ORIGINAL ARTICLE
INNOVATIONS IN RESEARCH METHODOLOGY

Changes in overall and special physical fitness of military cadets and physiotherapy students under the influence of various annual specialist trainings

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

Andrzej Chodała[1ABCDE], **Bartłomiej Gąsienica-Walczak**[2ABCDE]

[1] Faculty of Physical Education, Military University of Technology, Warsaw, Poland
[2] Health Institute, Podhale State College of Applied Sciences in Nowy Targ, Nowy Targ, Poland

Received: 30 September 2021; **Accepted:** 30 November 2021; **Published online:** 13 December 2021

AoBID: 16083

Abstract

Background & Study Aim: One of the basic tasks in the training process is to achieve the appropriate level of motor fitness and the expected functional abilities of the body (special physical fitness – in our research: the ability to fall safely). Previous studies have shown that the ability to fall safely is determined most by neuromuscular coordination, flexibility, strength of the muscles of the limbs (lower and upper) and abdominal muscles. However, the hypothesis is that a high level is not a prerequisite for achieving motor competences in the field of safe fall. The cognitive purpose of this work is to answer the question whether the annual specialist training of military cadets and physiotherapy students significantly modifies the overall and special physical fitness of young men?

Material & Methods: Three groups were tested. Experimental group (EG) of military cadets (n = 24), who had received one year special course of hand-to-hand combat training within the framework of physical education (twice weekly) as part of their university military studies (age 19.8 years; body height 178.2 cm, range 163 to 186 cm; body mass 75 kg, range 71 to 95 kg). Comparison group of military cadets (CG, n = 24), who had received one year standard physical education course (twice weekly) as part of their university military studies (age 19.7 years; body height 179.3 cm, range 166 to 190 cm; body mass 73.4 kg, range 55 to 102 kg). Physiotherapy students (PS, n=14) who had received one year of safe fall special course (once a week) as part of their university studies (age 21.1 years; body height 182.6 cm, range 172 to 193 cm; body mass 85.4 kg, range 69 to 95 kg).

The overall physical fitness was measured with four trials (standing broad jump, pull-ups, sit ups, bend trunk) from the International Physical Fitness Test (IPFT) – before and after the courses. Special physical fitness measured by Test For Safe Falls (TFSF) in the full basic version – only after completing the courses.

Results: Each year of specialized training resulted in an increase in overall physical fitness, with the highest total score of the four IPFT trials of 243 points (difference from the first study of 21.3 points, $p<0.001$) was found among EG military cadets. CG score of 215.4 points (difference from the first study of 23.8 points, $p<0.001$) and PS respectively: 203.1 – (11.2-, $p<0.01$). The highest effect of special physical fitness after a one-year course was found among physiotherapy students: 97.5 points (out of 100 possible) and respectively: EG military cadets 81.9-; CG 42.9-. In the CG cadets a correlation between TFSF and bend trunk and pull-up was found ($p<0.05$), also in physiotherapy students TFSF and bend trunk ($p<0.01$). In the EG cadets, no correlation was found between the TFSF scores and any of the four IPFT trials.

Conclusions: A modifying effect of one-year specialized training based on, among others, safe fall exercises on selected motor skills of overall physical fitness was found. The hypothesis that high overall physical fitness is not a prerequisite for achieving optimal motor competences in terms of the ability to fall safely has been positively verified once again.

Keywords: functional abilities of the body • International Physical Fitness Test • motor competence • Test For Safe Falls

Conflict of interest: Authors have declared that no competing interest exists

Ethical approval: The study was conducted within the research project URWWF/S/04: "Motor, methodological and mental effects of educating students in safe falling of blinds and/or after limbs amputations" (Resolution No. 03/02/2011, Bioethics Committee at the University of Rzeszow, Poland)

Provenance & peer review: Not commissioned; externally peer reviewed

Source of support: Departmental sources

Author's address: Bartłomiej Gąsienica-Walczak, Podhale State College of Applied Sciences in Nowy Targ, 71 Kokoszków Str., 34-400 Nowy Targ, Poland; e-mail: bartlomiej.gasienica@ppuz.edu.pl

INTRODUCTION

One of the basic tasks in the training process is to achieve an adequate level of motor fitness (overall physical fitness) and the expected functional abilities of the body (special physical fitness – in our research: the ability to fall safely as separate motor skills related to personal safety and prevention of body injuries [1-21] and broadly understood survival [22-24]. Safe fall (as special physical fitness) are part of the art of self-defence [25-30], a basic element of special military hand-to-hand combat [31, 32], as well as some martial arts and combat sports [e.g. 33, 34].

Sterkowicz et a. [26] have provided empirical evidence that that the ability to fall safely is determined most by neuromuscular coordination, flexibility, muscle strength of the limbs (lower and upper) and abdominal muscles. This proves that people with high physical fitness, however, who are unable to cushion the impact of their own body are at risk of serious injury or even death. In contrast, it is hypothesised that a high level of overall physical fitness is not a prerequisite for safe fall motor competence.

According to Kalina et al. [8] safe fall techniques can be learned by anyone regardless of gender, age or physique. Jaskólski and Nowacki [35] and Kalina et al. [8] consider that in the case of professionally trained persons, a fall is a controlled motor action that ensures optimal protection of the body colliding with the ground or, in a certain class of such situations, minimising damage or even preventing death. That is, in a situation of sudden loss of balance (especially due to external forces – e.g. slippery floor, pushing), a trained person immediately controls both the individual parts of the body according to the direction of the fall (front, back, sideways or in intermediate directions) as well as other relevant circumstances (objects in the area, etc.). A deliberately executed fall is understood to be a motor response to a sudden hazard that the person has identified and, by this action, has prevented unwanted consequences. Therefore, optimal body protection during a fall is combined with appropriate training [7, 8, 36]. This training will also ensure that optimal muscular strength and flexibility are achieved. It is by no means about maximising these motor characteristics.

The cognitive aim of this study is to answer the question: does the annual specialised training of military cadets and physiotherapy students modify overall and special physical fitness of young men in an expressive way?

Fall – is unintentional, a sudden change from vertical to horizontal posture [59]. Falling often leads to injury; that is why it is qualified in the International Classification of Disease (ICD). Codes include falls on the same or upper level, as well as others, unspecified falls. Falls results with a collision with walls, furniture, ground or other objects or obstacles [59, 16]

Technique – *noun* a way of performing an action [60].

Training session – *noun* a period of time during which an athlete trains, either alone, with a trainer or with their team [60].

Combat sport – *noun* a sport in which one person fights another, e.g. Wrestling, boxing and the martial arts [60].

Martial arts – *plural noun* any of various systems of combat and self-defence, e.g. judo or karate, developed especially in Japan and Korea and now usually practised as a sport [60].

Self-defence – *noun* fighting techniques used for defending oneself against physical attack, especially unarmed combat techniques such as those used in many of the martial arts [60].

Motor skills – *plural noun* the ability of a person to make movements to achieve a goal, with stages including processing the information in the brain, transmitting neural signals and coordinating the relevant muscles to achieve the desired effect [60].

MATERIAL AND METHODS

Participants

Three groups of students were tested. The first was an experimental group (EG) of military cadets (n = 24), age 19.8 years; body height 178.2 cm, range 163 to 186 cm; body mass 75 kg, range 71 to 95 kg. The second was an comparison group (CG) of military cadets (n = 24), age 19.7 years; body height 179.3 cm, range 166 to 190 cm; body mass 73.4 kg, range 55 to 102 kg. The third group were physiotherapy students (PS, n = 14), age 21.1 years; body height 182.6 cm, range 172 to 193 cm; body mass 85.4 kg, range 69 to 95 kg.

