LONG-TERM MONITORING OF PHYSICAL FITNESS OF SOLDIERS OF THE ARMY OF THE CZECH REPUBLIC

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Abstract

Our study deals with long-term monitoring of physical fitness of soldiers, namely members of the 31st Regiment specialising in Radiation, Chemical and Biological Protection (prchbo) in order to determine whether the annual fitness test has rising trend, or in another words, whether the military service physical training process is fittingly effective. The study was carried out by comparing the assessment of physical fitness each year between 2012 and 2019. The monitored group consisted of 316 professional soldiers, who participated in this assessment regularly, without interruption in the same disciplines. Due to the managed long-term military physical training process, overall improvement in the strength and endurance disciplines throughout the monitoring period took place. Men improved by 0.32 sit-ups, 0.74 push-ups and 0.24 pull-ups in the strength tests. Women improved by 0.83 sit-ups and 0:21 min in pull-ups endurance test. Men improved by 55.8 meters in Cooper test and 0:17 min in swimming in the endurance tests. Women improved by 135.6 meters in Cooper test. Increase in the number of overall rating excellent and good and decrease in the assessment of satisfactory and unsatisfactory occurred concurrently in men throughout the monitoring period. Significant increase in the number of excellent assessments, while at the same time reduction in the number of evaluations good and satisfactory occurred in women. None of the women was assessed as unsatisfactory during the whole monitoring period. Based on the acquired data, it may be stated that in the monitored years, the annual testing showed rising trend and thus the efficiency of the in-service physical training process proved to be good and appropriate.

Key words*: physical activity, examination of physical fitness, in-service physical training*

Introduction

In today's world, with the existence of potential threats to democratic society, it is essential to address all methods and means of its prevention, optimising the methods of dealing with and minimising the potential consequences. In the military environment of all armies, attention is paid primarily to the technical means; however, the human factor still plays a decisive role in any potential armed conflict. In this context, questions arise in the selection of human resources from the population to the armed forces, their preparation, education and training to attain target values and needs, which in the military environment are primarily oriented to the defence, and to identify and prevent the current local or global threats.

In addition to the professional and mental readiness, the physical readiness, which is the objective of in-service physical training, is particularly important for the successful management of set tasks, activities and situations related to the military issues (Všeob-P-35, 1995). This is provided by educationally managed process in such a way that the soldiers are able to duly carry out the tasks arising from their employment (Ministry of Defence, 2011).

The level of in-service physical training is determined by several factors. One of the most important is the quality of the physical training system itself, which as a comprehensive and internally integrated complex includes the physical training process, management process, organisational, personnel, material and financial security and other essential features. (Černohorský, 2009). Physical training is the key and integral part of the in-service training of every member of the army. The number of training hours devoted to each area of training is exactly set, namely the development of key abilities and skills, overcoming obstacles, development of endurance, self-defence, swimming, sports games (Ministry of Defence, 2005).

Good physical condition of soldiers is considered as essential condition for the effective performance of their service activities, whether it relates to the typical activities within the military base, during continuous military training in field conditions, several months of deployment in foreign operations, assistance in removing the consequences of natural disasters, assistance tasks to support the police within the Integrated Rescue System, or to represent the army in public. It is given by specific health and somatic indicators, which may be indicators of good health condition (Gangog, 2005).

Testing the physical performance of soldiers is also natural part of the system in foreign armies and is considered as a checking element to assess the effectiveness of the physical training system. Nine members of North Atlantic Treaty Organization (NATO) carry out testing once a year, taking into account the soldier's gender and age. Eight members introduced strict and fixed guidelines for meeting the minimum requirements with the assessment being passed/failed and using the run longer than 2 km for the assessment.

The majority of the world's armies are testing their soldiers, whether it relates to changes in somatic parameters over time, health indicators that have impact on health condition and physiological limitations, and limits in testing endurance, speed, and strength (Fajfrová et al., 2017; Tompkinson et al., 2009), or development over time of technology and robotics, equipment and armaments, etc. (Franz et al., 2015). It is clear that overweight and obesity, including non-infectious diseases, also play part in the professional military service (Fajfrová et al., 2017; Lindquist et al., 2001).

