

Original article

Relationships between somatic structure, physical fitness, and the results in passing selected obstacle courses by cadets from the General Tadeusz Kościuszko Military University of Land Forces

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INFORMATION

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ABSTRACT

The study aims to assess the relationship between the body structure, physical fitness, and functional parameters of the respiratory system of the cadets from the General Tadeusz Kościuszko Military University of Land Forces (AWL) and their results in passing selected obstacle courses. The research material was collected from testing cadets of the third year of management studies. The research included anthropometric measurements, physical fitness tests, spirometry, and tests determining the level of passing selected obstacle courses. Body height and weight were measured. The body mass index was also calculated. Besides, the following functional characteristics were measured: cardiopulmonary endurance, functional strength, running speed and agility, balance, forced expiratory volume in 1 second, forced vital capacity, and peak expiratory flow. The study also included tests determining the level of passing the land and water obstacle courses. Statistically significant relationships were found between height and weight, balance, and forced expiratory volume in 1 second. Moreover, there were correlations between body weight and body mass index and the results in passing the land obstacle course. In addition, there were connections between cardiopulmonary endurance and performance in passing the land obstacle course, body balance, and performance in passing the land and water obstacle course. All the relationships mentioned above were low and statistically significant.

KEYWORDS

body structure, physical fitness, physical skills



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Introduction

The training activities at military higher education institutions play a crucial role in the Polish Armed Forces training system. Higher military education is conducted in accordance with

educational programs developed by military higher education institutions in consultation with persons with qualifications appropriate for a given corps (person group) from the Ministry of National Defense. In the case of most of the education programs carried out at the General Tadeusz Kościuszko Military University of Land Forces in Wrocław, the relevant powers in this respect are held by the Inspector of the Land Forces of the General Command of the Polish Armed Forces [1]. The education of military students is consistent with the military training system, the assumptions of which are defined by the General Staff of the Polish Armed Forces [2]. The main task of higher military education is to educate future officers. The primary content of the military education curriculum conducted at military higher education institutions is to provide cadets with theoretical knowledge and practical skills necessary for every candidate for a professional soldier [3].

The five-year development of the biological condition of candidates for the land forces officers is a fundamental part of the teaching process carried out at the Wrocław Military University. Military training aimed at teaching necessary military skills is the first stage of this process. The appropriate level of cadets' physical fitness is one of the underlying factors determining military training effectiveness. The key components of the soldier's physical fitness, including a military student, which determine mastering basic military skills and performing numerous duties, include endurance, strength, speed, and flexibility [4, 5].

The objective of the work

The study aims to determine the relationship between the body structure and physical fitness and the results in passing the land and water obstacle courses by cadets from the General Tadeusz Kościuszko Military University of Land Forces in Wrocław.

Material and research methods

The research material was collected from the research of third-year cadets studying at the AWL in the field of management in 2018. The research covered 131 men. The average age of the respondents was 22.7 years.

The studies included anthropometric measurements, physical fitness tests, spirometric measurements, and tests determining the level of the ability to pass land and water obstacle courses.

Anthropometric measurements of the surveyed men were made using the Martin and Saller technique [6] in the first two weeks of June 2018 at the university. The measurements were made by the same persons using the same measuring instruments. The anthropometric measurements each time included the following physical features:

- body height – measured with an anthropometer, with an accuracy of 0.1 cm,
- body weight – determined by medical scales, the measurement was made with an accuracy of 0.1 kg.

Measurements of somatic features were performed each time in the morning, after fasting. On the day of the measurement, the students were released from the obligatory morning fitness training.

Based on the measurement of somatic features, the body mass index (BMI) was calculated.

Physical fitness trials were performed using test batteries that included:

- cardiopulmonary endurance – 3000 m run,
- functional strength – bent arm hang,
- running speed and agility – 10×5 m run,
- balance – Flamingo balance test.

In addition, the following functional parameters of the respiratory system were measured:

- forced expiratory volume in 1 second (FEV-1),
- forced vital capacity (FVC),
- peak expiratory flow (PEF).

The above parameters were measured using a Pneumo RS spirometer with an accuracy of 0.01 liter.

