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TÍTULO: Factores que influyen en los cambios en la preparación física de los cadetes durante la segunda mitad del estudio en una academia militar.

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RESUMEN: En el estudio participaron 112 jóvenes cadetes (17 a 18 años) y al final de la capacitación, 34 tuvieron resultados ejemplares y 78 buenos y satisfactorios de competencia profesional. En las muestras se determinaron cambios anuales en la estructura de la preparación física de éstos, caracterizada por cualidades físicas y nivel de desarrollo, utilizándose pruebas recomendadas por el sistema Eurofit, especialistas en educación física y entrenamiento militar. Los resultados mostraron diferencias significativas entre la estructura de los cambios en la preparación

física de los cadetes, y teniendo en cuenta los datos obtenidos, es aconsejable mejorar el programa de actividad física de los cadetes, debiendo incluir el desarrollo de cualidades físicas que mostraron los cadetes ejemplares.

PALABRAS CLAVES: preparación física, estructura de cambios, cadetes, academia militar

TITLE: Factors that influence changes in cadets' physical preparation during the second half of study at a military academy.

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ABSTRACT: The study involved 112 young cadets (17 to 18 years old), and at the end of the training, 34 had exemplary results and 78 good and satisfactory professional skills. In the samples, annual changes in the structure of their physical preparation were determined, characterized by physical qualities and level of development, using tests recommended by the Eurofit system, specialists in physical education and military training. The results showed significant differences

between the structure of the changes in the physical preparation of the cadets, and taking into account the data obtained, it is advisable to improve the program of physical activity of the cadets, including the development of physical qualities that the cadets showed exemplary results.

KEY WORDS: physical preparation, structure of changes, cadets, military academy.

INTRODUCTION.

While training in military institutions of higher education, the future officers have their professional competence formed. One of the components of such competence is the high level of physical preparation (Schmidt & Lee, 2013; Buns, 2015; Duncan, 2016; Rolyuk, Romanchuk, Boyarchuk, & Lojko, 2016). This level is achieved due to physical activity that occurs regularly in various forms of training with the optimal load parameters (Larkin, 2010; Wilmore, Costill, Kenney, 2012; Platonov, 2013).

The systematic physical activity positively affects not only physical preparation. It also promotes the development of other qualities, properties, abilities, which are crucial for the formation of professional competence in different types of activities (Mackinnon, Ritchie, Hooper, Abernethy, 2003; Bailey, 2010; Kirk, MacDonald, Suliva, 2013; Masaryková, Labudová, Matúš, 2016; Blândul, Bradea, 2017). This fully applies to the various military occupations and the training process of future officers in military academies (Romanchuk, 2012; Kontodimaki, 2013; Duncan, 2016; González, & Ozola, 2017).

In this regard, and taking into account the above and the current combat actions in the East of Ukraine, one of the critical issues of professional military education is the improvement of existing and creation of new programs of physical activity of the cadets that are realized during their studies at military academies. While solving this problem, it is promising to consider the features that the structure of physical preparation of students at a certain age (year of study at the University,

academy) is marked by. This structure is established through factor analysis, namely after the data interpretation of each of the selected factors (Zatsiorsky, 2002).

Today, such analysis is quite common in sports practice, in particular to determine the physical qualities that dominate in the structure of physical preparation of a sportsman. Given the established structure the training programs are developed that allow to take more fully into account the individual characteristics of each sportsman. This greatly increases the chance for these sportsmen to reach high positive result (Kirk, MacDonald, Suliva, 2013; Schmidt, Lee, 2013). As for the physical education of students, the information on the feasibility of improving its content on the basis of factor analysis is absent. Indirectly, the possibility and necessity to use the results of the factor analysis show the findings of various teams of researchers (Greenfield, & Edwards, 2015; Bliznevsky, Kudryavtsev, Kuzmin, & Yermakova, 2016).

The study of these authors and some others (Romanchuk, 2012; Bryman, 2015; Yi & Shin, 2018) for the factor analysis were used the values obtained in a certain period of time. In most cases, this period is the beginning of an academic year, the end of a semester or an academic year. The obtained values allow to determine the structure of certain characteristics of students in this period. In other words, the structure of the manifestations of certain characteristics of students at a particular point in time is established (Creswell, 2013). If such a structure, it is determined, at the beginning of the semester and at the end of the semester, then the data obtained can be compared to determine the presence or absence of a discrepancy between these structures. Such was the organization of the research, conducted by the above-mentioned team of researchers. At the same time, an insufficient attention of researchers was paid to other possible approach associated with the implementation of the factor analysis.

