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The Dependence of Physical Fitness on the Functional Capabilities of Girls During Education at the Military Academy

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Abstract

The purpose of the study is to study the statistical relationship between physical fitness and functional capabilities of girls – future officers at the stages of training at the military academy.

Materials and methods. The research subjects were 108 girls who started studying at military academies at the beginning of the experiment; their age ranges from 17 years and 3 months to 18 years and 5 months. The experiment took place over four academic years with the participation of the same girls. The main means of obtaining data were pedagogical testing and diagnosis of physiological characteristics, which took place every year.

Results. Every year there is a weak but statistically significant dependence of changes in the general physical fitness of girls on changes in their functional capabilities. At the same time, with each new year of study, this dependence only increases. Changes in general physical fitness depend somewhat more on changes in functional capabilities than on special ones. The latter is characterized by a tendency towards a slightly greater dependence in the 2nd and 4th years of study, compared to the results in the 1st and 3rd years.

Conclusions. Data from sources of information prove the need to take into account the results obtained in practical activities regarding the dependence of physical fitness on the functional capabilities of those who perform physical activity. This will contribute to increasing the effectiveness of the organization and the content of girls' physical activity in solving the defined tasks of professional training at the military academy.

Keywords: girls, physical activity, military academy, functional capabilities, physical fitness, the dependence of indicators.

Introduction

At the current stage, improving the organization, content and methods of physical activity of future officers during their training to improve their physical fitness and functional capabilities continues to be relevant. Effective here is the use of multivariate statistical methods. However, such studies are characterized by their isolated nature, which makes their conduct necessary.

Taking into account the information from current documentary sources (Instruction on physical training, 2014), today one of the promising directions for improving the organization, the content of the physical activity and methods of their implementation during the training of future officers in military academies continues to be related to improving their physical fitness and functional characteristics.

One of the leading reasons for such a position is that these characteristics are an important component of the readiness of future officers to solve the tasks defined by the military (Romanchuk & Boyarchuk, 2008; Sliusarchuk & Iedynak, 2015). In this regard, the attention of researchers to the formation of the most rational parameters of physical activity of future officers (and both young men and women) in terms of successfully solving the assigned tasks is increasing (Gonshovskyi, 2011; Anatskii, 2021). At the same time, one of the effective approaches involves the use of multivariate statistics methods (Ovcharuk, 2007; Gonshovskyi, 2010; Melnykov et al., 2018). However, we note the isolated nature of studies (Sliusarchuk et al., 2023) aimed at shaping the content of the physical activity of girls – future officers based on the results of the implementation of the specified methods. Taking into account the above, we state the need to conduct research in the specified scientific direction.

Considering the given information, it was noted that the use of data on the degree of dependence of physical fitness on the functional capabilities of girls will allow for an increase in the effectiveness of the content of the physical activity.

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This can help influence these capabilities and improve the first specified characteristic. This is one of the leading tasks of the specified pedagogical process in the military academy. Based on the above, the goal of the study was formulated: to study the statistical relationship between physical fitness and functional capabilities of girls – future officers at the stages of training at the military academy.

Materials and methods

Research participants

They were 108 girls (54 each), who started studying at one of the two military academies, which were research bases, at the beginning of the study. The age of all girls at the beginning of the study ranged from 17 years and 3 months to 18 years and 5 months.

Research organization

The research took place during four academic years with the participation of the same girls. The method of pedagogical testing and diagnosis of physiological characteristics was used to obtain the necessary empirical data. Both methods were implemented every year, in particular at the beginning and end of the first year of study, as well as at the end of the second, third, and fourth years of study. The testing took place during free time from training, the form of organization of this physical activity was a competition under the leadership of an experimenter and a teacher of physical education at the military academy. Tests were used to assess the state of development of the main motor qualities of the girls, who were divided into groups: the first – motor qualities that were part of general physical fitness (GPF), the second – qualities that were considered as components of special physical fitness (SPF). The first group included tests that made it possible to assess the state of development of the following motor qualities: speed (running 30 m), muscle strength (dynamometry of the hand of the leading hand), explosive strength of the muscles of the lower limbs (long jump from a standing position), mobility in the lumbar spine (leaning forward while sitting), coordination in cyclic locomotion (shuttle run 4x9 m), aerobic endurance (12 minute run) and static strength endurance (stand on bent arms). All these tests are widely used by domestic and foreign specialists in physical education research.

