

## Effect of rehabilitation program on the quality of life of people with forearm or hand gunshot wounds using physiotherapy methods

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### Abstract

The actualization of the rehabilitation problem of persons with gunshot wounds of the forearms and hands is associated with a large proportion of gunshot wounds of the upper limbs in the structure of combat trauma, the complexity of their treatment, many complications and a high degree of disability. *Purpose.* To investigate the impact of rehabilitation program on quality of people's life with forearm or hand gunshots using physiotherapy methods. *Approach.* The study was involved 76 men with gunshot wounds of the bones of the forearm and hand. The research was conducted on the basis of the military clinical hospital in Kyiv. Patients were randomly divided into 2 groups: the main group (MG, n=38) and the control group (CG, n=38). For the MG, was introduced an algorithm for the application of physical therapy measures, which was developed on the basis of the model of the International Classification of Functioning (ICF), Restriction of Life and Health. For rehabilitation of patients in the CG was used a standard program of the medical institution. In order to assess the effectiveness of rehabilitation interventions, examinations of patients were performed before the application of physical therapy measures and 6 months after the rehabilitation course. The research methods to comprehensively assess to the quality of patients' life: measurement of the functional independence on a scale FIM (Functional Independence Measure), assessment of the capacity of the upper limb on the scale DASH (Disability of the Arm, Shoulder and Hand Outcome Measure); Hamilton's alarm scale (The Hamilton Anxiety Rating Scale (HARS)), depression self-esteem scale PHQ-9 (Patient Health Questionnaire). *Results.* After the course of rehabilitation, the patients of the MG felt significantly fewer restrictions associated with dysfunction of the upper limbs, compared with the CG, which was reflected in the indicators of the scales FIM and DASH. Increasing activity in everyday life had a positive effect on the mental state of people with gunshot wounds of the upper limbs, in particular under the influence of rehabilitation measures in patients of the MG significantly reduced anxiety symptoms and depressive symptoms. *Conclusions.* Using of the developed algorithm of physical therapy measures based on the model of the ICF, RLH significantly improved various aspects of quality of patients' life with gunshot wounds of the forearm and hand and was more effective than the standard approach.

**Key words:** upper limb, combat trauma, therapeutic exercises, physical ability, functional recovering..

### Introduction

Among the various defeats that occur in military conflicts, gunshot wounds are one of the leading, both in frequency and severity. The actualization of the problem of persons' rehabilitation with gunshot wounds of the forearm and hand is associated with a large proportion of gunshot wounds of the upper limbs in the structure of combat pathology, the complexity of their treatment, a large number of complications and a high degree of disability (Bykov, Efimenko, Gumanenko, 2009). The achievements of modern medicine and clinical experience of the last decade have not reduced the urgency of this problem. In particular, the systemic aspects of the application of physical therapy measures in the complex rehabilitation of the thematic contingent are still insufficiently developed.

According to various authors, wounds of the upper limbs range from 23.2-28.5% to 41.2% of all combat wounds (Buryanov, Laksha, Borzykh, & Shydlovskiy, 2018; Gaida, Badyuk, & Sushko, 2018). Among the total number of limb injuries in 31.5% of cases there are gunshot fractures. Forearm fractures account for 15.7% of the structure of gunshot fractures of the upper limb, hand fractures - 32.4% of cases (Loskutov, Zherdev, Domanskyi, & Korol, 2016; Kordonska, 2018; Lis & Tomanek, 2021). According to Lisun DM, in general, the following trend is observed: the most common bone fractures in victims of hostilities occur in the distal parts, with the proportion decreases from the distal to the proximal end (Lysun, 2019).

In 62.5% of the injured wounds are multiple and combined (Efimenko et al., 2003; Buryanov, Laksha, Borzykh, & Shydlovskiy, 2018). Among gunshot fractures, 35.1% are fragmentary and 41.3% are fragmented. In 10% of

cases, gunshot fractures of the limbs are accompanied by damage to the main vessels, in 15-20% - nerve damage (Buryanov et al., 2015).

This nature of the lesions often leads to serious complications, is the cause of disability and causes difficulties in choosing the tactics of rehabilitation (Efimenko et al., 2003; Buryanov, Laksha, Borzykh, & Shydlovskiy, 2018; Bondar & Tomanek, 2018). It should be understood that as a result of gunshot wounds of the upper limb, patients primarily suffer from loss of autonomy and independence. Inability to take care of oneself, real or expected unemployment, material deprivation, social insecurity, lack of prospects for the future, anxiety for loved ones, loss of former ideals often lead to mental disorders. In particular, depressive and anxiety symptoms are observed in 49% and 93% of victims of gunshot wounds. (Kleinlugtenbelt et al., 2016). Rehabilitation measures for this contingent should be aimed at restoring not only for the morphological structure of the damaged limb, but also for its functional capabilities (the so-called "functional approach" in physical therapy). This will allow the wounded to regain lost social opportunities as soon as possible, in particular to return to professional activities. At the same time, the restoration of the ability to participate in various social situations should be considered as the most important goal of rehabilitation programs with the use of physical therapy (Builova, 2013).

The approach to the rehabilitation of patients from the standpoint of managing the individual's functional health is reflected in the International Classification of Functioning, Disability and Health (ICF). "Functioning" in the ICF is considered as an integrative indicator of human health at the level of the body (structure and function), adaptive behavior (activity) and participation in social situations, taking into account the influence of context (environmental and personal factors) (Builova, 2013).

