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Correspondence address: Ukraine, 61022, Kharkiv, Nauky Avenue, 4.
E-mail: ic.journal@knmu.edu.ua
as.shevchenko@knmu.edu.ua
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EDITORIAL

QUESTIONNAIRE-BASED ASSESSMENT FOR MONITORING THE CONDITION OF FEMALE POLE-ACROBATICS ATHLETES: CLUSTER AND CORRELATION ANALYSES

Zharova I.O., Antonova H.P.

National University of Physical Education and Sports of Ukraine, Kyiv, Ukraine

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ABSTRACT

Background. Monitoring the functional state of athletes undergoing intense asymmetric loads, as in pole acrobatics, traditionally relies on comprehensive instrumental assessments (dynamometry, bioimpedance, electromyography) that must be repeated several times. However, these methods are expensive, time-consuming, and poorly suited for frequent use, especially during rehabilitation for identified dysfunctions or injuries. This necessitates the development of accessible and reliable tests.

Aim. To determine the validity of replacing repeated instrumental studies of athletes' functional state (electrophysiological, strength, visual) with a questionnaire during their rehabilitation.

Materials and Methods. A retrospective analysis of archival data from 20 female pole acrobatics athletes (aged 23–40 years) was conducted. The analysis included 58 instrumental parameters from previous studies (dynamometry, bioimpedance analysis, surface and stimulation electromyography, photogrammetry) and 50 questionnaire responses. Due to the non-normal distribution of the data, non-parametric methods were applied: hierarchical cluster analysis (Ward's method) and Spearman's rank correlations. The cluster analysis grouped the questionnaire items and instrumental parameters into five meaningful domains that fully corresponded to the instrumental constructs: strength indicators, body morphology, postural symmetry, neuromuscular activation, and neuromuscular excitability.

Results. Within the clusters, fifteen stable and strong correlations were identified ($|\rho|=[0.60–0.88]$; $p<0.05$), which demonstrates the high convergent validity of the questionnaire. The most informative items were found to be Nos.25, 48, 49 (for strength); Nos.27, 23 (for body composition); Nos.1, 2 (for posture); Nos.20, 29 (for surface EMG); and Nos.41, 40 (for stimulation EMG).

Conclusions. The developed questionnaire captures variations in key physiological indicators and can replace repeated instrumental assessments when monitoring the condition of female athletes' post-rehabilitation.

Keywords: *bioimpedance analysis, surface and stimulation electromyography, postural indices, strength imbalance.*

Abbreviations

%FAT – Percentage of Fat And Tissue.
A/F – Amplitude/Frequency ratio.
ATSI – Anatomical Transverse Section Index.
BMR – Basal Metabolic Rate.
CMAP – Compound Muscle Action Potential.
EMG – ElectroMyoGraphy.
FAI – Frontal Asymmetry Index.
FFM – Fat-Free Mass.
HDI – Height Difference Index.
POTSI – Posterior Overall Trunk Shift Index.
RPE – Rating of Perceived Exertion.
TBW – Total Body Water.

Corresponding Author:
Antonova Hanna P. – PhD Student at the Department of Physical Therapy and Occupational Therapy, National University of Physical Education and Sports of Ukraine, Kyiv.
✉ Ukraine, 03150, Kyiv, Fizkultury str., 1.
E-mail: antonovapolesport@gmail.com

Introduction

Pole acrobatics is a coordinatively complex sports discipline that combines elements of gymnastics, acrobatics, and dance [1–6]. It places unique demands on the physical fitness of athletes, requiring simultaneous display of high levels of static and dynamic strength, flexibility, and specific endurance [7; 8]. Due to its biomechanical complexity and the load on the musculoskeletal

system, it is often compared to Olympic sports such as artistic gymnastics, particularly exercises on the parallel bars and rings [3; 9–12].

A key feature that distinguishes pole acrobatics is the pronounced asymmetrical nature of the loads [6; 13]. During training and competitions, athletes systematically use the dominant side of the body to perform pulling and holding elements, while the non-dominant side more often serves a supportive function [6]. Such a chronic, unilateral nature of training stimuli is a powerful factor leading to specific adaptive changes in the body. This phenomenon is well-studied in other asymmetrical sports, such as tennis, fencing, baseball (especially in pitchers), and many martial arts [14–22]. Long-term asymmetrical loads can lead not only to morphofunctional specialization but also to the formation of persistent muscle imbalances, which, in turn, are considered one of the leading risk factors for overuse injuries [23–26].

Our previous research, which forms the basis for this study, was dedicated to a comprehensive analysis of these adaptive processes [13; 27–30].

