

**PHYSICAL REHABILITATION AS A COMPONENT
OF INNOVATIVE SOLUTIONS FOR MANAGEMENT
OF HYDROECOLOGICAL THREATS DURING THE WAR
IN UKRAINE: FROM PRE-PROSTHETIC PREPARATION
TO POST-PROSTHETIC RECOVERY**

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INTRODUCTION

The war in Ukraine has caused complex, large-scale problems, challenges and threats that have formed in the healthcare system and, in particular, in the rehabilitation sector for victims. Military actions also pose a significant threat to the hydroecological security of the state, which is at the same time a significant factor that significantly reduces the effectiveness of rehabilitation in remote and hard-to-reach regions. Hydroecological threats are manifested, in particular, in such factors as the deterioration of the quality of drinking water, the destruction of water drainage and water supply systems for the population and, in general, a significant decrease in the quality of water resources and the disruption of the water balance of hydroecosystems. This is extremely dangerous and creates significant risks to human health.

The destruction of the Kakhovka hydroelectric power station, which occurred in June 2023, is an example of a large-scale hydroecological disaster that occurred in Ukraine due to the war. The consequence of this tragic event was the flooding of significant territories, which led to a significant deterioration in the health of the population. Medical care, access to rehabilitation measures designed to restore the mobility and functionality of the population, became unavailable or extremely limited in many cases.

The hydroecological balance was disrupted, and rapid contamination of water bodies with dangerous toxins was observed, which led to the degradation of water systems. It should be emphasized that these factors have a long-term negative impact on the sanitary-epidemiological situation and the state of public health. People's access to safe drinking water, which is the main factor supporting the optimal functioning of the body, has significantly decreased. The consequences of such hydroecological disasters are especially dangerous

for certain categories of the population. This is primarily the case for military personnel who have combat injuries. It is also especially dangerous for the elderly, for people with certain chronic diseases and for internally displaced persons, who are under severe stress.

In this context, physical rehabilitation becomes particularly important. Under such extraordinary conditions, physical rehabilitation is an important component of the crisis response system. This is determined, first of all, by the fact that this particular direction is aimed at restoring the functional independence of people with certain disabilities. As a result of effective rehabilitation interventions, the quality of life of affected individuals improves and their social adaptation is restored.

Modern innovative technologies play an important role in ensuring the accessibility of rehabilitation care. Here, first of all, we should mention telerehabilitation, monitoring of patients' condition based on digital systems, as well as mobile rehabilitation teams. The use of such approaches ensures the continuity of the rehabilitation process even in cases where resources are limited and the infrastructure is significantly damaged.

The purpose of our work was to analyze the role of physical rehabilitation as a component of innovative methods used in managing hydroecological threats during the war in Ukraine. Special attention was also paid to determining modern approaches to pre-prosthetic preparation and post-prosthetic recovery of patients, which is especially relevant at the present time. To achieve this goal, we have identified a number of tasks. First of all, it is necessary to analyze the impact of hydroecological threats on the health of the population. It is also necessary to characterize the importance of physical rehabilitation in the system of response to crisis events. It is important to study modern innovative rehabilitation technologies and determine their impact on the recovery of people affected by military actions.

In the work, to achieve the goal and fulfill the tasks set, we used an integrated approach. In particular, we used a set of theoretical research methods, such as analytical study of scientific literature, bibliographic search and content analysis. General scientific approaches were applied, such as analysis and synthesis, as well as comparison and collation of materials and systematization of the obtained facts.

The use of such methods contributed to the generalization of modern scientific data, which show the relationship, determination and interdependence of hydroecological threats, the consequences of military actions and the possibilities of physical rehabilitation as a significant factor in restoring the health of the population.

1. Hydroecological threats during the war in Ukraine and their impact on public health

Military actions as a factor in the formation of medical and social problems affecting human health and environmental risks. The war in Ukraine is a significant factor disrupting natural ecosystems. It has a complex impact on the environment and negatively affects aquatic ecosystems, the atmosphere, soils, as well as the social environment of people. The consequences of the war persist for many years after its end.

As a result of military actions, which cause artillery shelling and missile strikes, industrial enterprises are destroyed. Because of this, a significant amount of toxic substances enter the environment. Many such substances accumulate in soils and water bodies, and in the future these compounds can be included in the processes of the cycle of substances in nature¹. It should be emphasized that the destruction of chemical enterprises, as well as oil depots, is of particular danger. In this context, the destruction of warehouses where fuel and lubricants are stored is also dangerous. As a result of such events, a large number of toxic compounds are formed. In the future, these compounds form extensive areas of chemical pollution. The penetration of such toxic substances into surface waters, as well as into underground aquifers is especially dangerous.