The second group included tests determined by documentary sources (Instruction on physical training, 2014) and recommended by specialists in military physical education (Romanchuk, 2008; Larkin, 2010; Bradley, 2016). The tests used made it possible to assess the state of development of aerobic– anaerobic endurance (1000 m run), power endurance in dynamic mode (control strength exercise), speed endurance (100 m run), and coordination endurance (shuttle run 10×10 m). The method of conducting each test did not differ from the traditional one, which is widely presented in the special literature.

To assess the functional capabilities of the girls in the above periods, diagnostic procedures were carried out, which made it possible to determine the necessary physiological characteristics. Such was the state of functioning of the cardiovascular, respiratory, and neuromuscular systems of the body and the physical capacity of the girls. The procedures used are samples and tests recommended by specialists (Bar–Or, Rowland, 2004; Sokołowski, 2014; American College of Sports Medicine, 2017). With their help, the following characteristics were evaluated: blood pressure (BP – namely systolic (SBP) and diastolic (DBP)); heart rate at rest (HR); vital capacity (VC); Ruffier index (RTI), Robinson index (RI), vital capacity index (VCI), and index maximum isometric strength (IMIS). The value of HR testified to the state of heart activity, and together with BP and RI, the state of the cardiovascular system at rest. The value of the VC indicated the ability of the lungs to receive oxygen, and the value of the vital capacity index – the state of the respiratory system in conditions of a full supply of the body with oxygen. The value of the IMIS made it possible to assess the state of development of the skeletal muscles of the girls, which indirectly indicated the state of excess accumulation of structural and energy potentials in the muscles, which increase their working capacity. The RTI value made it possible to assess the physical performance of girls. The following certified equipment was used: to determine BP – Santamedical Adult Deluxe Aneroid Sphygmomanometer, IMIS – handgrip Camry dynamometer, VCI – spirometer NDD EasyOne Plus System 2000 – 2.

Data for the study were quantitative values obtained during testing and functional tests. Such values were compared with each other, which made it possible to determine the increase or decrease in the value of a certain indicator or its detection at the achieved level. At the same time, during the organization of the study, the provisions of the World Medical Association (WMA – 2013) on the ethical principles of medical research with human participation were taken into account. In this regard, an appropriate protocol was approved, and each girl consented to participate in the study.

Statistical analysis

All statistical analyzes were performed using SPSS Version 21. For each assessment, the following calculations were performed: arithmetic mean (M), standard deviation (SD), error of the mean (m), and Kolmogorov– Smirnov Test (KS). The latter made it possible to establish a normal distribution of individual values in a sample of females (Vincent, 2005). Multiple regression analysis was used to obtain the necessary data. This ensured the establishment of the statistical nature of the change in the following indicators: a complex of motor qualities that are part of general physical fitness (7 indicators) and physiological characteristics (8 indicators); a complex of motor qualities that are part of special physical fitness (4 indicators) and physiological characteristics (8 indicators).

Results

Before starting the analysis of the obtained data, the conformity of the values of each indicator of physical fitness and physiological characteristics to the normal distribution was determined. For this, the K–S Test was applied and a normal distribution of values in indicators of general physical fitness was found (Tab. 1). Moreover, this was characteristic not only for the beginning of the education of girls in the military academy but also for other studied periods.

Table 1. Results of general physical fitness of girls in different periods of the study