We quantitatively documented that long-term practice of pole acrobatics leads to multifaceted changes:

1) *morphological*, when a local increase in muscle mass and thickness was observed on the dominant side of the body, which is a direct structural reaction to a specific load;

2) *functional*, when a significant strength imbalance was found between the right and left limbs, reaching up to 12% in some athletes and persisting even after many years of training;

3) *neuromuscular*, when, using EMG, we recorded stable differences in the patterns of bioelectrical activity in paired muscles, indicating a long-term adaptation of the central nervous system to asymmetrical motor tasks;

4) *postural*, within which visual and photogrammetric screening revealed the presence of persistent postural deviations (e.g., asymmetry in shoulder height), which is reflected in specialized indices such as HDI and FAI.

Traditionally, an entire arsenal of instrumental methods, considered the "gold standard" in sports science, is used for the objective assessment of these parameters [31–33]. This includes dynamometry for measuring strength, bioimpedance analysis for body composition, surface EMG for assessing muscle activation, and photogrammetry for posture analysis [34–38]. Despite their high accuracy, this approach has significant limitations: it is expensive, requires specialized equipment and qualified personnel, and the assessment of a single athlete can be very time-consuming [39–42]. This makes instrumental methods poorly suited for frequent, routine monitoring, especially during rehabilitation from injuries, where continuous tracking of recovery progress is crucial.

In response to these challenges, sports science is actively seeking simpler, more accessible, and cost-effective monitoring tools. Questionnaires and surveys have long been successfully used to assess subjective aspects of an athlete's condition [43–47]. Numerous studies confirm a high correlation between athletes' subjective ratings (e.g., the Rating of Perceived Exertion scale) and objective physiological markers [48–51]. Questionnaires are effectively used for monitoring overtraining, stress, and recovery. However, most existing questionnaires are focused on assessing general condition and do not account for the specific asymmetrical changes that are a key issue in pole acrobatics [52–54].

The **aim** of the study was to determine the validity of replacing repeated instrumental studies of the functional state of athletes (electrophysiological, strength, visual) during their rehabilitation with questionnaire questions.

Materials and Methods

This study employed a retrospective correlational design based on the analysis of a pre-existing dataset. No new instrumental measurements were conducted at the current stage of work. The analysis included archival data from 20 professional female pole acrobatics athletes, aged 23–40 (mean age was [33.5±10.5] years), who had muscle and postural asymmetries identified during the study. These asymmetries were not accompanied by any pain sensations other than fatigue from intensive training. All participants had at least 18 months of systematic training and, at the time of the initial assessment, mean training experience – [6.7±4.9] years, had no acute injuries that could affect the results. These and other characteristics of female athletes are shown in *Table 1*.

The dataset used included the results of a questionnaire and five instrumental methods: bioimpedance analysis, dynamometry, photogrammetry, and surface and stimulation electroneuromyography. These methods were applied to measure parameters of posture, symmetry, and strength, which are detailed in the authors' previous publications.

1. Assessment of neuromuscular excitability.

The first step in assessing the athletes' functional state was the evaluation of peripheral nerve

Table 1. Characteristics of the study group

Characteristic	Value
Age, years	33.5±10.5
Training experience, years	6.7±4.9
Body mass, kg	59.1±10.4
Weekly training time, min	384±216
Stature, cm	168.5±18.5

conduction using stimulation myography with the Neuro-MEP-Micro system (DX Systems, Ukraine). This method allowed for the identification of baseline nervous system characteristics that underlie muscle function. The procedure involved stimulating nerves at the wrist and elbow to record the Compound Muscle Action Potential (CMAP). Key parameters such as latency, amplitude, and potential area were evaluated, enabling the detection of initial signs of asymmetry in functional activity between the right and left arms. The results, method, and features of its application are described in [13].

2. Assessment of neuromuscular activation.

Next, for a more in-depth analysis of muscle function, their bioelectrical activity was examined using an 8-channel surface electromyography (sEMG) system (Neurosoft, Ukraine). Signals were recorded from 12 paired muscles of the trunk and shoulder girdle, both at rest and during standardized functional tests that mimicked specific movements from pole acrobatics. Analysis of the peak amplitude (A_{max}) and the integral amplitude/frequency ratio (A/F) helped identify patterns of muscle imbalance and compensatory mechanisms developed through training. Publication [28] describes the results, method, and features of its application.

3. Body composition analysis.

To understand how functional asymmetries relate to structural changes, a body composition analysis was performed using the segmental bioimpedance analyzer Tanita MC-780 MA (Tanita Corp., Japan). This method allowed not only for the determination of general indicators like %FAT and FFM but also for a detailed assessment of the distribution of these components and the electrical impedance for each arm, leg, and the trunk separately. The results confirmed the presence of structural differences between the right and left sides of the body, indicating an uneven distribution of loads. For a detailed description of the results, method, and application, see publication [27].

4. Strength assessment.

The next logical step was the quantitative assessment of strength, as it is the final outcome of neuromuscular and structural organization. For this, the dynamometric system Back-Check 607 (Dr. Wolff, Germany) was used. The protocol included eight standardized static tests that modeled key movements in pole acrobatics, particularly lateral trunk flexions and various types of arm movements. This approach provided objective data on the peak and average force for the right and left sides, which was crucial for testing the hypothesis of strength asymmetry. A detailed account of the results, methodology, and specifics of its application is provided in publication [30].