Overall physical fitness

As indicators of overall physical fitness the results of four trials of the International Physical Fitness Test were adopted [37] (in brackets, measured

motor ability and aisle abbreviation): standing broad jump (lower limb muscle strength), pull-ups (upper limb muscle strength), sit ups (abdominal muscle strength), bend trunk (flexibility), while the sum of the scores of these four trials was adopted in this research as a criterion for overall physical fitness (Index IPFT-4). The conversion of results obtained in the particular tests was made on the basis of tables according to groups of the calendar age. Interpretation of results based on the recommendations of Tadeusz Ulatowski [38] on the basis of results addressed to athletes: overall score (in this research, the conventional Index IPFT-4) is the consequence of dividing by 2 the established norms for 8 trial total points IPFT. Thus: outstanding level 321 and more points, high level 2811 to 320-; medium level 241 to 280-; low level 201 to 240-; very low level 200 and less points. For individual trials they are in line with Ulatowski's recommendation [38]: outstanding level 81 and more points, high level 71 to 80-; medium 61 to 80-; low level 51 to 60-; very low level 50 and less points.

Trials were performed twice: before and after each annual training. The ordinal variable of the trials results presented – ranking position (RP) from highest to lowest arithmetic mean – is based on the arrangement of that group with the highest mean IPFT-4 Index value after the end of training. The third ranking position in the performance analysis is for the group with the lower Index IPFT-4 value after the training sessions. In the case of identical arithmetic means, the higher RP is determined by the smaller range of results and, when this criterion is equal, by the lower value of the standard deviation; when these specific indicators are also equal, the results are qualified at the same RP.

The RP migration of individual trials results in each of the observed groups in a 'before ↔ after' relationship and the scale of predicted positive changes (symbol '+') expressed in % are simple criteria for measuring the modifying power of training stimuli and other physical activities resulting from study specific and/or experimental programme modifications.

Investigating the relationship of either concordance or ranking position (RP) distinctiveness between the performance of individual Index IPFT-4 leader trials and the other groups, post-training, is the primary criterion for inferring the modifying effect of different training programmes on the overall physical fitness structure of the students studied.

Special physical fitness

The analysis of the effect of different workouts on special physical fitness was based on similar methodological criteria, but using a different tool. Special physical fitness was identified with the overall Test For Safe Falls (TFSF) [7, 8] – the conventional Index TFSF in these studies. The test comprises execution of four consequent tasks constituting a series of seven falls:

1. rear fall and rear fall with turn;
2. front fall;
3. fall to the side (left and right);
4. front fall with turn over the shoulder (left and right).

Each task was evaluated according to an arbitrary four-point scoring scale: 25 (excellence); 20 (good); 15 (sufficient); 0 (insufficient).

Test result (Index TFSF):

(total points)	time (s)	TFSF implementation grade
100–95	20	excellence
90–85	25	more than good
80–75	30	good
70–65	35	more than sufficient
60–55	40	sufficient
<55	<40	insufficient.

Order variable of the results presented tasks – RP from highest to lowest arithmetic mean – is based on the arrangement of that group whose average TFSF Index value is the highest. The third ranking position in the performance analysis is for the group that obtains the lower Index TFSF value after training. In the case of identical arithmetic means, the higher RP is determined by the smaller range of results and, when this criterion is equal, by the lower value of the standard

Coordination – *noun* the ability to use two or more parts of the body at the same time to carry out a movement or task [60].

Flexibility – *noun* **1.** the amount or extent to which something can be bent **2.** the extent to which something can change or respond to a variety of conditions or situations [60].

deviation; when these specific indicators are also equal, the results are qualified at the same RP (these criteria also apply to the analysis of overall physical fitness indicators).

The test was performed only once – after the end of each annual training. The ordinal variable in the presentation of the results of the phenomenon (before and after the completed trainings) is the score (from highest to lowest mean score) of the group with the highest mean Index IPFT-4 value after the training. The third ranking position in the analysis of results is for the group that obtains the lower Index IPFT-4 value after the end of the trainings.

The methodological criterion of PR migration of detailed results is not applicable as students were not familiar with safe falls techniques prior to the start of the courses.

Study design

Military cadets (EG, CG)

Both groups of military cadets (EG, CG) followed a one-year (41 weeks) general military training programme. The experimental group carried out physical education classes according to the author's programme, which included an intensification of hand-to-hand combat classes extended with elements of combat sports (twice a week, 80 minutes each). The comparison group did a standard physical education programme at the Military University of Technology. The training was divided into 3 parts: introductory (6 weeks); preparatory (17 weeks); proper (18 weeks).

Physiotherapy students

Students completed a one-year (20-week) course in "Safe falling theory and methodology" as part of their degree programme at Podhale State College of Applied Sciences in Nowy Targ. This training was divided into two parts: in semester one ("Safe falling course for people who are blind or have a visual impairment") the classes were held for 10 weeks, once a week and lasted 90 minutes; in semester two ("Safe falling course for people with limb amputations") the organisation, the number of training sessions and their time were identical.

RESULTS

Overall physical fitness

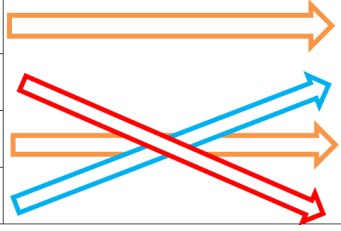
The most effective overall physical fitness stimulus identified with Index IPFT-4 was provided by the special training of military cadets EG (Table 1). Invariably, the leader of the compared motor skills cadets EG remained abdomen

Table 1. Summary of results according to RP leader Index IPFT-4 classification after training, military cadets EG (ordinal variable) and RP compliance or migration in relation to before training results.

Group	Before training			After training		
	statistical indicator	points	RP	statistical indicator	points	RP
Military cadets EG (n = 24)	**M**	**221.7**	1	**M**	**243.0**	1
	SD	22.7		SD	17.9	
	Min	170.0		Min	211.0	
	Max	271.0		Max	285.0	
Military cadets CG (n = 24)	**M**	**191.6**	3	**M**	**215.4**	2
	SD	34.6		SD	38.3	
	Min	93.0		Min	93.0	
	Max	249.0		Max	300.0	
PS students (n = 14)	**M**	**191.9**	2	**M**	**203.1**	3
	SD	27.1		SD	26.7	
	Min	143.0		Min	170.0	
	Max	242.0		Max	253.0	

Table 2. Summary of results of the tested students according to the RP motor skills military cadets EG (leader): RP1 – AMS after training and RP compliance or migration in relation to before training results.

Group	Before training			After training		
	statistical indicator	points	RP	statistical indicator	points	RP
Military cadets EG (n = 24)	**M**	**61.0**	**1**	**M**	**70.9**	**1**
	SD	11.3		SD	11.1	
	Min	46.0		Min	58.0	
	Max	99.0		Max	100.0	
Military cadets CG (n = 24)	**M**	**51.0**	**2**	**M**	**59.7**	**1**
	SD	5.9		SD	7.5	
	Min	42.0		Min	44.0	
	Max	66.0		Max	78.0	
PS students (n = 14)	**M**	**41.7**	**4**	**M**	**46.6**	**3**
	SD	6.8		SD	6.9	
	Min	29.0		Min	38.0	
	Max	51.0		Max	58.0	

Before training		Compatibility relationship or RP migration	After training		Modifying strength of training stimuli	
motor skill	RP		RP	motor skill	%	RP
AMS	1		1	AMS	+ 8.7***	2
FLEX	2		2	ULMS	+ 1.3	4
LLMS	3		3	LLMS	+ 9.9***	1
ULMS	4		4	FLEX	+ 3.9*	3

Model 1. Visualisation of RP concordance or migration of specific indicators (trials) Index IPFT-4 before and after training, classification leader, military cadets EG (n = 24) and nature and increment (%) of adaptive change: **AMS** abdominal muscle strength; **ULMS** upper limb muscle strength; **LLMS** lower limb muscle strength; **FLEX** flexibility; *p<0.05, ***p<0.001

muscle strength (AMS), a gain of 8.7% (p<0.001) – Table 2 and Model 1. The second RP falls to upper limbs muscle strength (ULMS) and is the result of a promotion from the fourth RP (measured before training) although the score gain was only 1.3% (Table 3 and Model 1). The third RP was retained by lover limbs muscle strength (LLMS) with the highest score gain (by 9.9%, p<0.001) – Table 4 and Model 1. A statistically significant (p<0.05) improvement in flexibility (FLEX) of 3.9% resulted in a migration from the second RP (before training measurement) to the last RP (after training) – Table 5 and Model 1.