The research involved tests determining the level of mastery of the following military skills:

- passing the land obstacle course in the Physical Fitness Center – 200 m individually,
- passing the water obstacle course – 50 m individually.

Measurements of functional characteristics and tests determining the level of mastering military skills were carried out in sports facilities of the AWL in Wrocław. The cadets performed fitness tests in sports clothes, always in similar conditions. In the Physical Fitness Center, the students performed passing the land obstacle course in field uniforms without weapons, headgears and belts. However, the cadets passed the water obstacle course in field uniforms, without weapons, headgears, belts, and field shoes.

The collected material was compiled with the use of basic statistical methods. The arithmetic mean, standard deviation, and coefficient of variation were calculated, which were used to characterize the level of selected morpho-functional traits of the tested and their ability to pass selected obstacle courses.

Internal relationships between physical features, motor and functional parameters of the respiratory system, and the ability to pass selected obstacle courses were determined using the Pearson's linear correlation coefficient. The interpretation of the correlation coefficient was made after Guilford [7]:

- > 0.20 – weak relationship
- 0.20-0.40 – low correlation
- 0.40-0.70 – moderate correlation
- 0.70-0.90 – high correlation
- 0.90-1.00 – very high correlation.

Results

The average values of selected somatic features, body mass index, functional features, and selected military skills are presented in Table 1.

The respondents' presented characteristics of the physical and functional structure imply the need to analyze the relationships between selected physical features and motor skills, the efficiency of the respiratory system, and the level of mastery of selected military skills.

Table 1. Statistical characteristics of selected functional features and soldier skills of the surveyed men

No.	Feature	\bar{x}	s	v
1.	Body height [cm]	177.76	5.41	3.04
2.	Body weight [kg]	75.50	7.35	9.74
3.	BMI [kg/m ²]	23.89	1.84	7.70
1.	3000 m run [s]	742.27	42.50	5.73
2.	Bent arm hang [s]	49.31	13.49	27.36
3.	Shuttle run 10x5 m [s]	19.07	1.17	6.16
4.	Balance [number of trials]	5.76	3.19	55.36
5.	FEV-1 [l]	4.98	0.22	4.50
6.	FVC [l]	6.08	0.26	4.21
7.	PEF [l/s]	10.76	1.08	10.01
10.	Land obstacle course – 200 m individually [s]	68.66	16.98	24.73
11.	Water obstacle course [s]	78.14	9.61	12.30

Source: Own study.

Table 2 presents the data on Pearson's linear correlation coefficients between the analyzed somatic features and functional features of the AWL surveyed students.

Among all analyzed relationships between selected functional features and physical parameters, statistically, significant relationships were observed between body height and balance and forced expiratory volume in 1 second, and between body weight and balance and forced expiratory volume in 1 second (Fig. 1-4). In all cases, these correlations are low, in a positive

Table 2. Correlations between physical features, motor parameters and the respiratory system efficiency

Feature	Cardiopulmonary endurance	Functional strength	Running speed and agility	Balance	Respiratory system efficiency		
	3000 m run	Bent arm hang	10x5 m run	Flamingo balance test	FEV-1	FVC	PEF
body height	-0.11	-0.12	0.07	0.21*	0.23*	0.19	0.01
body weight	0.05	-0.20	0.10	0.24*	0.21*	0.20	0.08
BMI	0.16	-0.15	0.07	0.14	0.09	0.11	0.09

* $p < 0.05$

Source: Own study.