It should be noted that the destruction of water pipes, dams, hydroelectric power plants, and treatment facilities is extremely dangerous. As a result of such destruction, there is a decrease in water quality, and, in general, a change in the hydrological characteristics of water bodies. At the same time, the hydrological regime of significant regions is modified. This leads to the formation of additional threats that can be observed far beyond the territories where combat clashes are taking place. Natural biomes also suffer significantly.

There is a destruction of forest areas and protected areas. Animals change their migration routes. In general, there is a disruption of the balance and degradation of natural ecosystems. War is also accompanied by significant fires that spoil the air. At the same time, combustion products, due to the influence of the wind, can spread over considerable distances^{2, 3}.

¹ Макаренко Н. А., Строкаль В. П., Бережнюк С. М., Бондар В. І., Павлюк С. Д., Вагалюк Л. В., Наумовська О. І., Ладика М. М., Ковпак А. В. Вплив російської воєнної агресії на природні ресурси України: аналіз ситуації, методологія. *Наукові доповіді НУБіП України*. 2022. № 4 (98). DOI: 10.31548/dopovidi2022.04.003.

² Шумидай І. Використання та наслідки водних ресурсів як зброї. *Екологічна і біологічна безпека в умовах війни: реалії України : зб. матеріалів наук.-практ. конф. (Київ, 19–20 липня 2023 р.)*. Київ, 2023. С. 107–110.

³ Хільчевський В. К. Водні та збройні конфлікти – класифікаційні ознаки: у світі та в Україні. *Hydrology, Hydrochemistry and Hydroecology*. 2022. № 1 (63). С. 6–19. DOI: 10.17721/2306-5680.2022.1.1.

We especially emphasize the negative impact of military actions on the system that ensures the health of the population. Environmental pollution worsens the sanitary and hygienic living conditions of people, the quality of drinking water supply deteriorates, and the availability of medical care decreases. Thus, we can note that medical, social and environmental characteristics, in conditions of hydroecological threats, are in a complex, multi-level relationship. Solving such problems requires a complex and comprehensive interdisciplinary approach.

Destruction of hydraulic structures and water infrastructure as a factor in the formation of long-term medical losses. Military actions that destroy water ecosystems, as well as hydroinfrastructure and hydraulic structures lead to extremely negative consequences. They are accompanied by significant medical losses, as well as significant environmental violations and social disturbances.

The operation of hydraulic units, the functioning of reservoirs, water purification mechanisms, as well as locks, water pumps, water pipelines, hydroelectric power stations and other structures ensure the stability of the hydrological regime.

In particular, the specified structures protect regions from such negative impacts as flooding and disruption of the ecological balance in natural ecosystems. The population is properly provided with clean drinking water.

In the case of destruction or damage to such facilities, sudden and uncontrolled changes in the hydrological regime of entire regions are observed.

Due to such adverse changes in hydroecosystems, settlements may be flooded. As a result, residential buildings are destroyed and roads are washed away. Such events also have a negative impact on agricultural fields. This is primarily due to the fact that the soil structure is disturbed and its fertile layer is destroyed. Such a destructive impact leads to soil erosion.

At the same time, there is a general degradation of the land cover, which is caused by the accumulation in the soil of various toxicants that enter from the water column during flooding. In particular, among such pollutants, heavy metals and oil products can be mentioned, first of all.

Secondary pollution of water bodies is very dangerous. As a result of flooding caused by military actions, significant quantities of industrial waste, contaminated household waste, fuel and agrochemicals, as well as various substances from destroyed residential buildings enter the hydroecosystem. It should be especially emphasized that the consequences of such secondary pollution have a very negative impact on the biological characteristics of water and its chemical and physical indicators.

A significant danger is caused by the lack of clean drinking water, which is caused by the destruction of water pipes due to military actions. First of all, this is important for older people and children, as well as for people with chronic internal diseases. Such a danger is also significant for internally displaced persons.

The lack of clean drinking water can cause various intestinal diseases, as well as contribute to the spread of various intestinal infections.

As a result of the negative impact on hydroecosystems, disruption of their hydrological regime, the death of many aquatic organisms is observed. This, in turn, causes a decrease in the species representation of hydrofauna and hydroflora. In the future, these factors disrupt the processes of self-purification of water bodies, which is ensured by the effective vital activity of aquatic organisms and optimal processes of the circulation of substances and energy in hydroecosystems through the proper functioning of food chains in trophic pyramids.

Therefore, taking into account the above factors, we can emphasize that the destruction, destruction or damage, as a result of military operations, of various hydrological structures and hydrotechnical structures, disruption of the optimal functioning of hydroecosystems leads to complex and long-term consequences from a medical point of view. The balance in the natural environment is disrupted, degradation of water bodies and adjacent territories is observed.

