ORIGINAL ARTICLE

CONTENTS

Mental cognitive processes and intellectual working capacity in cadets who were engaged in different types of physical activities

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ABSTRACT

Aim: To investigate the mental cognitive processes and intellectual working capacity of cadets who were engaged in different types of physical activities.

Materials and Methods: The research involved 346 male cadets aged 20-22 years who were engaged in different types of physical activities (orienteering, military pentathlon, polyathlon, hand-to-hand combat, kettlebell lifting, crossfit, arm-wrestling, powerlifting, sports games). Research methods: theoretical analysis and generalization of literary sources, psychodiagnostic testing, and methods of mathematical statistics. Psychodiagnostic testing involved the use of a set of techniques to assess the basic mental cognitive processes (attention, memory, thinking) and intellectual working capacity of cadets.

Results: The positive effect of different types of physical activities on the mental cognitive processes and intellectual working capacity in cadets was established. According to most of the studied parameters, the indicators of cadets engaged in orienteering were significantly ($p \leq 0.05$-0.001) better than those of the representatives of other sports. This is due to the specifics of the sport, which involves intense intellectual activity and requires a high level of development of such mental cognitive processes as attention, memory, and thinking, as well as intellectual working capacity.

Conclusions: The results obtained allow us to conclude that orienteering training can have a positive effect on both the indicators of cadets' academic and their future professional and combat activities.

KEY WORDS: mental cognitive processes, intellectual working capacity, cadets, physical activities, sport

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INTRODUCTION

The current conditions of warfare on the territory of Ukraine, and the level of improvement of combat materiel, military tactics, and martial arts require high-quality professional training of future military specialists [1, 2]. This trend involves the inclusion of modern military-applied sports in the content of physical training programs for cadets of HMEIs, which can ensure the formation of a high level of not only physical but also psychological readiness, as well as improve the dynamics of mental cognitive processes and intellectual working capacity [3, 4]. In modern conditions, orienteering is the most effective means of forming cadets' military-applied motor skills in combination with the development of their physical and psychological qualities, as well as improving intellectual working capacity that contributes to the formation of their psychophysical readiness to perform assigned tasks.

Orienteering is a modern military-applied sport in which competitors independently cover distances to control points on the terrain using only a map and compass while applying a large number of technical and tactical techniques as far as they run on rough terrain [5]. That is why the results in orienteering depend equally on the physical and intellectual abilities of those involved [6]. The results of scientific research [7] show that orienteering training helps to improve the functional state of the cardiorespiratory system, strengthen the body as a whole, increase the speed of action and thinking, and more effectively develop physical qualities, especially endurance. Unlike cross-country running, orienteering is not monotonous. From a

psychological point of view, it is an important factor in improving human working capacity [8]. Productive intellectual activity in orienteering requires the development and improvement of such mental cognitive processes as the perception of spatial and temporal processes, attention, short-term and long-term memory, and operational thinking [9, 10].

AIM

The aim is to investigate the mental cognitive processes and intellectual working capacity of cadets who were engaged in different types of physical activities.

MATERIALS AND METHODS

PARTICIPANTS

The research was conducted at the S. P. Koroliov Zhytomyr Military Institute (Ukraine). To solve the first task of the research, 479 cadets of different training years were involved in the survey. To solve the second task of the research, 346 cadets aged 20-22 years were involved, who were engaged in orienteering (n = 32) and other sports (n = 314) during their training: military pentathlon (n = 34), polyathlon (n = 36), hand-to-hand combat (n = 41), kettlebell lifting (n = 42), crossfit (n = 30), arm-wrestling (n = 37), powerlifting (n = 32) and sports games (football, volleyball, basketball, n = 62).

RESEARCH METHODS

To achieve the aim of the research, we used the following research methods: theoretical analysis and generalization of literary sources, psychodiagnostic testing, and methods of mathematical statistics. Theoretical analysis and generalization of literary sources and Internet data were used to clarify the current state of the problem under study and systematize and summarize information on the research topic. 25 sources from the databases Scopus, PubMed, Web of Sciences Core Collections and others were investigated.