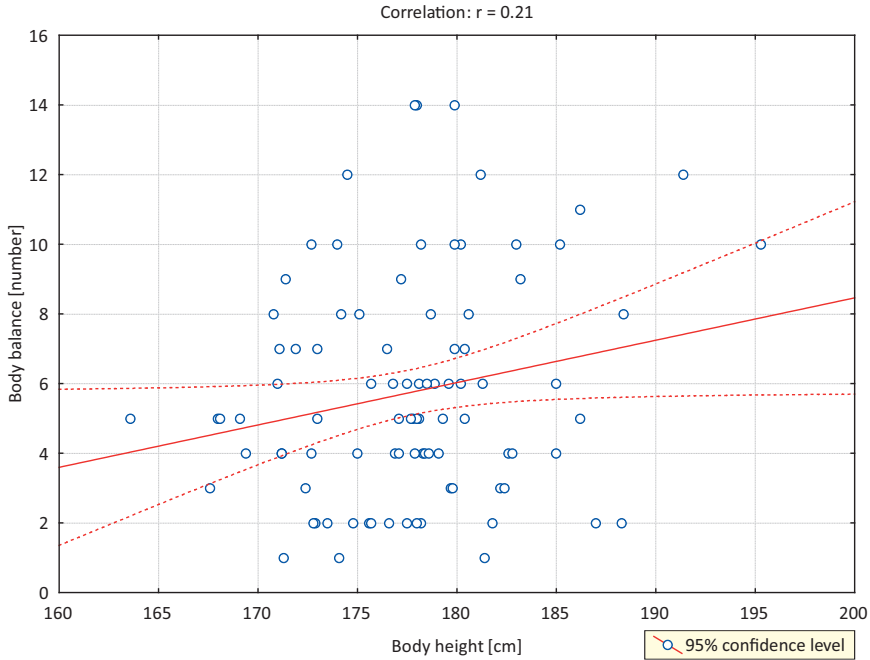


Fig. 1. Graphical image of the relationship between the body balance and body height
Source: Own study.

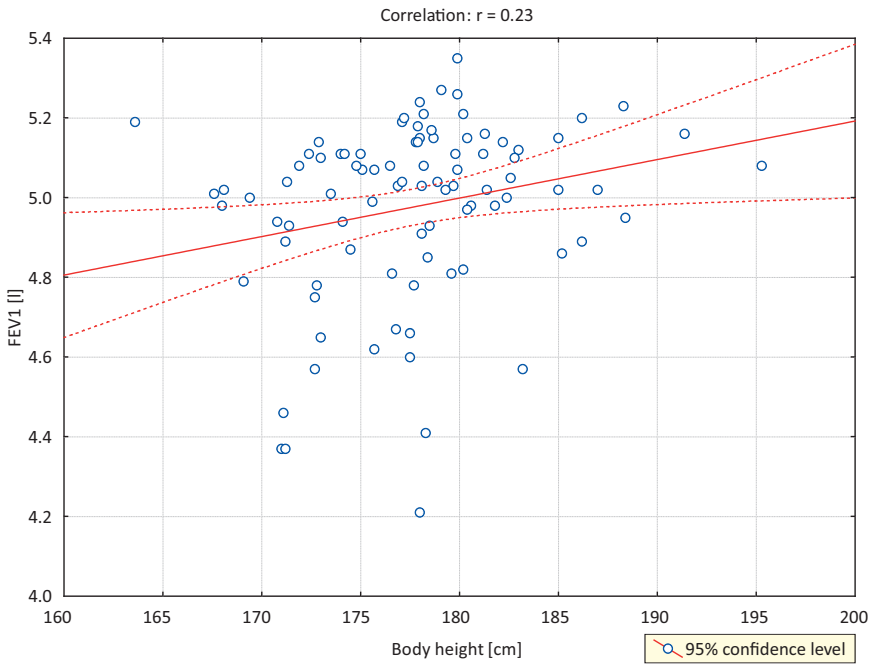


Fig. 2. Graphical image of the relationship between forced expiratory volume in 1 second and the body height
Source: Own study.