In the context of the methodological approach of the ICF, the assessment of quality of life (QOL) as a criterion of the effectiveness of the rehabilitation program becomes especially important. According to WHO experts, quality of life is an integral characteristic of physical, psychological, emotional and social functions of a person, based on his or her subjective perception ("What is Quality of life", 1996). Quality of life is related to health (health-related quality of life) characterizes the level of well-being and satisfaction with all aspects of life affected by the disease or the process of its treatment, from the patient's point of view. The patient's condition is analyzed not only from the standpoint of the severity of the pathological process, but also in view of the impact of the disease on the possibility of self-care and his life, work, social life, psychological state, etc. (Grygus et al., 2019; Karpukhina et al., 2020; Naumenko, & Goregliad, 2017; Nesterchuk et al., 2020; Tomanek & Lis, 2020; Sulistiya, F., & Komarudin, K. (2020).

According to the WHO recommendations, the following criteria should be taken under consideration when assessing QOL:

- physical (strength, energy, fatigue, energy, pain, discomfort, sleep, rest);
- psychological (emotions, thinking, appearance, experience);
- level of independence (daily activity, ability to work, dependence on treatment and medication);
- public life (personal relationships, sexual activity, social value of the subject);
- environment (life, well-being, safety, availability and quality of medical and social care, security, environmental situation, learning opportunities, availability to information);
- spirituality (religion, personal beliefs). (Novik, Ionova, & Shevchenko, 2012).

The algorithm of making professional decisions and drawing up rehabilitation / physical therapy programs in the ICF approach significantly increases the effectiveness of the services provided. However, the analysis of the available literature revealed a very limited number of works that describe the use of this approach for the development of integrated rehabilitation / physical therapy programs for people with gunshot wounds and use quality of life assessment as a criterion for the effectiveness of rehabilitation interventions (Novik, Ionova, & Shevchenko, 2012; Grin, 2019; Kalinkina, 2019).

**Purpose of the research.** To investigate the impact of rehabilitation program on quality of people's life with forearm or hand gunshots using physiotherapy methods

### **Material & methods**

*Participants:* The study was involved 76 men with gunshot wounds of the bones of the forearm and hand. The research was conducted on the basis of the National Military Medical Clinical Center "The Main Military Clinical Hospital" in Kyiv.

Patients were randomly divided into 2 groups: the main group (38 persons) and the control group (38 persons). All participants who were engaged in the study signed an informed consent form. The study was conducted in compliance with the international principles of the Helsinki Declaration of the World Medical Association (World Medical Association, 2013) and in accordance with the Law of Ukraine "Fundamentals of Ukrainian legislation on health care" (Law of Ukraine, 1992) about ethical norms and rules of medical research with human participation. The age of persons varied from 18 to 52 years, averaging 33.8; 6.7 years ( $\bar{x}$ ; S). The duration of combat injury ranged from 6 to 18 months. Among patients, 29% had fracture injuries, 42% were fragmented,

18% had nerve damage, and 11% had tendon damage. 47% of patients had multiple injuries, 15% had isolated injuries, and 38% had combined injuries.

Patients were randomly divided into 2 groups: the main group (38 people) and the control group (38 people). The main and control groups were compared by age of patients, duration of gunshot wound and the nature of the injury

*Research methods:* in order to assess the effectiveness of rehabilitation interventions, examinations of patients were performed before the application of physical therapy measures (initial examination) and 6 months after the rehabilitation course. The following research methods were used to comprehensively assess to the quality of patients' life: measurement of the functional independence on a scale FIM (Functional Independence Measure), assessment of the capacity of the upper limb on the scale DASH (Disability of the Arm, Shoulder and Hand Outcome Measure); Hamilton's alarm scale (The Hamilton Anxiety Rating Scale (HARS), depression self-esteem scale PHQ-9 (Patient Health Questionnaire).

Functional independence scale FIM consists of 18 items that reflect the state of motor (items 1 - 13) and intellectual (items 14 - 18) functions. Each of the functions is evaluated in points - from one to seven. The total score can range from 18 to 126 points; the higher mark - the bigger independence of the patient in everyday life (Linacre, Heinemann, Wright, Granger, & Hamilton, 1994).

The DASH questionnaire consists of 30 questionnaires related to the state of hand function over the last week. Each question has 5 possible answers, evaluated in points from 1 to 5: easy - 1, difficult moderate - 2, difficult - 3, very difficult - 4, impossible - 5 (Veehof, Slegers, van Veldhoven, Schuurman, & van Meeteren, 2002). The total amount of points is calculated to assess the efficiency of the upper limb. The interpretation of results: 1 - 30 points - excellent; 31- 60 - good; 61 - 90 - satisfactory; > 91 - unsatisfactory.

The Hamilton scale contains 14 indicators, the severity of which is assessed in points: 4 - very severe, 3 - severe, 2 - moderate, 1 - mild, 0 - absent. Points are summed and evaluated as follows: the sum of points 6 or less - no symptoms of anxiety, 7 - 13 points - may be anxiety disorders, 14 -20 points - anxiety; 21 - 28 points - symptomatic anxiety, more than 29 points - a patient with severe anxiety (Hamilton, 1960).