The essence of the approach is that information about the difference between the value of each indicator at the beginning and at the end of the study is the material for analysis. This difference is determined for each student involved in the study. In other words, there is established the structure of changes of a certain feature, but not the structure of its manifestation at a particular point in time (Ovcharuk, Iedynak, 2007).

The importance of such information to form the content of physical activity program aimed at increasing the level of physical preparation of students is caused by a set of reasons. The main reason is the ability to establish the physical qualities, from which to a large extent depends the change in the physical preparation level of students for a certain period. Selection of definite physical qualities among all others and a purposeful impact on such qualities during physical activity is one of the promising ways to increase the level of physical preparation of students (Armstrong, Mechelen, 2009; Wilmore, Costill, Kenney, 2012). One of the main reasons to achieve such result is connected with the conditions of achieving an adaptation effect during a separate lesson of a certain direction and a series of such lessons (Wuest, Bucher, 2005; Dick, 2007; Platonov, 2013).

DEVELOPMENT.

Methodology.

The research included conducting pedagogical experiment organized with the help of longitudinal method. The experiment duration was five years old. During the experiment the structure of changes in physical preparation of cadets was studied during the study period at the military academy, considering the level of their professional competence. For this purpose, were recorded the results of the tests, which characterize various physical qualities. The testing took place at the beginning of the first year of study during September and at the end, namely: during the first three years of study in May-June, during the fourth year of study in March-April.

According to the results of final exams, each cadet was ranked by one of the two samples: "E" ("excellent", high level of professional competence) and "GS" ("good" or "satisfactory," the average professional competence). Only then the process of the test results processing was started using adequate methods of mathematical statistics. The study involved 112 boys, the age of all was within the range of 17-18 years. With the beginning of the study, 60 boys became cadets of the military academy, the rest (52 boys) - one year later.

The study was conducted in compliance with the World Medicine Association declaration of Helsinki: Ethical principles for medical research involving human subjects, 2013. The study protocol was approved by the Ethical committee of the Kamianets-Podilskyi National Ivan Ohiienko University. We studied the structure of change in the physical preparation of cadets during the entire period of study at the Academy, but taking into account the level of their professional competence. Such a level was determined by the results of the exams that the cadets made at the end of the training at the academy. Two samples were formed of all the 112 cadets: sample "E" included 34 cadets, sample "GS" - the remaining 78 cadets.

To obtain the necessary data, a battery of tests was formed. These tests met the established requirements (Turvey, Fonseca, 2009; Schmidt, & Lee, 2013) and contained the most common in the practice of physical education motor tasks (Eurofit, 1993; Fitness testing, 2017; Thomas, Nelson, Silverman, 2011; ACT, 2012; What is physical fitness, 2017). The battery included tests that allowed to explore such physical qualities: dynamometry (handgrip Camry dynamometer, back dynamometer from Baseline Products) - maximum isometric strength; jump in length from place, pitching 1 kg ball with two hands from behind the head sitting legs apart - speed force of the muscles of the lower and upper extremities; 100 m running speed endurance; 3000 m 20 m running - aerobic endurance; bent suspension - static strength endurance; forward tilt, dislocation of a ruler behind the back with two hands, without bending them in the elbow joints - flexibility; high-speed

endurance coordination in complex motor activity - special exercise for the military men (general control exercise on the barrier of obstacles); 20-meters run test - to evaluate the complex development of two independent components of speed qualities, namely the speed of the individual movement and the frequency of movements; in this case, another independent component (the time of the motor reaction) in the test was isolated so that it did not affect the result.

Taking into account the recommendations, we also studied some manifestations of coordination, in particular of cyclic locomotion (shuttle run 3x10 m) of acrobatic motions (three forward somersaults) (Omorczyk, Lah, 2009). The data obtained in "E" and "GS" were compared to establish the presence or absence of differences between them. Such data were the results of factor analysis. These data reflected the change of physical fitness of cadets during each year of study at the military academy, depending on their belonging to "E" or "GS". All statistical analyses were performed using SPSS Version 21.

