ORIGINAL ARTICLE

CONTENTS

Adaptive volleyball as a means of physical education and sports rehabilitation of combatants

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ABSTRACT

Aim: To determine the impact of adaptive volleyball training sessions on the psycho-emotional and functional state of combatants.

Materials and Methods: The research involved 64 service members participating in combat operations who underwent rehabilitation in 2024-2025 after injuries and damages to the musculoskeletal system. The duration of the research was 6 weeks. The research employed theoretical, empirical, and mathematical statistical methods.

Results: It has been found that adaptive volleyball training sessions have a positive effect on the indicators of psycho-emotional and functional state of combatants. A significant improvement in the indicators of emotional state ($p \leq 0.001$) by 1.33 points and neuro-emotional stress ($p \leq 0.05$) by 4.43 points has been found. The functional state of the respiratory system in combatants also improved by 5.6 seconds in the Stange test and by 2.9 seconds in the Genchi test. The indicators of the functional state of the cardiovascular system in combatants, according to the Rufier Index, have also improved by 0.83 c. u. after the use of adaptive volleyball training sessions. Still, the changes were not significant ($p > 0.05$) due to the short period of the research.

Conclusions: It has been established that adaptive volleyball is an effective means in the framework of physical education and sports rehabilitation for individuals who have suffered musculoskeletal injuries. It has been proven that adaptive volleyball training sessions have a positive effect on the indicators of the psycho-emotional and functional state of combatants.

KEY WORDS: adaptive volleyball, combatant, psycho-emotional state, functional state, physical education and sports rehabilitation

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INTRODUCTION

The consequences of the hostilities in Ukraine have led to an increase in the number of people with disabilities, including those with musculoskeletal disorders. The vast majority are service members and employees of other law enforcement agencies. After receiving medical care, including surgical intervention, these individuals require further comprehensive rehabilitation measures to restore their self-care functions, motor skills, and social activities. To this end, healthcare facilities, the Ministry of War Veterans Affairs, and related agencies are expanding and diversifying rehabilitation services.

Physical education and sports rehabilitation is essential and effective. It is considered a system of measures developed through the use of physical exercises aimed at restoring and compensating for the body's functional capabilities, improving physical and mental health, and overall well-being [1, 2]. Exercise is beneficial for people who have been injured, wounded, and are undergoing rehabilitation; people with disabilities, as it prevents secondary complications (muscle atrophy, osteoporosis) and helps to improve psycho-emotional and functional state [3, 4]. An essential task in the rehabilitation of combatants who have suffered musculoskeletal injuries through physical culture and sports is to restore mobility in joints, strengthen muscles, improve coordination and endurance, and reduce pain through vigorous physical activity [5, 6].

One type of physical education and sports rehabilitation is adaptive sports [7]. By adapting traditional sports to people with disabilities and involving them in participation, it is possible to more effectively overcome the effects of injuries, wounds, post-traumatic stress disorder, increase self-esteem, reduce symptoms of depression and tension, improve the process of socialization, etc. [8]. The adaptive sports program includes various game-based activities, such as adaptive volleyball, wheelchair basketball, amputee football, swimming, track and field, cycling, archery, table tennis, etc.

The analysis of modern scientific works gives grounds to state that adaptive volleyball is an effective means of physical culture and sports rehabilitation of people with musculoskeletal disorders [9, 10]. This sport is a complex coordination sport, involves various muscle groups, requires concentration, quick thinking, and rapid reaction. The key feature of adaptive volleyball is moving around the court with support on the hands and buttocks. During training, players develop the ability to coordinate their actions, taking into account anatomical and physiological features; develop skills in performing several technical and tactical actions necessary for a successful game; develop special physical qualities, in particular speed, agility during the performance of complex coordination movements [11]. Adaptive volleyball is the only team sport for people with amputations and other musculoskeletal injuries that is cultivated in many countries and is part of the Paralympic Games. Experts say that people without notable physical limitations can also play and train in this sport, since the specifics of adaptive volleyball do not provide any advantage on the court [12].

Scientists [10, 13] note that the inclusion of adaptive volleyball in the rehabilitation program for service members with lower limb amputation is a logical response to the challenges of today, as this area helps to expand the functional capabilities of a person, promotes faster recovery of physical and mental health, and more effective overcomes the effects of stress. Other researchers emphasize the effectiveness of the impact of adaptive game sports on the psycho-emotional state and socialization of participants, including people with disabilities [14].

