PERFORMANCE OF ARMY PROFESSIONALS FROM A PHYSICAL POINT OF VIEW

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Abstract: The probability of soldier success in the military missions is closely connected to the technology and various equipment, that they can use. Except for technology factors, the soldiers must meet their psychophysical and physical parameters. Usually, both psychophysical and physical personal parameters are evaluated during the recruitment process. The main problem could be within evaluation during common duties of the enlistment. The problems with evaluation could be connected to soldiers' gender. The objective of the paper is to find out the relationship between gender and soldiers' physical results. The sample consisted of 3317 persons, who attended army training by 15 km march. We employed the Pearson chi-square test to evaluate the potential relationship.

Keywords: physical parameter, military march, human sustainability, personal potentials

1 Introduction

One of the successes of a soldier's activities in modern operations is the high level of physical fitness in the area of physical preconditions. It represents a set of strength, speed, dexterity, and endurance skills. For the development of these abilities, their mutual interaction and the creation of conditions for appropriate loading of the organism are important. The specific tasks of a soldier in most cases require their performance under conditions that limit these activities (Vazirian et al., 2020). In many cases, non-standard to extreme situations can occur. These conditions then require the soldier to acquire skills and acquire habits in areas that use elements and sets of exercises from STP to train these expected activities. Induction of real situations can be modeled by different ways of loading. The experience and skills gained from the training should then be used in a real situation with a certain degree of stereotype. Special physical training is focused on the training of members of the Czech Armed Forces (ACR), in which a specific part of their physical and mental readiness to perform movement-specialized tasks of military expertise, which these members perform or are preparing for, is purposefully created. The selection and classification of STP topics are based on the target profile of a trained soldier in the military field (Windle, Gregory, Dixon, 1999; Kozáková, Saliger, 2019).

The topic of pedestrian movements does not currently have an anchor, for example in the form of aid or military professional publication, which would deal more comprehensively with both the content, professional and methodological aspects of training. At the same time, historically the past and the present show that the movements made by soldiers (e.g. infantry, tactical, accelerated, hard, or with load) are of irreplaceable importance in fulfilling the tasks of the individual and the unit in contemporary operations (Fraser et al., 2021; Friedl, 2018; Drain et al., 2016).

1.1 Factors affecting a soldier's performance when making foot movements

Many factors affect the soldier in the course of his activities or in combat deployment, which directly or indirectly affects his final performance. In general, we can divide them into a group of endogenous and exogenous factors. The interdependence of factors on a soldier's performance is shown in Figure 1.

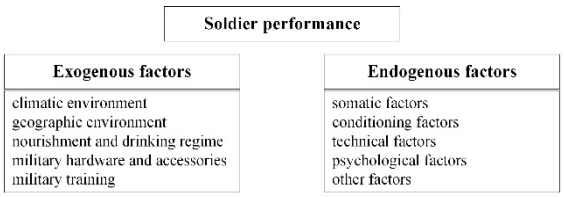

Figure 1: Influencing factors of soldier's performance

1.1.1 Endogenous factors

The internal factors of the organism are given more weight because they significantly affect its internal processes. These factors are closely related, interact, and, in many cases, combine. Internal factors affecting a soldier's performance include:

- somatic factors;
- conditioning factors;
- technical factors;
- psychological factors;
- other factors.

Somatic factors are relatively stable and genetically determined factors having an irreplaceable role in the performance of military tasks. The main somatic factors include:

- body height and weight;
- proportionality of length dimensions;
- body composition (represented by active body mass and the representation of individual types of muscle fibers);
- body type (sum of shape features of individuals based on endomorphic, mesomorphic, ectomorphic components).

Partial somatic factors may be the lengths of body segments and their mutual proportionality. From the somatotype point of view, the human body is made up of three components: the skeleton, body fat, and muscles. The ratio of the individual components that make up the somatotype can be partially influenced. The construction of the skeleton is genetically determined and changes in the sense of "improvements" are difficult to implement in military practice. However, it is important not to overload during exercise. Overloading the body brings with it degenerative, often irreversible changes observable at an advanced age in the spine and joints. The components of active muscle mass and fat can be affected. A larger proportion of active muscle mass is usually reflected in a higher level of strength. Appropriate exercises together with other factors cause muscle hypertrophy, i.e. an increase in their volume. According to Bilzon et al. (2001) activities that require strength or endurance, are the most suitable subjects with a minimal proportion of body fat. Such soldiers are anthropometrically adapted to perform military tasks such as handling heavy material or rescue activities, including carrying the wounded on stretchers.