The Scale of Depression PHQ - a module, or cluster, associated with the detection of depressive symptoms "Patient Health Questionnaire"(Patient Health Questionnaire, PHQ), which is currently used in diagnostics separately from the main questionnaire. The scale contains of 9 statements. The patient is asked to answer the question: "Have you been worried about the following problems in the last two weeks?". Each question has four possible answers, which are evaluated in points: not every day (0 points), several days (1 point), more than half a day (2 points), almost every day (3 points). The severity of depression is assessed by the sum of points: 1-4 points - minimal depression, 5-9 - mild depression, 10-14 - moderate depression, 15-19 - severe depression, 20-27 - extremely severe depression (Kroenke, Spitzer, & Williams, 2001).

*The research design.* An algorithm for the application of physical therapy measures was developed for men of the main group, which was developed on the basis of the ICF model. According to this algorithm in the process of rehabilitation for patients selected individualized measures of physical therapy aimed at maximum recovery of the patient with impaired upper limb functions, restoration of professional modes and self-care skills. Physical therapy programs included the use of various therapeutic exercises and therapeutic massage. Active-passive, voluntary-involuntary, synergistic, assisted exercises, resistance exercises, with objects, with weights, with the use of training equipment were used to restore the amplitude of movement, manipulative function of the hand and coordination of movements, muscles of the upper limb. Therapeutic massage was used to eliminate the pain syndrome, increase joint mobility, and relax muscles. The peculiarity of the method was the conduction of individual physical therapy classes focused on achieving the personal goals of patients, formed taking into account the professional orientation and hobbies.

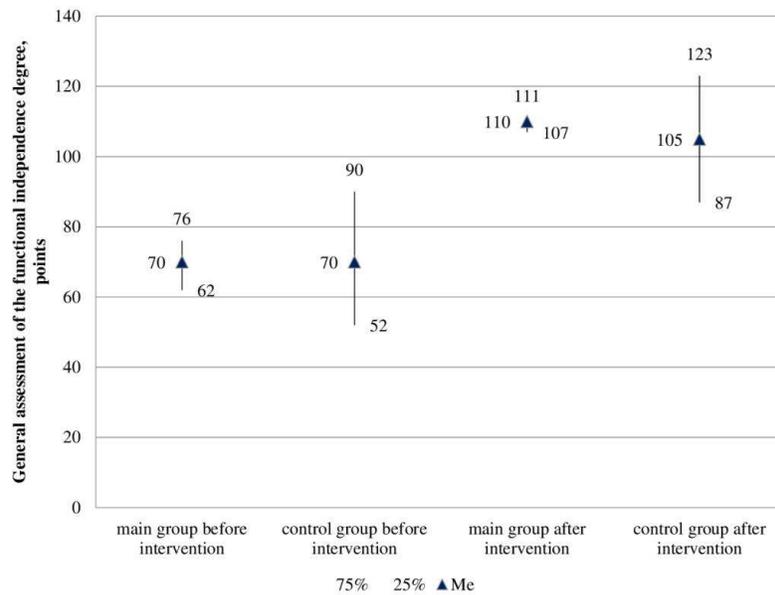
The control group used therapeutic physical exercises in the form of standardized complexes of therapeutic gymnastics, therapeutic massage, methods of hardware physiotherapy. The total duration of the rehabilitation course, the number of therapeutic exercises and massage procedures were the same for the patients of the main and control groups.

*Statistical analysis.* The analysis of the correspondence of the type of distribution of quantitative indicators of the law of normal distribution was tested by the Shapiro-Wilk test (W). For the quantitative indicators that had a normal distribution, the mean was determined ( $\bar{x}$ ) and standard deviation (S). For the metrics that had a distribution that did not fit the normal, we determined the median (Me) and the upper and lower quartiles (25%; 75%). The significance of the difference for the independent groups was evaluated using the Mann-Whitney U-test and for the dependent groups using the Wilcoxon test. Statistical analysis of the received results was conducted using the program Statistic 6.0 (StatSoft, USA).

## Results

The dynamics of the degree of functional independence of patients with gunshot wounds of the upper limbs under the influence of rehabilitation interventions was assessed on a scale FIM. Fig.1 shows the indicators of the overall assessment of the patients' functional independence in the main and control groups before and after rehabilitation.

As can be seen, functional improvement was observed in both study groups (the difference between the indicators was statistically significant compared to the previous result at the level of  $p < 0.01$ ). However, the positive dynamics in the main group was more pronounced (the difference between the indicators was statistically significant compared to the result of the control group at the level of  $p < 0.05$ ).



**Fig. 1.** Dynamics of the degree of functional patients' independence with gunshot wounds of the upper limbs under the influence of rehabilitation interventions on the FIM scale, points, Me (25%;75%)

A scale DASH was used to assess the capacity of the upper limb, DASH - Disability of the Arm, Shoulder and Hand Outcome Measure (Table 1).