Psychodiagnostic testing involved the use of a set of techniques to assess the basic mental cognitive processes (attention, memory, thinking) and intellectual working capacity of cadets: the method for studying the switching of attention referred to as the "A. H. Ivanov-Smolenskyi's Correction Task", the method for studying stability and concentration of attention referred to as the "Tangled Lines", the method for studying visual operative memory referred to as the "Operative Memory", the method for studying short-term memory capacity referred to as the "Jacobson's Method", the method for studying the peculiarities of thinking referred to as the "Identification of Essential Features", the method for studying intellectual working capacity referred to as "V. Ya. Anfimov's Correction Task".

The essence of the "A. H. Ivanov-Smolenskyi's Correction Task" was to work through a letter table in 8 minutes, in which the first 4 minutes were given to cross out the letter "A" and underline the letter "K", and the remaining 4 minutes were allocated to underline the letter "A" and cross out the letter "K". The evaluation was based on a nine-point scale, taking into account the total number of letters reviewed, the number of errors made, and the number of letters correctly marked. The "Tangled Lines" method involved the cadet working with a form containing 25 tangled lines and the task of tracking the course of each line using only visual control. The maximum number of traced lines was evaluated. The test took 7 minutes to complete. The "Operative Memory" method consisted of the experimenter reading out numbers (15 series of 5 numbers in each) and the cadets memorizing these 5 numbers in the order in which they were read out. Then they mentally added the first number to the second, the second to the third, the third to the fourth, the fourth to the fifth, and wrote the four sums in the appropriate line of the form. After that, the number of correctly found amounts was calculated (the maximum number was 60). The norm for an adult is 30 and above. The "Jacobson's Method" contains four similar series. In each of them, one of the given sets of digital series was read out to the cadets with an interval of 1 s. After reading each series, after 2-3 s, the subjects of interest reproduced the elements of the series on a sheet of paper in the sequence with which they were read by the experimenter. The results were processed to determine the series that were reproduced in full and in the sequence with which they were read out by the experimenter; the maximum length of the series that the cadet reproduced correctly in all sets; the number of correctly reproduced series. The indicator of short-term memory was assessed on a 10-point scale. The "Identification of Essential Features" method was used to study the peculiarities of cadets' thinking and was aimed at identifying essential and secondary features of objects and phenomena. The nature of the identified features can be used to judge the dominance of an abstract or concrete type of thinking. The cadets were given a text in which one word was out of parenthesis and the rest of the words were in-between parenthesis. All words in-between parenthesis were related to the word out of parenthesis. The task was to choose only two words that were most related to the word out of parenthesis. The cadets' thinking skills were assessed on a 9-point scale. The "V. Ya. Anfimov's Correction Task" involved cadets

working with a correction table for 5 minutes, where they had to cross out the letters D and V. To process the results, the total number of characters reviewed, the number of letters crossed out, the total number of letters to be crossed out in the reviewed text, and the number of mistakes made were calculated. Based on these indicators, the level of cadets' intellectual working capacity was determined.

PROCEDURE

The research was conducted in 2021-2025 in two stages: the first stage (2021) involved processing the literature on the research topic and summarizing the experience of military personnel in combat operations to clarify the role and importance of orienteering in ensuring the physical readiness of servicemen to perform assigned tasks in modern combat operations. The second stage (2022-2025) provided for a comparative analysis of indicators of mental cognitive processes and intellectual working capacity in the cadets (in the 5th training year) who were engaged in orienteering and the cadets who were engaged in other sports in the HMEI. The study of indicators of mental cognitive processes and intellectual working capacity in cadets was conducted with the involvement of specialists from the Institute's Psychological Department in compliance with all the requirements for psychological and sociological research.

STATISTICAL ANALYSIS

The mathematical and statistical methods were used to process the experimental data obtained. The compliance of the sample data distribution with the Gauss' law was assessed using the Shapiro-Wilk W test. The reliability of the difference between the indicators was determined using the Student's t-test. The results were presented as $M \pm m$, where M is the arithmetic mean, m is the error of the arithmetic mean. The reliability of the difference for all statistical tests was set at $p < 0.05$. All statistical analyses were performed using STATISTICA 6.1 software package (number AGAR909E415822FA), adapted for medical and biological research.