Kakhovka HPP as an example of a large-scale hydroecological disaster, which creates risks for the sanitary and epidemiological safety of the population and limits access to medical care. In June 2023, as a result of the war, the Kakhovka Hydroelectric Power Plant was destroyed. This is the largest and largest-scale hydroecological disaster of the war period in Ukraine and in Europe as a whole. The destruction of such an important strategic facility comprehensively and simultaneously affected the medical and environmental spheres, as well as the economic and social field of activity.

As a result of the destruction of the Kakhovka hydroelectric power station dam, colossal volumes of water were released in an uncontrollable flow. These water flows quickly flooded the territory located downstream of the Dnieper River. The houses of people who were forced to flee were flooded. The water swallowed various industrial enterprises and social infrastructure facilities. Agricultural fields were also under water.

Hydroecosystems were significantly affected, which, as a result of this disaster, changed their hydrological regime. The river network was significantly affected. The disturbances were also reflected in the change in the groundwater level. Significant negative changes were also observed in the structural and functional characteristics of coastal ecosystems^{4, 5}.

⁴ Шерстюк Д., Ільєнко Т. Супутниковий моніторинг за біологічним індикатором стану Чорного моря внаслідок руйнування Каховської ГЕС. *Екологічна і біологічна безпека в умовах війни: реалії України* : зб. матеріалів наук.-практ. конф. (Київ, 19–20 липня 2023 р.). Київ, 2023. С. 105–107.

⁵ Drebot O., Vysochanska M., Sakharnatska L. Environmental and economic consequences regarding the assessment of the explosion of Kahovska HPP. *Ecological and Biological Security in Wartime: Realities of Ukraine* : collection of materials of the scientific and practical conference (Kyiv, July 19–20, 2023). Kyiv, 2023. P. 7–8.

Rapid water flows carried a variety of pollutants in significant quantities: household waste, chemicals of various structures, petroleum products, industrial compounds. The aquatic environment was also heavily polluted by various substances released as a result of the destruction of infrastructure.

It should be emphasized that such factors negatively affected the provision of clean drinking water to the population, and also adversely affected the epidemiological situation in general. The destruction of the Kakhovka hydroelectric power station exacerbated not only medical risks. The environmental consequences of this event were also very significant.

So, we note that due to the hydroecological disaster that occurred as a result of military operations at the Kakhovka hydroelectric power station, significant restrictions arose in the provision of medical care, the psychological and emotional burden on people significantly increased, and their living conditions significantly worsened. The population was forced to be in a strong stressful situation for a long time.

2. Physical rehabilitation in the system of response to hydroecological threats in wartime

Physical rehabilitation as a component of crisis management during military operations. In the health care system, physical rehabilitation is a very important component. In wartime, the importance of physical rehabilitation becomes more important, since this aspect ensures the continuity of medical care from the acute phase to the long-term formation of functional independence of people with certain disorders.

The importance of physical rehabilitation in cases of hydroecological disasters is multilevel and multifunctional. In particular, we can distinguish the therapeutic and adaptive functions that physical rehabilitation performs under such conditions. Its preventive role and social purpose are also important.

Let us consider the more thoroughly defined functional characteristics of physical therapy.

If we are talking about the therapeutic value of physical rehabilitation, then, first of all, we should focus on restoring the functional characteristics of patients who have been impaired as a result of various injuries or diseases. A negative role in the impairment of certain body functions is also played by prolonged hypodynamia of sick people, caused by certain traumatic events.

The preventive function is also important. It is aimed, first of all, at preventing various complications. We are talking, in particular, about such phenomena as contractures, stagnant processes in the respiratory system, muscle atrophy, as well as decompensation of chronic diseases.

As for the adaptive function of physical therapy, it ensures, first of all, the patient's adaptation to new, changed by certain factors, living conditions. It is necessary to ensure, as a result of appropriate rehabilitation interventions, the maximum possible level of independence of a person, taking into account all factors limiting his activity.

The social function of physical rehabilitation is especially important. This function is designed to significantly improve the patient's quality of life and integrate him into society. In this case, it is necessary to take into account the new circumstances that arose, in particular, after the loss, due to hydroecological disasters and hostilities, of the previous living environment in which the person was located^{6, 7}.

In difficult conditions, when infrastructure is damaged or destroyed, the organization of rehabilitation assistance is especially important. During military operations, local, incomplete access to hospitals and clinics is noted in many regions. In many cases, an acute shortage of medicines and medical equipment may be noted. Often, there may also be a shortage of medical personnel.

