an individual soldier as well as of a whole unit represent one of the key elements of combat readiness that is gaining its importance at training a modern army (Karpljuk, Žitko, Rožman, Suhadolnik and Karpljuk, 2000). Combat readiness represents the ability and readiness of armed forces as a whole or its branches, services and units to incorporate themselves in an action in different circumstances and at different times. The level of combat readiness is dependent on many factors: the defense doctrine, the level of country's readiness to war, the efficiency of mobilization system, the level of preparedness of a territory, reserves and others (Vojna enciklopedija, 1973). The tasks of the modern military are connected to extremely high and long-lasting physical and psychological efforts, demanding proper physical training and psychological conditioning from soldiers (Tkavc, 2004). Therefore physical training has to be based on endurance, strength and speed training on one side and on the development of mental abilities, cohesivity within the group and cohesivity of factors, related to the conditions on the battlefield, on the other side (Picarielo, 2000). Slovenia became a member of NATO and the European Union in the year 2004. Both these partnerships require new solutions in the organization and functioning of the SAF. Apart from that it is also necessary to consider the changes from a conscript army to a professional one, which is completed by a compulsory and voluntary reserve. All these changes demand a higher level of professionalization and standard combat readiness.

Sport in the SAF is defined precisely by the Directive of Sport (Direktiva za šport, 2005). It cites that readiness of the members of the SAF is provided by planned and organized execution of physical training of the units, in sports education, and in sports competitions. Further on it is provided by sport for all, checking of motor abilities, top-level sport, international sports cooperation, and the development of sport in the SAF. The Directive also defines that military personnel should attend sports exercises (expert-led physical training) as part of on-the-job training up to an hour daily. Apart from that the training has to include combat sports, orienteering, military pentathlon, swimming, cycling, climbing the horizontal and vertical rope, ball games, selection

competitions at the unit level, and especially marches. The training is complemented by recreational exercises in the afternoon hours. Two sports days have to be executed annually (in summer and winter time). Once a year all military personnel have to take part in at least one test and evaluation of physical competence, which represents a constituent part of the training process in the SAF. Its purpose is to ensure a systematical insight in the physical readiness of the members and units of the SAF, which is important for executing military service as well as for giving grades, related to promotion and fulfilling the conditions for renewing employment contracts (Direktiva za šport, 2005). Besides, physical testing is also a means of evaluating the efficiency of programs of training, planning, organizing, and executing sports activities in the SAF (Direktiva za šport, 2005).

Since 1996 SAF uses 3 tests (push-ups in 2 minutes, sit-ups in 2 minutes and running/walking the 3200m distance) to evaluate the physical efficiency of soldiers. This test battery was taken from US army. To gain more information about the physical competence of soldiers we upgraded the test battery, having the motor model of Pistotnik (2003) taken into account. Therefore the main goal of the article was to analyze whether there is any correlation between 4 motor abilities (flexibility, speed, strength and coordination) and working efficiency of the soldiers in the battle unit of the SAF. The research could confirm that certain level of motor abilities is important for efficient performing of each day's tasks in the modern military.

2. METHODS

2.2. Sample of participants

The sample of participants consisted of 115 male soldiers of the SAF, aged 21 to 36 (age = 27,1 ± 3,7 years; height = 177,3 ± 7,4 cm, weight = 78,3 ± 10 kg). The soldiers were serving in a battle unit in the first brigade of the SAF. On the day of testing they had to be clinically healthy. Before testing they were informed about the purpose of the study.

2.3. Sample of variables

For the assessment of motor abilities 11 tests (descriptions are available with authors) were applied, measuring flexibility, speed, strength and coordination (Table 1). Working efficiency (WE) were computed from 19 items of soldier's efficiency (Fig. 1), which were evaluated by their commanders (superior officers who know them personally). They used values from 1 to 5 to determine how characteristically is each of 19 statements for individual soldier (1 – not characteristically; 5 – very characteristically). The soldier's value of WE was the average value of all 19 items.

Fig. 1: *Questionnaire of working efficiency*

1.	He does not have any problems with performing each day's tasks.
2.	The level of efficient performing decreases during the day.
3.	He has a liking for high intensity training.
4.	He shows high level of strength and stamina when performing tasks on the terrain field.