ETHICS

This research complies with the ethical standards of the Order of the Minister of Defense of Ukraine "On Approval of the Regulation on the Organization of Scientific and Technical Activity in the Armed Forces of Ukraine" No. 385 dated 27.07.2016. The procedure for organizing the study, the stages, the venue, and the permission for the involvement of cadets in the research were previously agreed with The Committee on Compliance with Academic Integrity and Ethics of the S. P. Koroliov Zhytomyr Military Institute (Protocol No. 12 dated 30.08.2019). Also this research followed the regulations of the World Medical Association Declaration of Helsinki and ethical principles for medical research involving human subjects. Informed consent was received from all cadets who took part in this research.

RESULTS

Systematic physical exercises have a positive effect on the mentality of those who exercise, improving brain function. A high level of physical fitness reduces fatigue and delays its onset, thereby increasing the body's resistance to specific adverse effects. Exercise can either stimulate intellectual working capacity or inhibit such processes, depending on the intensity of physical activity. Optimal physical activity activates perception and improves the efficiency of information processing and assimilation. Given the high level of mental stress that cadets receive in the face of increasing amounts of information in the process of training at HMEIs and further professional and combat activities, the requirements for the level of development of mental cognitive processes (attention, memory, and thinking), as well as the level of their intellectual working capacity, are increasing.

Attention plays a significant role in cognitive processes. Any intellectual activity is accompanied by a strain of human attention. Attention means the focus and concentration of mental activity on a particular object. Attention is one of the most important mental functions that ensures optimal training and education of cadets. The success of cadets' academic activities depends on the development of attention, and knowledge of the structure of attention makes it possible to control it. Analyzing the results of the study of attention switching in cadets, significant differences in the studied indicators of cadets engaged in orienteering compared to cadets of other sports specializations were found. The results of the "A. H. Ivanov-Smolenskyi's Correction Task" showed that the cadets who were engaged in orienteering training had significantly better indicators than the representatives of strength sports: kettlebell lifting, crossfit, arm-wrestling and powerlifting by 2.03 ($p \leq 0.001$), 1.19 ($p \leq 0.01$), 0.82 ($p \leq 0.05$) and 2.06 ($p \leq 0.001$) points respectively (Table 1). Compared to the cadets who were engaged in military sports all-around (pentathlon, polyathlon), the indicators of attention switching were also better in orienteers, but no significant difference was found between them ($p > 0.05$). It was also found that the cadets who were engaged in hand-to-hand combat and game sports had better attention indi-

Table 1. Comparative analysis of indicators of switching and stability and concentration of attention in the cadets who were engaged in orienteering and other sports (M±m)

Kind of sports	n	Switching of attention, points	t	Stability and concentration of attention, c. u.	t
Orienteering	32	7.15±0.22	-	18.31±0.63	-
Military pentathlon	34	6.93±0.25	0.6606	16.21±0.50	2.6110
Polyathlon	36	6.82±0.24	1.0136	15.28±0.52	3.7092
Hand-to-hand combat	41	7.18±0.20	0.1009	19.63±0.62	1.4934
Kettlebell lifting	42	5.12±0.29	5.5768	16.87±0.51	1.7766
Crossfit	30	5.96±0.31	3.1305	15.35±0.66	3.2441
Arm-wrestling	37	6.33±0.23	2.5764	19.51±0.68	1.2945
Powerlifting	32	5.09±0.32	5.3048	16.79±0.73	1.5763
Game sports	62	7.29±0.18	0.4925	18.54±0.59	0.2665

Note: n - number of cadets; M - the arithmetic mean; m - the error of the arithmetic mean; t - the reliability of the difference between the cadets' indicators determined using the Student's t-test