**Table 1.** Dynamics of patients' life quality indicators with gunshot wounds of the upper limbs under the influence of rehabilitation interventions on DASH scale, points, Me (25%;75%)

Questions	Before intervention		After intervention	
	main group (n=38)	control group (n=38)	main group (n=38)	control group (n=38)
1. Open a tight or new jar	4(3;5)	4 (3;5)	2(2;3)**	2(2;3)**
2. Write	4(3;5)	4 (3;5)	1(1;2)**	2(2;3)**
3. Turn a key	4(3;5)	4 (3;5)	1(1;2)**	2(2;3)**
4. Prepare a meal	4(3;5)	4 (3;5)	1(1;2)**#	3(2;3)**
5. Push open a heavy door	4(3;5)	4 (3;5)	2(1;2)**	2(2;3)**
6. Place an object on a shelf above your head	4(3;5)	4 (3;5)	2(1;2)**	2(2;3)**
7. Do heavy household chores (e.g., wash walls, wash floors)	4(3;5)	4 (3;5)	2(1;2)**#	3(2;3)**
8. Garden or do yard work	3(3;5)	4 (3;5)	2(1;3)**	2(2;3)**
9. Make a bed	3(3;5)	4 (3;5)	1(1;2)**	2(2;2)**
10. Carry a shopping bag or briefcase.	4(3;5)	4 (3;5)	1(1;2)**	2(2;3)**
11. Carry a heavy object (over 10 lbs)	4(3;5)	4 (3;5)	2(1;3)**	3(2;3)**
12. Change a lightbulb overhead	4(3;5)	4(3;5)	1(1;2)**	2(2;2)**
13. Wash or blow dry your hair	4(3;5)	4(3;5)	1(1;2)**	2(2;3)**
14. Wash your back	4(3;5)	4(3;5)	1(1;2)**#	3(2;3)**

15. Put on a pullover sweater	4(3;5)	4(3;5)	1(1;2)**#	2(2;3)**
16. Use a knife to cut food	4(3;5)	4(3;5)	1(1;3)**	2(2;3)**
17. Recreational activities which require little effort (e.g., cardplaying, knitting, etc.)	4(3;5)	4(3;5)	1(1;2)**	2(2;2)**
18. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.)	4(3;5)	4(3;5)	2(1;2)**#	3(2;3)**
19. Recreational activities in which you move your arm freely (e.g., playing frisbee, badminton, etc.)	4(3;5)	4(3;5)	1(1;2)**#	2(2;3)**
20. Manage transportation needs (getting from one place to another)	4(3;5)	4(3;5)	2(1;2)**	2(2;3)**
21. Sexual activities	4(3;5)	4(3;5)	2(1;2)**	2(2;3)**
22. During the past week, to what extent has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups? (circle number)	4(3;5)	4(3;5)	2(1;3)**	2(2;3)
23. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem? (circle number)	4(3;5)	4(3;5)	1(1;2)**#	2(2;3)**
24. Arm, shoulder or hand pain	3(3;5)	3(2;5)	1(1;2)**#	2(2;3)
25. Arm, shoulder or hand pain when you performed any specific activity	4(3;5)	4(3;5)	2(1;3)**	3(2;3)**
26. Tingling (pins and needles) in your arm, shoulder or hand	3(3;4)	3(3;4)	1(1;2)**#	2(2;3)*
27. Weakness in your arm, shoulder or hand	4(3;5)	4(3;5)	1(1;2)**	2(2;3)**
28. Stiffness in your arm, shoulder or hand	4(4;5)	4(3;5)	1(1;2)**#	3(2;3)**
29. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? (circle number)	3(3;5)	4(3;5)	1(1;2)**	2(2;3)**
30. I feel less capable, less confident or less useful because of my arm, shoulder or hand problem. (circle number)	4(3;5)	4(2;5)	1(1;2)**	2(2;3)*
DASH Disability/Symptom score	115(91;149)	118(88;149)	41(31;66)**#	67(60;87)**

Note. \* - the difference between the indicators is statistically significant compared to the previous result at the level of  $p < 0,05$ ; \*\* -  $p < 0,01$ ; # - the difference between the indicators is statistically significant compared to the result of the control group at the level.

As can be seen from the data in Table 1, before the rehabilitation measures, the ability to perform most activities of daily life was assessed by patients as "difficult", "very difficult" and "impossible". After the rehabilitation course, a significant improvement in the capacity of the upper limbs was observed in both groups of patients, but in the main group it was more pronounced. Most of the activities related to the upper limb functions after the rehabilitation course were assessed by the patients of the main group as "easy" or "moderately difficult". The control group was dominated by "moderately difficult" and "difficult".

The total score Me (25%; 75%) on the DASH scale after the rehabilitation course in the main group corresponded to a grade of "good" 41 (31; 66) points), while in the control group received a result of

"satisfactory" 67 (60; 87) points), the difference between the main and control group is statistically significant at the level of  $p < 0,05$ .