The results obtained during the testing, were processed in several stages. First, the test results of each cadet from the sample "E" and sample "GS" during the studied periods were determined. Then in each test the difference was established between the result that was obtained at the beginning and the end of the first year, between the last result and the one obtained in the end of the second year, between the end of the second and third year, and at the end of the third and fourth years of study. These difference values were data for factor analysis. Used factor analysis, which envisaged the definition of the main components of the use of varimax rotation for the normalization of data (Creswell, 2013; Ivashchenko, & Nosko, 2016). During the interpretation of the matrices that were obtained after using factor analysis, into consideration was taken only statistically significant factor of loadings (r), namely, which were at the level of 0.05, 0.01, 0.001 (Vincent, 2005).

Results and discussion.

During the third year of training, changes in physical preparation of the cadets that were included in the sample E to a certain extent reflected the established structure. This structure combined six statistically independent factors. The contribution of five of them in total dispersion amounted to 64.2%, the contribution of the sixth integrative factor amounted to the rest of 35.8% (fig. 1).

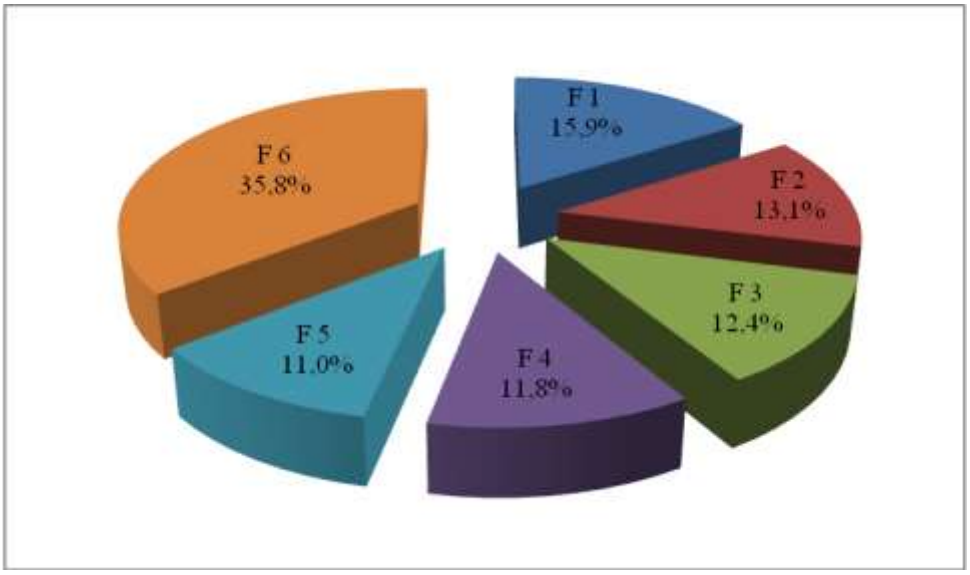

Figure 1: Factorial structure changes in the physical preparation of cadets from sample E during the third academic year. F_1 - special exercise for the military, F_2 - hanging on the hands, bent in the elbow joints, F_3 - three forward somersaults, F_4 - sitting forward tilt, F_5 - dynamometry of hand muscles and back muscles, F_6 - not considered factors.

In GS, the changes of physical preparation of cadets were also largely characterized by six factors, but the contribution of five was at 52.8%, while the contribution of the sixth (integrative) factor amounted to 47.2% (fig. 2).