The highest RP stability of measured motor skills before and after training is characterised by physiotherapy students, but the increase in scores did not reach statistical significance. Moreover, the ULMS and AMS indices after training were classified on the same RP and this fact does not

Table 3. Summary of results of the tested students according to the RP motor skills military cadets EG (leader): RP2 – ULMS after training and RP compliance or migration in relation to before training results.

Group	Before training			After training		
	statistical indicator	points	RP	statistical indicator	points	RP
Military cadets EG (n = 24)	**M**	**51.8**	**4**	**M**	**59.0**	**2**
	SD	11.3		SD	12.2	
	Min	32.0		Min	41.0	
	Max	77.0		Max	86.0	
Military cadets CG (n = 24)	**M**	**45.5**	**3**	**M**	**46.8**	**4**
	SD	18.9		SD	20.4	
	Min	0.0		Min	0.0	
	Max	89.0		Max	100.0	
PS students (n = 14)	**M**	**44.9**	**3**	**M**	**46.6**	**3**
	SD	14.8		SD	9.9	
	Min	4.0		Min	35.0	
	Max	65.0		Max	66.0	

Table 4. Summary of results of the tested students according to the RP motor skills military cadets EG (leader): RP3 – LLMS after training and RP compliance or migration in relation to before training results.

Group	Before training			After training		
	statistical indicator	points	RP	statistical indicator	points	RP
Military cadets EG (n = 24)	**M**	**54.2**	**3**	**M**	**57.8**	**3**
	SD	8.6		SD	6.7	
	Min	34.0		Min	43.0	
	Max	71.0		Max	70.0	
Military cadets CG (n = 24)	**M**	**42.0**	**4**	**M**	**52.0**	**3**
	SD	9.9		SD	9.0	
	Min	18.0		Min	18.0	
	Max	55.0		Max	64.0	
PS students (n = 14)	**M**	**53.5**	**1**	**M**	**57.4**	**1**
	SD	9.4		SD	7.9	
	Min	40.0		Min	42.0	
	Max	70.0		Max	72.0	

undermine the methodological interpretation of the result on the RP stability of empirical variables in the PS group (Model 2). Lack of RP stability but migration of all motor skills before and after training are characterised by military cadets CG. Two of these (AMS, ULMS) are statistically significantly different (Model 3).

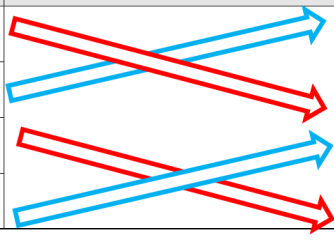
Under the influence of annual training, only among military cadets EG positive migration of Index IPFT-4 indicators shows that there were no individuals qualified to a very low level – before training there was 16.7% of such individuals and not a single one qualified to high level (after training 4.2%). This group, before training, was

Table 5. Summary of results of the tested students according to the RP motor skills military cadets EG (leader): RP4 – FLEX after training and RP compliance or migration in relation to before training results.

Group	Before training			After training		
	statistical indicator	points	RP	statistical indicator	points	RP
Military cadets EG (n = 24)	**M**	**54.8**	**2**	**M**	**55.4**	**4**
	SD	17.7		SD	10.1	
	Min	10.0		Min	35.0	
	Max	100.0		Max	73.0	
Military cadets CG (n = 24)	**M**	**53.1**	**1**	**M**	**57.0**	**2**
	SD	12.1		SD	12.3	
	Min	31.0		Min	31.0	
	Max	87.0		Max	87.0	
PS students (n = 14)	**M**	**51.9**	**2**	**M**	**52.6**	**2**
	SD	12.2		SD	11.6	
	Min	31.0		Min	38.0	
	Max	70.0		Max	71.0	

Before training		Compatibility relationship or RP migration	After training		Modifying strength of training stimuli	
motor skill	RP		RP	motor skill	%	RP
LLMS	1		1	LLMS	+ 3.9	2
FLEX	2		2	FLEX	+ 0.6	4
ULMS	3		3	ULMS	+ 1.7	3
AMS	4		3	AMS	+ 4.9	1

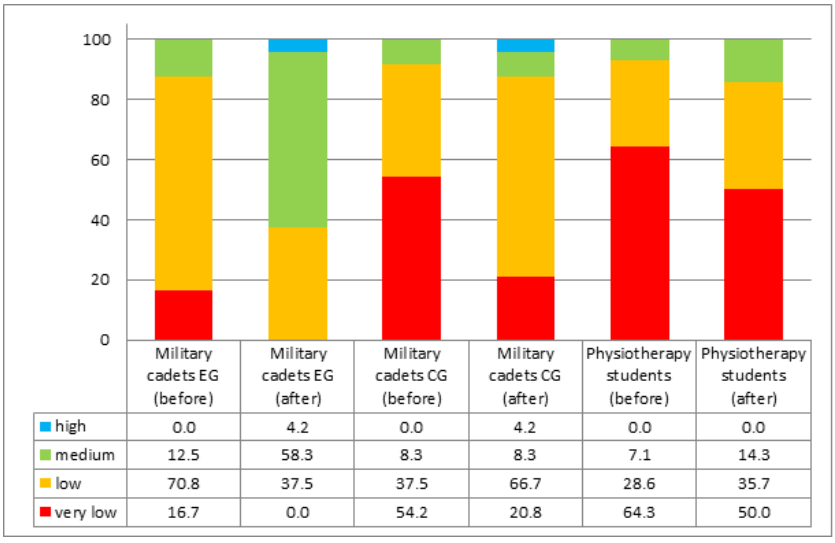
Model 2. Visualisation of RP concordance of specific indicators (trials) before and after training PS students (n = 14) and increment (%) of adaptive change: **AMS** abdominal muscle strength; **LLMS** lower limb muscle strength; **ULMS** upper limb muscle strength; **FLEX** flexibility – description consistent with the leader's RP (EG)

Before training		Compatibility relationship or RP migration	After training		Modifying strength of training stimuli	
motor skill	RP		RP	motor skill	%	RP
FLEX	1		1	AMS	**+9.9*** **	1
AMS	2		2	FLEX	+0.6	4
ULMS	3		3	LLMS	+3.6	3
LLMS	4		4	ULMS	**+7.3****	2

Model 3. Visualisation of RP concordance of specific indicators (trials) before and after training military cadets CG (n = 24) and increment (%) of adaptive change: **AMS** abdominal muscle strength; **LLMS** lower limb muscle strength; **ULMS** upper limb muscle strength; **FLEX** flexibility – description consistent with the leader's RP (EG); **p<0.01, ***p<0.001