From a long-term perspective, it is essential to find out how effective the system of military in-service physical training is, what is its ability to prepare soldiers for the assessment of physical fitness (PF) and in which direction this PF assessment is progressing.

Methods

The study was carried out with the consent of the military base commander, the informed consent of the soldiers who participated in the research investigation and was in accordance with the latest revision of the Declaration of Helsinki.

The sample of participants

The monitored group consisted of soldiers from the 31st Regiment specialising in Radiation, Chemical and Biological Protection (31st Prchbo) in Liberec, which is subordinated to the Ground Forces Command. The total number of tested soldiers (N = 524.25 ± 54.2) in each year was given by the current number of members of the regiment (N = 559.13 ± 68.13). The average participation in the PF assessment was 93.91 ± 2 %. The absence was given by long-term medical restrictions, reduced medical classification, parental/maternity leave or foreign operations.

To compare the results of the soldiers PF level (based on long-term monitoring and subsequent determination of the PF level trend), results related to soldiers who participated in the PF assessment every year and always carried out the same disciplines were used, namely 316 soldiers in total, of whom 268 were men and 48 women.

During the monitoring period, the average age of men was 29.3 ± 4.7 years (min 22, max 61) and females 30.7 ± 5.7 years (min 20, max 46). Table 1 shows the age categories of soldiers by gender and their average age in the given category.

Table 1. Soldiers age categories by gender (Ministry of Defence, 2011)

AC	Men			Women		
	Age	*M*	*SD*	Age	*M*	*SD*
I.	≤ 30	27.3	4.8	≤ 25	24.7	6.3
II.	31-35	33.2	4.8	26-30	27.5	6.3
III.	36-40	37.7	4.8	31-35	33.2	6.3
IV.	41-45	43.1	4.8	36-40	37.9	6.3
V.	46-50	47.6	4.8	41-45	42.9	6.3
VI.	≥ 51	53.2	4.8	≥ 46	48.8	6.3

Abbreviations: AC – Age category; *M* – Arithmetic mean; *SD* – Standard deviation

Soldiers in the 6th age category are required to meet the endurance assessment only (Ministry of Defence, 2011). Based on the result of each test, soldiers are rated between 1 and 4 (1 – Excellent, 2 – Good, 3 – Satisfactory, 4 – Unsatisfactory) and then a combination of strength and endurance test assessments determines the final PF assessment rating; again between 1 and 4.

Table 2 shows the numbers of soldiers by gender and the selection of a combination of strength and endurance tests used for the PF assessment.

Table 2. Summary giving the number of soldiers by selection of strength and endurance tests [number]

Gender	Strength disciplines		Endurance disciplines	
	Sit-ups/ push-ups	Pull-ups/Pull-ups endurance on horizontal bar	Cooper test	Swimming
Men	201	64	248	20
Women	34	12	48	0
Total	235	76	296	20

PF assessment

Long-term PF monitoring was carried out during the annual PF assessment of soldiers, members of the Army of the Czech Republic (AČR), between 2012 and 2019. The PF assessment is a specific form of determining individual physical fitness. Its general principles, content, organisation and assessment are governed by Normative Decree of the Ministry of Defence (Ministry of Defence, 2011; Ministry of Defence, 2015). It is organised annually from 1 May to 30 June, with an alternate dates in September.

It relates to the prescribed set of strength and endurance tests/requirements (Ministry of Defence, 2011). Men are required to pass the PF assessment based on sit-ups and push-ups strength tests or pull-ups on horizontal bar, and on Cooper endurance test or swimming. Women are assessed on the number of sit-ups or pull-ups endurance on the horizontal bar and on Cooper endurance test or swimming. When evaluating the results of each test, the age of the soldier, which is classified according to the year of birth and the gender are taken into account.

PF assessment process

The PF assessment was carried out at the regimental military base, under the guidance of the physical training commanding officer, and under the standard conditions specified by the Ministry of Defence Decree (Ministry of Defence, 2011). The strength tests took place in gym; endurance tests were carried out within the sports complex and swimming pool.