5. Postural assessment.

The final stage of the instrumental diagnostics was a comprehensive analysis of postural symmetry using the photogrammetric system APECS-Clinic (Saneftec, France). This visual screening integrated all previous data to assess how the identified neuromuscular, structural, and strength characteristics manifest in the athlete's overall posture. The system automatically calculated several objective asymmetry indices, such as HDI, FAI and POTSI, providing a holistic picture of postural balance. The results of the study, the methodology used, and the specifics of its application are detailed in publication [29].

Each athlete completed a specially designed 50-item questionnaire aimed at the subjective assessment of their functional state and perception of asymmetry (see *Fig. 1*).

For statistical data processing, hierarchical cluster analysis, Ward's method with Euclidean distance as the measure of dissimilarity, was applied. The purpose of this stage was to group variables (instrumental and questionnaire-based) into meaningful groups, or clusters, that would reflect key physiological domains (e.g., "strength", "morphology", "posture", etc.).

Within each identified cluster, Spearman's rank correlation coefficient (ρ) was used to assess the strength and direction of the relationship between subjective responses and objective indicators. Associations were considered statistically significant at $|\rho| \geq 0.60$ with a significance level of $p<0.05$ for a sample size of $n=20$. This threshold ($|\rho| \geq 0.60$) was chosen to highlight only the strongest and most practically significant relationships.

The Statistica 10.0 (Statsoft, USA) was used for statistical data processing. In total, 58 instrumental variables and 50 questionnaire scores for each of the 20 participants were included in the analysis.

Functional-status assessment questionnaire for female pole-acrobatics athletes

Before you begin, identify and remember which side of your body is dominant. The dominant arm is the one you normally use for pulling, hanging, pull-ups, or actively controlling a pole element. The dominant leg is the leg on the same side as the dominant arm. The non-dominant arm is regarded as the supporting arm. All subsequent questions refer to differences between the dominant and non-dominant arms.

Instructions: rate each statement on a scale from 1 to 10, where:

1 = not felt at all … 10 = felt very strongly / constantly / clearly.

1. I feel that one shoulder is positioned higher than the other.
2. I notice a tilt of the torso toward the dominant or non-dominant side.
3. I experience greater load on one leg during prolonged standing.
4. During symmetrical elements my body feels asymmetrically controlled.
5. My back appears more arched or flattened on one side.
6. In a passive hang I maintain balance better with one side.
7. I sense that one side of the trunk is more involved in stabilization.
8. Post-exercise soreness occurs more often in the dominant-shoulder region.
9. The back on the dominant side feels tighter or denser.
10. One arm has a superior ability to support or push.
11. Back muscles fatigue more on one side.
12. In static exercises one arm tires more quickly.
13. In strength movements one side activates more strongly and assumes a larger share of the load.
14. I rely more on one arm for balance.
15. In prolonged static poses one side controls the position better.
16. After exercises with symmetrical loading fatigue is perceived on one side.
17. During an exercise the muscles do not always respond immediately, and I do not feel their activation.
18. During transitions between movements one arm reacts more slowly.
19. At times one side of the muscles activates with a delay or shows a slowed response.
20. Touch or support with one hand feels less distinct.
21. Under load one arm engages with a noticeable delay.
22. In backbends or bridges one side of the trunk feels more flexible.
23. I perceive a greater volume or weight of muscles on one side.
24. When performing tricks one arm or leg tolerates the load better.
25. My non-dominant arm always activates better during elements requiring a supporting function.
26. I feel reduced control of trunk stability on one side.
27. In weight-bearing leg positions one leg controls movement less effectively.
28. After training, the muscles on one side feel more "pumped" or heavier.
29. Transitions between elements are easier on one side.
30. When balance is lost I compensate more frequently with one side.
31. In prolonged static poses one side controls the position better.
32. After exercises with symmetrical loading fatigue is perceived on one side.
33. When looking in a mirror, one clavicle appears noticeably higher than the other.
34. I sense that the pelvis "sags" more on one side.
35. I observe that the ribs protrude asymmetrically on the left and right.
36. In forward flexion one side of the spine bulges more.
37. Mild tingling appears sooner in one arm after hanging.
38. After a brief skin contact the sensation subsides more slowly on one side.
39. During rapid grip changes one hand responds more weakly.
40. Sometimes the signal to the muscles of one leg arrives with a delay.
41. During dynamic combinations one side of the back begins to tremble sooner.
42. In isometric holds the scapula on one side pulses unpleasantly.
43. During a quick transition from hang to support one pectoral muscle contracts more noticeably.
44. I feel spasms only on one side of the lower back after leg raises.
45. One leg feels "heavier" after prolonged sitting.
46. In handstands I feel greater muscle tension in one arm.
47. During a handstand it is easier to keep balance toward the dominant side.
48. After an intense workout, either the left or the right pectoral muscle feels bulkier.
49. During asymmetric elements involving pulling and support one arm loses stability more quickly.
50. During a rapid lift into an element one arm moves less synchronously or more slowly.