The organization of rehabilitation assistance in such situations is significantly relevant. This is due to the fact that rehabilitation interventions can effectively restore the mobility of patients with certain traumatic disorders.

Under such conditions, it is necessary to introduce mobile rehabilitation teams. Remote technologies are beginning to play a significant role in hard-to-reach regions. In this case, the leading role is given to telerehabilitation and telemedicine.

The main tasks of physical therapy in patients affected by military operations and environmental disasters. It should be noted that patients affected by hydroecological disasters caused by the war in Ukraine require complex rehabilitation interventions, which are characterized by multi-level characteristics.

This is due, among other things, to the fact that the population affected by such factors may have a number of long-term functional disorders. Injured people also in many cases require acute medical interventions.

The tasks that arise in such complex situations are multi-level and are implemented in several stages.

⁶ Balogun J. A. Contemporary and Global Perspectives in Physical Therapy. Cham : Springer Nature, 2025. 490 p.

⁷ Іванець О. Р., Макар О. Р. Синергія внутрішньої медицини та фізичної терапії у відновленні здоров'я постраждалих внаслідок водних забруднень бойового походження. *Внутрішня медицина XXI століття: інтеграція знань та практики* : зб. наук. праць наук.-практ. конф. з міжнар. участю, 12 червня 2025 р., Львів. Львів : ДНТ «ЛНМУ ім. Д. Галицького», 2025. С. 21–24.

First of all, tasks that ensure the prevention of complications caused by the immobilization of patients must be performed. These are the primary goals of physical therapy. It is necessary to ensure, in particular, the prevention of bedsores and joint contractures in patients. Hypostatic pneumonia and thromboembolic complications are also dangerous. As a result of immobilization, many patients develop muscle atrophy.

In order to prevent such phenomena, rehabilitation interventions such as early passive mobilization are carried out. In the absence of contraindications, active mobilization is used. Breathing exercises, which are carried out under the supervision of a physical therapist, are quite effective in such situations.

In the case of insufficient mobility of the patient, correct positioning and periodic change of body positions in the hospital bed are effective.

The second stage of physiotherapy interventions involves an emphasis on restoring basic movement functions. These are more distant rehabilitation goals. In this case, first of all, the patient must be taught to sit and stand. It is necessary to ensure its correct verticalization, which is necessary to restore optimal blood circulation. In the future, it is necessary to carry out a set of physiotherapeutic exercises aimed at restoring the patient's walking. In this case, if necessary, various aids and assistive technologies can be used. Proper coordination of movements and balance are very important in restoring locomotor functions. It is necessary to ensure the activation of postural mechanisms.

To restore the mobility of patients, physiotherapy exercises using dosed load are extremely important. This load is gradually increased within the functional capabilities of the patient. Such exercises provide a gradual restoration of the patient's muscle strength. They also provide training for the patient's endurance and improve his functional ability⁸.

As a result of hydroecological disasters caused by military operations, a significant number of people may be in a humid environment for a long time, in conditions of flooding under the influence of contaminated water.

Such patients may have manifestations of chronic hypoxia and reduced saturation. They often have various bronchopulmonary complications and a general decrease in physical activity and performance. In such cases, cardiorespiratory rehabilitation and physical therapy, which is used in case of impaired respiratory system activity, are extremely important.

It is also necessary to emphasize the importance of psycho-emotional rehabilitation. Patients who have lost their homes as a result of hydroecological disasters are in a state of chronic stress, which is characterized by a fairly high

⁸ Balogun J.A. Contemporary and Global Perspectives in Physical Therapy. Cham : Springer Nature, 2025. 490 p.

level. They also lose social ties, as they are forced to move to other regions. In general, this negatively affects the level of motivation of patients and reduces the effectiveness of rehabilitation interventions. Psychological support, in this case, plays a significant role and is an important factor in restoring patients' mobility as a result of physical therapy measures.

Physical rehabilitation as an important tool for restoring human potential in the system of innovative approaches to managing environmental threats during the war. It should be noted that as a result of military operations in Ukraine, the mechanisms of environmental control and management of hydroecological threats, which are usually used, are becoming more complicated. They often become inaccessible or their use is not effective enough.

This necessitates the development and use of highly effective digital systems and response models. They must have a high level of integration and take into account a number of factors and factors that are characterized by significant variability under certain circumstances. Such digital management systems must operate effectively under conditions of high uncertainty.

Such modern innovative approaches must function as a multi-level system that provides hydroecological monitoring, the dynamics of certain changes. It must also provide objective and substantiated data for formulating certain conclusions and providing recommendations.