Statistical analysis

Data transfer from the PF assessment record sheets and processing of the key statistical characteristics (M, SD) was carried out using Microsoft Excel 2016 MSO (Microsoft Corporation, 2016), enabling basic checks and work with data. Basic descriptive statistics, respectively summarisation and processing of acquired data in the form of tables and graphs and calculation of their numerical characteristics, arithmetic means and standard deviations were used to describe the monitored group and to achieve the research objective.

IBM SPSS Statistics Version 26.0 statistical software (IBM Corporation, 2018) was used to assess the numerical characteristics of the statistical relationship of the measured variables. Average performances in each discipline were assessed by the nonparametric Pearson correlation coefficient, with the relationship level according to the absolute value: 0.1 to 0.3 weak correlation, 0.4 to 0.6 medium correlation, 0.7 to 0.8 strong correlation, > 0.9 very strong correlation (Kotz and Nadarajah, 2004). The starting point of our study was the assumption that owing to the managed long-term in-service physical training process, or that the soldiers have organised physical training during the monitored years, their PF will improve and gradually achieve better results.

Results

Graphs representing the continuous average performances each year for strength disciplines by gender are shown in Figures 1 to 3.

Figure 1. Average values of sit-ups strength test in men and women

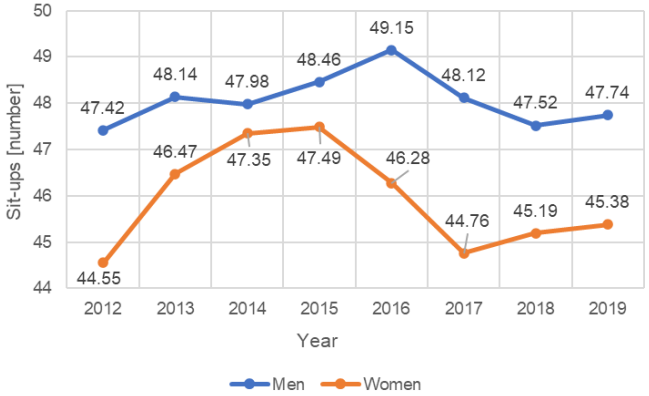


Figure 2. Average values of push-ups and pull-ups strength test in men

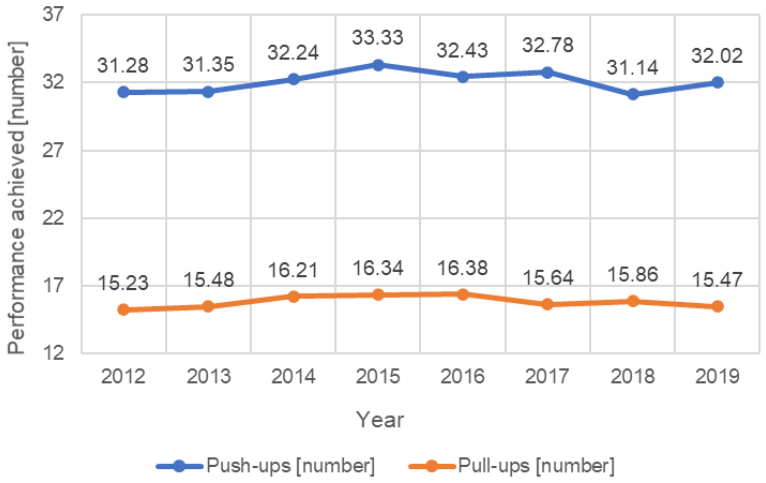
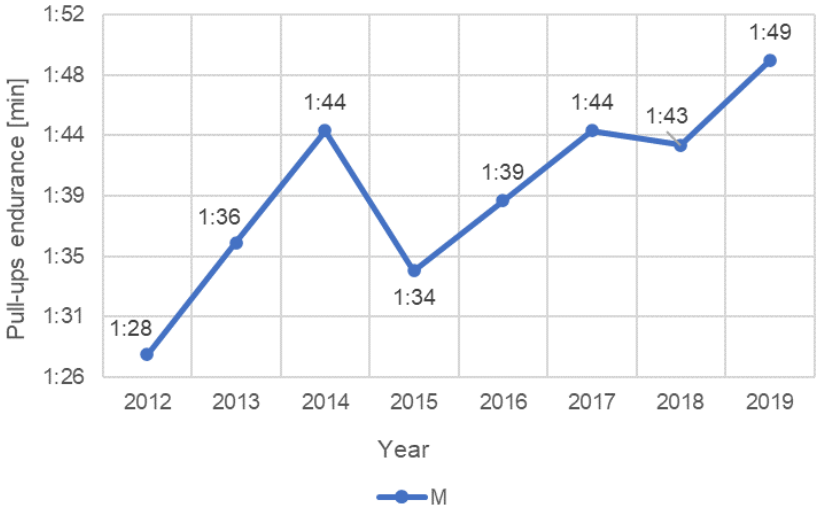