The name of the parameter	M	SD	m	K– S, p
at the beginning of study				
30 meter sprint, s	6.8	0.61	0.06	> 0.20
Handgrip strength test, kg	22.6	3.08	0.30	> 0.20
Standing long jump, cm	181.1	10.5	1.01	> 0.20
Forward bend, cm	12.3	2.76	0.27	> 0.20
Shuttle run 4×9 m, s	11.67	0.46	0.04	> 0.20
12 minute run, m	1882.6	144.7	13.9	> 0.20
Flexed – arm hang, s	15.95	6.06	0.58	< 0.15
at the end of the first year of study				
30 meter sprint, s	7.02	0.59	0.06	> 0.20
Handgrip strength test, kg	24.0	3.95	0.38	> 0.20
Standing long jump, cm	183.7	12.52	1.20	> 0.20
Forward bend, cm	15.5	3.43	0.33	> 0.20
Shuttle run 4×9 m, s	11.1	0.54	0.05	> 0.20
12 minute run, m	2047.9	203.88	19.62	> 0.20
Flexed – arm hang, s	17.73	6.21	0.60	> 0.20
at the end of the second year of study				
30 meter sprint, s	7.01	0.55	0.05	> 0.20
Handgrip strength test, kg	25.8	4.43	0.43	> 0.20
Standing long jump, cm	186.2	13.38	1.29	> 0.20
Forward bend, cm	17.6	3.08	0.30	> 0.20
Shuttle run 4×9 m, s	11.02	0.58	0.06	> 0.20
12 minute run, m	2057.1	195.26	18.79	> 0.20
Flexed – arm hang, s	19.13	8.1	0.78	> 0.20
at the end of the third year of study				
30 meter sprint, s	7.48	0.68	0.07	< 0.20
Handgrip strength test, kg	27.9	4.29	0.41	> 0.20
Standing long jump, cm	188.4	13.19	1.27	> 0.20
Forward bend, cm	17.4	2.87	0.28	> 0.20
Shuttle run 4×9 m, s	11.59	0.70	0.07	> 0.20
12 minute run, m	2021.7	189.69	18.25	> 0.20
Flexed – arm hang, s	15.68	4.96	0.48	> 0.20
at the end of the fourth year of study				
30 meter sprint, s	7.78	0.55	0.05	> 0.20
Handgrip strength test, kg	27.3	4.42	0.43	> 0.20
Standing long jump, cm	182.1	13.59	1.31	< 0.20
Forward bend, cm	16.8	2.85	0.37	< 0.15
Shuttle run 4×9 m, s	11.88	0.67	0.06	< 0.20
12 minute run, m	2151.1	164.76	15.85	> 0,20
Flexed – arm hang, s	13.21	5.19	0.50	> 0.20

A similar result was obtained when processing the values of the K–S Test, which indicated indicators of special physical fitness (Tab. 2).

Taking into account the data of both tables, it was ascertained the possibility to use parametric criteria in the future, as well as methods of mathematical statistics adequate to this result.

At the same time, it was noted that the studied physiological characteristics had certain features and similar trends. Thus, in the latter case, regardless of the year of study, in most physiological characteristics, the distribution of the individual results of the girls corresponded to the normal range (Tab. 3).

Table 2. Results of special physical training of girls in different periods of the study

The name of the parameter	M	SD	m	K– S, p
at the beginning of study				
Complex strength exercise, number	26.80	4.88	0.47	< 0.15
100 meter sprint, s	17.61	0.98	0.09	> 0.20
Shuttle run 10×10 m, s	34.18	2.07	0.20	> 0.20
1000 meter run, s	283.1	31.39	3.02	< 0.15
at the end of the first year of study				
Complex strength exercise, number	29.60	4.57	0.44	> 0.20
100 meter sprint, s	16.37	1.03	0.10	> 0.20
Shuttle run 10×10 m, s	34.77	2.22	0.21	> 0.20
1000 meter run, s	242.8	28.17	2.71	> 0.20
at the end of the second year of study				
Complex strength exercise, number	31.40	4.82	0.46	> 0.20
100 meter sprint, s	16.06	0.87	0.08	< 0.15
Shuttle run 10×10 m, s	35.51	2.16	0.21	> 0.20
1000 meter run, s	252.4	27.02	2.60	> 0.20
at the end of the third year of study				
Complex strength exercise, number	33.68	4.46	0.43	> 0.20
100 meter sprint, s	16.04	0.86	0.08	> 0.20
Shuttle run 10×10 m, s	35.67	2.32	0.22	> 0.20
1000– meter run, s	254.5	26.64	2.56	> 0.20
at the end of the fourth year of study				
Complex strength exercise, number	36.11	4.27	0.41	< 0.15
100 meter sprint, s	15.75	0.79	0.08	> 0.20
Shuttle run 10×10 m, s	35.45	2.58	0.25	< 0.20
1000 meter run, s	244.5	25.11	2.42	> 0.20

The exception in all years of study was the VC indicator, in some years of study as follows: at the beginning of the study – SBP and DBP, at the end of the first year – only DBP, at the end of the third – HR and SBP, at the end of the fourth – the most, namely HR, DBP, VC, and VCI. In this regard, they noted the need to take into account the obtained data in the statistical analysis of the values of such indicators.

When solving another task, data were obtained regarding the degree of statistical dependence of changes in the general physical fitness of girls on changes in their functional capabilities during each year of study. Thus, the value of the coefficient of multiple regression during the 1st year of study was at the level of 0.294, during the 2nd year of study – at the level of 0.330, during the 3rd – 0.342, and during the 4th – 0.367. In other words, in all cases, there was a weak but statistically significant dependence of the change in the general physical fitness of girls on the state of change in their physiological characteristics. The obtained data were interpreted as follows: with each new year of study, the dependence of the change in their general physical fitness on the change in functional capabilities increases.