Fig. 1. Questionnaire for self-assessment of functional asymmetries.

In the first stage, all variables were tested for normality of distribution using the Shapiro-Wilk test. The results showed that the distribution of all indicators was significantly different from normal ($W=[0.81–0.96]$; $p<0.05$). This justified the need to use non-parametric, "distribution-free" statistical methods.

The study was conducted in compliance with the ethical standards and principles of the Declaration of Helsinki. All participants signed an informed consent to participate in the study.

Results

The developed questionnaire is intended to become a reliable and valid alternative to comprehensive instrumental assessment, allowing for quantitative demonstration that athletes' subjective responses reliably reflect objective changes in their bodies. This opens the prospect of creating a scientifically validated, shortened version of the questionnaire that can be used for frequent, inexpensive, and effective monitoring, which is particularly important during rehabilitation and for injury prevention.

To do this, we used a popular two-stage statistical approach [55–58]. First, using cluster analysis, we grouped the objective and subjective data into meaningful clusters to verify whether the questionnaire items correspond to key physiological constructs (strength, morphology, etc.). Then, within each cluster, we calculated Spearman's rank correlations between each question and its corresponding instrumental parameter to assess the strength and significance of their relationship. This approach, in full or in part, has been previously used in a number of studies that have demonstrated its validity [43; 56; 59]. Such a study design [43; 60–63] allows us not just to assume, but to quantitatively demonstrate that the subjective responses of athletes reliably reflect objective changes in their bodies. This opens the prospect of creating a scientifically validated, shortened version of the questionnaire that can be used for frequent, inexpensive, and effective monitoring, which is particularly important for rehabilitation and injury prevention [64–67].

The primary task of our analysis was to understand if an internal logical structure exists within the dataset, which combined objective instrumental parameters and the subjective responses of the athletes. For this, we applied hierarchical cluster analysis, a statistical method that allows for the grouping of variables based on their similarity.

The results of the analysis, presented as dendrograms (*Figures 2–6*), revealed five distinct and meaningfully interpretable clusters. Importantly, these clusters naturally grouped the instrumental parameters with their corresponding questionnaire items by content (*Table 2*).

This served as the first significant piece of evidence that the questionnaire measures the same physiological constructs as the instrumental methods.

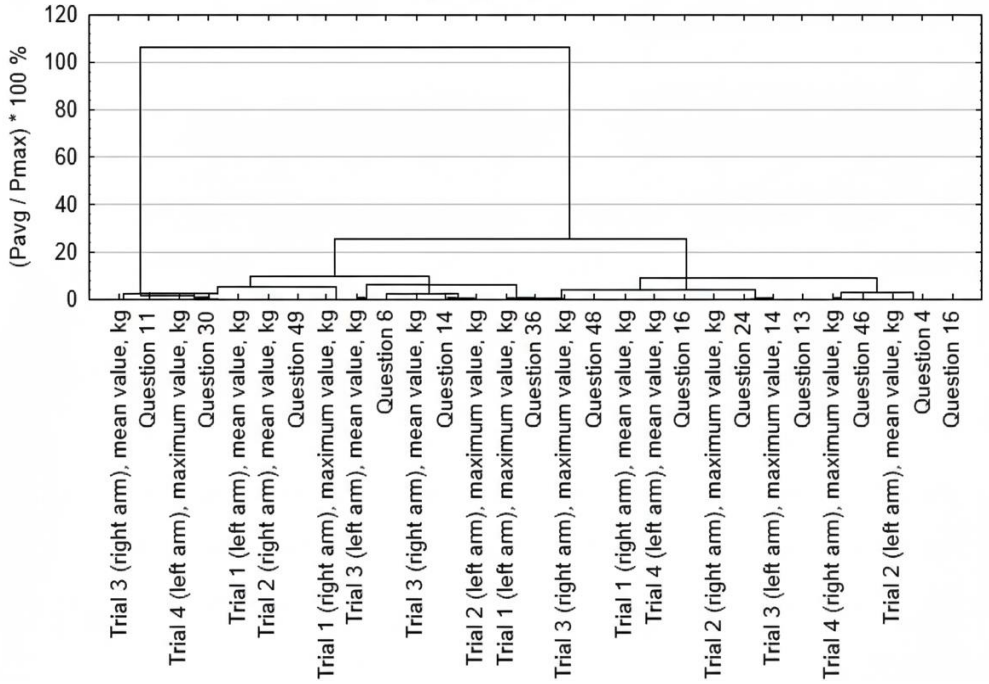

Fig. 2. Cluster 1 (Strength metrics, Back-Check).