The need to study the impact of adaptive volleyball as a means of physical culture and sports rehabilitation on the psycho-emotional and functional state of combatants has prompted our research.

AIM

The aim is to determine the impact of adaptive volleyball training sessions on the psycho-emotional and functional state of combatants.

MATERIALS AND METHODS

PARTICIPANTS

The research, which was conducted in 2024-2025, involved 64 service members participating in combat operations who were undergoing the final stage of rehabilitation after injuries and damages to the musculoskeletal system, in particular the lower extremities and spine, and were recommended for physical training and sports rehabilitation based on medical reports. The rehabilitation activities were conducted at rehabilitation centers in Kyiv, Kyiv Oblast, and Zhytomyr. Adaptive volleyball training sessions were held at the sports bases of the National Academy of Internal Affairs (NAIA) and S. P. Koroliov Zhytomyr Military Institute (ZhMI) five times a week. The results were analyzed at the Department of Physical Education and Sports Rehabilitation of S. P. Koroliov ZhMI and the Department of Special Physical Training of the NAIA. The psycho-emotional and functional state of combatants was tested at the beginning of their arrival at the training bases of the educational institutions and after six weeks of systematic training.

RESEARCH METHODS

The research employed theoretical, empirical (psycho-diagnostic, functional methods), and mathematical statistical methods. Two psycho-diagnostic methods were used to study the dynamics of psycho-emotional state indicators in the participants of the experiment: "Self-Assessment of Emotional State" (developed by A. Wessman and D. Ricks) and "Assessment of Neuro-Emotional Stress" (proposed by T. A. Nemchyn). The "Self-Assessment of Emotional State" method is designed for self-assessment of the emotional states of combatants on a ten-point scale. The participants were asked to choose from each of the following statements ("Resilience-anxiety", "Vigor-fatigue", "Elation-depression", "Self-confidence-helplessness") the one that most accurately reflects their emotional state during the research period and mark the corresponding number in the form. The integral indicator of the emotional state of combatants was determined using the appropriate formula. If the emotional state indicator is within 8-10 points, it can be interpreted as very good; within 6-7 points – as good; 4-5 points – as worsened; 1-3 points – as poor.

The "Assessment of Nero-Emotional Stress" method comprises 30 characteristics of this condition, categorized into three degrees of severity: A (low), B (average), and C (high). By choosing one of the three answer options (A, B, C), the participants of the experiment

Table 1. Dynamics of the indicators of psycho-emotional and functional state of combatants in the process of adaptive volleyball training sessions (n = 64)

Initial stage	Final stage	Reliability of the difference	
X ± m	X ± m	t	p
Level of emotional state, points			
5.31 ± 0.21	6.64 ± 0.19	4.70	p ≤ 0.001
Level of neuro-emotional stress, points			
61.24 ± 1.52	56.81 ± 1.47	2.10	p ≤ 0.05
Stange test, seconds			
54.7 ± 2.15	60.3 ± 1.98	1.92	p ≥ 0.05
Genchi test, seconds			
38.9 ± 1.22	41.8 ± 1.08	1.78	p ≥ 0.05
Rufier Index, c. u.			
7.27 ± 0.48	6.44 ± 0.45	1.26	p ≥ 0.05

Notes: X – arithmetic mean; m – standard error; t – Student's t-test value; p – p-value
Source: compiled by the authors of this study

assessed their state of neuro-emotional stress at the current time. The data were processed by summing the points: for answer A – 1 point, B – 2 points, and C – 3 points. The range from 30 to 50 points characterizes a low level of neuro-emotional stress, 51-70 points – average; from 71 to 90 points – high.

The functional capabilities of the participants were assessed using the Stange test (duration of breath holding during inhalation), the Genchi test (duration of breath holding during exhalation), and the Rufier Index. Breath-holding tests allow for assessing the functional capabilities of the respiratory system. The level of functional capabilities of individuals was assessed by the duration of breath holding during inhalation: more than 60 seconds (excellent), 40-60 seconds (good), 30-40 seconds (satisfactory), and less than 30 seconds (low). During exhalation, a breath-hold of more than 40 seconds indicates an excellent level of functional capacity; 30-40 seconds – good; 25-30 seconds – satisfactory; less than 25 seconds – low. The Rufier test determines the level of cardiovascular reserve during any physical activity. After 3-5 minutes of rest in a sitting position, the combatant's heart rate was counted for 15 seconds. The data obtained were recorded, and the participant was asked to perform 30 squats with arms extended forward for 45 seconds. At the end of the squats, the employee sat down, and the heart rate was counted for the first 15 seconds and the last 15 seconds of the first minute of recovery. The functional capabilities of the cardiovascular system were assessed by the Rufier Index (RI) using the formula: RI = ((P1 + P2 + P3) - 200) / 10, where P1 is the resting heart rate, and P2, P3 are the heart rate in the first 15 and last 15 seconds of the first minute after squats. The assessment of the RI was carried out according to the following criteria: ≤ 0 c. u. (athletic heart); 0.1-5.0 c. u. (excellent); 5.1-10.0 (good); 10.1-15.0 (satisfactory); 15.1-20.0 (unsatisfactory).