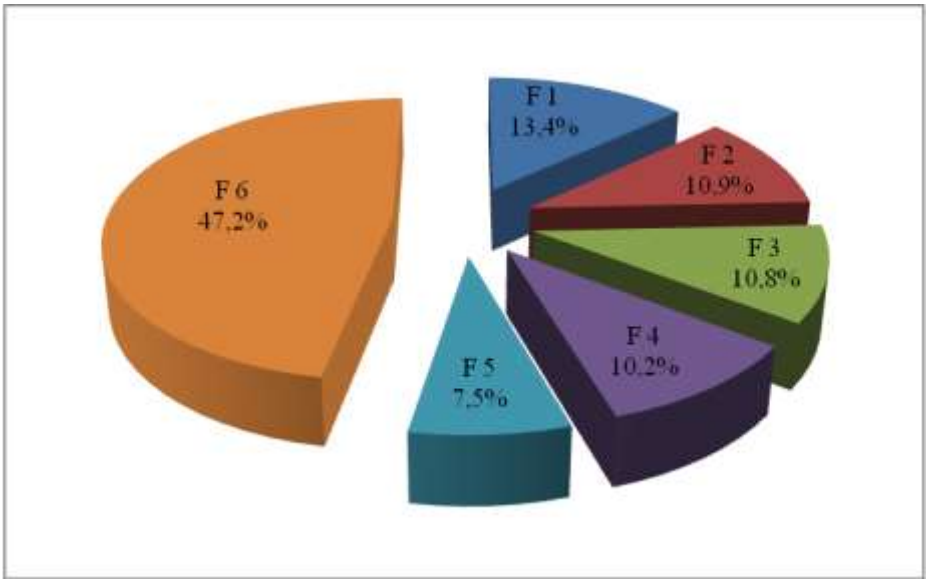

Figure 2: Factorial structure changes in the physical preparation of cadets from sample GS during the third academic year. F_1 - handgrip dynamometry and dynamometry of the back muscles, F_2 - 20 m running, F_3 - 100 m running, F_4 - shuttle running 3x10 m, F_5 - hanging on the hands, bent in elbow joints, F_6 - not considered factors.

In addition, in E and GS, the difference between the other results was found. So, the most important indicator of the first factor in E was a special exercise for the military with factor loadings r=0.776. The contribution of this factor to the total dispersion amounted to 15.9%. In GS the most important indicators were two, namely the handgrip dynamometry and dynamometry of the back muscles with the factor loadings r=0.755 and r=0.741 respectfully.

The contribution of factor in total dispersion was at the level of 13.4%. The contribution of the second factor was different: in E it was 13.1%, in GS this contribution amounted to 10.9%. In the first sample the most important indicator was hanging on the hands, bent in the elbow joints (r=0.731). In GS the most important indicator was also one, but it was 20 meters running with the factor loadings on level r=0.664. The contribution of the third factor in E was 12.4%, in GS - 10.8%. In first ones was discovered the single most important indicator, namely three forward somersaults, and factor loadings r=0.739. In GS for the third factor statistically significant was also one variable,

namely, 100 meters running; the factor loading of this variable amounted to r=0.631. The fourth factor had the following peculiarities: in E its contribution to the total dispersion was at the level of 11.8% in GS - level of 10.2%. In the first sample the most important indicator was the sitting forward tilt (r=0.746), in GS this indicator was shuttle running 3x10 meters (r=0.686). The fifth factor in E had a volume of 11%, most of the factor loadings found in two variables, namely, dynamometry of hand muscles (r=0.721) and dynamometry of the back muscles (r=0.803). In GS the volume of the fifth factor was equal to 7.5%, the most important indicator was hanging on the hands, bent in elbow joints, and factor loadings amounted to r=0.761.

In the last (fourth) year of training changes in physical preparation of cadets were characterized by certain features. In E these changes to 65.8% were identified five statistically independent factors. The remaining 34.2% were in the sixth factor, which united the unidentified figures (fig. 3). In GS were also

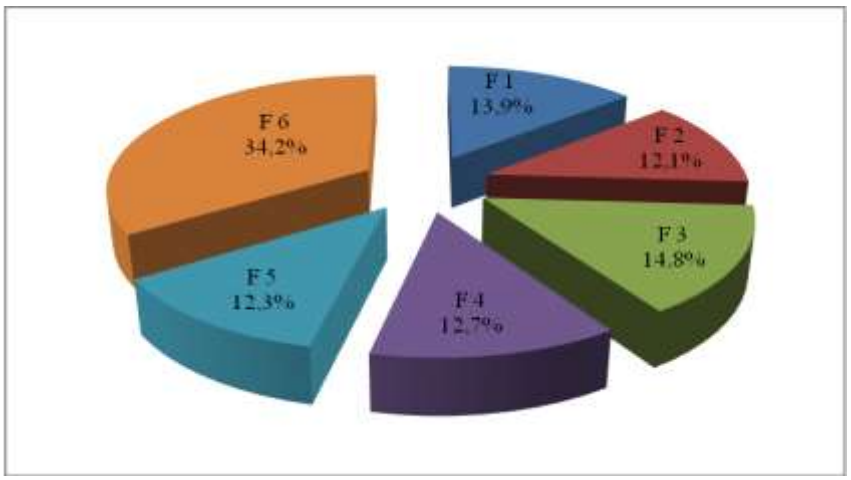

Figure 3: Factorial structure changes in the physical preparation of cadets from sample E during the fourth academic year. F_1 - 3000 m running, F_2 - special exercise for the military, F_3 - pitching 1 kg ball, F_4 - dynamometry of back muscles, F_5 - the shuttle running 3x10 m, F_6 - not considered factors.