Conditioning factors are represented by motoric abilities. Manifestations of strength, endurance, speed, and coordination can be identified in each soldier's physical activity. The proportion of each type of motoric skill depends on the nature of the task being performed. Experience from foreign military operations, where our soldiers have participated and continue to participate in a wide range of tasks, suggests that an effective way to achieve optimal levels of physical fitness leads through a variety of training variations. These should focus in particular on the four main components of motoric skills affecting the required physical fitness in the performance of special physical activities in the operating environment. It is about endurance, strength, speed, and flexibility. According to Černohorský (2009), motoric skills represent the integration of the internal properties of the organism, which enable the fulfillment of a certain group of movement tasks and are retrospectively conditioned by them. Genetic assumptions are significantly

reflected in the level of human mobility. According to Schmidt (1991), the motoric ability is a permanent, predominantly genetically determined trait that underlies and at the same time supports various types of motoric and cognitive activities**.** Měkota and Blahuš (1983) define motoric skills in general as a set of prerequisites for successful physical activity, which represent the internal integrated assumptions of the organism. For some of them, a biological basis can be found (e.g. some anatomical differences in extremely capable individuals). Others are manifested in physiological functions, but especially in the results of physical activity.

Most authors, such as Čelikovský et al. (1985) and Hošková and Matoušová (2007) distinguish four areas of motoric skills, namely strength, speed, endurance, and dexterity. In addition, Bursová and Rubáš (2001) classify balance and rhythmic movement skills. The development of motoric skills takes place through motoric training, which is also often called training. In motoric training, it is generally believed that gains in motoric skills above their baseline are maintained for approximately as long as it takes to achieve this increase. This judgment is only indicative and cannot be considered dogma. However, for each motoric ability, the ratios of development and decline are somewhat different. According to Čelikovsky et al. (1985), motoric skills, unlike movement skills, are not narrowly specific prerequisites for fulfilling a movement task. The degree of their specificity or uniqueness depends on the nature of the motoric activity, gender, and the level that the individual has reached during his or her life. In an individual's daily life, individual motoric skills are evenly accepted (Sekanina, 2016).

Observable improvement in strength skills can be achieved quickly through training. Comprehensive development of strength skills carried out depending on the individual peculiarities of soldiers is preferred. They train with a lower weight for better coordination of movements. Rather, local muscle groups are strengthened with an emphasis on proper breathing. During strength training, there is great fatigue and therefore it is important to perform compensatory exercises that eliminate the negative effects of strengthening not the body of the soldier. We can generally divide force abilities into individual types of force:

- maximum;
- fast and explosive;
- endurance.

Military activities are associated with the solution of movement tasks, which can be represented by simple or complex movement patterns. Movement tasks usually offer more options for how to solve them effectively. In general, the technique can be understood as a way of solving physical activity, which is within the capabilities of a soldier with biomechanical laws of movement and is carried out based on neurophysiological mechanisms of movement control. When performing tasks, a combination of other internal factors influencing performance is used, especially somatic, fitness, and mental. Variable options for solving military activities determine the content and nature of the specific activity for which the soldiers are preparing for a long-term, purposeful and systematic preparation. Technology is mainly a matter of motoric control. The aim of the technique is a perfect and efficient arrangement of movement in time, which leads to the successful completion of movement activity. This is done through the nervous system, which ensures the interaction of all the muscle groups involved. In connection with the application of the factor of technology in the field of military, one can agree with the opinion of Schnabel et al. (2003), who states that the coordination ability, which is considered the "Organizer" of other motoric skills within the given motoric skills, plays a special role during physical activities. Coordination skills thus significantly facilitate the creation of spatial, temporal, and dynamic characteristics of movement patterns. Technology should be an integral part of physical training throughout the active service of a professional soldier. Initially, it is about learning and improving the basics. When basic skills are mastered, phases of automation and degree of adaptability are formed through differentiation, integration, stabilization. It is the process of the latter that integrates the perfection of performing physical activity and the ability to perform the skill in a specific environment. An example could be a swimming skill that is manageable in the process of automation even in circumstances where a soldier is exposed to swimming in a river or a natural reservoir, and clothing and with weapons. The ability of soldiers to swim in these non-standard conditions is in line with the output requirements of the automation process and the degree of adaptability. The degree of variability, in turn, will allow the soldier to correctly choose the most suitable variant needed to solve the movement task. Technology is inextricably linked to motoric skills, coordination, and psychological factors (Sekanina 2016).