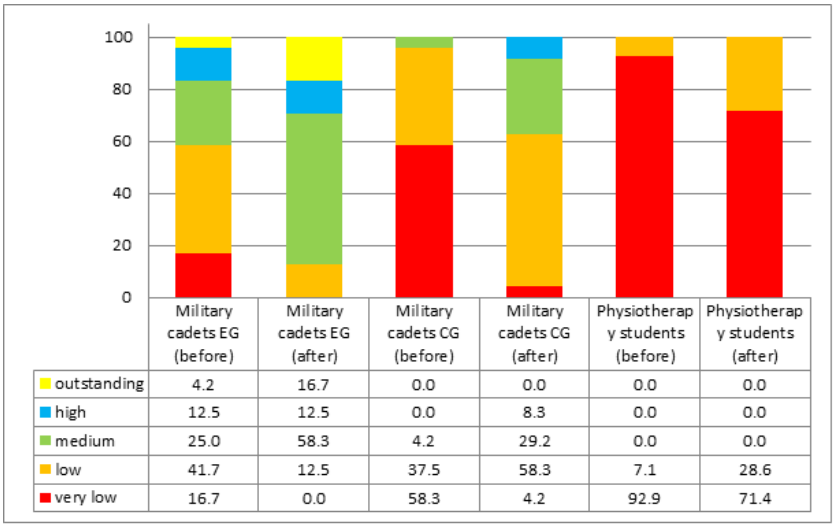
dominated by low level (70.8%), while the after training medium level (58.3%). Similar, but already less effective, is the migration of Index IPFT-4 among military cadets CG – before training, very low level was dominant (54.2%), after training low level (66.7%). Among physiotherapy students before and after training very low level was dominant – accordingly: 64.3% and 50% (Figure 1).

One-year training resulted in a positive migration of the AMS index in all groups. However, only in military cadets EG after training there were no individuals qualified to a very low level, and from 4.2% cadets of outstanding level, after training the proportion increased to 16.7%. Among cadets EG before training low level was dominant (41.7%) – after training medium level (58.3%). A similar trend was found among cadets CG, but with qualitatively lower coverage – from very low to low level. Among physiotherapy students before and after training very low level was dominant (Figure 2).



	Military cadets EG (before)	Military cadets EG (after)	Military cadets CG (before)	Military cadets CG (after)	Physiotherapy students (before)	Physiotherapy students (after)
high	0.0	4.2	0.0	4.2	0.0	0.0
medium	12.5	58.3	8.3	8.3	7.1	14.3
low	70.8	37.5	37.5	66.7	28.6	35.7
very low	16.7	0.0	54.2	20.8	64.3	50.0

Figure 1. Visualisation of the proportion of students qualifying for each level of overall physical fitness based on Index IPFT-4 after training.



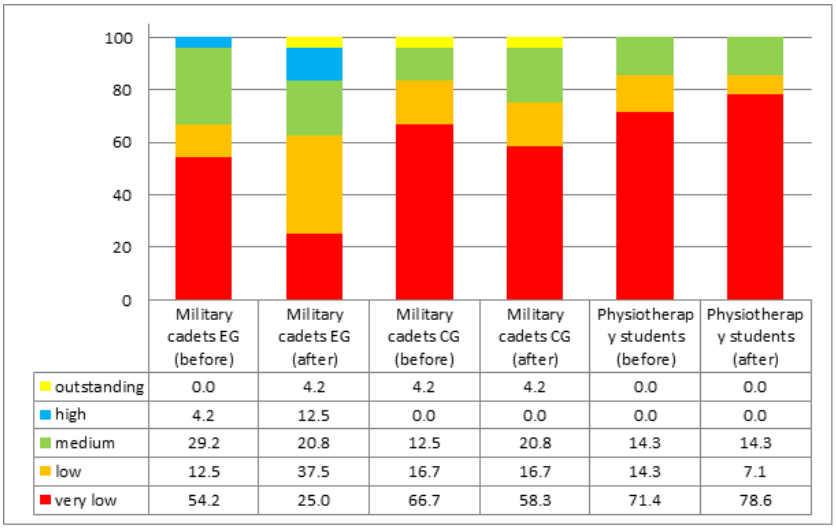
	Military cadets EG (before)	Military cadets EG (after)	Military cadets CG (before)	Military cadets CG (after)	Physiotherapy students (before)	Physiotherapy students (after)
outstanding	4.2	16.7	0.0	0.0	0.0	0.0
high	12.5	12.5	0.0	8.3	0.0	0.0
medium	25.0	58.3	4.2	29.2	0.0	0.0
low	41.7	12.5	37.5	58.3	7.1	28.6
very low	16.7	0.0	58.3	4.2	92.9	71.4

Figure 2. Visualisation of the proportion of students qualifying for each AMS level determined during the after-training measurements.

Among military cadets EG and CG, positive migration of ULMS indicator was found, but it is more pronounced in EG. A negative migration was found amongphysiotherapy students (very low level: before training 71.4%, after 78.6%). Among both cadets CG and PS before and after training very low level was dominant (Figure 3).

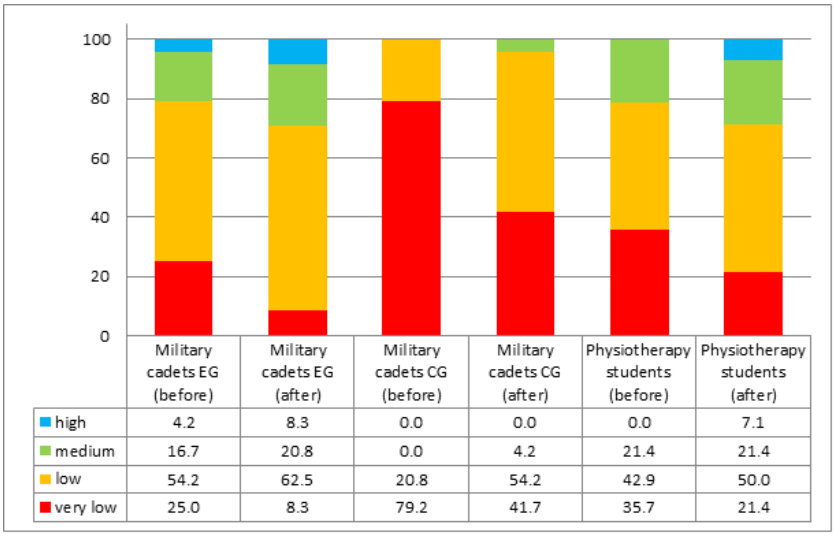
Positive migrations of the LLMS indicator were found in all study groups. In terms of stimulating this motor skill the training of military cadets EG and physiotherapy students was the most effective (Figure 4).

Although physiotherapy students revealed the highest proportions of very low level FLEX indicator before and after training (57.1% and 50%, respectively), most of them (14.3%) are characterized by high level. The smallest proportions of those with very low level of flexibility were among cadets CG before and after training. However, among them, the scale of positive



	Military cadets EG (before)	Military cadets EG (after)	Military cadets CG (before)	Military cadets CG (after)	Physiotherapy students (before)	Physiotherapy students (after)
outstanding	0.0	4.2	4.2	4.2	0.0	0.0
high	4.2	12.5	0.0	0.0	0.0	0.0
medium	29.2	20.8	12.5	20.8	14.3	14.3
low	12.5	37.5	16.7	16.7	14.3	7.1
very low	54.2	25.0	66.7	58.3	71.4	78.6

Figure 3. Visualisation of the proportion of students qualifying for each ULMS level determined during the after-training measurements.



	Military cadets EG (before)	Military cadets EG (after)	Military cadets CG (before)	Military cadets CG (after)	Physiotherapy students (before)	Physiotherapy students (after)
high	4.2	8.3	0.0	0.0	0.0	7.1
medium	16.7	20.8	0.0	4.2	21.4	21.4
low	54.2	62.5	20.8	54.2	42.9	50.0
very low	25.0	8.3	79.2	41.7	35.7	21.4

Figure 4. Visualisation of the proportion of students qualifying for each LLMS level determined during the after-training measurements.