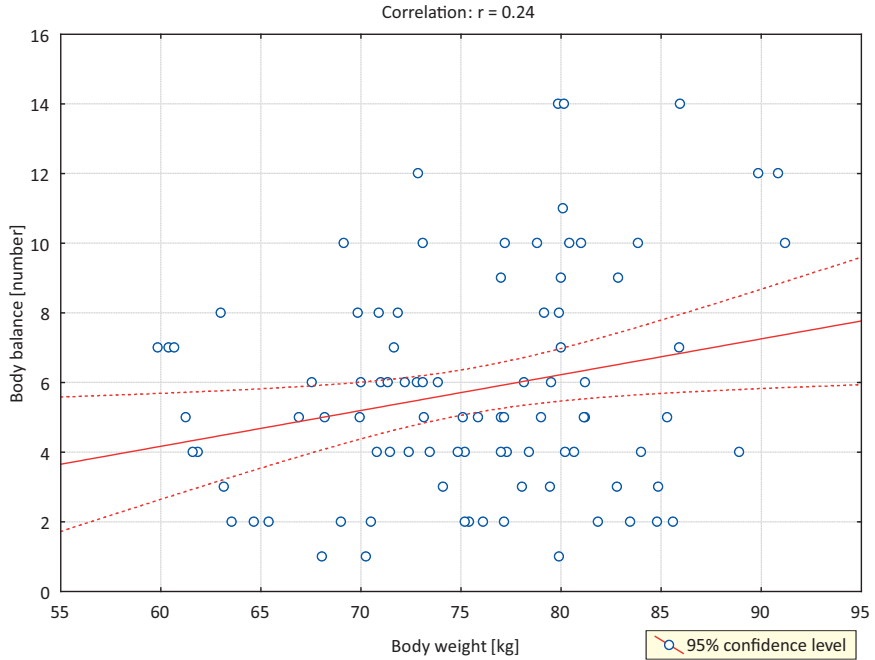


Fig. 3. Graphical image of the relationship between the body balance and body weight
 Source: Own study.

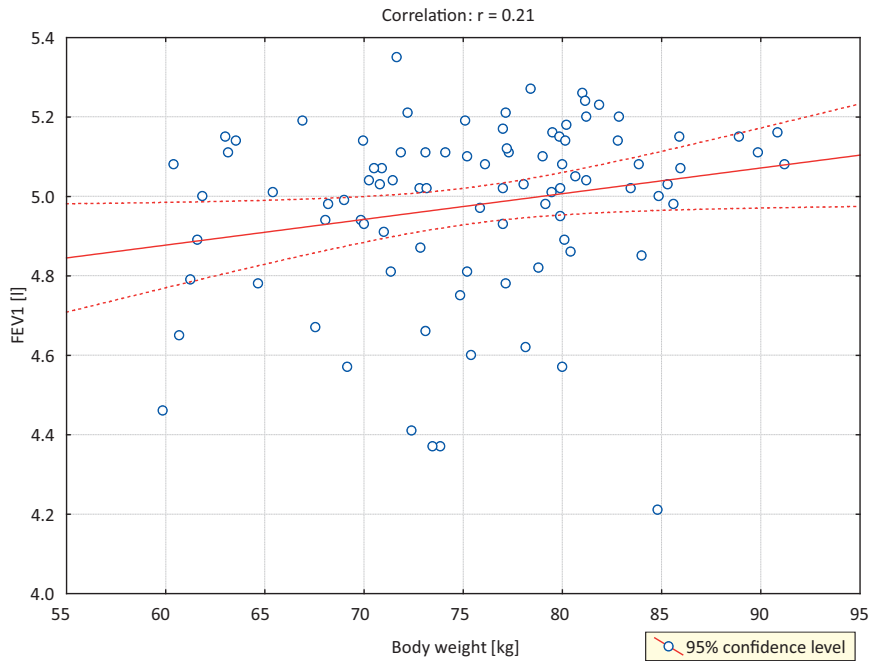


Fig. 4. Graphical image of relationships between forced expiratory volume in 1 second and the body weight
 Source: Own study.

direction. Therefore, it can be concluded that the higher the height and weight of the cadets, the more favorable their results in the body balance test and the measurement of forced expiratory volume in 1 second.

The analysis of the linear correlation of coefficients between the results in passing selected obstacle courses, physical features, and the weight-height index shows the existence of significant rectilinear relationships between the results in passing the land obstacle course and body weight and body mass index (Table 3, Fig. 5-6). Both correlations are low. These are positive correlations, allowing the assumption that the higher the value of body mass and body mass index in the studied cadets, the longer the time of passing the 200-meter obstacle course at the Physical Fitness Center.

Table 3. Correlations between the physical features of the cadets and the selected obstacle courses

Feature	Land obstacle course	Water obstacle course
body height	0.11	-0.11
body weight	0.26*	-0.16
BMI	0.24*	-0.13

* p < 0.05

Source: Own study.