As for the dependence of changes in the special physical fitness of these girls on the studied functional capabilities, a somewhat different result was obtained here. In particular, the value of the coefficient of multiple regression during the

Table 3. Results of physiological characteristics of girls in different periods of the study

The name of the parameter	M	SD	m	K– S, p
at the beginning of study				
HR at rest, bpm^{-1}	80.7	5.29	0.51	< 0.20
SBP, mmHg	114.6	5.02	0.48	< 0.01
DBP, mmHg	74.7	4.78	0.46	< 0.01
VC, l	1.94	0.24	0.02	< 0.05
VCI, ml·kg^{-1}	34.86	5.68	0.55	< 0.10
IMIS, %	30.51	5.55	0.53	> 0.20
RTI, conditional units	10.84	0.7	0.07	> 0.20
RI, conditional units	92.64	5.89	0.56	> 0.20
at the end of the first year of study				
HR at rest, bpm^{-1}	74.5	4.99	0.48	> 0.20
SBP, mmHg	117.4	4.68	0.45	> 0.20
DBP, mmHg	78.2	4.73	0.46	< 0.05
VC, l	2.69	0.25	0.02	< 0.05
VCI, ml·kg^{-1}	41.18	5.63	0.54	> 0.20
IMIS, %	41.66	6.14	0.59	> 0.20
RTI, conditional units	9.76	0.81	0.08	> 0.20
RI, conditional units	84.42	5.61	0.54	> 0.20
at the end of the second year of study				
HR at rest, bpm^{-1}	73.5	4.08	0.39	> 0.20
SBP, mmHg	119.3	4.01	0.39	< 0.20
DBP, mmHg	78.3	3.27	0.31	< 0.10
VC, l	2.7	0.25	0.02	< 0.05
VCI, ml·kg^{-1}	40.01	5.13	0.49	> 0.20
IMIS, %	44.83	5.89	0.57	> 0.20
RTI, conditional units	9.72	0.71	0.07	> 0.20
RI, conditional units	83.81	5.29	0.51	> 0.20
at the end of the third year of study				
HR at rest, bpm^{-1}	76.1	3.96	0.38	< 0.01
SBP, mmHg	122.3	3.57	0.34	< 0.05
DBP, mmHg	78.5	2.92	0.28	> 0.20
VC, l	2.65	0.29	0.03	< 0.05
VCI, ml·kg^{-1}	37.74	4.84	0.47	> 0.20
IMIS, %	44.99	5.64	0.54	> 0.20
RTI, conditional units	9.95	0.71	0.07	< 0.20
RI, conditional units	84.7	5.54	0.53	> 0.20
at the end of the fourth year of study				
HR at rest, bpm^{-1}	75.4	3.42	0.33	< 0.01
SBP, mmHg	122.6	2.75	0.26	< 0.10
DBP, mmHg	77.8	3.41	0.33	< 0.05
VC, l	2.97	0.31	0.03	< 0.05
VCI, ml·kg^{-1}	38.6	4.83	0.46	< 0.05
IMIS, %	45.86	5.54	0.53	> 0.20
RTI, conditional units	9.17	0.60	0.06	> 0.20
RI, conditional units	83.65	5.50	0.53	> 0.20

1st year of study was 0.229, during the 2nd year – 0.298, during the 3rd year – 0.228, and the 4th year – 0.242. The interpretation of established data testified to the existence of a dependence of changes in the special physical fitness of girls on changes in their functional capabilities. At the same time, the comparison showed a tendency towards a slightly greater effect in the 2nd and 4th years of study, compared to achievements during the 1st and 3rd years of study.

In addition, it was noted that a change in general physical fitness depends somewhat more on changes in functional capabilities than on changes in special physical fitness.

Discussion

The issue of improving the organization, content and methods of physical activity of future officers during training at the military academy remains important. The direction of such improvement is primarily related to the task of improving the physical fitness and functional capabilities of such girls (Vogt, 2011; Instruction on physical training, 2014). One of the promising directions in solving this problem continues to be the use of the results obtained using the methods of multivariate statistics (Melnykov et al., 2018; Sliusarchuk et al., 2022).

Some of the reasons for this are the formation of the most rational parameters of physical activity at the stages of training in the VA (Gonshovskyi, 2011; Sliusarchuk, 2016; Anatskii, 2021). It is they that make it possible to achieve a highly positive result in increasing the level of physical fitness. The determining reason is that the latter is one of the important components of the future officer's readiness to solve tasks defined by military and professional duties (Romanchuk & Boyarchuk, 2008; Sliusarchuk & Iedynak, 2015).