It was found six factors that were statistically independent, but five factors in total dispersion occupied a volume of 61.8%. The last sixth factor, which united the unidentified figures, had a volume value of 38.2% (fig. 4). Having analyzed the composition of the selected factors we have received such result.

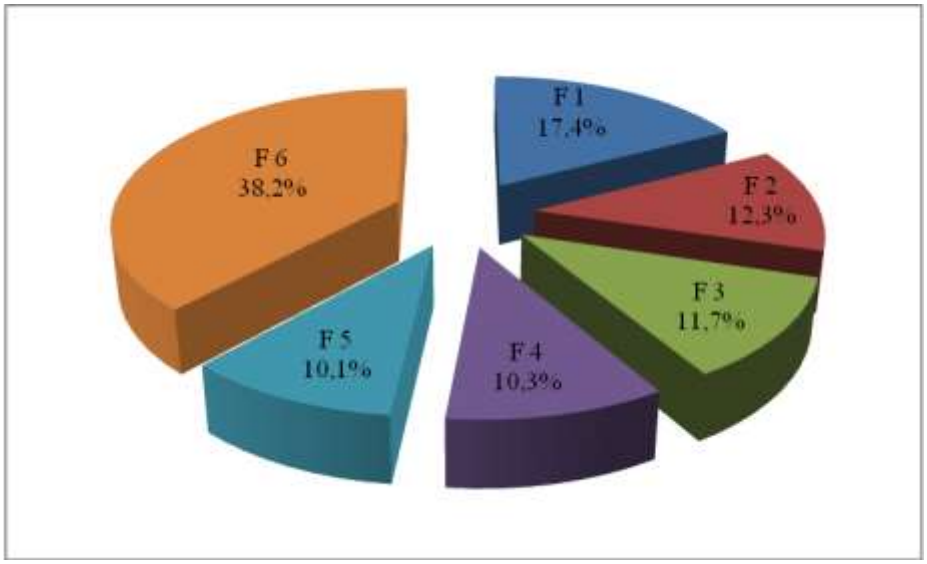

Figure 4: Factorial structure changes in the physical preparation of cadets from sample GS during the fourth academic year. F_1 - 100 m running, F_2 - pitching 1 kg ball, F_3 - dynamometry of the back muscles, F_4 - tilt forward while sitting, F_5 - three forward somersaults, F_6 - not considered factors.

The first factor in the E had a volume of 13.9% in GS, this amount was 17.4%. But the structure of this factor consisted of different numbers of variables which had the greatest factor loadings. In E the variable (the most important indicator) was 3000 m running, and its factor loading was r=0.886. In GS was also found one of the most important indicators - 100 m running with a load factor at the level r=0.793.

The contribution of the second factor to the total dispersion was achieved varying degrees of values: in E it was 14.8%, in GS - 12.3%. The most important indicator in the E was a special exercise for the military, and factor loadings of this indicator was r=0.671. In GS the most important indicator was pitching 1 kg ball with two hands from behind the head sitting, and factor loadings was r=0.765.

The contribution of the third factor to the total dispersion was: E - 12.1%, GS - 11.7%. The most important indicators in these samples also differed: in E, they were pitching 1 kg ball with two hands from behind the head sitting (r=0.732), GS - dynamometry of the back muscles (r=0.697). The fourth factor was noted by the contribution to the total dispersion: in E rate of contribution amounted to 12.7%, in GS - 10.3%, and the most important indicator in the first sample was dynamometry of back muscles (r=0.881), GS - tilt forward while sitting (r=0.806). The fifth factor in E had contribution to the total dispersion at the level of 12.3%, in GS - contribution to the total dispersion at the level of 10.1%. In E the most important indicator was the shuttle running 3x10 m (r=0.742), GS - three forward somersaults (r=0.903).

The data of factor analysis is only the first step in achieving the goal. In the next stage these data should be interpreted. In this connection it is expedient to consider information of the following researchers (Ovcharuk, Iedynak, 2007; Creswell, 2013; Greenfield, Almond, Clarke, & Edwards, 2015; Bliznevsky, Kudryavtsev, & Yermakova, 2016), certifying that.