Achieving such high efficiency involves, in particular, the use of geographic information systems and remote sensing of the Earth based on the use of satellite technologies. Unmanned aerial vehicles that can use automated sensor systems also play an important role in this case. To analyze large arrays of multifaceted and multi-level data, it is necessary to apply appropriate software based on artificial intelligence to the obtained indicators.

Particular emphasis should be placed on aspects that ensure the integration of hydroecological monitoring with the health care system of the population located in dangerous regions. It is also important to integrate the objective data obtained as a result of hydroecological monitoring with the civil protection system of the population.

It should be emphasized that physical rehabilitation, under such conditions, should be considered as a significant, effective and efficient tool that ensures, in general, the restoration of human potential. Such potential, as a result of hydroecological disasters, is significantly reduced and requires active support.

So, in general, it should be noted that today a new concept of risk management that arises as a result of hydroecological disasters should be formed.

Physical rehabilitation in such a concept will occupy a significant position, since it is physical rehabilitation measures that allow for the rapid and effective restoration of human potential, the resource of which in many cases may be limited.

In general, such a modern innovative approach should be based on the use of relevant digital technologies, which should be based on interdisciplinary, interdisciplinary communication and mutual integration.

Such a modern hydroecological risk management system should be characterized by significant mobility, efficiency and the ability to function in unpredictable crisis situations.

3. Pre-prosthetic and post-prosthetic rehabilitation as a stage of restoring functional independence of individuals after combat injuries in the crisis response system for hydroecological disasters

Modern aspects of combat injuries and limb amputations. Injuries that are received today as a result of combat actions are characterized by a number of features. In particular, such injuries are characterized by the complex influence of mechanical, thermal, and psycho-emotional factors. They have significant energy of damage. Polytraumas are also observed quite often.

Mine and explosive injuries, which are the most common, can often lead to amputations. In such cases, it often happens that only amputation can save a person's life. For patients with amputations, there is a fairly high risk of complications caused by infections. They also have heterotopic ossification and phantom pain. Sometimes, as a result of such surgical interventions, pathological scars develop on the stump⁹.

It should be emphasized that during hostilities, hydroecological factors also have a significant negative impact. Such factors can significantly affect the development of combat trauma. First of all, such a negative impact of hydroecological factors can be caused by damage and failure of water supply systems. A significant negative impact is caused by flooding of certain regions as a result of hydroecological disasters and water contamination with various toxic chemical and biological substances. Such factors create additional increased risks of wound infection. Contaminated water in the combat zone serves as a negative factor that facilitates the contamination of wounds with various toxic substances, as well as bacterial flora^{10, 11, 12}.

⁹ Салєєва А. Д., Семенєв В. В., Носова Т. В., Василенко І. М., Басєв П. О., Корнєєв С. В., Литвинєнко О. М., Карпенко І. В., Чернишова І. М., Кабаненко І. В. Біомеханічні основи протезування та ортезування : навчальний посібник. Харків : ХНУРЕ, 2022. 352 с.

¹⁰ Шерстюк Д., Ільєнко Т. Супутниковий моніторинг за біологічним індикатором стану Чорного моря внаслідок руйнування Каховської ГЕС. *Екологічна і біологічна безпека в умовах війни: реалії України* : зб. матеріалів наук.-практ. конф. (Київ, 19–20 липня 2023 р.). Київ, 2023. С. 105–107.

¹¹ Шумигай І. Використання та наслідки водних ресурсів як зброї. *Екологічна і біологічна безпека в умовах війни: реалії України* : зб. матеріалів наук.-практ. конф. (Київ, 19–20 липня 2023 р.). Київ, 2023. С. 107–110.

¹² Drebot O., Vysochanska M., Sakhnatska L. Environmental and economic consequences regarding the assessment of the explosion of Kahovska HPP. *Ecological and Biological Security in Wartime: Realities of Ukraine : collection of materials of the scientific and practical conference* (Kyiv, July 19–20, 2023). Kyiv, 2023. P. 7–8.

Preprosthetic rehabilitation. Successful prosthetics of the patient largely depends on pre-prosthetic rehabilitation interventions.

Pre-prosthetic rehabilitation performs a number of very important functions. One of the leading tasks of rehabilitation interventions during this period is the formation of a stump, which is determined by functional suitability. No less important is the task of preventing contractures. During this period, it is also important to carry out a number of measures that control swelling and reduce pain in the injured limb. Rehabilitation interventions that ensure the maintenance and improvement of joint mobility, as well as the restoration of muscle strength, are also essential and basic¹³. Psychological preparation of the patient for prosthetics and the formation of his positive motivation are also necessary.

It should be noted that patients with combat injuries have very complex injuries. They also have a high probability of various postoperative complications, as well as certain psycho-emotional disorders. Certain concomitant traumatic injuries can develop to a significant extent. All these factors, their complex interaction and impact on the patient's body, determine the significant importance of pre-prosthetic preparation.