Figure 3. Average values of pull-ups endurance in women



The average performances achieved in each strength test during the monitoring period, were as follows: 48.06 ± 0.52 sit-ups (min 29.87 ± 2.26; max 68 ± 1.22), 32.07±0.73 push-ups (min 18.87 ± 1.45; max 49 ± 1.22), 15.82±0.41 pull-ups (min 5.87 ± 0.59; max 25.25 ± 1.85) in men and 45.93 ± 1.06 sit-ups (min 32.62 ± 1.31; max 54.25 ± 3.03) and 1:38 ± 0:06 min in pull-ups endurance (min 0:37 ± 0:09; max 2:10 ± 0:10) in women. Graphs representing the continuous average performances each year for endurance disciplines by gender are shown in Figures 4 and 5.

Figure 4. Average values of Cooper endurance test in men and women

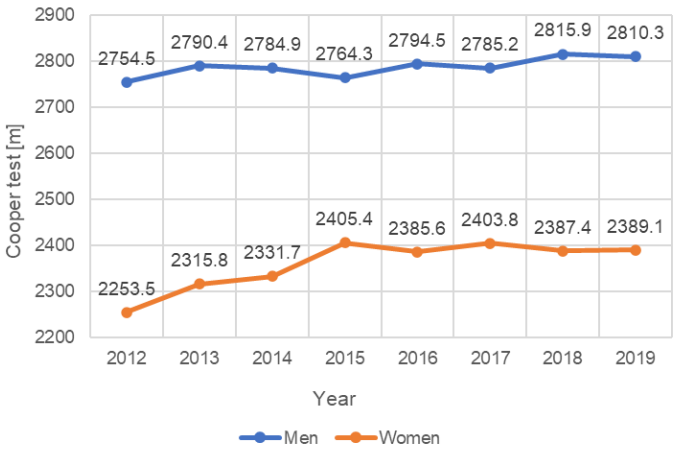
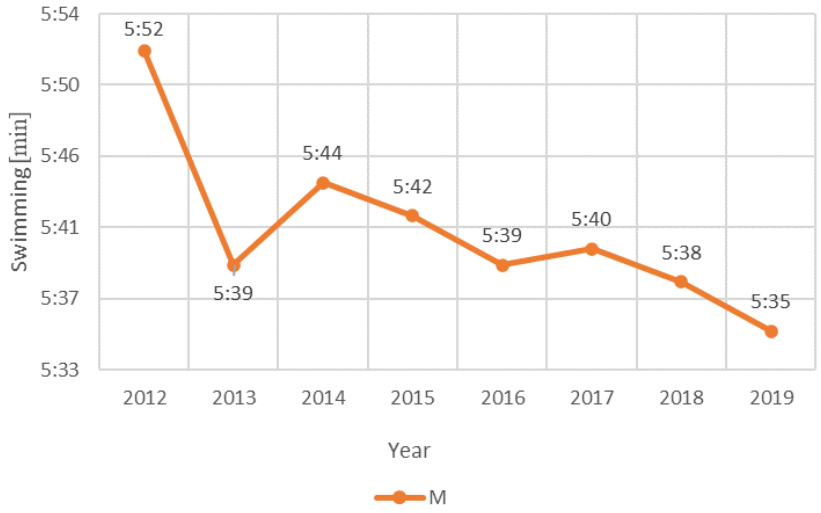