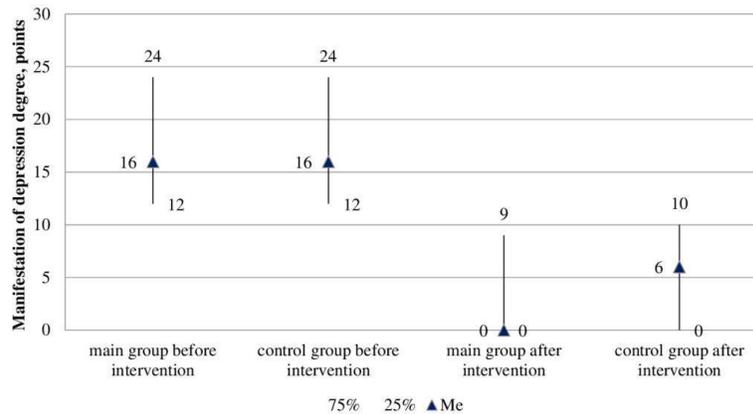
An examination of the level of anxiety on the Hamilton scale showed that before rehabilitation, patients had clinically detected anxiety. The dynamics of the indicators on the Hamilton alarm scale is shown in Table 2. As can be seen from the above data, after the course of rehabilitation in the main group in most patients no symptoms of anxiety were observed, although the condition of some patients can be described as "borderline". In the control group, despite the positive dynamics, in the vast majority of patients after the course of rehabilitation still observed anxious symptoms of varying severity (the difference between the main and control groups was statistically significant at the level of  $p < 0.05$ ).

**Table 2.** Dynamics of the patients' level of anxiety with gunshot wounds of the upper limbs under the influence of rehabilitation interventions on the Hamilton scale, points, Me (25%;75%)

Indicators	Before intervention		After intervention	
	main group (n=38)	control group (n=38)	main group (n=38)	control group (n=38)
1. Anxious mood (anxiety, expectations of the worst, anxious fears, irritability)	2(2;3)	3(2;3)	0(0;1)**#	1(1;2)**
2. Tension (feeling of tension, easily crying, trembling, feeling anxious, inability to relax)	3(2;4)	3(2;4)	0(0;2)**#	1(1;3)**
3. Fears (darkness, strangers, loneliness, animals, crowds, transport)	2(2;3)	2(2;3)	0(0;1)**#	1(1;2)**
4. Insomnia (difficulty falling asleep, intermittent sleep that does not bring rest, feelings of brokenness and weakness when waking up, nightmares)	3(2;4)	3(2;4)	1(0;2)**	1(0;3)**
5. Intellectual disorders (difficulty concentrating, memory impairment)	3(2;4)	3(2;3)	1(0;1)**	1(1;2)**
6. Depressed mood (loss of habitual interests, feelings of satisfaction from hobbies, depression, early awakenings, daily mood swings)	3(2;4)	3(2;4)	1(0;2)**	1(1;2)**
7. Somatic muscle symptoms (pain, twitching, tension, clonic convulsions, gnashing of teeth, broken voice, increased muscle tone)	3(2;4)	2(2;4)	1(0;2)**	1(1;3)**
8. Somatic sensory symptoms (ringing in the ears, blurred vision, hot and cold flushes, feeling weak, tingling)	2(2;4)	3(2;4)	0(0;2)**#	1(0;3)**
9. Cardiovascular symptoms (tachycardia, palpitations, chest pain, pulsation in the blood vessels, frequent sighs)	2(2;3)	2(2;3)	0(0;1)**	1(0;2)**
10. Respiratory symptoms (pressure and compression in the chest, shortness of breath, frequent sighs)	2(2;3)	2(2;3)	0(0;1)**	1(0;2)**
11. Gastrointestinal symptoms (difficulty swallowing, flatulence, abdominal pain, heartburn, bloating, nausea, vomiting, rumbling, diarrhea, constipation, weight loss)	2(2;3)	2(2;3)	0(0;1)**	1(0;2)**
12. Genitourinary symptoms (frequent urination, strong urge to urinate, amenorrhea, menorrhagia, frigidity, premature ejaculation, loss of libido, impotence)	2(2;3)	2(2;3)	0(0;1)**	1(0;2)*
13. Autonomic symptoms (dry mouth, redness or pallor of the skin, sweating, headaches with a feeling of tension)	2(2;3)	2(2;3)	0(0;1)**#	1(1;2)*
14. Behavior during the test (fidgeting on a chair, restless movements, tremor, tense facial expression, sighing or rapid breathing, frequent swallowing of saliva)	2(2;3)	2(1;3)	0(0;1)**	1(0;2)*
Total points	33(28;48)	34(27;47)	4(0;14)**#	14(7;32)**

Note. \* - the difference between the indicators is statistically significant compared to the previous result at the level of  $p < 0,05$ ; \*\* -  $p < 0,01$ ; # - the difference between the indicators is statistically significant compared to the result of the control group at the level of  $p < 0,05$ .

Assessment of depression on the PHQ-9 scale showed that in patients with gunshot wounds of the upper limb before the start of rehabilitation, mostly severe and extremely severe depressive symptoms were observed. The implementation of rehabilitation interventions contributed to a statistically significant improvement in the psycho-emotional state of patients in both groups (the difference is statistically significant compared to the previous result at the level of  $p < 0,01$ ). But, as can be seen from Fig. 2, the positive dynamics was better in the main group. The results obtained in the main group after the course of rehabilitation showed mostly no symptoms of depression or minimal or mild manifestations. In the control group, the proportion of patients with no depressive symptoms was smaller compared to the main group.



**Fig. 2.** Dynamics of patients' manifestations of depression with gunshot wounds of the upper limbs under the influence of rehabilitation interventions on the scale of self-assessment of depression questionnaire PHQ-9, points, Me (25%;75%)

### Discussion

Despite the fact that in our time has achieved some progress in the recovery of victims of gunshot wounds of the upper limbs, the problem of rehabilitation of the thematic contingent remains relevant (Shevchuk, Kravchenko, Beliaieva, & Yavorovenko, 2016; Ostroushko, 2017; Kalmykov, & Kalmykova, 2018).