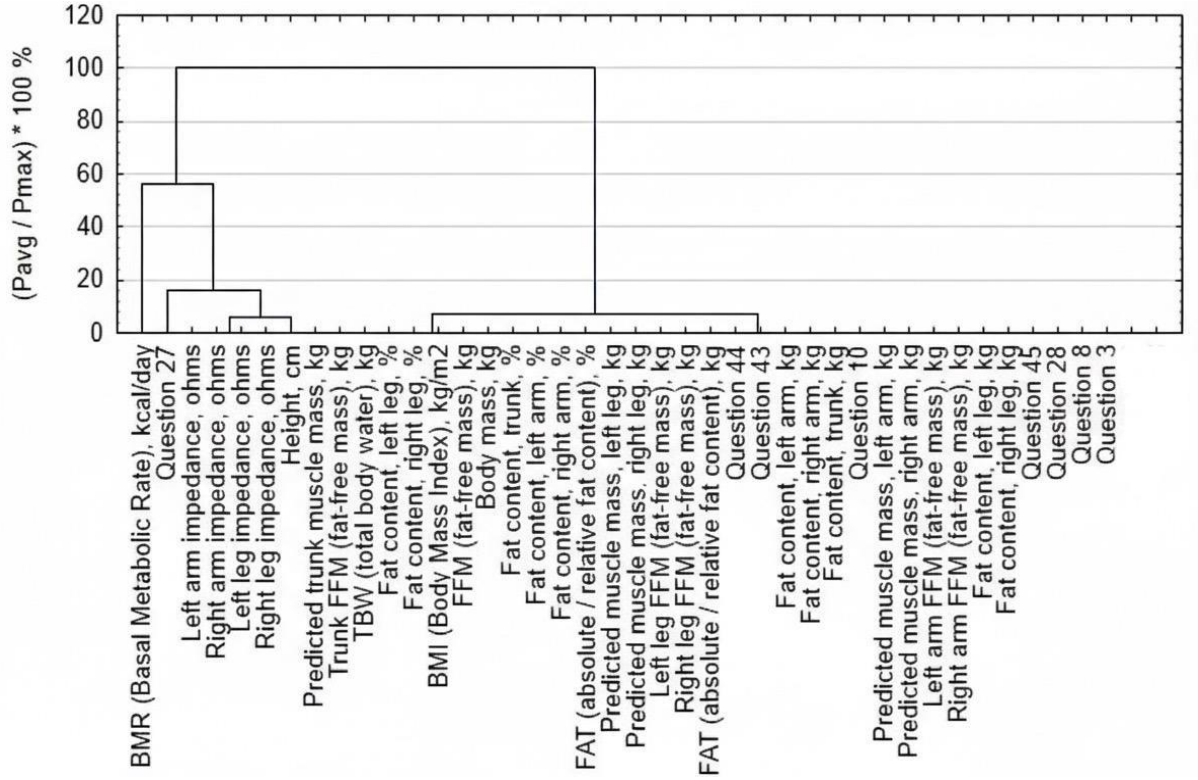

Fig. 3. Cluster 2 (Body composition, Tanita).