Source: compiled by the authors of this study

Table 2. Comparative analysis of indicators of visual operative memory and short-term memory capacity in the cadets who were engaged in orienteering and other sports (M ± m)

Kind of sports	n	Visual operative memory, points	t	Short-term memory capacity, points	t
Orienteering	32	51.81±1.21	-	8.26±0.29	-
Military pentathlon	34	48.27±1.25	2.0348	7.06±0.23	3.2421
Polyathlon	36	46.29±1.13	3.3341	6.92±0.20	3.8038
Hand-to-hand combat	41	48.91±1.15	1.7516	7.96±0.17	0.8924
Kettlebell lifting	42	47.83±1.22	2.3163	6.82±0.18	4.2189
Crossfit	30	42.05±1.29	5.5183	5.97±0.31	5.3946
Arm-wrestling	37	38.67±1.20	7.7106	5.69±0.21	7.1778
Powerlifting	32	39.04±1.27	7.2799	5.22±0.26	7.8051
Game sports	62	53.12±1.18	0.7751	8.17±0.16	0.2717

Note: n - number of cadets; M - the arithmetic mean; m - the error of the arithmetic mean; t - the reliability of the difference between the cadets' indicators determined using the Student's t-test

Source: compiled by the authors of this study

cators compared to orienteers by 0.3 and 0.11 points, respectively, but the difference between them was not significant ($p>0.05$). In general, the representatives of orienteering, hand-to-hand combat and game sports showed a high level of indicators of attention switching, while the rest had a satisfactory level.

Attention concentration is the ability to focus on one object or action while being distracted by other objects or actions for a certain period. It is thanks to a high level of concentration of attention that tasks requiring accuracy can be performed without errors. A high level of concentration is a professionally important quality for servicemen: the higher the level of concentration, the more successfully they can perform tasks that require accuracy and concentration. The analysis of indicators of attention concentration and span in cadets engaged in various sports showed that the indicators of cadets engaged in orienteering differ in a certain way from those shown by cadets who specialized in other sports due to the error-free performance of a task that required accuracy and concentration on the content of the task. Thus, the test results of orienteering cadets (18.31 c. u.) were significantly better compared to the cadets who were engaged in military pentathlon – by 2.10 c. u. ($p \leq 0.05$), polyathlon – by 3.03 c. u. ($p \leq 0.01$), crossfit – by 2.96 c. u. ($p \leq 0.05$) (Table 1). The results of cadets-orienteers turned out to be somewhat better in comparison with kettlebell lifters and powerlifters, but the difference between them was unreliable ($p > 0.05$). The best test results and, accordingly, the level of attention concentration and span (above average) were found in cadets who were engaged in hand-to-hand combat (19.63 c. u.), arm-wrestling (19.51 c. u.), game sports (18.54 c. u.) and orienteering (18.31 c. u.). The

Table 3. Comparative analysis of indicators of peculiarities of thinking and intellectual working capacity in the cadets who were engaged in orienteering and other sports (M ± m)

Kind of sports	n	Peculiarities of cadets' thinking, points	t	Intellectual working capacity, c. u.	t
Orienteering	32	18.61±0.56	-	961.17±10.53	-
Military pentathlon	34	16.83±0.52	2.3292	934.77±10.31	1.7914
Polyathlon	36	15.93±0.48	3.6336	918.77±9.81	2.9462
Hand-to-hand combat	41	15.28±0.35	5.0426	920.81±8.43	2.9921
Kettlebell lifting	42	16.07±0.37	3.7843	933.13±8.21	2.1000
Crossfit	30	14.73±0.63	4.6031	922.34±11.43	2.4985
Arm-wrestling	37	14.02±0.45	6.3892	909.46±10.98	3.3990
Powerlifting	32	14.21±0.57	5.5065	906.42±11.46	3.5179
Game sports	62	17.02±0.31	2.4841	942.34±7.65	1.4467

Note: n - number of cadets; M - the arithmetic mean; m - the error of the arithmetic mean; t - the reliability of the difference between the cadets' indicators determined using the Student's t-test

Source: compiled by the authors of this study

representatives of other sports had an average level of attention concentration and span.