Figure 5. Average values of swimming endurance test in men



The average performances achieved in Cooper endurance test [m] each year were as follows: 2,787 ± 19.44 m (min 2,242.5 ± 68.51; max 3,250 ± 35.35) in men and 2,359.04 ± 50 m (min 1931.25 ± 65.84; max 2708.13 ± 31.31) in women. Then, the swimming average time was 5:41 ± 0:05 min (min 3:46 ± 0:03; max 7:03 ± 0:12) in men. None of the women took part in the endurance swimming test in each of the monitored years, consequently this test was not evaluated. Table 3 shows the assessment of the change in evaluating the strength and endurance tests over the monitored years by the nonparametric Pearson correlation coefficient.

Table 3. Pearson correlation coefficient for each test by gender

Gender	Test name	*r*
Men	Sit-ups [number]	0.610
	Push-ups [number]	0.187
	Pull-ups [number]	0.127
	Cooper test [m]	0.612
	Swimming [min]	-0.789
Women	Sit-ups [number]	-0.106
	Pull-ups endurance [s]	0.809
	Cooper test [m]	0.814

Abbreviations: r – Pearson correlation coefficient

Strong positive relationship shows in both endurance disciplines in women (r = 0.814, r = 0.809). In contrast, strong negative relationship shows in the endurance swimming test in men (r = -0.789). Table 4 shows the outcome of the overall PF assessment by gender [number of soldiers].

Table 4. Number of men and women in each category of PF assessment evaluation [number]

Year	Excellent		Good		Satisfactory		Unsatisfactory	
	Men	Women	Men	Women	Men	Women	Men	Women
2012	52	25	120	17	87	6	9	0
2013	49	27	142	14	69	7	8	0
2014	56	30	129	12	77	6	6	0
2015	58	33	134	10	69	5	7	0
2016	59	31	132	13	73	4	4	0
2017	62	32	128	12	73	4	5	0
2018	63	32	139	10	59	5	7	0
2019	68	33	141	11	53	4	6	0

The average number of men with excellent rating was 58.37 ± 5.72, good 133.12 ± 7, satisfactory 70 ± 9.79 and unsatisfactory 6.5 ± 1.5. The average number of women with excellent rating was 30.38 ± 2.73, good 12.38 ± 2.17 and satisfactory 5.13 ± 1.1. None of the women were unsatisfactory during the whole monitoring period. Table 5 shows the assessment of the change in evaluating the strength and endurance tests over the monitored years by the nonparametric Pearson correlation coefficient.

Table 5. Pearson correlation coefficient relating to PF assessment by gender

Gender	PF assessment evaluation	*r*
Men	Excellent	0.958
	Good	0.494
	Satisfactory	-0.824
	Unsatisfactory	-0.581
Women	Excellent	0.848
	Good	-0.739
	Satisfactory	-0.802
	Unsatisfactory	-

Abbreviations: r – Pearson correlation coefficient

Very strong and strong positive relationship shows in excellent rating in men and women (r = 0.958, r = 0.848). On the other hand, strong negative relationship shows in satisfactory rating in men (r = -0.824) and good and satisfactory ratings in women (r = -0.739, r = -0.802).

Discussion

In accordance with Act No 221/1999 Coll. on Professional soldiers, as amended, it is essential to consider the physical fitness as the fundamental responsibility of all professional soldiers. Soldiers are expected to maintain the highest possible level of physical fitness in order to be prepared to carry out their duties anywhere in the world at any time. (Russel et al., 2019).

Owing to the relatively large fluctuation in regiment members (conscription of recruits, transfers between the army units, leaving the active service) and also due to the option of selecting the PF assessment tests, out of the total average number of 524.25 ± 54.18 members of the regiment participating in the PF assessment each year, 316 soldiers in total (60.89 % ± 6 %) were tested in the same disciplines during the monitoring period. The percentage participation of all regiment members in the PF assessment in each of the monitored years was 93.96 % ± 2 %, which may be compared, for example, with 5-year (2012 to 2016; data for 2017 to 2019 not yet published) all-army average of 85.42 % ± 0.24 % of assessed soldiers.