5.	His performing on the terrain field is highly efficient and predictable.
6.	He shows high level of reliability when performing tasks on the terrain field.
7.	Other factors (weather, surroundings) don't have impact on his efficiency on the terrain field.
8.	His shooting efficiency is high.
9.	He has high level of basic physical readiness.
10.	He is rarely absent from activities on the terrain filed because of injuries.
11.	His attitude towards other soldiers on the terrain filed activities is good.
12.	His attitude towards superior officers on the terrain field activities is perfect.
13.	He is rarely absent from work because of health problems.
14.	He behaves consistent and stable under stress.
15.	He often conflicts.
16.	He can set high goals and reach them independently.
17.	He is highly motivated for his work (as a soldier).
18.	His motivation for performing each day's tasks is high.
19.	His performing of motor tasks is highly efficient.

2.4. Data analysis

The basic statistical parameters of all the variables were computed in the first phase of the data analysis. In the second, the Pearson correlation coefficients (r) between the individual motor variables and their individual correlations with working efficiency were computed. Statistical significance was tested two-sidedly, 5 % (and 10 %) error level was used.

3. RESULTS AND DISCUSION

The results of basic statistical parameters are shown in Table 1. According to 10 % alpha error we have found 5 statistically significant correlations between strength tests and working efficiency (Table 2).

Table 1: *Basic statistical parameters of all used variables*

Variable	Ability	Unit	Mean	Std. Dev.
Working efficiency (WE)		value	3.6	0.7
Weight		cm	78.3	10
Height		kg	177.3	7.4
Arm twist with a stick (AT)	flexibility of shoulder joint	0.5 cm	92.07	17.56
Bend and touch while sitting (BT)	flexibility of trunk	0.5 cm	54.96	8.05
Tapping with dominant arm (TA)	speed of alternative movements	n	49.76	5.79
Ruler catch (RC)	speed of simple movement	0.5 cm	16.74	3.59
Medicine ball throw (MBT)	explosive strength of arms	cm	526.9	77.6
Standing long jump (SLJ)	explosive strength of legs	cm	223.7	23.2
Pull-ups (PUL)	repetitive strength of arms	n	6.1	3.8
Sit-ups (SU)	repetitve strength of trunk	n	29.8	9.9
Squats (S)	repetitive strength of legs	n	56.3	6.0
Polygon backwards (PB)	coordination	0.1 sek.	10.62	2.21
Figure 8 with bending (F8)	coordination	0,1 sek.	19.62	1.40

Table 2: *Pearson correlation coefficients between motor abilities and working efficiency*

Variable	***WE***
Arm twist with a stick	- 0.06
Bend and touch (BT)	.02
Tapping with dominant arm (TA)	.17
Ruler catch (RC)	-.19**
Medicine ball throw (MBT)	.18*
Standing long jump (SLJ)	.27**
Pull-ups (PUL)	.30**
Sit-ups (SU)	.01
Squats (S)	.15
Polygon backwards (PB)	**-.25****
Figure 8 with bending (F8)	**-.16**

Legend: statistically significant correlations $p<0.05$ are marked with two asterisks, $p<0.1$ are marked with one asterisk

Motor tests correlated significantly with working efficiency were tests of strength, coordination and speed. Muscle strength is desirable characteristics for soldiers, as it has been related to performance ability in common military tasks (Alum, 2005). Several studies proved that strength and muscular endurance are the best predictors for carrying out the operational demands of elite military units (Harman and Frykman, 1995, Simpson, Gray and Florida-James, 2006).

The strength of arms seems to have the highest impact on working efficiency. Movements with arms are common in performing each day's tasks in the army. Soldiers whose arm strength is of higher level seem to be more capable of executing demands of modern military. The MBT test involves rapidly projecting object in a single voluntary effort. The central characteristic of so called power tests (test of explosive strength) is the ability to develop force rapidly (Knapik, Sharp, Darakjy, Jones, Hauret and Jones, 2006). Soldiers who could express arm movements of high intensity appear to be more efficient when performing each day's tasks in the army. Soldiers who are capable of expressing movements of high intensity quickly could show liking for training of high intensity, could be more motivated for motor tasks of high intensity (for example throws of army weapons, sudden shooting...) and are probably more efficient when performing those sort of tasks.