Each the most important indicator in our case were considered as a certain physical quality. If there were several indicators, then initially, we looked for commonalities or correlations based upon logic. If it was impossible to determine, then we chose a specified one with a larger factor load. Taking into account the above, we determine that groups E and GS significantly differed from each other based upon the indicators, the magnitude of the contribution of each to the overall change in the physical preparation and the overall dispersion values of all isolated factors. This was done for all second half of study of the young men at the military academy. Regarding the most important indicators that were determined for groups E and GS in the third and fourth years of study at a military academy, their interpretation led to such a result.

For the third year of study, the factor analysis showed that improvement of the physical preparation of the cadets depended on the development of their physical qualities. For group E, it was due to endurance when manifesting maximum speed in a complex coordination motor activity, endurance when manifesting strength in the static mode, coordination in acrobatic locomotion, flexibility in different parts of the body, and maximum isometric strength.

For group GS, it was due to maximum isometric strength, speed qualities, endurance when manifesting speed during simple cyclic and acyclic locomotion, coordination in cyclic locomotion, and to endurance when manifesting strength in the static mode. For the fourth year of study, improvement in the physical preparation for group E depended on the development of aerobic endurance, endurance when manifesting maximum speed in a complex coordination motor activity, speed force of the muscles of the upper extremities, maximum isometric strength, and coordination in cyclic locomotion. In group GS, was the improvement of endurance in the most rapid execution of simple cyclic and acyclic locomotion, speed force of the muscles of the upper extremities, maximum isometric strength, flexibility in different parts of the body, and coordination in acrobatic locomotion.

The differences were due to several reasons, some of which included the following. The cadets of groups E and GS had different functional systems that were formed under the influence of physical activity programs in the third and fourth years of study (the program was mandatory for all cadets and exactly the same in both groups). Such systems provide specific types of muscle activity at a higher stage of long-term adaptation (Katzmarzyk, Silva, 2013). In other words, in one of these types of muscle activity the individual attains a much higher result than if it has a lower level of long-term adaptation. Given the above, one of the reasons that the cadets group E at the finals showed the highest results were associated with characteristics of the changes in the structure of their physical preparation.

To a certain extent, it confirms this cause of the high results of the cadet from group E during the finals of the GS group. So, at the end of training in the Academy the structure of physical preparation of cadets of the GS group at 61.8% was determined in several types of muscular activity. We quoted them earlier and detailed consideration of each of them shows that the support systems of most of them are different. In particular, one functional system ensures the expression of maximum isometric strength, other functional system - manifestation of flexibility in different parts of the body, coordination in acrobatic locomotion, and endurance in the most rapid execution of simple cyclic and acyclic locomotion. In other words, at the end of the training the cadets of group E showed indicators of their physical preparation provided by fewer functional systems than in the GS group. The result in the latter was a reflection of the low stage of long-term adaptation. This is because the body is not able to reach high stages of long-term adaptation in various areas (Katzmarzyk, Silva, 2013). The main cause for this result is the dispersed cumulative adaptation that occurs when using training programs that involve the development of not one (two), but many physical qualities, or physiological characteristics (Wilmore, Costill, Kenney, 2012; Iedynak, Galamandjuk, & Chopik, 2017).

The next reason of the obtained result was associated with differences in state formation to the motivation of the cadets to achieve the highest level of professional competence. After all, motivation is one of the leading internal factors that determines the result reached by the individual in a particular activity (Ajzen, 2005; Stanley, Cumming, Standage, & Duda, 2012; Iedynak, & Yurchyshyn, 2017).

CONCLUSIONS.

In addition, the result to some extent reflects the optimal program of physical activity of cadets in each year of study at the military Academy. In particular, the contribution of each factor to the total dispersion can be interpreted as the number of lessons of the same direction in general content of

physical preparation of cadets in a particular year of study. The possibility of such data interpretation of the factor analysis was emphasized by Creswell (2013), Bliznevsky, Kudryavtsev, Kuzmin, & Yermakova (2016), Melnykov, Iedynak, Galamandjuk, & Mazur (2018).

We believe that in connection with discrepancy of the structure of changes in physical preparation of cadets in E group and GS group, the physical activity programs should be based on data of group E. This is due to the fact that it included cadets whose professional competence after graduating from the military Academy was rated by the highest mark.

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