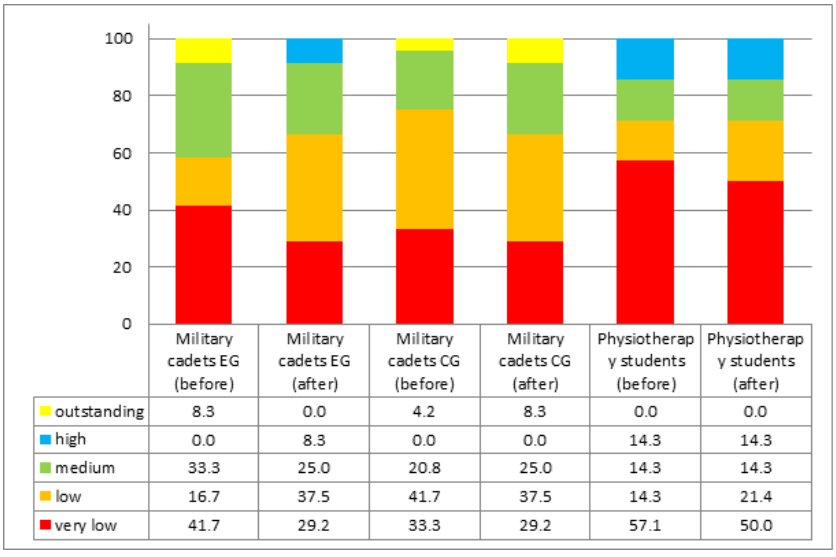


Figure 5. Visualisation of the proportion of students qualifying for each FLEX level determined during the after-training measurements.

Table 6. Results of tasks of the TFSF according to the RP of the leader (ordinal variable: from the highest to the lowest arithmetic mean of tasks PS students): tasks according to the TFSF structure: 1 rear fall and rear fall with turn; 2 front fall; 3 fall to the side (left and right); 4 front fall with turn over the shoulder (left and right).

RP	Results (Index TFSF: M, SD, min÷max)	Statistical indicator	Tasks of the TFSF: 2		3		1		4	
			points	RP	points	RP	points	RP	points	RP
1	PS students, n = 14 (97.5 ±4.7, 85÷100)	**M**	**24.6**	1	**24.6**	1	**24.3**	2	**23.9**	3
		SD	1.3		1.3		1.8		2.1	
		Min	20.0		20.0		20.0		20.0	
		Max	25.0		25.0		25.0		25.0	
2	Military cadets EG, n = 24 (81.9 ±9.9, 65÷100)	**M**	**19.4**	4	**20.2**	3	**21.7**	1	**20.6**	2
		SD	3.1		3.5		3.5		3.4	
		Min	15.0		15.0		15.0		15.0	
		Max	25.0		25.0		25.0		25.0	
3	Military cadets CG, n =24 (42.9 ±25.2, 0÷80)	**M**	**13.3**	1	**10.2**	3	**8.8**	4	**10.6**	2
		SD	7.3		8.3		7.6		8.8	
		Min	0.0		0.0		0.0		0.0	
		Max	20.0		20.0		15.0		25.0	

migration was the lowest – the highest among cadets EG (Figure 5).

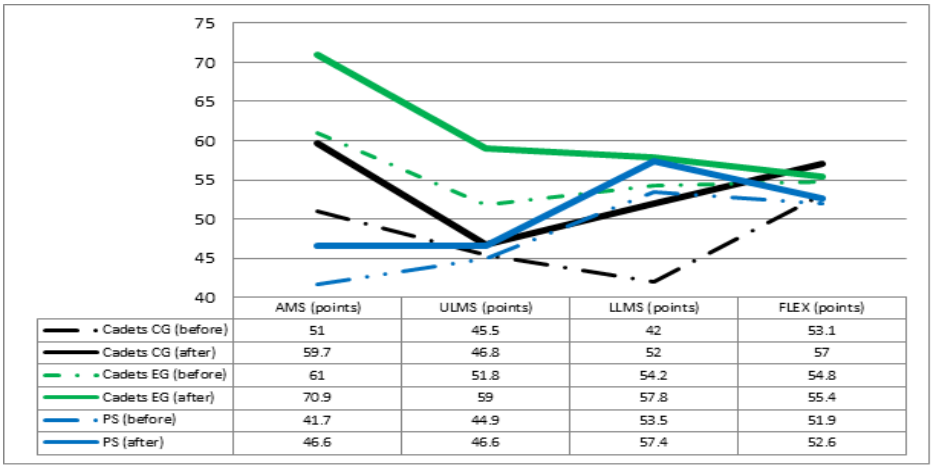
Special physical fitness

PS students mastered the safe fall skill at the highest level (mean TFSF score 97.5 ±4.7 points). Both the front fall skill (task 2) and the fall to the side skill (task 3) were ranked at the first RP with a mean score of 24.6 ±1.3 points out of a possible 25 (Table 6). Despite significant variation in terms of the level of these skills, identical RPs apply to: the first, task 2 in PS and military cadets CG; the second, task 4 in military cadets EG and CG; the third, task 3 in military cadets EG and CG (Table 6).

Profiles of general and special physical fitness of male subjects modified by different training and correlations of the main indicators of these phenomena

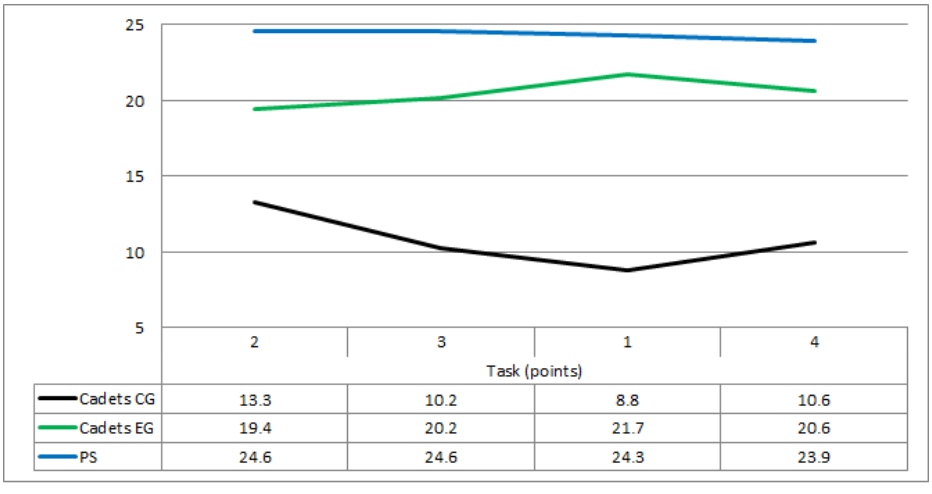
Profiles

A synthetic visualisation of the results described in Tables 2 to 5 and Models 1 to 3 shows that



	AMS (points)	ULMS (points)	LLMS (points)	FLEX (points)
Cadets CG (before)	51	45.5	42	53.1
Cadets CG (after)	59.7	46.8	52	57
Cadets EG (before)	61	51.8	54.2	54.8
Cadets EG (after)	70.9	59	57.8	55.4
PS (before)	41.7	44.9	53.5	51.9
PS (after)	46.6	46.6	57.4	52.6

Figure 6. Synthetic visualisation of the positive changes of overall physical fitness indicators observed under the influence of one year of specialised training based on exercises qualified to varying degrees for hand-to-hand combat.