Memory is a mental cognitive process that helps to organize and preserve experience; a process that reflects the functions of storage, memorization, and reproduction. The analysis of the cadets' visual operative memory indicators showed that the best values were found in cadets who were engaged in game sports (53.12 points), orienteering (51.81 points), and hand-to-hand combat (48.91 points). No significant difference was found between the memory indicators of cadets in these sports ($p > 0.05$). Significantly better indicators of visual operative memory were found in cadets-orienteers compared to the representatives of such sports as military pentathlon ($p \leq 0.05$), polyathlon ($p \leq 0.01$), kettlebell lifting ($p \leq 0.05$), crossfit ($p \leq 0.001$), arm-wrestling ($p \leq 0.001$) and powerlifting ($p \leq 0.001$) (Table 2). The development of memory is significantly influenced by academic activities and solving intellectual tasks during the training process. This was most clearly manifested in the representatives of game sports and orienteering. In general, the level of indicators of operative memory in cadets specializing in different sports was within the normal range.

Short-term memory is a type of memory that is characterized by very short-term storage and immediate reproduction (recovery) of perception. This memory stores what attention is directed to and is unchanged in terms of modality. This makes it possible to control the duration of the stored traces through repetition. The analysis of the cadets' short-term memory capacity showed the best results for the cadets who were involved in the orienteering training compared to the cadets who specialized in other sports (Table 2). Thus, the test results of the cadets who were involved in orienteering were significantly better than those of the cadets who were engaged in military pentathlon – by 1.20 points ($p \leq 0.01$), polyathlon – by 1.34 points ($p \leq 0.01$), kettlebell lifting – by 1.44 points ($p \leq 0.001$), crossfit – by 2.29 points ($p \leq 0.001$), arm-wrestling – by 2.57 points ($p \leq 0.001$) and powerlifting – by 3.04 points ($p \leq 0.001$). No significant difference was found between the indicators of the cadets who were engaged in orienteering, hand-to-hand combat, and game sports ($p > 0.05$). It should be noted that a high level of indicators of short-term memory was found in the representatives of such sports as orienteering, game sports, and hand-to-hand combat: an average level – in the representatives of military pentathlon, polyathlon, and kettlebell lifting; a low level – in the cadets who were engaged in crossfit, arm-wrestling, and powerlifting. The analysis of short-term memory capacity confirms our previous conclusions about the positive impact of orienteering training on improving the level of development of mental cognitive processes in cadets during their training.

Any intellectual activity is accompanied by such a mental cognitive process as thinking. Thinking is the basis for the successful acquisition of new knowledge, skills, and abilities by cadets during their training at a HMEI. That is why it is so important to develop the skills of imaginative and logical thinking in future military professionals. While studying the peculiarities of cadets' thinking, we found a similar trend to the previous indicators i. e. a high level of indicators among cadets who were engaged in orienteering. Thus, cadets-orienteers had the best indicators of thinking peculiarities among the representatives of all other sports (18.61 points), which corresponds to the abstract-logical style of thinking (Table 3). This value turned out to be

significantly ($p \leq 0.05$-0.001) better than among the representatives of all other studied sports, which eloquently testifies to the effectiveness of orienteering training. According to the interpretation of errors, the cadets who received low scores in the research adhered mainly to erroneous judgments, which indicates the dominance of the concrete-logical style of thinking over the abstract-logical one.

Intellectual work reflects the perception and processing of information by the brain. It is characterized by a significant increase in the function of certain sensory systems, concentration, memory and thinking. When new information is received, it is compared with previously learned and existing information and integrated. Integration of information enriches memory and helps build a program of action and decision-making. In the process of performing intellectual work, attention and memorization increase. The analysis of cadets' intellectual working capacity showed that cadets-orienteers had significantly better indicators ($p \leq .05$-$.001$) compared to the representatives of most sports, except for military pentathlon and game sports (Table 3). The level of development of intellectual working capacity in cadets representing all sports was assessed as good. The obtained results indicate that orienteering training had a positive impact on the level of development of mental cognitive processes and intellectual working capacity of cadets in the process of their training in the HMEI.