Multifactorial, combined lesions with many complications cause long-term, persistent limitations of upper limb function, which affect the quality of self-care, independence in daily and social activities.

For the full rehabilitation for persons with the consequences of gunshot wounds requires the most successful restoration of not only morphofunctional indicators, but also such characteristics as activity and ability to participate in certain life situations. The use of the model of the International Classification of Functioning, Disability and Health in the rehabilitation process allows us to focus on the individual problems of the patient and select physical therapy measures according to his needs (Grin, 2019; Kalinkina, 2019).

One of the most important criteria for the effectiveness of physical therapy programs for people with gunshot wounds of the upper limbs is the dynamics of the patients' quality of life under the influence of rehabilitation interventions.

However, it should be noted that most of the works available for analysis on the rehabilitation of persons with gunshot wounds use a methodological approach focused on medical diagnosis, selection and implementation of measures aimed at restoring or compensating for identified structural and functional disorders. The proposed rehabilitation measures do not take into account the individual needs of the patient and his family, do not relate to his social life (the so-called medical model of rehabilitation). Instead, in last decades, there has been a paradigm shift in international practice regarding the provision of rehabilitation care and the implementation of the so-called biopsychosocial model. The main goals are to promote the well-being of the patient, improve his ability to perform tasks that arise in everyday life, ensuring maximum participation in everyday life situations (Builova, 2013).

This research evaluated the effectiveness of the approach to programming physical therapy in individuals with gunshot wounds of the upper limbs based on the ICF model, compared with the traditional approach, which involved the use of standardized sets of therapeutic exercises. The impact of rehabilitation

interventions on various aspects of patients' quality of life was considered: functional independence, upper limb capacity, levels of anxiety and depression.

Comparative analysis of research in the main and control groups showed that the developed and implemented algorithm for programming physical therapy of persons with gunshot wounds of the upper limbs has a number of advantages over the standard approach, which confirms the conclusions of Kalinkina (2019), Green (2019) on the feasibility of using the ICF model in the rehabilitation process.

In particular, the application of a biopsychosocial approach in working with patients contributed to a better recovery of self-care, daily and social activity. After the rehabilitation course, patients in the main group felt significantly fewer limitations associated with upper limb dysfunction compared with the control group, which was reflected in the FIM and DASH scales. These results are explained by the fact that the proposed approach allowed the rehabilitation process to focus not only on restoring strength, amplitude and coordination of movements of the affected limbs, but also on restoring lost self-care skills and achieving personal goals of patients. At the same time, the increasing in activity in everyday life had a positive effect on the mental state of people with gunshot wounds of the upper limbs, in particular under the influence of rehabilitation measures in patients of the main group significantly reduced anxiety and depression. These data are generally consistent with the data of Stevelink, Malcolm, Mason, Jenkins, Sundin, and Fear (2015) prevalence of mental health disorders in military personnel with a combat trauma and with the data of Ivashchenko, Shakhlina, and Lazareva (2016) about the positive effect of physical activity on the mental state of persons with combat injuries and supplement the data of Allami, Yavari, Karimi, Masoumi, Soroush, and Faraji (2017), Epstein, Heinemann, and McFarland (2010) about the indicators of combatants' quality of life.

### Conclusions

1. The complex nature of gunshot wounds of the upper limbs and the high frequency of their complications cause difficulties in choosing the tactics of rehabilitation. Physical therapy is an integral part of the rehabilitation of wounded with gunshot wounds to the upper extremities, but the problem of physical therapy in gunshot wounds is not sufficiently understood in specialized sources, the use of modern approaches with emphasis on the International Classification of Functioning, Disability and Health don't have suitable practical development.

2. An initial examination of 76 men with gunshot wounds of the bones of the forearm and hand showed that the injury resulted in reduced quality of life: patients had significant limitations in various activities of daily living, decreased functional independence, accompanied by high levels of anxiety and depressive disorders.

3. Comparative analysis of the main and control groups in the dynamics of rehabilitation treatment showed that the use of the developed algorithm of physical therapy based on the ICF model significantly improved various aspects of quality of life of patients with gunshot wounds of the forearm and hand and was more effective than the standard approach.