	2	3	1	4
	Task (points)			
Cadets CG	13.3	10.2	8.8	10.6
Cadets EG	19.4	20.2	21.7	20.6
PS	24.6	24.6	24.3	23.9

Figure 7. Synthetic visualisation of the effects of motor competences in the field of safe falling acquired during of one year of specialised training based on exercises qualified to varying degrees for hand-to-hand combat: tasks according to the TFSF structure: 1 rear fall and rear fall with turn; 2 front fall; 3 fall to the side (left and right); 4 front fall with turn over the shoulder (left and right).

the applied training stimulates the least improvement in FLEX and the most improvement in AMS (Figure 6). Furthermore, an important finding is the proportion of students qualifying for each level of overall physical fitness based on Index IPFT-4 (Figure 1) and for each of the four measured motor skills (Figures 2 to 5).

The visualisation of the results described in Table 6 primarily shows the scale of variation in the effectiveness of the individual training sessions in terms of safe fall skill (Figure 7).

Correlations

Statistically significantly correlate Index IPFT-4 with Index TFSF ($r = 0.567$, $p<0.01$) only military cadets CG. For military cadets EG $r = 0.265$ and physiotherapy students $r = 0.492$.

The most statistically significant correlations between IPFT-4 (trials) and TFSF indicators (tasks) were found in the military cadets CG group (Table 7). Their front fall motor competence correlates positively with upper and lower limb muscle strength, while front fall with turn over

Table 7. Correlation coefficients of IPFT-4 indicators (tabulated according to leader's ordinal variable: cadets EG) with TFSF indicators (tabulated according to leader's ordinal variable: PS) military cadets CG (n = 24).

Indicators of correlated phenomena in accordance with ordinal variables				
IPFT-4	TFSF (task):			
	2	3	1	4
AMS	0.352	0.200	0.329	−0.036
ULMS	**0.515****	0.321	0.313	**0.466***
LLMS	**0.406***	0.276	0.307	0.108
FLEX	0.337	0.269	0.378	**0.608****

Table 8. Correlation coefficients of IPFT-4 indicators (tabulated according to leader's ordinal variable: cadets EG) with TFSF indicators (tabulated according to leader's ordinal variable: PS) physiotherapy students (n = 14) .

Indicators of correlated phenomena in accordance with ordinal variables				
IPFT-4	TFSF (task):			
	2	3	1	4
AMS	0.355	0.355	0.065	0.357
ULMS	−0.100	−0.100	0.169	0.104
LLMS	0.195	0.195	**0.608***	0.139
FLEX	0.360	0.360	0.421	0.430

Table 9. Correlation coefficients of IPFT-4 indicators (tabulated according to leader's ordinal variable: cadets EG) with TFSF indicators (tabulated according to leader's ordinal variable: PS) military cadets EG (n = 24).

Indicators of correlated phenomena in accordance with ordinal variables				
IPFT-4	TFSF (task):			
	2	3	1	4
AMS	0.355	0.046	−0.290	0.111
ULMS	**0.559****	0.046	0.046	0.268
LLMS	−0.166	0.002	0.193	−0.078
FLEX	−0.048	0.110	0.006	0.069

the shoulder also correlates positively with flexibility (0.608, p<0.01) and with ULMS (r = 0.466, p<0.05). Statistically significant correlations of leaders of motor competence to safe fall (PS) apply only to rear fall and rear fall with turn and LLMS (Table 8). Military cadets EG – front fall with ULMS r = 0.559, p<0.05 (Table 9).

DISCUSSIONS

The results of our research are covered most synthetically in the presented profiles of overall and special physical fitness (Figure 6 and 7 and in the section reporting the correlations of the main indicators of overall physical fitness and special physical fitness (Tables 7 to 9). From the methodological perspective of simplifying the knowledge of the most important research (scientific) findings, we emphasize the fact that respecting ordinal variables for both independent sets results in the same window in each table reporting the indicators 'r' of identical empirical variables, but relatively to a given group of people. So you can see 'with the naked eye' that in both groups of military cadets (Table 7 and 9) the repeated statistically significant correlation are indicators ULMS and front fall. This result is not repeated either in the relation to the PSs we studied or in other researchers [4, 39-41], so this coincidence can be considered coincidental.

Regardless of the group studied, annual specialized training resulted in an increase (in terms of total points) in overall physical fitness. The differences in scores after and before training in all study groups were statistically significant, but the difference between the overall physical fitness PS test before and after training is the lowest. This is mainly due to the structure of the training used. The program for physiotherapy students lasted 20 weeks (once a week 90 minutes – including an active part of 45 minutes, and during the 45 minutes of the second/first part of the training sessions students documented the efforts of the exercise subgroup [41]). In contrast, military cadets 41 weeks (twice a week for 80 minutes each). Despite these differences, PS significantly (in the statistical sense of p<0.05) increased overall physical fitness.

Specialized training of military cadets EG resulted in an increase in overall physical fitness by almost 24 points (6%) and this result is statistically significant (p<0.001). It was this group that implemented classes according to a program that included intensification of activities extended by elements of combat sports (judo and sumo). Although it is known that combat sports stimulates, among other things, flexibility, muscular strength, balance, agility and motor coordination [42], thus overall physical fitness. However, this principle cannot be generalized to all sports and martial arts [43-46].

An important observation is the level of safe fall (special physical fitness). Physiotherapy students whose training was based mainly on safe fall techniques scored an average of 97.5 points (out of a possible 100) – result TFSF. This is an excellent level. Military cadets EG during training extended by elements of combat sport (especially judo) also perfected safe fall skills, which positively influenced the TFSF result (on average about 82 points). This is a level on the border of good and more than good.

Here the paradox of judo is revealed – in the initial period of training (about 3 months), judo students learn to safe fall and belay a falling partner, but during training and tournament fights, the one who performs the throw generally does not focus attention on belaying the competitor, and the one knocked off balance tries not to fall on his back (ippon), in order not to lose the fight before time. What's more, Boguszewski's research [47] clearly shows that among combat sport athletes (judo and wrestling) there is a lack of people who flawlessly performed the original version of "the susceptibility test to the body injuries during the fall" [48], and among physiotherapy students (participating in the safe fall courses described here) we documented cases that after a year's training the maximum number of errors was reduced completely [41, 49].

Another regularity was also revealed. In the circumstances of testing new, hitherto unknown motor activities, when optimal adaptive effects are not achieved (among the basic reasons may be insufficient methodological competence of the teacher, too few training sessions etc.), more statistically significant correlations appear with indicators of overall physical fitness – our study the example of military cadets CG (they occasionally learned safe fall, so they achieved an average TFSF score of 42.9 points, with only an average of 8.8 – to 13.3 points (out of 25 possible) of individual tasks, but every third correlation with the

results of trials IPFT was statistically significant). Since we used only four trials IPFT, in this study, so it is reasonable to note that the higher the training level of combat sport athletes the lower the correlations of indicators indicating high performance in competitive judo with indicators of overall physical fitness [50] – e.g. Wolska [51] used a set of trials IPFT [37].

Thus, we emphasize that the above results are further evidence of the truth of the hypothesis that high levels of safe fall do not correlate with overall physical activity. This is a skill that can be effectively learned universally by people regardless of age, gender of physical fitness, various physical and mental dysfunctions, etc. [8]. Moreover, these are important arguments that it is unjustified to predict a reduced risk of injury from falls even in cases of people with very high physical fitness. The highest level of overall physical activity will neither ensure the avoidance of falls nor adequate protection of the most sensitive distal parts of the body (knees, hips, wrists, elbows, head) from damage during collision with a hard surface or vertical obstacle in extreme situations. Otherwise, there would have to be a high positive correlation of TFSF scores with each of the trials measuring overall physical fitness and consequently with the cumulative score of those trials, and this is not the case in our study alone, with respondents confirming that they remember various incidents involving unintentional falls

The argumentation presented above (although limited by the editorial framework) provides enough evidence to substitute in the public space instead of the general recommendation „combat sports and martial arts are used for prevention of fall injuries", with indications of specific health exercise systems with indication of specific adaptive effects as well [52-55] – because not all combat sports and martial arts include teaching safe fall in their programs. We take the position that the deliberate teaching of safe fall should be recommended in the public space as one of the primary methods of prevention and treatment of innovative agonology [17, 56, 57]. According to Dobosz et al. [24] teaching to fall is the most effective and economical method of reducing deaths, injuries and disability associated with falls [58]. Thus, it is an important part of the mission to promote personal safety, showing a direct link to improving the effectiveness and quality of public health globally.