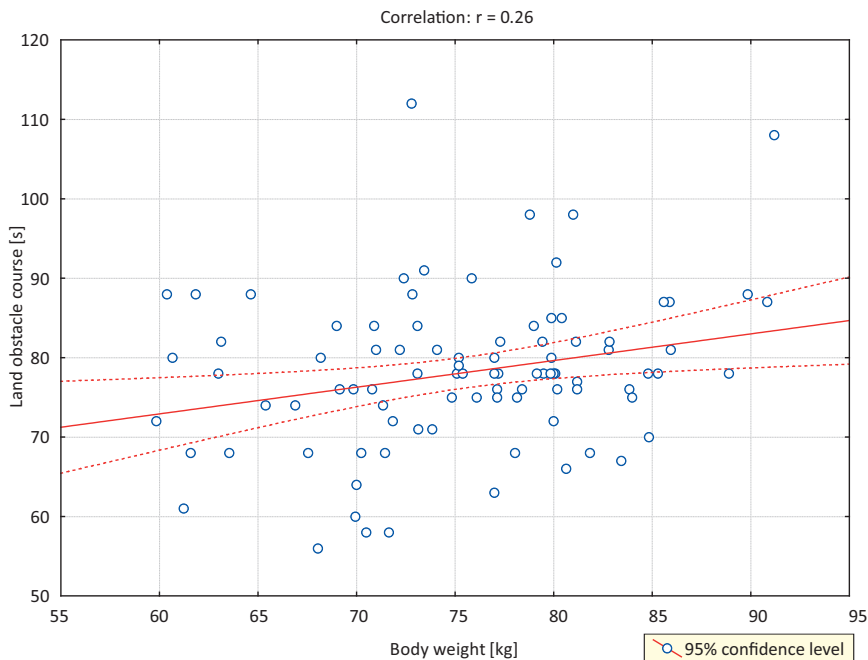


Fig. 5. Graphic image of the relationship between the body weight and results in passing the land obstacle course

Source: Own study.

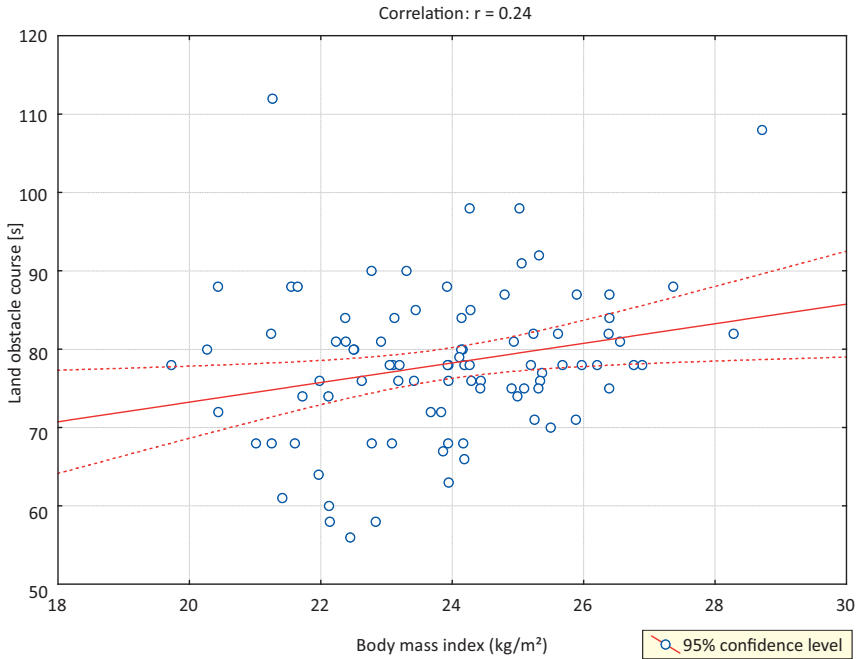


Fig. 6. Graphic image of the relationship between the results in passing the land obstacle course and the body mass index

Source: Own study.