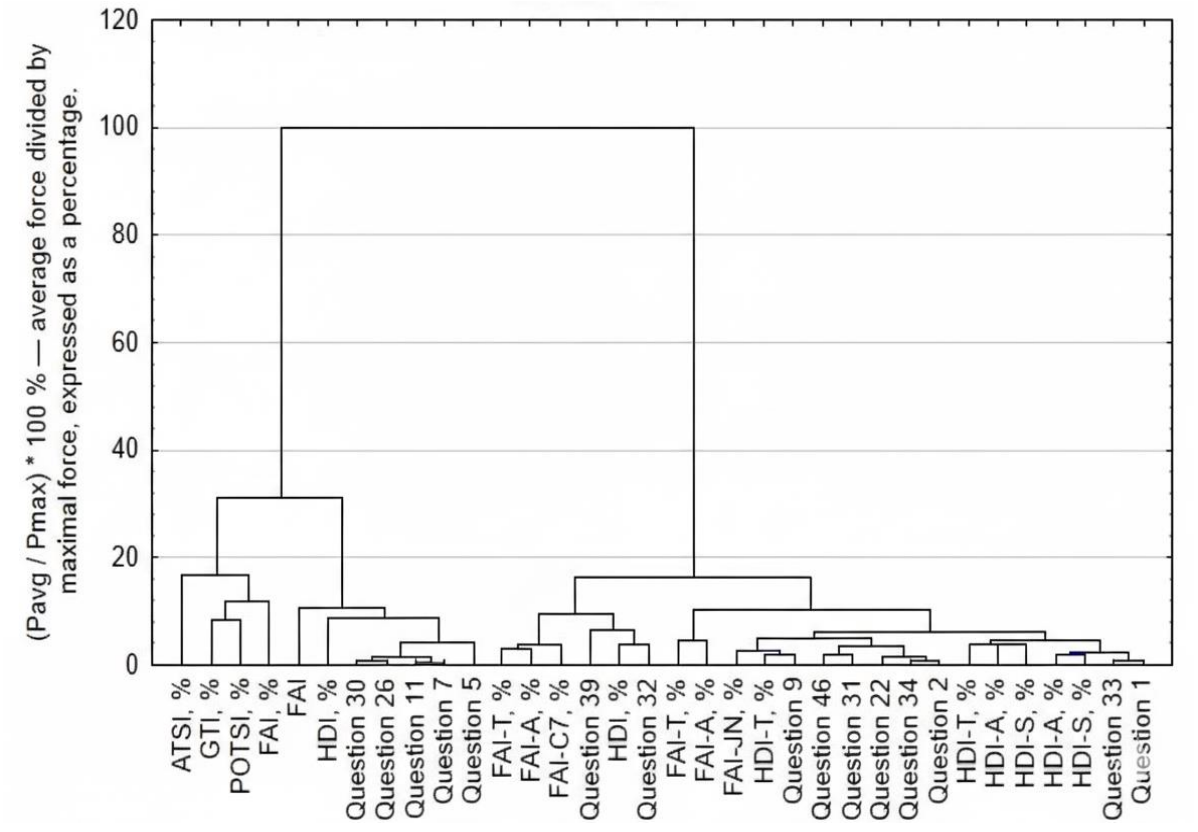

Fig. 4. Cluster 3 (Postural symmetry, visual screening).

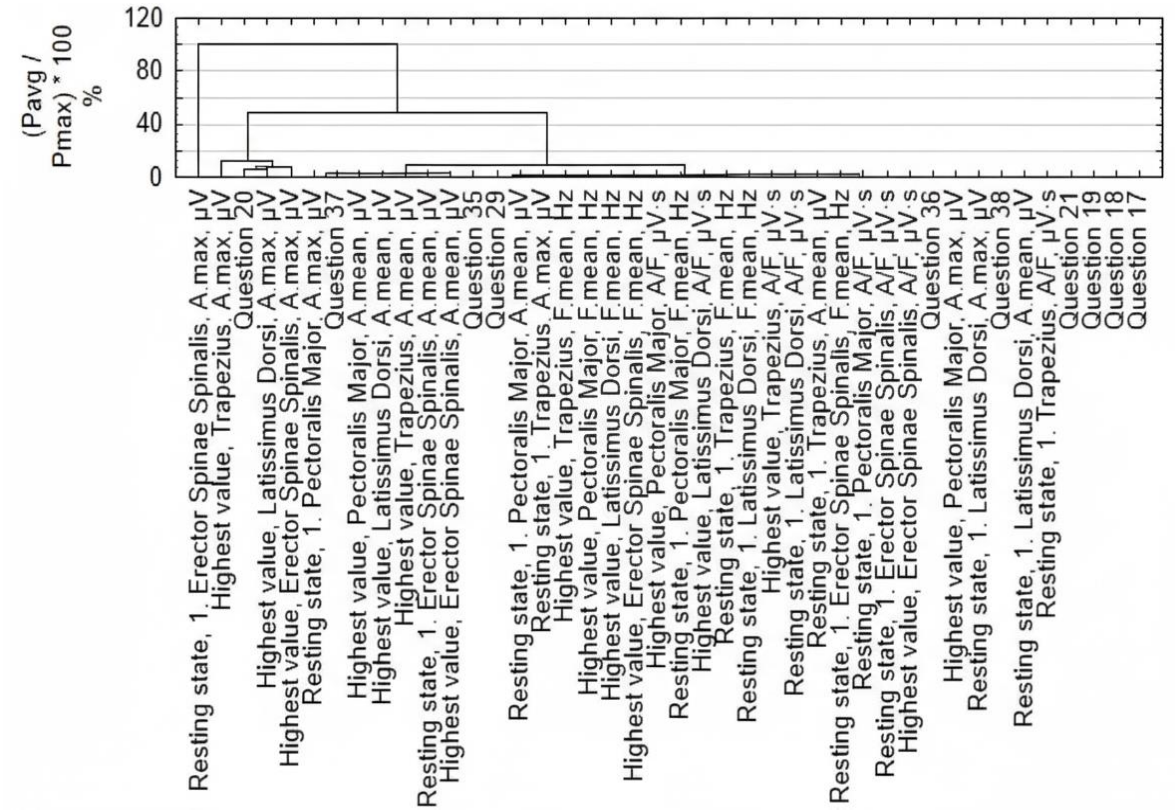

Fig. 5. Cluster 4 (Neuromuscular activation, surface EMG).