In modern conditions, when the war is ongoing, the stage of pre-prosthetic preparation of the patient becomes important as one of the components of the crisis response system. This is due, first of all, to the fact that effective and optimal pre-prosthetic rehabilitation measures ensure a faster return of people to an active and high-quality lifestyle. At the same time, under the conditions of optimal rehabilitation interventions, the period of functional dependence of patients is reduced.

Pre-prosthetic rehabilitation, in general, ensures high efficiency of further rehabilitation measures designed to effectively restore patients' mobility, ensure a high quality of their life and an appropriate level of socialization. A correctly formed, as a result of pre-prosthetic rehabilitation, stump should be characterized by such features as the proper volume of soft, elastic tissues. It should not cause pain during loads, have the correct shape and appropriate length.

It should be noted that such violations as contractures and secondary complications of the stump lead to a slowdown in the effectiveness of successful subsequent prosthetics of the patient. Therefore, the prevention of such phenomena is one of the primary tasks of pre-prosthetic rehabilitation interventions. This is due, first of all, to the fact that contractures, as a result of amputation, can form in a short period of time. Sometimes they are already observed within a few weeks after the operation.

¹³ Салєєва А. Д., Семенець В. В., Носова Т. В., Василенко І. М., Басєв П. О., Корнєєв С. В., Литвиненко О. М., Карпенко І. В., Чернишова І. М., Кабаненко І. В. Біомеханічні основи протезування та ортезування : навчальний посібник. Харків : ХНУРЕ, 2022. 352 с.

Psychological adaptation is also necessary for the successful recovery of the patient, the formation of compliance, and the effective implementation of further rehabilitation interventions. Psychological adaptation is an important element in the complex of measures to restore and ensure a high quality of life for a person^{14, 15}.

As a result of properly conducted psychological adaptation, the provision of appropriate psychological support and the implementation of certain explanatory work and psychological education of the patient, the consequences of the injury are overcome. The level of anxiety in patients decreases, motivation for effective, rather than formal, rehabilitation measures increases. The person's social activity is restored to a large extent. There is a conscious perception of a new image of their body after the trauma. It should be noted that psychological adaptation is an extremely necessary and most complex basic factor in pre-prosthetic and post-prosthetic rehabilitation of patients who have received injuries as a result of hostilities.

In today's realities, when there is a war in Ukraine, the aspect of psychological adaptation is especially relevant. This is due, first of all, to the fact that currently there is a significant increase in both military personnel and civilians who have severe injuries and amputations^{16, 17}.

The process of psychological adaptation should, first of all, form the patient's positive motivation and his active position regarding rehabilitation interventions. It is important for the patient to understand the goal that needs to be achieved in the rehabilitation process over a certain period of time.

Very important during the period of psychological adaptation is proper social support. These two components of rehabilitation are considered in close connection. After physical recovery, as a result of socialization, a person must return to active life in society. This is an extremely important, complex task of the entire rehabilitation process¹⁸.

¹⁴ Desmond D., MacLachlan M. Psychosocial issues in the field of prosthetics and orthotics. *Journal of Prosthetics and Orthotics*. 2002. Vol. 14. No. 1. P. 19–22.

¹⁵ Kashif A. W., Walia T. S., Saluja S. K. Effect of short-term psychiatric intervention in amputees. *Medical Journal Armed Forces India*. 2004. Vol. 60, №3, P. 231–234.

¹⁶ Павлюк М., Овдій І. Психологічна адаптація військовослужбовців Збройних Сил України. *Вісник Національного університету оборони України*. 2022. Т. 70. №6. С. 134–141. DOI: 10.33099/2617-6858-2022-70-6-134-141.

¹⁷ Іванець О. Р., Макар О. Р. Психоемоційний дистрес як предиктор результатів фізичної терапії у онкопациєнтів із переломами діяфіза плечової кістки в умовах війни. *Матеріали Всеукраїнської науково-практичної конференції з міжнародною участю «Перспективи розвитку медичної реабілітації на різних рівнях надання медичної допомоги»* / Тернопіль : ТНМУ. 2026. С. 59–63.

¹⁸ Когут О. О., Вишніченко С. І. Результати апробації програми реабілітації військовослужбовців. *Науковий вісник Ужгородського національного університету. Серія: Психологія*. 2023. № 3. С. 127–132. DOI: 10.32782/psy-visnyk/2023.3.22.

Post-prosthetic rehabilitation. The main task of post-prosthetic rehabilitation is to achieve the goal, which is to restore the functional independence of a person. To do this, first of all, it is necessary to carry out a number of rehabilitation measures that will ensure the patient's adaptation to the prosthesis.