STATISTICAL METHODS

The methods of mathematical statistics were used to process the data obtained. The reliability of the difference between the indicators was determined using the Student's t-test. The results were presented as X ± m, where X is the arithmetic mean, m is the standard error. The reliability of the difference 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

The procedure for organizing the study and the topic of the article were previously agreed with the Committee on compliance with Academic Integrity and Ethics of the NAIA. Also this study followed the regulations of the World Medical Association Declaration of Helsinki. Informed consent was received from all participants who took part in this study.

RESULTS

The results of the study of the dynamics of the emotional state of combatants before and after two-week adaptive volleyball training sessions are presented in Table 1. It was found that the integral indicator of the emotional state of the participants of the experiment, which was determined by the indicators of each scale

("Resilience-anxiety", "Vigor-fatigue", "Elation-depression", "Self-confidence-helplessness"), before the beginning of adaptive volleyball training sessions was estimated as worsened (5.31 ± 0.21 points), and at the final stage – as good (6.64 ± 0.19 points). Positive changes of 1.33 points are estimated to be reliable ($p \leq 0.001$).

The results of the study on neuro-emotional stress in combatants, according to the method proposed by T. A. Nemchyn, provide grounds for stating a positive trend. In particular, at the initial stage, this indicator was 61.24 ± 1.52 points, at the final stage – 56.81 ± 1.47. The obtained data indicate a positive influence of adaptive volleyball training sessions on the level of neuro-emotional stress in participants of the experiment. The difference between the fixed indicators before and after the two-week training sessions is reliable, with a mean difference of 4.43 points ($p \leq 0.05$). The level of neuro-emotional stress during the experiment was estimated as average. The obtained results testify to the improvement of the indicators of the psycho-emotional state of participants of combat actions during adaptive volleyball training sessions by both methods. This may be due to the influence of physical activity experienced by the participants of the experiment during the performance of specific motor actions of this sport. Exercise helps to reduce cortisol in the body and stimulates the production of endorphins. The cohesion, emotional support of each other that accompanies the game and the positive psychological atmosphere on the playground also have a positive effect on the participants' psycho-emotional state.

The analysis of the Stange test, which assessed the time of breath holding during inspiration, showed improvement at the final stage of the experiment; however, no significant difference was found ($p > 0.05$). The level of functional capabilities of the respiratory system of combatants at the initial stage was assessed as good. The increase in the test was 5.6 seconds and reached 60.3 ± 1.98 seconds, which corresponded to a high level. The analysis of the Genchi test gives grounds to state a similar dynamics – the level of functional capabilities of the respiratory system of combatants was assessed as good (38.9 ± 1.22 seconds). The increase in the test value was 2.9 seconds (41.8 ± 1.08 seconds), but the difference is not significant compared to the initial stage of the experiment ($p > 0.05$). The average value of the Genchi test in the participants of the experiment at the final stage indicates an excellent assessment of the functional capabilities of the respiratory system.

The analysis of the Rufier Index testifies to a good level of functional capacities of the cardiovascular system in the participants of the experiment and positive dynamics after the use of adaptive volleyball training sessions; however, changes in the results are unreliable ($p > 0.05$). At the initial stage, the Rufier Index of the combatants was 7.27 ± 0.48 c. u., and at the final stage, it improved by 0.83 c. u. to reach 6.44 ± 0.45. The obtained data allow us to assert that adaptive volleyball training sessions positively influence indicators of psycho-emotional and functional state of combatants. Functional reserves of the cardiovascular system gradually increased, since it is impossible to achieve significant changes in such a short period of time.