CONCLUSIONS

A modifying effect of one-year specialized training based on, among others, safe fall exercises on selected motor skills of overall physical fitness was found. The hypothesis that high overall physical fitness is not a prerequisite for achieving optimal motor competences in terms of the ability to fall safely has been positively verified once again.

REFERENCES

1. Kalina R. Nauczanie sposobów bezpiecznego padania. Prz Wojsk Ląd 1976; 5: 77-81 [in Polish]
2. Kalina A. Universal character of exercises on safe falls – an empirical verification. In: Kalina RM, Kaczmarek A, editors. Ukierunkowane przygotowanie obronne. Warszawa: Polskie Towarzystwo Naukowe Kultury Fizycznej, Sekcja Kultury Fizycznej w Wojsku; 1997: 100-106 [in Polish]
3. Chodała A. Ocena umiejętności bezpiecznego upadania podchorążych realizujących różne programy edukacji fizycznej. In: Dąbrowski A, Jasiński T, Kalina RM, editors. Sporty walki w edukacji dzieci i młodzieży: perspektywa metodyczna. Płock: Szkoła Wyższa im. Pawła Włodkowica, Wydawnictwo Naukowe NOVUM; 2002: 207-210 [in Polish]
4. Syska J, Bógdał D. Związek umiejętności bezpiecznego upadku z wszechstronną sprawnością fizyczną. In: Dąbrowski A, Jasiński T, Kalina RM, editors. Sporty walki w edukacji dzieci i młodzieży: perspektywa metodyczna. Płock: Szkoła Wyższa im. Pawła Włodkowica, Wydawnictwo Naukowe NOVUM; 2002: 211-217 [in Polish]
5. Chodała A, Kalina RM. Związek wszechstronnej sprawności fizycznej z umiejętnościami bezpiecznego upadania. In: Sokołowski M, editor. Biospołeczne aspekty kultury fizycznej w wojsku. Poznań: Akademia Wychowania Fizycznego; 2003: 101-109 [in Polish]
6. Kalina RM, Kalina A. Theoretical and methodological aspects of teaching lower extremity amputees safe falling. Adv Rehab 2003; 17(3): 71-87
7. Kalina RM, Kruszewski A, Jagiełło W et al. Combat sports propaedeutics – basics of judo. Warszawa: Akademia Wychowania Fizycznego; 2003
8. Kalina RM, Barczyński B, Jagiełło W et al. Teaching of safe falling as most effective element of personal injury prevention in people regardless of gender, age and type of body build – the use of advanced information technologies to monitor the effects of education. Arch Budo 2008; 4: 89-89
9. Kalina RM. Miękkie lądowanie. Med Trib 2009; 13: 28-29 [in Polish]
10. Gąsienica-Walczak B, Barczyński BJ, Kalina RM et al: The effectiveness of two methods of teaching safe falls to physiotherapy students. Arch Budo 2010; 6(2): 63-71
11. Gąsienica Walczak B, Kalina RM. Zmodyfikowany test bezpiecznego upadania – aplikacje w diagnozowaniu specyficznych kompetencji motorycznych osób niewidomych. In: Włoch T, editor. Międzynarodowa Jubileuszowa Konferencja Naukowa Wydziału Rehabilitacji Ruchowej AWF Kraków. Kraków: Akademia Wychowania Fizycznego; 2012: 100 [in Polish]
12. Michnik R, Jurkojć J, Wodarski P et al. Similarities and differences of body control during professional, externally forced fall to the side