To achieve this goal, it is necessary to ensure the fulfillment of a number of important tasks. In particular, first of all, the patient must be taught to use the prosthesis correctly and care for it.

The formation of new motor skills is also extremely important, since, as a result of prosthetics, the patient's center of mass shifts. This leads to new sensations regarding the position of the body in space. In general, due to prosthetics, the kinesiology and biomechanics of human gait change. Certain compensatory mechanisms arise that require adjustment. Appropriate gait patterns are formed that can affect certain phases of the prosthetic patient's movement.

In general, as noted, the process of adaptation and getting used to the prosthesis includes several stages that are closely correlated with each other. We are talking, first of all, about the biomechanical and sensory levels. The physiological and psychological components, as well as the social aspect, are also extremely important^{19, 20, 21, 22, 23}.

We emphasize that the ability to have proper mobility, to restore walking patterns and skills is one of the most important tasks of post-prosthetic rehabilitation measures. This is due, first of all, to the fact that the level of functional independence of a person is determined, first of all, by his ability to move independently, without outside help²⁴.

¹⁹ Gailey R. S., Allen K., Castles J., Kucharik J., Roeder M. Review of secondary physical conditions associated with lower-limb amputation and long-term prosthesis use. *Journal of Rehabilitation Research and Development*. 2008. Vol. 45. No. 1. P. 15–30. DOI: 10.1682/JRRD.2006.11.0147.

²⁰ Heyns A., Jacobs S., Negrini S., Patrini M., Rauch A., Kiekens C. Systematic Review of Clinical Practice Guidelines for Individuals with Amputation: Identification of Best Evidence for Rehabilitation to Develop the WHO's Package of Interventions for Rehabilitation. *Archives of Physical Medicine and Rehabilitation*. 2021. Vol. 102 (6). P. 1191–1197. DOI: 10.1016/j.apmr.2020.11.019.

²¹ Одинець Т., Белов Є., Ванюк О. Фізична терапія військовослужбовців після ампутацій. *Physical Culture and Sport: Scientific Perspective*. 2023. № 4. С. 43–49. DOI: 10.31891/pcs.2023.4.6.

²² Ніканоров О., Крикунов О. Особливості фізичної терапії військовослужбовців з ампутацією нижніх кінцівок. *Спортивна медицина, фізична терапія та ерготерапія*. 2023. № 2. С. 84–87. DOI: 10.32652/spmed.2023.2.84-87.

²³ Highsmith M. J., Kahle J. T., Bongiorno D. R. Clinical practice guidelines for rehabilitation of individuals with lower limb amputation: an update from the Academy of Orthotists and Prosthetists. *Prosthetics and Orthotics International*. 2021. Vol. 45, No. 1. P. 6–27. DOI: 10.1177/0309364620976806.

²⁴ Lathouwers E., Diaz M. A., Maricot A., Tassignon B., Cherelle C., Cherelle P., Meeusen R., De Pauw K. Therapeutic benefits of lower limb prostheses: a systematic review. *Journal of NeuroEngineering and Rehabilitation*. 2023. Vol. 20. Article 4. DOI: 10.1186/s12984-023-01128-5.

An important point that eliminates asymmetric gait patterns of the patient is the ability to correctly and evenly distribute his weight between the healthy limb and the prosthetic one. Rehabilitation interventions and patient education are largely designed to develop precisely such skills in people learning to walk after prosthetics²⁵.

For the patient to use the prosthesis effectively and safely during movement, balance training is very important in the rehabilitation process. It is also necessary to include exercises in the rehabilitation process that improve the patient's coordination of movements, as well as his endurance²⁶.

As a result of military operations in many regions of Ukraine, it is quite difficult to conduct rehabilitation interventions. Therefore, under such conditions, digital technologies and telerehabilitation become important for the recovery of patients. Such modern, innovative approaches that ensure the rehabilitation process and effective intervention of physical therapists are of particular importance and are very relevant^{27, 28}.

In the conditions of the war that is going on in Ukraine, such aspects acquire special importance and are in dire need for the widest possible implementation. This is necessary for the optimal restoration of patients' activity.

Given the above circumstances, it is digital technologies and telerehabilitation that are important instrumental factors that play a significant role in the formation of a continuous process of patient recovery²⁹.

To assess the proper effectiveness of the rehabilitation process, a number of tests and scales are used, which are marked with the corresponding functional characteristics. In particular, in this case, the Berg scale, the Barthel index, the "Get up and go" test, the 6-minute walk test, the 10-meter walk test and a number of other criteria are used, which allow an objective assessment of the functional state of the patient.