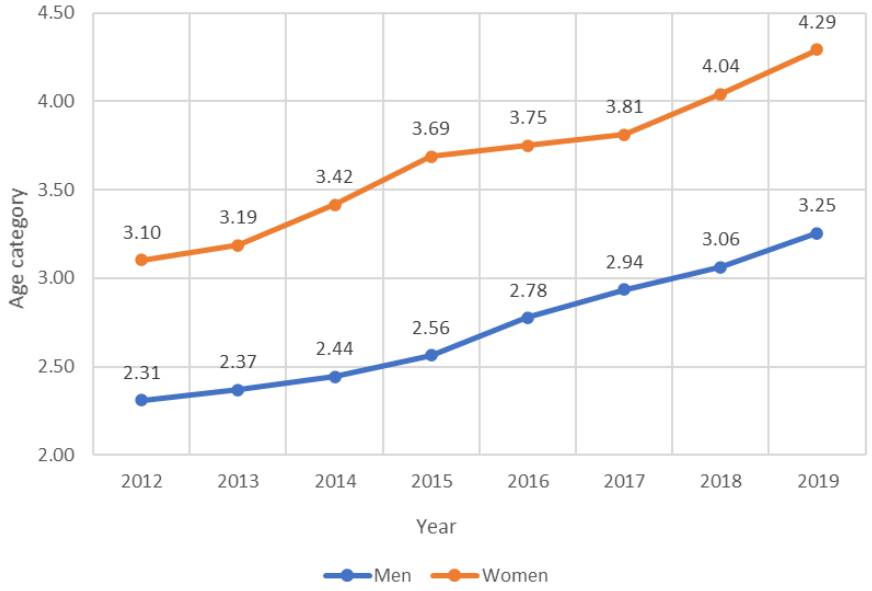
A total of 311 soldiers took part in strength disciplines and 316 in endurance disciplines. The difference of five soldiers (3 men, 2 women) was due to their age, when they were included in the 6th age category and took part in endurance disciplines only. None of the women chose the swimming endurance test in each of the monitored years.

Compared to the all-army results, the monitored soldiers who met the PF assessment standards achieved better results by 3.27 % ± 0.3 % (monitoring troops M = 97.95 ± 0.45 %; results-army M = 95.03 ± 0.77 %).

The overall PF assessment evaluation of the monitored soldiers who had the "met" rating during the measurement period has the mean positive relationship of r = 0.581. In comparison, the "failed" rating had the mean negative relationship of r = -0.581.

During the monitoring period of the AČR PF assessment, the average age category (AC) increased in men from 2.31 to 3.25 [category] and in women from 3.10 to 4.29 [category]; refer to Figure 6.

Figure 6. Age category of soldiers in monitored years



Due to the fact that with increasing age decrease in muscle and aerobic endurance takes place, we could assume deterioration in the output monitored parameters (Máček & Radvanský, 2011). Long-term body aerobic loading retains relatively good endurance and condition until old age (McArdle et al., 2010; Zając-Gawlak et al., 2017).

From the performances achieved in each strength and endurance test, it is evident that regardless of the increasing calendar age, due to the long-term systematic physical training process, soldiers continuously achieved better or the same results as in previous years. The decline in performance occurred only exceptionally, and as a rule, the performance improved the following year.

The average performance achieved in each strength and endurance test is comparable, for example, between members of the 73rd Tank Battalion (73rd TB) and AČR members (Table 6).