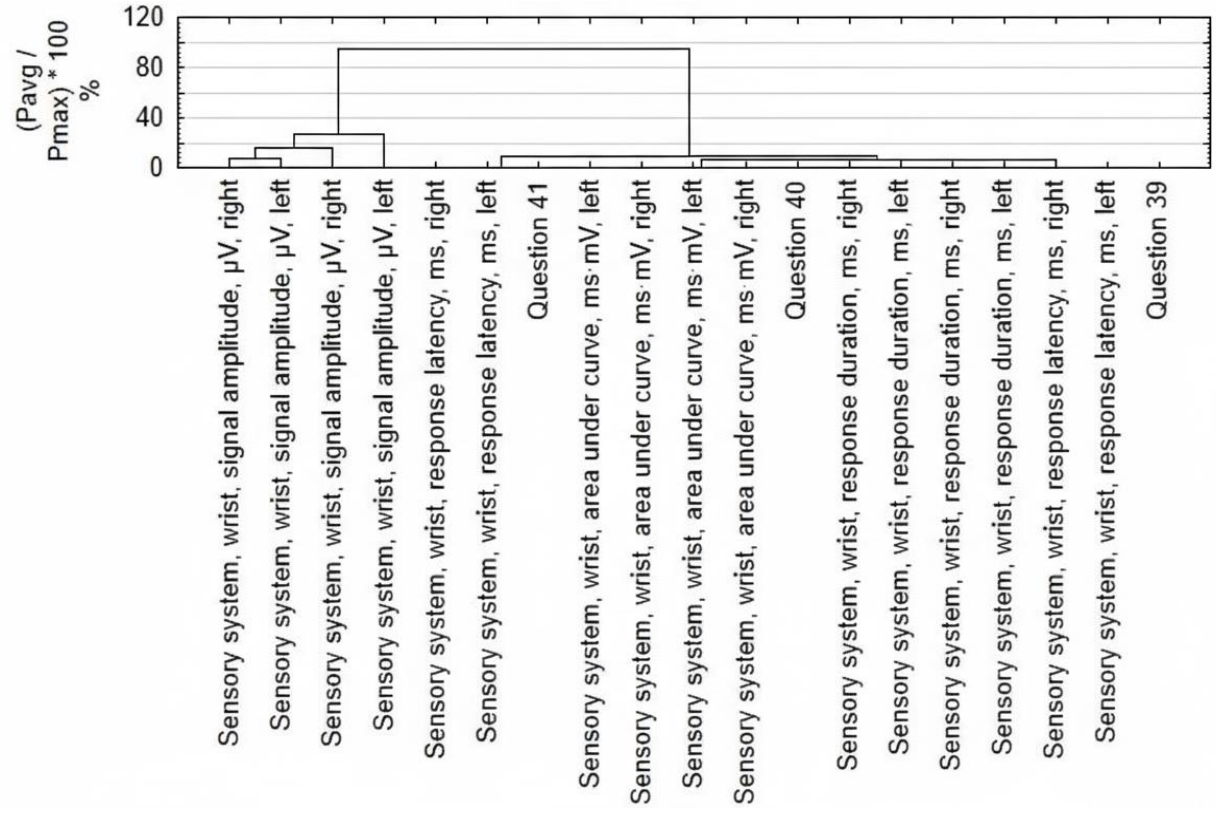

Fig. 6. Cluster 5 (Neuromuscular excitability, stimulation myography)

Table 2. Cluster structure obtained from hierarchical analysis and the corresponding indicative questionnaire items

No.	Cluster	Key variables	Indicative questionnaire items
1	Strength metrics (Back-Check)	Maximum / mean force in 8 trials	4, 6, 25, 48, 49
2	Body composition (Tanita)	Body mass, BMR, TBW, %FAT, segmental impedance	10, 23, 27, 44
3	Postural symmetry (visual screening)	HDI-S, HDI-A, FAI-A/C7, ATSI, POTSI	1, 2, 5, 32, 46
4	Neuromuscular activation (surface EMG)	A/F index and A_{max} of m. trapezius, m. latissimus dorsi, m. pectoralis muscles	20, 29, 35, 37
5	Neuromuscular excitability (stimulation myography)	Latency, amplitude, and area of the CMAP at the wrist	40–42

The formed clusters were named according to the nature of the variables they contained:

Cluster 1 "Strength Indicators" combined the results of the Back-Check dynamometry and questionnaire items related to the subjective perception of strength and strength imbalance (items 4, 6, 25, 48, 49).

Cluster 2 "Body Composition" included data from the bioimpedance analysis (body mass, % fat, segmental impedance) and questions reflecting the perception of one's own anthropometric data (items 10, 23, 27, 44).

Cluster 3 "Postural Symmetry" grouped objective postural asymmetry indices obtained from the visual screening and questionnaire items describing the sensation of trunk tilt and shoulder girdle asymmetry (items 1, 2, 5, 32, 46).

Cluster 4 "Neuromuscular Activation" combined surface EMG parameters (activity of the trapezius, latissimus dorsi, and pectoral muscles) and questions related to the sensation of muscle tone and fatigue (items 20, 29, 35, 37).

Cluster 5 "Neuromuscular Excitability" included parameters from stimulation myography (latency and amplitude of CMAP) and questions concerning muscle reaction speed and sensory perceptions (items 40–42).

Thus, the cluster analysis confirmed our initial hypothesis: the developed questionnaire possesses high construct validity, as its internal structure fully replicates the logic of a comprehensive instrumental assessment.