Psychological factors support motivation (Karna and Knap-Stefaniuk, 2017) and will is an important part of training, in which soldiers learn to control mental processes and develop specific resilience for certain situations as an extension of innate psychological resilience and general resilience. Motoric skills and psyche based on perfect functional readiness of the organism represent a set of assumptions called conditions. Properly and functionally focused fitness training contributes to the optimal physical and mental readiness of the individual. Physical readiness is a disposition potentially stored in the soldier, which, however, is non-functional if it is not currently activated and permanently dynamized and regulated during the individual's psyche. This means that, in addition to physical activity and the associated fatigue, moral freedoms and especially psychological resistance to adverse influences caused by carried equipment and conditions, climatic conditions, fatigue, injuries come to the fore. In combat conditions, there are also significant stress effects of the previous or next load (combat). We understand stress in psychology as a state of the organism that responds to the pressure of the environment with anxiety, tension, or defense. Stress is understood primarily as the overall condition of the body after the failure of normal mechanisms of adaptation (Knap-Stefaniuk and Burkiewicz, 2019). Stress factors can be heat, cold, but also physical exertion and mental pressures resulting from, for example, expecting something unpleasant. Stress also causes overloading of individual mental functions (e.g. attention and perception) or overall burden on personality.
The soldier can withstand the load to a certain limit. This means that it first responds with an alarm response when it internally mobilizes all forces and shows increased activity. For example, despite fatigue and injury, he is even able to multiply his strength. After a certain time, a stage of resistance occurs. There is a certain coping with a stressful situation, the individual seems to get used to stressful circumstances, he simply does not have time to collapse. Only after the danger has passed does the stage of exhaustion begin. Everything is solved and one can even completely collapse, similar to a marathon runner. But sometimes it crashes before the situation is resolved. This is especially true where the individual is exposed to long-term permanent stress and cannot regenerate (Vaněček 1999).

The technical factor deals with the selection of the optimal solution for a given task implemented in specific conditions. However, the optimal solution depends on the technical maturity of the soldier. Technology and tactics are interconnected. Complex psychological processes are applied when choosing the most suitable tactical solution. The thought process is the initiator of tactical skills. In it, the soldier applies the acquired abilities and skills in the field of physical and other types of training. In the process of thinking, he then evaluates the situation and selects the most appropriate solution to manage the task. His experience is also valuable support in the decision-making process and the selection of the right solution (Knap-Stefaniuk, and Ambrozová, 2021). Based on thought processes such as analysis and synthesis, induction, deduction, it evaluates the situation and prepares the most suitable solution. Important factors entering the field of tactics are intelligence and memory. With the help of memory, the soldier can maintain a lot of information that can be used to solve the situation. Motoric memory is particularly important in the area of military practice requirements. It is constantly evolving, supplementing,

improving, and is a factor dynamizing thought processes. Mechanisms such as anticipation and intuition are applied when selecting the most tactically appropriate solution to perform the task. A practical example, where the tactics factor plays a significant role, is man-to-man combat without the ability to take advantage of the firing effects of a firearm. The soldier must evaluate as much information as possible as soon as possible to help him find a solution to gain an advantage over the opponent. Tactics can then, in certain cases, turn the disadvantage into an advantage. Tactical maturity depends on the experience gained by soldiers in previous training (Sekanina 2016; Wrigley, Mosely, Mosely).

Other factors influencing a soldier's performance are specific internal factors that, by their nature, limit him to some extent. These selected factors influencing a soldier's performance include, above all, his health, physical fitness, and physical performance.

1.1.2 Exogenous factors

The requirements of military practice are also related to operating in various operational environments. The operating environment can be represented by conditions that are quite different from those in which the soldiers are preparing. A different environment also requires special training, which is focused on managing the following external factors:

- the nature of the operating environment;
- climate conditions;
- geographical conditions;
- nutrition and drinking regime;
- equipment and armament;
- military training.

1.2 Characteristics of the professional minimum in special physical training

Under the fulfillment of the ACR's priority tasks, especially in foreign operations, and due to the effective and rational connection with new trends within the concepts of acquiring and evaluating knowledge from the deployment of individual task forces, it is necessary to devote an appropriate level of training in physical training. The requirements for a high level of physical readiness and special military-practical skills, based on deployment in current NATO and EU operations, correlate with the need to unify and improve the training of individuals and units in special physical training topics. Training in STP focuses on mastering the professional minimum as a basic level of soldier training and subsequent mastery of professional examination disciplines as an extension with an increased emphasis on the goals and focus of individual organizational units (Pierce et al., 2017; Veenstra et al., 2018).