Among all the relationships between the analyzed functional features and the results in passing selected obstacle courses, statistically significant relationships occur only between cardio-pulmonary endurance and body balance and the results in passing the land obstacle course in the Physical Fitness Center, and between the body balance and the results in passing the water obstacle course (Table 4, Fig. 7-9). All relevant relationships have a positive direction.

Table 4. Correlations between the functional features of the cadets and the selected obstacle courses

Feature	Land obstacle course	Water obstacle course
3000 m run [s]	0.28*	0.07
Bent arm hang [s]	-0.16	-0.00
Shuttle run 10 x 5 m [s]	0.11	0.11
Balance [number of trials]	0.34*	0.28*
FEV-1 [l]	0.01	-0.05
FVC [l]	0.05	0.00
PEF [l/s]	-0.09	-0.15

* $p < 0.05$

Source: Own study.

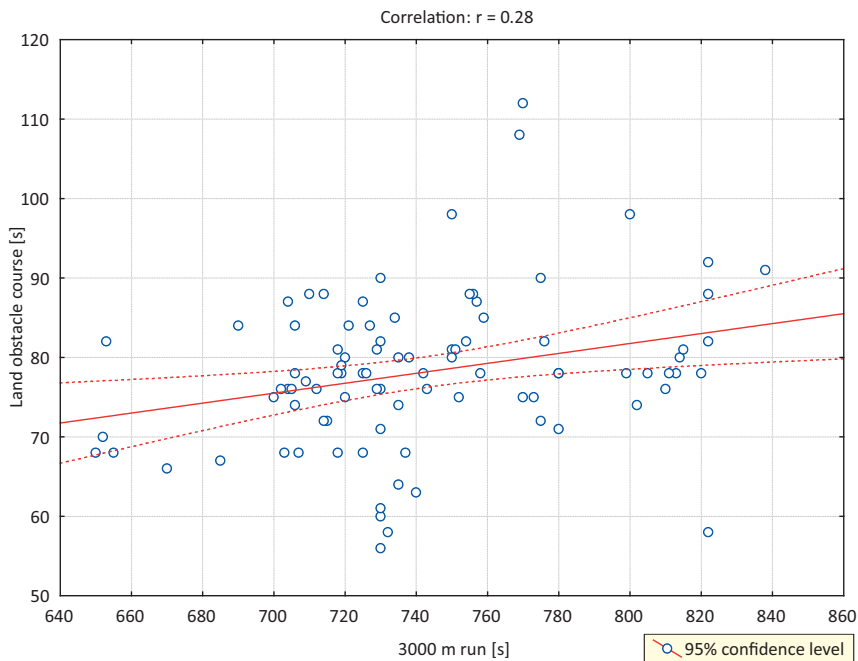


Fig. 7. Graphic image of the relationship between the results in passing the land obstacle course and cardiopulmonary endurance

Source: Own study.