### References

- Allami, M., Yavari, A., Karimi, A., Masoumi, M., Soroush, M., & Faraji, E. (2017). Health-related quality of life and the ability to perform activities of daily living: a cross-sectional study on 1079 war veterans with ankle-foot disorders. *Military Medical Research*, 4(1), 37. <https://doi.org/10.1186/s40779-017-0146-1>
- Bondar, A., Tomanek, M. Menedžment pozaškil'nih navčal'nih zakladiv fizkul'turno-sportivnogo naprâmu (eng. Management of extracurricular educational institutions of physical culture and sports direction), Bydgoszcz 2018.
- Builova, T. V. (2013). Mezhdunarodnaya klassifikatsiya funkcionirovaniya kak klyuch k ponimaniyu filosofii reabilitatsii [International classification of functioning as a key to understanding the philosophy of rehabilitation]. *Journal MediAl*, 2(7), 26–31.
- Buryanov, O. A., Strafun, S. S., Shpalak, I. P., Laksha, A. M., Hadushko, O. A., Yarmoliuk, Yu. O., ... & Lykhodii, V. V. (2015). *Vohnepalni poranennia kintsivok. Travmatychnyi shok* [In the fires of the wounds of the pictures. Traumatic shock]. Kyiv.
- Buryanov, O. A., Laksha, A. A., Borzykh, N. O., & Shydlovskiy, M. S. (2018). Biomekhanichno obgruntovane khirurhichne likuvannia poranenykh z vohnepalnymy perelomamy dovhykh kistok [Biomechanically substantiated surgical treatment of the wounded persons with the gun-shot fractures of long bones]. *Klinichna khirurgiia. January*, 85(1), 67–70. <https://doi.org/10.26779/2522-1396.2018.01.67>
- Bykov, I. Iu., Efimenko, N. A., Gumanenko, E. K. (Ed.) (2009). *Voенno-polevaya hirurgiya (natsionalnoe rukovodstvo)* [Military Field Surgery (National Guide)]. Moscow: GEOTAR-Media.
- Efimenko, N. A., Shapovalov, V. M., Dulaev, A. K., Baranovskii, A. M., Retunskikh, V. P., Ivanov, P. A., & Dydykin, A. V. (2003). Harakteristika boevoy travmy i lechebnyie meropriyatiya pri ognestrelnykh perelomah dlinnykh kostey konechnostey [Characteristics of combat trauma and therapeutic measures for gunshot fractures of the long bones of the extremities]. *Military Medical Journal*, (5), 4–12.

- Epstein, R. A., Heinemann, A. W., & McFarland, L. V. (2010). Quality of life for veterans and servicemembers with major traumatic limb loss from Vietnam and OIF/OEF conflicts. *Journal of rehabilitation research and development*, 47(4), 373–385. <https://doi.org/10.1682/jrrd.2009.03.0023>
- Gaida, I. M., Badyuk, M. I., & Sushko, Yu. I. (2018). Osoblyvosti struktury ta perebihu suchasnoi boiovoi travmy u viiskovosluzhbovtziv Zbroinykh Syl Ukrainy [Peculiarities of structure and current of modern combat trauma among servicemen of the Armed Forces of Ukraine]. *Pathologia*, 15(1), 73–76. <https://doi.org/10.14739/2310-1237.2018.1.129329>
- Grin, S. O. (2019). *Fizychna reabilitatsiia viiskovosluzhbovtziv z naslidkamy vohnepalnykh perelomiv kistok homilky* [Physical rehabilitation of servicemen with the consequences of gunshot fractures of the shin bones]. (Extended abstract of candidate's thesis). National University of Ukraine on Physical Education and Sport, Kyiv.
- Grygus I., Nesterchuk N., Zukow W., Nikolenko O., Prymachok L. (2019). The quality of life in COPD patients in the process of physical rehabilitation. *Journal of Physical Education and Sport*, Vol. 19 (issue 2), Art 163, pp. 1126–1132. DOI:10.7752/jpes.2019.02163
- Hamilton, M. (1960). A rating scale for depression. *Journal of neurology, neurosurgery, and psychiatry*, 23(1), 56–62. <https://doi.org/10.1136/jnmp.23.1.56>
- Ivashchenko, S. N., Shakhlina, L. Ya.-G., & Lazareva, O. B. (2016). Osoblyvosti pobudovy fazovoi modeli fizychnoi reabilitatsii viiskovosluzhbovtziv, shcho postrazhdaly vnaslidok boiovykh dii [Peculiarities of designing the phased model of physical rehabilitation of servicemen injured as a result of military operations]. *Scientific Journal of National Pedagogical Dragomanov University. Series 15. Scientific and pedagogical problems of physical culture (physical Culture and Sports)*, (3(72)), 63–67.
- Kalinkina, O. D. (2019). *Fizychna reabilitatsiia osib iz vohnepalnymy perelomamy proksymalnoho viddilu plechovoi kistky* [Physical rehabilitation of persons with gunshot fractures of the proximal humerus]. (Extended abstract of candidate's thesis). National University of Ukraine on Physical Education and Sport, Kyiv.
- Kalmykov, S., & Kalmykova, Y. (2018). Aktualni pytannia fizychnoi terapii pry vohnepalnykh ushkozhdzhenniakh diafizu plecha [Topical issues of physical therapy for gunshot lesions of the diaphysis of the shoulder]. *Slobozhanskyi herald of science and sport*, 1(64), 24–30. <https://doi.org/10.15391/snsv.2018-1.004>
- Karpukhina Yu., Vasylieva N., Grygus I., Muszkieta R., Zukow W. (2020). Study of quality of life and effectiveness of physical therapy of women after mastectomy in the COVID-19 pandemic conditions. *Balne Research Journal*. 11(3):315-322. DOI 10.12680/balneo.2020.359
- Kleinlugtenbelt, Y. V., Nienhuis, R. W., Bhandari, M., Goslings, J. C., Poolman, R. W., & Scholtes, V. A. (2016). Are validated outcome measures used in distal radial fractures truly valid? A critical assessment using the COnsensus-based Standards for the selection of health Measurement Instruments (COSMIN) checklist. *Bone & joint research*, 5(4), 153–161. <https://doi.org/10.1302/2046-3758.54.2000462>
- Kordonska, A., & Hurnyak, I. (2018). Efficient use of common resources in conditions of sustainable development. *Torun International Studies*, 1(11), 75-87. doi: <http://dx.doi.org/10.12775/TIS.2018.007>
- Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *Journal of general internal medicine*, 16(9), 606–613. <https://doi.org/10.1046/j.1525-1497.2001.016009606.x>
- Law of Ukraine Fundamentals of the Ukrainian Legislation on Health Care. No 2802-XII (1992). Retriever from <https://zakon.rada.gov.ua/laws/show/2801-12#Text>
- Linacre, J. M., Heinemann, A. W., Wright, B. D., Granger, C. V., & Hamilton, B. B. (1994). The structure and stability of the Functional Independence Measure. *Archives of physical medicine and rehabilitation*, 75(2), 127–132.
- Lis, A., Tomanek, M. (2021). Mapping the intellectual and conceptual structure of physical education research: Direct citation analysis. *Physical Education of Students*, 2021;25(2):67–84. <https://doi.org/10.15561/20755279.2021.0201>
- Loskutov, O. Ye., Zherdev, I. I., Domanskyi, A. M., & Korol, S. O. (2016). Khirurhichna taktyka likuvannia vohnepalnykh poranen kintsivok v umovakh bahatoprofilnoi likarni [Surgical management of gunshot wounds of extremities in multiprofiled hospital]. *Travma*, 17(3), 169–172. <http://dx.doi.org/10.22141/1608-1706.3.17.2016.75804>
- Lysun, D. M. (2019). *Poshkodzhennia kintsivok vnaslidok suchasnykh boiovykh dii: kliniko-epidemiolohichniy analiz* [Damage to the extremities as a result of modern hostilities: a clinical and epidemiological analysis]. (Candidate's thesis). SI «Institute of Traumatology and Orthopedics of the National Academy of Medical Sciences of Ukraine». Kyiv.
- Naumenko, L. Y., & Goregliad, O. M. (2017). Doslidzhennia yakosti zhyttia patsientiv pid chas likuvannia vohnepalnykh ran kintsivok shliakhom nakladannia nehatyvnoho tysku [Quality of Life Assessment for