High level of repetitive arm strength is also important. In our research it was measured with pull-up test. This type of test involves repeatedly moving the portion of the body in a specific period of time and measures so called muscle endurance (Knapik et al., 2006). Soldiers who could execute repeatable arm movements for longer time seem to be more efficient with performing other tasks in the army as well. On the terrain field activities soldiers should perform some basic movements of the body such as creeping, crawling and climbing. High level of repetitive strength of arms is necessary for efficient executing of those movements. They could probably do better if they are stronger. Some previous researchers (Dolenec, 2001) also found out that tests of repeti-

tive strength need to be carried out with a certain degree of motivation. As soldiers could be more motivated in executing pull-ups they could also show more interest in performing other task at work. The criterion variable measures their interest and motivation for physical activity as well.

The second test of explosive strength (power), which shows high correlation with the WE, is standing long jump. It measures explosive strength (power) of legs, which is important when one needs to move quickly. The SLJ test involves rapidly projecting the entire body, which is characteristic for power tests (Knapik et al., 2006). When being on the terrain field soldiers come into situation when they need to perform short sprints to hide for example. Often they are practising quick starts when they need to run and find a shelter. When moving on the terrain they have to jump over obstacles sometimes. All those movements require quick development of great amount of muscle power (explosive strength). Soldiers whose explosive strength of legs is on higher level are probably more efficient in performing those sorts of movements (short sprints, quick starts, sudden jumps...). Therefore they could be better evaluated from their commanders (they have gained higher value of WE).

There was also significant correlation between coordination and WE. The motor task in variable PB demands the activation of the entire body and it is a combination of complex motor structures performed with maximum speed (Pistotnik, 2003). A certain order and mode of overcoming an obstacle (or distance) is needed. These characteristics are also typical for physical training of soldiers. When being outside (on terrain) the soldier must solve the space related problems quickly – for example avoiding an obstacle when running, crawling under or climbing over a fallen tree... This test of coordination shows the ability of efficient resolution of space-related problems, which gives the soldier on terrain the ability to adapt quickly to his constant changing environment. The soldier must respond quickly to complex motor problems that arrive during the activity (changing geography of land for example). To be able to solve space related problem quickly and efficiently should be an advantage when dealing with that sort of demands (which could be also shown as better value of working efficiency).

Test RC (ruler catch) measures the speed of simple movement. Soldiers, who were able to squeeze hand quickly and catch the falling ruler before it hits ground, achieved better results. The correlation between this motor task and WE is probably due to quick reaction, which is important in every day's military tasks (such as quick response in shooting – pulling a trigger, hitting the target).

There was no significant correlation between flexibility and WE. It could not be concluded that this ability isn't important for soldiers. It is recommended that soldiers have certain level of flexibility to avoid injuries and to express better motor performance.

4. CONCLUSION

The results have shown that high level of motor abilities was important for achieving good values of working efficiency. Their superior officers better-evaluated soldiers, who could express higher level of arm and leg strength, who could perform the complex motor tasks quickly and solve the space related problem efficiently. Stronger,

faster and more coordinated soldiers appeared to be more effective with carrying out the each day's demands of modern military. The highest impact on working efficiency of soldiers had the tests of arm strength.

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SUMMARY

The objective of the research was to find a correlation between motor abilities and working efficiency of soldiers in a battle unit of Slovenia Armed Forces (SAF). The subject consisted of 115 soldiers (age = 27,1 ± 3,7 years) who were serving in the first brigade of the SAF. Motor abilities were measured with 11 motor tests, assessing the level of flexibility, speed, strength and coordination. To evaluate working efficiency of soldiers a special questionnaire was used, which consisted of 19 statements. Superior officer was asked to fill a questionnaire for each inferior soldier with values from 1 to 5. The correlation between motor abilities and working efficiency was assessed with the Pearson's correlation coefficient. We have found 5 statistically significant correlations. Motor tests correlating most with working performance were tests of arm strength.

Keywords: *Slovenia Armed Forces (SAF), motor abilities, working efficiency*

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