Table 6. Comparison between monitored soldiers and members of 73rd TB

Gender	Group	Sit-ups [number]	Push-ups [number]	Pull-ups [number]	Pull-ups endurance [min]	Cooper test [m]	Swimming [min]
Men	Monitored	48.06 ± 0.52	32.07 ± 0.73	15.82 ± 0.41	-	2787 ± 19.44	5:41 ± 0:05
	73rd TB	47.38 ± 0.84	31.16 ± 1.08	14.13 ± 1.14	-	2691 ± 23.18	5:36 ± 0:34
Women	Monitored	45.93 ± 1.06	-	-	1:38±0:06	2359 ± 50	-
	73rd TB	44.22 ± 3.18	-	-	1:26±0:15	2239 ± 20,81	-

When comparing the first and last monitored year, it is clear that overall improvement in both strength and endurance disciplines occurred. In the strength tests, men improved by 0.32 sit-ups, 0.74 push-ups and 0.24 pull-ups, whilst women improved by 0.83 sit-ups and 0:21 min in pull-ups endurance. In the endurance tests, men improved by 55.8 m in Cooper test and 0:17 min in swimming whilst women improved by 135.6 m in Cooper test.

The comparison of NATO armies in testing soldiers' physical performance shows common trend of restricting the selection of basic assessment test disciplines, which leads to the assessment of strength and endurance motoric skills only. The British army soldiers undergo tests composed of 3 exercises, namely gradual lifting of "powerbags" weighing 15, 20, 25, 30, 35 and 40 kg to a height of 1.45 m, carrying 2 canisters weighing 20 kg for 150 m in 2 min and running 2.4 km. Members of the Norwegian army undergo testing composed of 3 km run, sit-ups, push-ups and pull-ups. The Swedish army soldiers undergo testing composed of 2 km run and the "Multitest Strength" set of tests carried out in the following sequence: push-ups, sit-ups, vertical jump, torso extension and endurance on horizontal bar. The Finnish army soldiers carry out

Cooper test and the "Muscle fitness tests", i.e. repeated sit-ups, push-ups and standing long jump. Soldiers of the Armed Forces of the Slovak Republic carry out the PF assessment composed of strength, endurance and speed tests and are classified in 8 age categories (Ministry of Defence of the Slovak Republic, 2015).

In order to determine/confirm the effectiveness of the in-service physical training process, or the improving trend in the PF assessment, the number of soldiers with overall assessment rating good, satisfactory and unsatisfactory must continuously decrease, whilst the number soldiers with excellent rating must increase. On the other hand, the status may be considered as effective if the number of soldiers with unsatisfactory rating is zero, the number of soldiers with satisfactory rating is minimised and it may be considered as successful if the soldiers' rating is excellent or good. The number of male soldiers with excellent or good rating increased, whilst the satisfactory or unsatisfactory rating decreased throughout the monitoring period at the same time. The number of female soldiers with excellent rating significantly increased, whilst the good or satisfactory rating decreased and none of them was assessed as unsatisfactory during the whole monitoring period.

The performance in each test does not inevitably have to show significant improvement over the years, as even the small improvement in each test in the context of the increase in soldier's age and the related classification into higher age category results in better assessment in strength/endurance tests and in the overall PF assessment evaluation.

The optimal PF level demonstrably contributes to improving the quality of human life in terms of the body composition health indicators (Malina et al., 2004), directly and indirectly affects the human health and has preventive effect on increasing the spectrum and number of health indicators relating to diseases of mass occurrence of non-infectious nature (Barnett et al., 2016). At the same time, lifestyle, absence of leisure-time physical activity and sedentary lifestyle combined with poor eating habits lead to deterioration in the quality of body composition, high proportion of fat mass and decrease in the proportion of active mass and its components (Cuberek et al., 2019; Riegerová et al., 2006).

Conclusion

In general, military in-service physical training focuses on increasing the overall physical fitness, minimising the number of soldiers rated as unsatisfactory in the PF assessment, and providing conditions for the improvement and upkeep of adequate physical fitness. The achieved performance in each PF assessment test, as well as the overall PF assessment evaluation achieved during the monitored years directly reflects soldiers' PF. Due to the long-term impact of the army in-service physical training process, the improvement in the performance of strength and endurance tests, as well as the improvement in the overall PF assessment evaluation arisen in the monitored years. In particular, in the PF assessment evaluation "excellent" rating, very strong relationship was found in men and highly positive relationship was found in women. Thus, the effectiveness of the army in-service physical training process proved to be good or appropriate, given the rising trend in the overall PF assessment evaluation. Taken as a whole, it may be stated that the soldiers' PF, members of the 31st prchbo, is at a very good level.

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