So, in general, we can note a complex and multidisciplinary structure of pre-prosthetic and post-prosthetic rehabilitation interventions, which ensure

²⁵ Amma R., Hisano G., Murata H., Major M. J., Takemura H., Hobara H. Inter-limb Weight Transfer Strategy During Walking After Unilateral Transfemoral Amputation. *Scientific Reports*. 2021. Vol. 11. Article 4793. DOI: 10.1038/s41598-021-84357-9.

²⁶ Major M. J., Twiste M., Kenney L. P. J., Howard D. Biomechanical factors affecting individuals with lower limb amputations running using running-specific prostheses: a systematic review. *Gait & Posture*. 2022. Vol. 92. P. 83–95. DOI: 10.1016/j.gaitpost.2021.10.044.

²⁷ Іванець О. Р., Макар О. Р. Телереабілітація у фізичній терапії після перелому діяфіза плечової кістки: перспективи впровадження. *V Національний конгрес фізичної та реабілітаційної медицини 14–15 листопада 2025 року*, м. Львів. С. 22–24.

²⁸ Бакалюк Т. Г., Стельмах Г. О., Макачук Н. Р. Телереабілітаційні технології в підготовці фахівців з фізичної терапії. *Медицина освіти*. 2022. № 3. С. 58–63. DOI: 10.11603/m.2414-5998.2022.3.13400.

²⁹ Phuphanich M. E., Sinha K. R., Truong M., Pham Q. G. Telemedicine for musculoskeletal rehabilitation and orthopedic postoperative rehabilitation. *Physical Medicine and Rehabilitation Clinics of North America*. 2021. Vol. 32. No. 2. P. 319–353. DOI: 10.1016/j.pmr.2020.12.004.

the proper level of restoration of patient mobility. Such measures involve the integration and combination of medical approaches, measures carried out by physical therapists. Digital technologies and telerehabilitation are of particular importance, as well as relevant aspects that optimize the socialization of patients. Psychological rehabilitation and psychological support are also necessary, which form the patient's positive motivation and the presence of which ensures the special effectiveness of the rehabilitation process.

CONCLUSIONS

Physical rehabilitation in wartime is an important component of the crisis response system to the consequences of hydroecological threats in Ukraine. It ensures the preservation of the functional stability of the population, maintaining the quality of people's lives and reducing the negative consequences of critical situations.

War and the associated hydroecological disasters, in particular the destruction of hydraulic structures and water infrastructure, create significant risks to the health of the population. The consequences of such events are a deterioration in the quality of water resources, an increase in the risk of diseases. The number of traumatic injuries, amputations, functional disorders and psycho-emotional disorders is increasing.

Physical rehabilitation is one of the important areas that helps overcome the consequences of war and related environmental crises. It ensures the restoration of people's mobility and the prevention of complications. At the same time, the functional independence of the affected persons is maintained and their level of disability is reduced. Of particular importance are pre-prosthetic and post-prosthetic rehabilitation, which prepare the patient for the use of the prosthesis, increase his mobility and promote social adaptation.

The use of innovative technologies, in particular telerehabilitation, digital monitoring and mobile rehabilitation teams, increases the availability and continuity of rehabilitation care in wartime conditions and contributes to more effective and optimal patient recovery.

Promising areas of further research are the improvement of innovative rehabilitation technologies. It is important to further develop and improve personalized digital patient recovery programs. Such programs should also be used to study the long-term consequences of hydroecological disasters that affect the health of the population.

The implementation of such approaches will contribute to improving the quality of rehabilitation care and strengthening the stability of the healthcare system, taking into account modern military and environmental challenges.

SUMMARY

Presented are current, modern approaches that characterize physical rehabilitation as a component of innovative approaches to managing hydroecological threats under war conditions in Ukraine. The impact of military factors on the health of the population and the destruction of hydrological infrastructure is shown.

Emphasis is placed on the functional capabilities of injured people. Attention is drawn to the growing need for comprehensive rehabilitation care. The features of modern injuries and limb amputations resulting from hostilities are analyzed. The basic principles of organizing pre-prosthetic and post-prosthetic rehabilitation are considered. Special attention is paid to preventive measures regarding complications that may arise.

The features of restoring motor activity of patients are analyzed. The role of psychological rehabilitation and social integration of injured people is shown. In the context of ensuring a continuous rehabilitation process in crisis conditions, the introduction of telerehabilitation and digital monitoring technologies is emphasized.

The special role of mobile rehabilitation teams and information platforms, which are designed to ensure effective rehabilitation in crisis situations, is noted. The possibilities of using telerehabilitation, digital monitoring technologies, mobile rehabilitation teams and information platforms to ensure the continuity of patient recovery in crisis situations are presented.

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