DISCUSSION

The relevance of the research is confirmed by the publications of other scientists [15, 16], who argue that the outbreak of hostilities in Ukraine has exacerbated the rehabilitation direction in the field of physical education, as the problem of returning combatants to everyday life is significant. One of the key areas of physical education and sports rehabilitation is adaptive sports [7, 17], which is now becoming widespread in Ukraine thanks to government initiatives and the activities of public organizations.

The obtained results confirm the data of other scientists on the positive impact of adaptive sports in general and physical exercises in particular on improving the psycho-emotional and functional state of veterans [8, 18]. Involvement in adaptive sports is one of the most effective tools for the rehabilitation and social integration of veterans and combatants [7, 8]. Scientists are convinced that adaptive sports for combatants, veterans, and people with disabilities is not only physical activity, but also an essential tool for their rehabilitation, reintegration, and return to a full life. It is one of the key areas of involvement for such persons in physical education and sports, as well as the formation of a culture of conscious choice and adherence to an active and healthy lifestyle [19].

Experts are convinced that the development of adaptive sports is aimed at improving services in the field of physical culture and sports and building barrier-free accessibility, which has become a new value for many Ukrainians during the war. Adaptive sport makes it easier to compensate for physical, mental, and social changes in a person; the use of metered exercise activates the processes of readaptation and helps improve a person's communication and social skills. According to researchers, the use of adaptive sports in the rehabilitation system for service members with lower limb amputation leads to an increase in functional mobility, psychological stability, and daily activity [20]. The results of our research do not contradict the findings of other scientists, but rather expand and supplement them.

CONCLUSIONS

Based on the study of scientific literature, it is stated that adaptive sport is an essential means of physical education and sports rehabilitation of combatants who have been injured, wounded, and are undergoing rehabilitation, as well as persons with disabilities. Exercise provided by this sport prevents secondary complications, helps to restore joint mobility, strengthen muscles, improve coordination and endurance, reduce pain, and is a tool for their physical, psychological, and social rehabilitation and return to full life. It has been established that it is effective to use adaptive volleyball for people who have suffered musculoskeletal injuries, people with amputations of the lower one or both limbs, in the framework of physical education and sports rehabilitation. It has been found that adaptive volleyball training sessions have a positive effect on the indicators of the psycho-emotional and functional state of combatants. A significant improvement in the indicators of emotional state ($p \leq 0.001$), which was assessed at the final stage of the experiment as good, and neuro-emotional stress ($p \leq 0.05$) was noted. The level of neuro-emotional stress in the participants of the experiment during the training was estimated as average.

Positive changes in the functional state of the experiment participants were observed, but these changes were not statistically significant ($p > 0.05$). The level of functional capabilities of the respiratory system of the combatants, as assessed by the Stange test at the final stage of the experiment, was found to be high (60.3 ± 1.98 seconds). According to the Genchi test, it was rated as excellent (41.8 ± 1.08 seconds). According to the Rufier Index at the final stage of the experiment, the functional reserves of the cardiovascular system were assessed as good – 6.44 ± 0.45 c. u., but the changes in the results were also not reliable ($p > 0.05$) due to the short period of the research.

PROSPECTS FOR FURTHER RESEARCH

We see prospects for further research in studying the impact of training sessions in other types of adaptive sports on the psycho-emotional and functional state of combatants, including persons with disabilities.