The professional minimum of special physical training is a set of special physical exercises based on the basic needs of a soldier operating in a foreign operation and is determined for each ACR soldier from basic function to the level of the brigade (base). The professional minimum as a basic level of training is further followed by training in special physical training according to service classification (combat unit, security unit, staff, etc.). The content, training, and control mechanisms of the follow-up training are determined by the commander in cooperation with the physical education worker according to the needs of the unit, the level of training, and the specifics of the unit. The level of training and readiness is checked within the professional examination of physical training and control exercises of commanders (Jebavý, 2010; Looney et al., 2021).

2 Materials and Methods

The tested sample population consists of 3317 persons, who attended army training by 15km march. We employed the Pearson chi-square test to evaluate the potential relationship. The group comprised 361 women, and 2956 men. The diversity was caused due to the general imbalance of gender distribution in the army.

Pearson's independence test is used provided that there is a need to verify the independence of the two characters. An important assumption is that there is a match between the theoretical and the observed frequency - that is, the variables tested will be independent of each other. This assumption is verified using Pearson's distribution test statistics.

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{\left(n_{ij} + n \times \hat{p}_{ij}\right)^2}{n \times \hat{p}_{ij}}$$

At the selected level of significance α, the critical domain W_α is necessary. This critical field verifies the specified level of significance α. The value of $\hat{p}_{ij}$ then contains estimates of the current probabilities. If the value of the test criterion is reached in the specified critical field, the null hypothesis on the whole α level of significance is rejected and subsequently, an alternative hypothesis is accepted (Stříž, Rytíř, Klímek, 2008).

The null hypothesis H_0 is not rejected at the significance level α if the significance value is at the level of the specified error rate (concerning the significance level). An important condition is the determining level of reliability according to the relevant level of significance. If the significance confirms the dependence of two characters, it is necessary to define the strength of this dependence. This force is defined by the Pearson contingency coefficient, which explains the strength of the observed dependence of the two characters. The value of the contingency coefficient can take values in the interval 0 and 1 (Řezanková, 2010, Anděl 2007).

$$c_p = \sqrt{\frac{\chi^2}{\chi^2 + n}}$$

3 Results

The main objective of the paper is to find out the relationship between gender and soldiers' physical results. There was a defined hypothesis according to the objective. This hypothesis is:

- H0: gender of an applicant does not influence soldiers' physical results;
- H1: gender of an applicant influences soldiers' physical results.

All collected data was put into processing by IBM SPSS Statistics 25, in which we employed Pearson's chi-square test for the independence of two variables. The Pearson's chi-square test for independence compares two parameters in the case of the mutual relationship. By confirmation of alternative hypothesis H_1 at significance 95% level, the test criteria meet a certain value in the critical subject. It means, that exists a relationship between individual variables (Gravetter and Wallnau 2009; Vaughan 2003).

By the defined possibility of a relationship between variables, the result is compared to an error value of 0.05, which represents a significant level of 95%. If the result is under 0.05, it is possible to state, that there is statistical dependence between two variables. Otherwise, if the value is over 0.05, there is no statistical dependence. The intensity of gained relationships is given by the contingency coefficient. The intensity pertains to interim 0 and 1. If the value is close to 1, this intensity is considered to be high. Vice versa, a value close to 0 is explained as having low or no intensity.

The data was obtained due to an experiment of a military march for 15 km. In this experiment participated 3400 soldiers. Summer and autumn of 2021. From that amount, we received only 3317 results about march, which means 97,56 %.

The time values of individual participants in the military march were in time units (hours and minutes). For evaluation, we transferred nominal values of the march into a time group with ordinal parameters. According to the core results, we stated five new time groups. The best time group for the evaluated military march is till 2 hours. The worst time results were over 4 hours. For purpose of the Pearson's chi-square test of independence, we stated pivot table, on which the calculation is based.

Table 1. Pivot table between gender and military march

		Military march - groups					
		No info	till 2h	till 3h	till 4h	over 4h	Total
Gender	Male	576	75	1564	732	9	2956
	Female	76	0	175	109	1	361
	Total	652	75	1739	841	10	3317

Source: own work by authors

For evaluation of gained data (gender, military march time, military march time group) we applied Pearson's chi-square test of independence. For two potential relationship, we found out, that there is considered statistical dependencies – reach a significant p-value under 0,05. In the results of the Pearson's chi-square test of independence (see Table 2). The p-value of dependencies are (results match the required level of significance of potential error under 5%):

- gender and march time (p-value = 0,000);
- gender and march time group (p-value = 0,006).