DISCUSSION

Scientists [11] note that orienteering is a sport in which participants act completely independently, out of sight of rivals, spectators, judges, and even coaches. Therefore, in this sport, in addition to physical, functional, technical, and tactical training, thorough psychological preparation, perseverance, courage, and determination are required to achieve the goals. Scientists [8] argue that during orienteering training, the scope of attention increases, and the attention is switched, the problems of inability to control one's emotions and mood are solved, as the success of athletes of any level in orienteering competitions often depends on this.

Scientists [12] argue that under the influence of orienteering training, concentration, and attention switches, as well as visual memory, are significantly developed. Orienteering is characterized by the most organic combination of motor and intellectual qualities and has an extraordinary impact on relieving nervous stress from the human body, as well as a means of improving health for people of all ages [13, 14]. According to scientists [15], such moral and volitional qualities in orienteering as perseverance in achieving goals, courage, discipline, and independence acquire their specific manifestations. Scientists [8, 9,16] assures that in the process of orienteering training such qualities as determination, ability to control oneself, thinking effectively in conditions of high physical and mental stress, and ability to self-organization. Orienteering is often characterized by the fact that to fulfill a given plan of action, great willpower is required to find the optimal solution (solving a problem that arises unexpectedly), which is associated with the occurrence of stressful situations. The effects of stress can occur when athletes are in unfamiliar territory, away from other people, without access to advice or support. Formation and strengthening of moral qualities, readiness to provide necessary assistance to teammates or, under certain conditions, to rivals, as well as respect for the environment, and the desire to learn about and protect nature, contribute to the harmonious development of the individual. Military personnel also face similar conditions in their professional and combat activities, which determines the relevance of the chosen area of research. The above conditions contribute to the rapid processing of a large amount of specific information, which is associated with the development of the ability of servicemen to maintain intellectual working capacity under the influence of various negative factors of activity [17]. It is worth noting that orienteering requires activation of the mind, a series of actions that provide the ability to move around the area with the help of a map and compass, to implement the planned path on the terrain, while developing operative thinking, to predict the course of future events, to choose the right algorithm for solving difficult situations [18, 19]. Scientists [2, 4, 20] connects the development of the orienteer's mental functions with the operation of images in a specific space, with the suddenness of decision-making in emerging situations. Therefore, the issue of introducing orienteering into the physical training of cadets of HMEIs as a means of developing their motor skills and forming military-applied skills to increase the effectiveness of their future professional and combat activities is timely and relevant. This conclusion is confirmed by the practice of training military personnel of the armies of the leading NATO countries, where terrain orientation skills are one of the most important military-applied skills of military personnel of all specialties, both soldiers and officers [21, 22]. The authors [2] of are convinced that the ability to navigate the terrain is mandatory for all military personnel, without exception, which directly affects the level of combat capability of the army. The results of our research complement and extend the findings of other scientists [5, 7, 11, 12, 23-25].

CONCLUSIONS

The positive effect of different types of physical activities on the mental cognitive processes and intellectual working capacity in cadets was established. According to most of the studied parameters, the indicators of cadets engaged in orienteering were significantly ($p \leq .05$-$.001$) better than those of the representatives of other sports. This is due to the specifics of the sport, which involves intense intellectual activity and requires a high level of development of such mental cognitive processes as attention, memory, and thinking, as well as intellectual working capacity.

The development and improvement of these processes in cadets during orienteering training will help to ensure the effectiveness of their academic and future professional and combat activities, and the formation of skills of quick decision-making against the background of great physical and mental stress. This determines the expediency of introducing orienteering to physical training in HMEIs not only to develop motor skills and form military-applied skills in cadets but also to ensure the effective course of their mental cognitive processes in the process of their future professional and combat activities.

PROSPECTS FOR FURTHER RESEARCH

The prospect of further research is to develop a methodology for the development of motor skills and cognitive abilities in cadets through orienteering during training at a HMEI under martial law.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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