performed by men aged 24 and 65 years. Arch Budo 2014; 10: 233-243

13. Mroczkowski A. Motor safety of a man during a fall. Arch Budo 2015; 11: 293-303
14. Mosler D. Fall as an extreme situation for people with mental disorders: a review. Arch Budo Sci Martial Art Extreme Sport 2016; 12: 87-94
15. Gąsienica-Walczak B. Acceptance of the sense of implementing safe fall programs for people with visual impairments or after amputation of limbs – the perspective of modern adapted physical activity. Phys Educ Students 2019; 23(6): 288-296
16. Gąsienica Walczak B, Barczyński BJ, Kalina RM. Fall as an extreme situation for obese people. Arch Budo Sci Martial Art Extreme Sport 2019; 15: 93-104
17. Kalina RM, Kalina A. Three methods of prophylaxis and therapy of innovative agonology, important from the perspective of personal safety Arch Budo Sci Martial Art Extreme Sport 2020; 16: 7-15
18. Kubacki R, Bołociuch M, Rauk-Kubacka A. Teacher Ball Ukemi: metody i narzędzia modelowania sposobów nauczania bezpiecznego upadania. Jelenia Góra: Wydawnictwo AD Rem; 2020 [in Polish]
19. Mroczkowski A. Susceptibility to Head Injury during Backward Fall with Side Aligning of the Body. Appl Sci 2020; 10: 8239
20. Gąsienica Walczak B, Kalina RM. Validation of the new version of "the susceptibility test to the body injuries during the fall" (STBIDF-M). Arch Budo 2021; 17: 371-400
21. Karner K. Sicheres Fallen. Wien: Allgemeine Unfallversicherungsanstalt (AUVA); 1996 [in German]
22. Bąk R. Relationship the body balance disturbation tolerance skills with susceptibility to the injuries during the fall of young women and men. Arch Budo Sci Martial Art Extreme Sport 2018; 14: 189-196
23. Tomczak A., Kalina R.M., Chodała A. "Wielobój survivalowy" jako wielowymiarowy test oceniający kompetencje psychomotoryczne żołnierzy do walki o przetrwanie. In: Klukowski K., Klimczak J, editors. Przygotowanie psychofizyczne oraz kształtowanie umiejętności niezbędnych w działaniach interwencyjnych i ratunkowych służb mundurowych. Szczytno: Wydawnictwo Wyższej Szkoły Policji, Polskie Towarzystwo Naukowe Kultury Fizycznej, Sekcja Kultury Fizycznej w Wojsku; 2005: 76 [in Polish]
24. Dobosz D, Barczyński BJ, Kalina A et al. The most effective and economic method of reducing death and disability associated with falls. Arch Budo 2018; 14: 239-246
25. Kalina RM. Sporty walki i trening samoobrony w edukacji obronnej młodzieży. Warszawa: Polskie Towarzystwo Naukowe Kultury Fizycznej, Sekcja Kultury Fizycznej w Wojsku 1997 [in Polish]
26. Sterkowicz S, Chwała W, Ambroży T. Zdolności motoryczne warunkujące rezultat w teście podstawowej umiejętności samoobrony. In: Korzeniowski L, editor. Kształcenie pracowników ochrony: założenia programowe. Kraków: Liport LFK; 2001 [in Polish]
27. Syska JR, Magnuska M. Ocena podstawowej umiejętności samoobrony studentek i studentów wychowania fizycznego. Wych Fiz Sport 2003; 47: 77-86 [in Polish]
28. Harasymowicz J, Kalina RM. Training of psychomotor adaptation – a key factor in teaching self-defence. Arch Budo 2005; 1: 19-26
29. Harasymowicz J, Kalina RM: Honourable self-defence – the theoretical and methodological basis of training. Płock: Wydawnictwo Naukowe NOVUM; 2006
30. Kalina RM, Jagiełło W, Wiktorek P. Motor competence in self-defence of students of a detectives' school during their course of studies. Arch Budo 2007; 3(3): 1-6
31. Chodała A. Współzależność wszechstronnej, ukierunkowanej i specjalnej sprawności fizycznej mężczyzn realizujących wieloletni trening militarny. In: Kalina RM, Klukowski K, Jędrzejak K, Kaczmarek A, editors. Współczesne kierunki rozwoju kultury fizycznej w formacjach obronnych. Warszawa: Polskie Towarzystwo Naukowe Kultury Fizycznej, Sekcja Kultury Fizycznej w Wojsku; 2000; 57-63 [in Polish]
32. Ashkinazi S, Jagiełło W, Kalina RM et al. The importance of hand-to-hand fights for determining psychomotor competence of antiterrorists. Arch of Budo 2005; 1: 8-12
33. Sterkowicz S, Madejski E. ABC Hapkido. Kraków: Firma Handlowo-Usługowa Kasper; 1999 [in Polish]
34. Wolska B, Adam M, Klimowicz P. The correlation of general and special physical fitness indices with body weight and composition 13–16 year–old female judo athletes. Arch Budo Sci Martial Art Extreme Sport 2016; 12: 95-101
35. Jaskólski E, Nowacki Z. Teoria, metodyka i systematyka miękkiego padania. Part I. Teoria miękkiego padania. Wrocław: Wyższa Szkoła Wychowania Fizycznego; 1972: 83-88 [in Polish]
36. Mroczkowski A. Motor safety of a man during a fall. Arch Budo 2015; 11: 293-303
37. Pilicz S, Przewęda R, Dobosz J et al. Physical Fitness Score Tables of Polish Youth. Criteria for Measuring Aerobic Capacity by the Cooper Test. Studia i Monografie. Vol 86. Warszawa: Akademia Wychowania Fizycznego; 2002
38. Ulatowski T. Wszechstronna sprawność fizyczna – podstawa mistrzostwa, konieczność testowania. In: Śledziewski D, Karwacki A, editors. Szkolenie uzdolnionej sportowo młodzieży w polskim systemie edukacyjnym. Warszawa: Estrella; 2003
39. Chodała A. Porównanie efektywności dwóch metod treningu fizycznego żołnierzy przygotowywanych do misji „operacje inne niż wojna". [PhD dissertation]. Warszawa: Akademia Wychowania Fizycznego Jóefa Piłsudskiego; 2003 [in Polish]
40. Syska JR. Psychomotoryczne efekty uprawiania przez kobiety nowoczesnych form gimnastyczno-tanecznych z elementami samoobrony. [PhD dissertation]. Warszawa: Akademia Wychowania Fizycznego Józefa Piłsudskiego; 2005 [in Polish]
41. Gąsienica Walczak BK. Motoryczne, metodyczne i mentalne kwalifikacje studentów fizjoterapii z zakresu bezpiecznego upadania – perspektywa prewencji upadków osób z wadami wzroku, z unieruchomioną lub amputowaną kończyną. [PhD dissertation]. Rzeszów: Uniwesytet Rzeszowski, Wydział Medyczny; 2017 [in Polish]
42. Osipov AY, Kudryavtsev MD, Jagiełło W et al. Increasing of special physical fitness of the female athletes practicing sambo. Arch Budo 2020; 16: 53-59
43. Ramírez-Granizo IA, Ubago-Jiménez JL, Zurita-Ortega F et al. Effectiveness of an intervention program on basic physical and coordination skills and its relationship with BMI in individuals with intellectual disability. Arch Budo 2020; 16: 235-243
44. Schwartz J, Takito MY, Del Vecchio FB et al. Health-related physical fitness in martial arts and combat sports practitioners. Sport Sci Health 2015; 11: 171-180
45. Polak E, Seredynski A, Przednowek K. Physical fitness profiles of junior athletes practicing selected combat sports. In: Proceedings of the 5th IMACSSS World Scientific Congress; 2016 Oct 6-8; Rio Maior, Portugal. Rev Artes Marciales Asiat 2016; 11(2): 28-29
46. Witkowski K, Bajor J, Gąsienica Walczak B. General physical fitness of recreational krav maga trainees and non-trainees at the age of 18 during the pandemic COVID-19. Arch Budo Sci Martial Art Extreme Sport 2021; 17: 49-58
47. Boguszewski D. Zdrowotne aspekty sportów i sztuk walki. Warszawa: Warszawski Uniwersytet Medyczny; 2017 [in Polish]
48. Kalina RM, Barczyński BJ, Klukowski K et al. The method to evaluate the susceptibility to injuries during the fall – validation procedure of the specific motor test. Arch Budo 2011; 7(4): 201-215
49. Gąsienica Walczak B, Barczyński BJ, Kalina RM. Evidence-based monitoring of the stimuli and effects of prophylaxis and kinesiotherapy based on the exercises of safe falling and avoiding collisions as a condition for optimising the prevention of body injuries in a universal sense – people with eye diseases as an example of an increased risk group. Arch Budo 2018; 14: 79-95
50. Sterkowicz S, Blecharz J, Lech G. Zróżnicowanie zawodników judo wysokiego poziomu sportowego w aspekcie wskaźników doświadczenia, rozwoju fizycznego, sprawności psychomotorycznej oraz działalności startowej. In: Sterkowicz S, editor. Czynności zawodowe trenera i problemy badawcze w sportach walki. Zeszyty Naukowe. Kraków: Akademia Wychowania Fizycznego im. Bronisława Czecha; 2001; 83: 124-135 [in Polish]

51. Wolska B. Sprawność fizyczna a poziom sportowy zawodniczek judo na wybranych etapach wieloletniego szkolenia. [PhD dissertation]. Gdańsk: Akademia Wychowania Fizycznego i Sportu; 2018: 41 [in Polish]
52. Yuan WX, Cherkashin I, Cherkashina E et al. Influence of taijiquan martial art on the indicators of external respiration function and psychophysiological state of basketball players. Arch Budo 2020; 16: 107-117
53. Huang P, Cherkashina E, Cherkashin I et al. Historical and pedagogical experience in national khapsagai wrestling and its implementation in modern physical education practice. Arch Budo 2021; 17: 329-339
54. Huang PJ, Ermakov P, Fedotova O et al. Influence of a 16-week training program with Muay Thai components on BMI, body composition, and risk of sudden cardiac death among obese men. Arch Budo 2021; 17: 185-196
55. Zhang X, Liu Y, Zhang W et al. The effect of Chinese traditional exercise on cognitive function improvement in the elderly – meta analysis. Arch Budo 2021; 17: 307-318
56. Michnik R, Jurkojć J, Wodarski P et al. Similarities and differences of the body control during professional collision with a vertical obstacle of men aged 24 and 65. Arch Budo 2015; 11: 27-39
57. Michnik R, Wodarski P, Bieniek A et al. Effectiveness of avoiding collision with an object in motion – virtual reality technology in diagnostic and training from perspective of prophylactic of body injuries. Arch Budo 2017; 13: 203-210
58. World Health Organization. Falls [Internet] 2021 Apr 26 [cited 2021 May 22]. Available from: URL:https://www.who.int/news-room/fact-sheets/detail/falls
59. World Health Organization. WHO Global Report on Falls Prevention in Older Age. Geneva: World Health Organization; 2007
60. Dictionary of Sport and Exercise Science. Over 5,000 Terms Clearly Defined. A & B Black; London 2006

Cite this article as: Chodała A, Gąsienica-Walczak B. Changes in overall and special physical fitness of military cadets and physiotherapy students under the influence of various annual specialist trainings. Arch Budo Sci Martial Art Extreme Sport 2021; 17: 167-182