The p-values express the probability of validity of the null hypothesis. The lower the p-value, the lower the probability of a null hypothesis. Therefore, it can be concluded from the above data that we can only accept alternative hypotheses about the validity of the relationship between gender and military march or military march groups. Furthermore, we should consider the level of significance chosen. We are working with a 5% significance level in the paper, so the p-value should be lower than this significance level. Only for social networks the p-value $<\alpha = 0.05$, therefore we reject the null hypothesis and accept the alternative hypothesis about the dependence of selected elements.

The power of dependencies is given by the contingency coefficient. For gender and march time, the coefficient is at 0.263 and is considered as medium power. In the case of gender and march time (groups) the intensity is 0.066 and it is rather low.

Table 2. Observed relations between gender and military march

	Gender		
	Pearson chi^2 p-value	*Contingency coefficient*	*Spearman correlation*
military march	0,000	0,263	0,073
military march (groups)	0,006	0,066	0,026

Source: own work by authors

A major problem in terms of the time each managed was its subsequent evaluation. In the case of categorization of times, the said shift to 15 km a total of 1209 individuals. The individual categories are then defined by the transfer time, i.e. within 2 hours, within 3 hours, within 4 hours. Except for these categories, 35 % of individuals were excused or did not participate in the move to 15 km, but to 20 km. The standard performance, i.e. the transfer in time to 3 hours, was achieved in each adept in basically a similar number.

Due to the created time categories, it can be stated that the evaluated data tend to have a normal distribution (see values in Table 3). As these values cover most of the units, it would be appropriate to adjust the final assessment of the performance achieved, taking into account the time achieved. Time groups should then not be based on hourly intervals, but optimally on 30-minute intervals.

The main problem of the military march is that all participants reach excellent evaluation without any reflection of the reached time. An important stimulus that can significantly affect the setting of time limits for the assessment of the transfer is the inclusion of the individual in the relevant unit with a reflection on the needs of this unit. In the context of a move, one can see the difference in the time achieved, if the basic parameter during the move will be the endurance or, conversely, the speed and explosiveness of the individual (his dynamics).

Table 3. Pivot table between military march and its evaluation

		Military march - groups				
		No info	till 2h	till 3h	till 4h	Total
Evaluation	Excellent	0	35	917	257	1209
	Insufficiently	4	0	0	0	4
	Total	4	35	917	257	1213

Source: own work by authors

To explain the situation with the length of military march and final evaluation there is employed Pearson's chi-square test of independence.

The observed p-value of the relationship between final evaluation and military march (time group) reaches the required level – it is 0.000, which means the significant statistical dependency. The intensity of this dependence is 0.707, which is a rather strong value.

Table 4. Observed relations between final evaluation and military march (time group)

	Evaluation of military march	
	Pearson chi^2 p-value	*Contingency coefficient*
military march (time groups)	0,000	0,707

Source: own work by authors

4 Conclusion

The time when an individual exceeds a specified distance of 15 km is affected by several factors such as the gender of the individual. However, if this time is to be part of an individual's evaluation, there is a discrepancy in how the time achieved will be evaluated. Due to the potential optimal result of 2 hours, it can be seen as an excellent result. In the case of time falling into another time category, such time can be accepted (depending on the set limits for success), but it is no longer possible to call it excellent by the logic of the matter. The analyzed data contained the recorded evaluation excellently for all individuals who completed the said 15 km movement, regardless of the time achieved. This discrepancy is evident in the schematic expression of the evaluation with the achieved time category. An excellent result is expressed just for time up to 2 hours, other time groups have a lower value (in terms of data normalization).

Based on the analysis and research survey in the verification of current standards of professional examination of ACR members in the researched issue, the author proposes to change the time standard for the evaluation scale of extended control tests, specifically for pedestrian movements of 15 km with a load of 10 kg. The individual performance of each soldier depends on various factors (mainly endogenous and exogenous). However, the key role plays the military training, which confirms complex health in connection to the cardiovascular system and total psychological health (Looney et al., 2018; Drain et al., 2016; Farina et al., 2019).

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Secondary Paper Section: AE, ED, KA