- Patients with Negative Pressure Therapy of Ballistic Injuries of the Extremities]. *Modern medical technologies*, (3),60–64.
- Nesterchuk N., Grygus I., Ievtukh M., Kudriavtsev A., Sokolowski D. (2020). Impact of the wellness programme on the students' quality of life. *Journal of Physical Education and Sport*, Vol 20 (Supplement issue 2), Art 132 pp 929–938.
- Novik, A. A., Ionova, T. I. & Shevchenko, Iu. L. (2012). *Rukovodstvo po issledovaniyu kachestva zhizni v meditsine* (3rd ed.) [A guide to the study of quality of life in medicine]. Moscow: Publishing House of the Russian Academy of Natural Sciences.
- Ostroushko, O. (2017). Osoblyvosti fizychnoi reabilitatsii pry vohnepalnykh poranenniakh plechovoho suhloba [Physical rehabilitation peculiarities during shotgun injures of shoulder joint]. *Theory and Methods of Physical Education and Sports*, (2), 59–62. <https://doi.org/10.32652/tmfvs.2017.2.59-62>
- Shevchuk, V. I., Kravchenko, V. V., Beliaieva, N. M., & Yavorovenko, O. B. (2016). *Osoblyvosti medyko-socialnoyi ekspertyzy ta reabilitaciyi invalidiv vijskovoyi sluzhby ta uchasnykiv antyterrorystychnoyi operaciyi* [Features of medical and social examination and rehabilitation of disabled military service and participants of the antiterrorist operation]. Vinnitsa.
- Stevellink, S. A., Malcolm, E. M., Mason, C., Jenkins, S., Sundin, J., & Fear, N. T. (2015). The prevalence of mental health disorders in (ex-)military personnel with a physical impairment: a systematic review. *Occupational and environmental medicine*, 72(4), 243–251. <https://doi.org/10.1136/oemed-2014-102207>
- Sulistiya, F., & Komarudin, K. (2020). The relation between emotional quotients (EQ) towards physical education performance in junior high school in Yogyakarta. *Quality In Sport*, 6(2), 64-71. doi:<http://dx.doi.org/10.12775/QS.2020.013>
- Tomanek, M., & Lis, A. (2020). Managing information on the physical education research field: Bibliometric analysis. *Physical Education of Students*, 24(4), 213-226. <https://doi.org/10.15561/20755279.2020.0404>
- Veehof, M. M., Slegers, E. J., van Veldhoven, N. H., Schuurman, A. H., & van Meeteren, N. L. (2002). Psychometric qualities of the Dutch language version of the Disabilities of the Arm, Shoulder, and Hand questionnaire (DASH-DLV). *Journal of hand therapy : official journal of the American Society of Hand Therapists*, 15(4), 347–354. [https://doi.org/10.1016/s0894-1130\(02\)80006-0](https://doi.org/10.1016/s0894-1130(02)80006-0)
- What quality of life? The WHOQOL Group. World Health Organization Quality of Life Assessment. (1996). *World health forum*, 17(4), 354–356.
- World Medical Association (2013). World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA*, 310(20), 2191-2194. <https://doi.org/10.1001/jama.2013.281053>