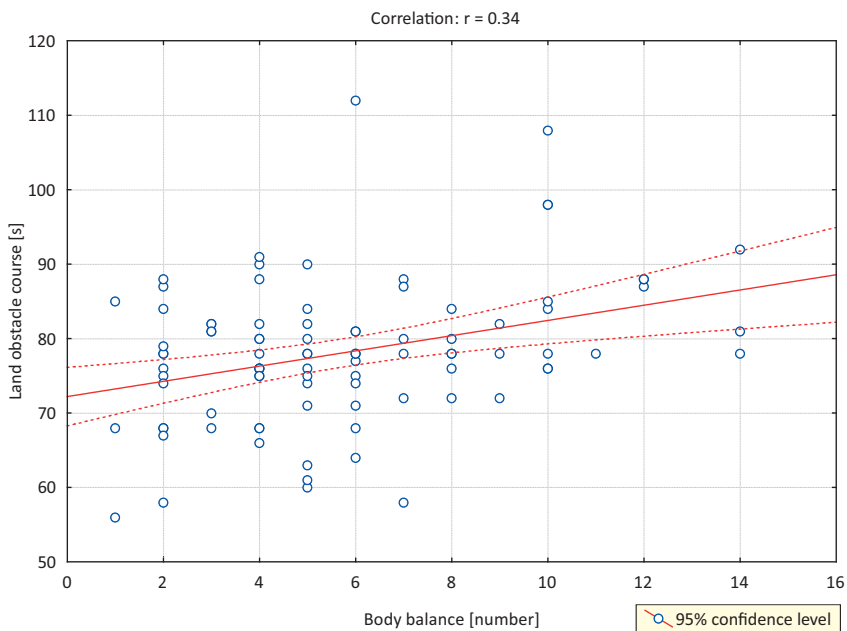


Fig. 8. Graphic image of the relationship of the results in passing the land obstacle course and the body balance

Source: Own study.

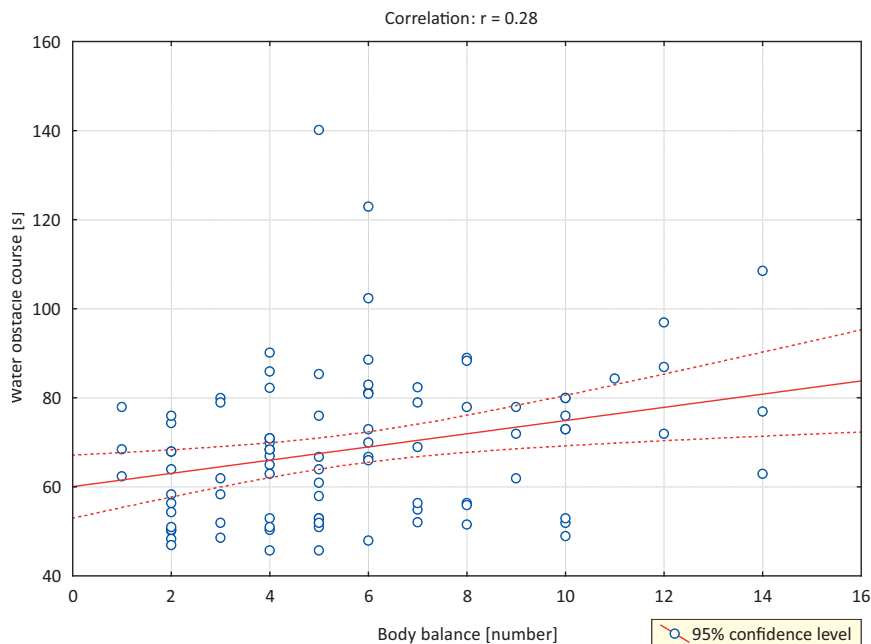


Fig. 9. Graphic image of relations between the results in passing the water obstacle course and the body balance

Source: Own study.

Discussion

The developed empirical material only partially confirmed the existence of rectilinear relationships with directions of positive changes in the structure and function of motion.

As a result of the conducted analysis, it should be stated that a significant positive relationship was found between the body height and weight and the balance and forced expiratory volume in 1 second of the examined men (Fig. 1-4).

Other authors partially confirm the results obtained among the examined cadets. The correlation analysis results of Kłossowski and Stelęgowski [8] showed little correlation between physical features and physical fitness of first-year cadets of the Air Force Academy in Dęblin. They did not find any correlation between height and weight and the test results determining the level of cardiopulmonary endurance in the cadets.

Research conducted by Ciszek and Kumala [9] among the Junior Specialist School soldiers in Wrocław confirmed a significant relationship between body weight, body mass index, and relative strength, the level of which was assessed by the researchers using a pull-up test on a high bar. Moreover, these authors found significant rectilinear relationships between the body weight and the weight-height index and the endurance of the studied soldiers, the level of which was determined by 1000 m run.

In the research carried out by Korzewa et al. [10] with second-year cadets from the AWL, the authors observed significant rectilinear relationships between the body height, body weight, and body mass index and static force, the explosive force of the upper limbs and cardiopulmonary endurance of the cadets. All these correlations were positive. They also noticed

the existence of significant relationships between the body weight and weight/height index and the results of running speed and agility (the test determining this motor parameter was a 20 m shuttle run). The direction of these relationships was negative.