When studying the statistical dependence between physical fitness and functional capabilities of girls – future officers at the stages of training in the VA, the existence of such dependence was revealed. Confirmation of the existence of a certain dependence between the specified characteristics of future officers can be found in other researchers (Ovcharuk, 2007; Gonshovskyi, 2010; Melnykov, 2018). In our case, the result showed that influencing the functional capabilities of girls during various forms of physical activity can also improve physical fitness. This is consistent with the information that the use of physical activities of a certain orientation at a young age in some cases stimulates, in others, on the contrary, inhibits the development of a specific functional capacity (Banah, 2020). This is due to the fact that significant morphological and functional changes occur during physical activity, each of which is different for different body systems and depends on the period of ontogenesis. Components of the body's morphology and functions, depending on the reaction to physical exertion, are divided into conservative and labile. The impact on the latter during physical activity is a stimulator and regulator of the body's development. Taking into account the available information (Sands & Sands, 2012; Schmidt & Lee, 2014), intensification of development is the basis for increasing the level of manifestation of various motor qualities; the latter in general physical fitness and special physical fitness are combined. Here it is necessary to take into account that the existing types of endurance are based on the features of the energy supply of the work being performed – anaerobic, aerobic, and mixed (Romanchuk et al., 2019; Wilmore, Costill & Kenney, 2022). Muscular strength occurs when skeletal muscles are maximally tensed at minimal speed, while explosive power is the opposite at the maximal possible speed (Ruppole, 2017). Different types of coordination are caused by different psychophysiological mechanisms and functions of ensuring action (Schmidt & Lee, 2014). Expression of speed qualities is provided by inde-

pendent functional systems, namely for the realization of the speed of a single movement, frequency of movements, motor reaction (simple and complex), and rhythm as a complex characteristic (Silverman & Deuster, 2014; Di Tore, 2016). Flexibility is considered in connection with the morphological and functional properties of the apparatus of movement and support, which determine the amplitude of movements, as well as to a certain extent – with strength capabilities, the effectiveness of nervous regulation of movements, inter– and intra– muscular interactions (Alter, 2004).

Conclusions

1. Data from sources of information prove the need to take into account data on the dependence of physical fitness on the functional capabilities of those who engage in physical activity in practical activities. However, until now there are no data on such dependence in girls – future officers during their physical activity at the military academy.

2. Every year there is a weak but statistically significant dependence of changes in the general physical fitness of girls on changes in their functional capabilities. At the same time, with each new year of study, this dependence only increases.

3. Changes in general physical fitness depend somewhat more on changes in functional capabilities than on special ones. The latter is characterized by a tendency towards slightly greater dependence in the 2nd and 4th years of study, compared to the results in the 1st and 3rd years.

Conflict of interest

The authors state no conflict of interest.

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Залежність фізичної підготовленості від функціональних можливостей дівчат під час навчання у військовій академії

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 6 с., 3 табл., 27 джерел.

Мета дослідження – вивчити статистичну залежність між фізичною підготовленістю та функціональними можливостями дівчат – майбутніх офіцерів на етапах навчання у військовій академії.

Матеріали і методи. Досліджуваними були 108 дівчат, які з початком експерименту розпочали навчання у військових академіях; їхній вік – від 17 років і 3 місяців до 18 років і 5 місяців. Відбувався експеримент протягом чотирьох навчальних років за участі тих самих дівчат. Основними засобами одержання даних були педагогічне тестування і діагностика фізіологічних характеристик, відбувалися вони щороку.

Результати. Щорічно має місце слабка, але статистично значуща залежність зміни у загальній фізичній підготовленості дівчат від змін у їхніх функціональних можливостях. При цьому, з кожним новим роком навчання така залежність лише посилюється. Від змін у функціональних можливостях дещо більшою мірою залежать зміни у загальній фізичній підготовленості, ніж у спеціальній. Для останньої характерна тенденція до дещо більшої залежності в 2-ий і 4-ий роки навчання, порівняно з результатами у 1-ий та 3-ій роки.

Висновки. Дані джерел інформації засвідчують необхідність ураховувати у практичній діяльності одержані результати щодо залежності фізичної підготовленості від функціональних можливостей тих, хто здійснює фізичну активність. Це сприятиме підвищенню ефективності організації та змісту фізичної активності дівчат у вирішенні визначених завдань професійної підготовки у військовій академії.

Ключові слова: дівчата, фізична активність, військова академія, функціональні можливості, фізична підготовленість, залежність показників

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