REFERENCES

1. Talbot LA, Brede E, Metter EJ. Psychological and Physical Health in Military Amputees During Rehabilitation: Secondary Analysis of a Randomized Controlled Trial. Mil Med. 2017;182(5):e1619-e1624. doi:10.7205/MILMED-D-16-00328. DOI
2. Dupuis F, Perreault K, Hébert LJ et al. Group Physical Therapy Programs for Military Members With Musculoskeletal Disorders: A Pragmatic Randomized Controlled Trial. J Orthop Sports Phys Ther. 2024;54(6):417-426. doi:10.2519/jospt.2024.12342. DOI
3. Clark B, Clark L, Showalter C, Stoner T. A call to action: direct access to physical therapy is highly successful in the US military. When will professional bodies, legislatures, and payors provide the same advantages to all US civilian physical therapists? J Man Manip Ther. 2022;30(4):199-206. doi:10.1080/10669817.2022.2099893. DOI
4. Farrokhi S, Mazzone B, Moore JL et al. Physical Therapy Practice Patterns for Military Service Members with Lower Limb Loss. Mil Med. 2019;184(11-12):e907-e913. doi:10.1093/milmed/usz107. DOI
5. Ladlow P, Phillip R, Etherington J et al. Functional and Mental Health Status of United Kingdom Military Amputees Postrehabilitation. Arch Phys Med Rehabil. 2015;96(11):2048-2054. doi:10.1016/j.apmr.2015.07.016. DOI
6. McDonald JR, Wagoner M, Shaikh F et al. Mental and Physical Health-Related Quality of Life Following Military Polytrauma. Mil Med. 2024;189(11-12):2550-2561. doi:10.1093/milmed/usae055. DOI
7. Lee KK, Uihlein MJ. Adaptive Sports in the Rehabilitation of the Disabled Veterans. Phys Med Rehabil Clin N Am. 2019;30(1):289-299. doi:10.1016/j.pmr.2018.08.001. DOI
8. Rayes R, Ball C, Lee K, White C. Adaptive Sports in Spinal Cord Injury: a Systematic Review. Curr Phys Med Rehabil Rep. 2022;10(3):145-153. doi:10.1007/s40141-022-00358-3 DOI
9. Leung KM, Chung PK, Chu W, Ng K. Physical and psychological health outcomes of a sitting light volleyball intervention program on adults with physical disabilities: a non-randomized controlled pre-post study. BMC Sports Sci Med Rehabil. 2021;13(1):100. doi:10.1186/s13102-021-00328-7. DOI
10. Leung KM, Chung PK, Chu W. Evaluation of a sitting light volleyball intervention to adults with physical impairments: qualitative study using social-ecological model. BMC Sports Sci Med Rehabil. 2020;12:41. doi:10.1186/s13102-020-00187-8. DOI
11. Macedo CSG, Tadiello FF, Medeiros LT et al. Physical Therapy Service delivered in the Polyclinic During the Rio 2016 Paralympic Games. Phys Ther Sport. 2019;36:62-67. doi:10.1016/j.ptsp.2019.01.003. DOI
12. Leung KM, Chung PK, Chan AWK et al. Promoting healthy ageing through light volleyball intervention in Hong Kong: study protocol for a randomised controlled trial. BMC Sports Sci Med Rehabil. 2020;12:6. doi:10.1186/s13102-019-0151-7. DOI
13. Molik B, Morgulec-Adamowicz N, Marszałek J et al. Evaluation of Game Performance in Elite Male Sitting Volleyball Players. Adapt Phys Activ Q. 2017;34(2):104-124. doi:10.1123/apaq.2015-0028. DOI

14. Petrigna L, Petta A, Giustino V et al. A scoping review on how physical fitness is evaluated in sitting volleyball players. J Sports Med Phys Fitness. 2023;63(3):430-435. doi:10.23736/S0022-4707.22.13982-4. DOI
15. Armitage RC. War in Ukraine: public health, rehabilitation and assistive technologies. Disabil Rehabil Assist Technol. 2022;17(8):989-990. doi:10.1080/17483107.2022.2110950. DOI
16. Biloshytska OK, Bespalova OY, Seminska NV, Galkin OY. Concept of a multifunctional prosthetic and rehabilitation center with an innovative educational component for patients with limb amputation in the context of war in Ukraine. Wiad Lek. 2025;78(6):1160-1167. doi:10.36740/WLek/207373. DOI
17. Whiting ZG, Falk D, Lee J et al. Community organization factors affecting veteran participation in adaptive sports. J Spinal Cord Med. 2022;45(3):395-401. doi:10.1080/10790268.2020.1803657. DOI
18. Sutton RJ, Kay CWP, McKenna J, Kaiseler M. Sustained positive behaviour change of wounded, injured and sick UK military following an adaptive adventure sports and health coaching recovery course. BMJ Mil Health. 2023;169(6):499-504. doi:10.1136/bmjmilitary-2021-001784. DOI
19. Tow S, Gober J, Nelson MR. Adaptive Sports, Arts, Recreation, and Community Engagement. Phys Med Rehabil Clin N Am. 2020;31(1):143-158. doi:10.1016/j.pmr.2019.09.003. DOI
20. Tinney MJ, Caldwell ME, Lamberg EM. Adaptive Sports and Recreation in Persons with Limb Loss/Limb Deficiency. Phys Med Rehabil Clin N Am. 2024;35(4):769-793. doi:10.1016/j.pmr.2024.06.004. DOI

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CONFLICT OF INTEREST
The Authors declare no conflict of interest

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