Due to the lack of available publications dealing with the relationship between functional features and selected obstacle courses, their in-depth analysis was not performed. Only Korzewa et al. [10] performed an analysis of the relationship between selected motor skills and the running strength test among military students. The correlation analysis revealed the presence of significant rectilinear connections between most of them, i.e., the explosive force of the upper limbs, the explosive force of the lower limbs, agility, motor skills, and the results of passing the running strength test by the AWL students. In the case of the relationship between the explosive force of the upper limbs, the explosive force of the lower limbs and the results obtained in the strength running test, the correlations were negative. The correlation was positive for the links between agility and the results in passing the strength running test. According to the authors, the analysis confirmed the usefulness of the running strength test as a universal tool for assessing the cadets' physical abilities.

Conclusions

1. Increased body dimensions, i.e., height and body weight, significantly and favorably only correlate with the body balance level of cadets and their results in the measurement of forced expiratory volume in 1 second.
2. In the research group, there was a significant correlation between the body mass and body mass index (positive direction) with the results in passing the land obstacle course in the Physical Fitness Center.

The occurrence of statistically significant relations between cardiopulmonary endurance and results in passing the land obstacle course as well as between the balance of the body and passing the land and water obstacle courses was noted. All the presented correlations are low and a positive direction characterizes them.

Acknowledgement

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Conflict of interests

The author declared no conflict of interests.

Author contributions

The author contributed to the interpretation of results and writing of the paper. The author read and approved the final manuscript.

Ethical statement

The research complies with all national and international ethical requirements.

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Biographical note

Dariusz Lenart – Lt. Col. Dr., Assistant Professor-Head of the Department of Physical Education and Sport at the General Tadeusz Kościuszko Military University of Land Forces. His scientific interests focus on environmental conditions of somatic development and physical fitness of professional soldiers and candidates for professional soldiers, morphological modulators of soldiers' physical fitness, the influence of human biological condition on the level of mastering military skills, the secular trend of body structure and functional features of students of military higher education institutions, physical activity of soldiers in the light of selected lifestyle and quality of life factors, physical activity of professional soldiers and candidates for professional soldiers.

Związki między budową somatyczną, sprawnością fizyczną a wynikami w pokonywaniu wybranych torów przeszkód przez podchorążych Akademii Wojsk Lądowych imienia generała Tadeusza Kościuszki

STRESZCZENIE

Celem pracy jest ocena związków między budową somatyczną, sprawnością fizyczną i parametrami funkcjonalnymi układu oddechowego podchorążych Akademii Wojsk Lądowych imienia generała Tadeusza Kościuszki a wynikami w pokonywaniu przez nich wybranych torów przeszkód. Materiał badawczy został zebrany w wyniku badań podchorążych trzeciego roku studiów na kierunku zarządzanie. Badania obejmowały

pomiary antropometryczne, testy sprawności fizycznej, spirometrię oraz testy określające poziom pokonywania wybranych torów przeszkód. Mierzono wysokość i masę ciała. Obliczono również wskaźnik masy ciała. Ponadto zmierzono następujące cechy funkcjonalne: wytrzymałość krążeniowo-oddechową, siłę funkcjonalną, szybkość biegową i zwinność, równowagę, natężoną objętość wydechową w 1 sekundzie, natężoną pojemność płuc, szczytowy przepływ wydechowy. Badanie obejmowało również testy określające poziom pokonywania lądowego i wodnego toru przeszkód. Istotne statystycznie związki wystąpiły między wysokością a masą ciała i równowagą oraz natężoną objętością wydechową w 1 sekundzie. Ponadto zachodziły korelacje między masą ciała i wskaźnikiem masy ciała a wynikami w pokonywaniu lądowego toru przeszkód lądowych. Oprócz tego wystąpiły powiązania między wytrzymałością krążeniowo-oddechową a wynikami w pokonywaniu lądowego toru przeszkód, równowagą ciała a wynikami w pokonywaniu lądowego i wodnego toru przeszkód. Wszystkie przedstawione powyżej związki były niskie i istotne statystycznie.

SŁOWA KLUCZOWE budowa somatyczna, sprawność fizyczna, umiejętności fizyczne

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