The next step was to determine not just the presence but also the strength of the relationship between subjective ratings and objective data within each cluster. For this, we calculated Spearman's rank correlation coefficients. The analysis revealed a series of statistically significant and strong correlations, which confirmed the high convergent validity of the questionnaire. The most indicative and informative relationships are presented in *Table 3*.

In the strength cluster (Cluster 1), very high positive correlations were found. For example, responses to item 48 ("After an intense workout, either the left or the right pectoral muscle feels bulkier".) had a correlation coefficient of $\rho=0.80$ with the objective measure of right-arm strength in the lateral abduction test. Item 25 ("My non-dominant arm always activates better during elements requiring a supportive function") also strongly correlated with right-arm strength ($\rho=0.79$). This directly indicates that the athletes' subjective feelings about the strength and function of their arms reliably reflect the real, instrumentally measured strength imbalance.

In the body composition cluster (*Cluster 2*), item 27 ("In positions supported by the legs, one leg has worse motor control") showed an extremely high correlation with objective body mass ($\rho=0.82$). Strong negative correlations were also found: for instance, item 10 ("One arm has a more developed ability for support and push-off") was closely related to the electrical impedance of the left leg ($\rho=–0.79$). This suggests that athletes are capable of subjectively assessing not only their overall mass but also specific features of their body composition that affect bioimpedance parameters.

In the postural cluster (*Cluster 3*), the highest coefficients in the entire study were obtained. Item 1 ("I feel that one shoulder is higher than the other") demonstrated a very high correlation with the vertical shoulder asymmetry index HDI-S ($\rho=0.88$).

Table 3. Selected highest Spearman rank correlations within clusters (<0.05)

Cluster	Questionnaire item	Instrumental metric	ρ (Spearman)
1	25	Trial 1 (right), kg	0.79
	48	Trial 4 (right), kg	0.80
	49	Trial 2 (left), kg	0.70
2	27	Body mass, kg	0.82
	23	BMR, kcal × day⁻¹	0.77
	10	Impedance, left leg, Ω	–0.79
	44	FAT, %	–0.67
3	1	HDI-S, %	0.88
	5	HDI-A, %	0.76
	2	FAI-A, %	0.74
4	20	A/F m. latissimus (rest)	–0.87
	29	A/F m. pectoralis (load)	–0.86
	35	A/F m. pectoralis (rest)	0.79
5	41	Latency (wrist R), ms	0.71
	40	CMAP amplitude (wrist R), μV	–0.62

Notes: all listed correlations are statistically significant; only the most informative pairs are shown;
Trials 1, 2 and 4 – static-dynamometry positions in the Back-Check test:
- Trial 1 – trunk lateral flexion;
- Trial 2 – arm flexion in pronation;
- Trial 4 – lateral abduction in supination;
- kg – kilograms, absolute force;
- BMR – Basal Metabolic Rate, kcal × day⁻¹;

Ω – ohms, electrical impedance of the body segment in bioimpedance analysis;
FAT % – percentage Body-Fat Content;
HDI-S – Height Difference Index – Shoulders (vertical difference between shoulder points);
HDI-A – Height Difference Index – Axillae (vertical difference between axillary points);
FAI-A – Frontal Asymmetry Index – Axillae (frontal trunk asymmetry at axillary level);
A/F – Amplitude-to-Frequency ratio (integrated EMG amplitude ÷ mean frequency);
m. latissimus / m. pectoralis – musculus latissimus dorsi / musculus pectoralis major;
Latency – time from electrical stimulus to CMAP onset, ms;
ms – milliseconds;
μV – microvolts.

This is an extremely important result, showing that a simple questionnaire item can, with high accuracy, replace the complex procedure of photogrammetric analysis for a screening assessment of posture.

In the neuromuscular activation and excitability clusters (*Clusters 4* and *5*), strong relationships were also identified. For example, item 20 ("Touch or support with one arm is less 'perceptible'") was strongly negatively correlated with the activity of the latissimus dorsi muscle at rest (A/F, ρ=–0.87). This means that the lower the subjective sensitivity, the higher the objective muscle activity, which may indicate chronic tension.

Therefore, the high correlation coefficients obtained (ranging from |ρ| of 0.62 to 0.88) within each cluster provide compelling evidence that the developed questionnaire can accurately capture variations in objective parameters. This justifies its potential use as a standalone tool for monitoring the condition of athletes. Thus, the questionnaire enables effective regular monitoring of athletes' condition without complex equipment.

Based on the results of the cluster analysis, the most significant questions of the questionnaire were identified and an abbreviated version of the questionnaire was proposed as part of the most important questions (*Fig. 7*).

Questionnaire for Self-Assessment of Functional Asymmetries

Cluster 1: Strength Indicators
1. (No.25) My non-dominant arm always activates better during elements requiring a supporting function.
2. (No.48) After an intense workout, either the left or the right pectoral muscle feels bulkier.
3. (No.49) During asymmetric elements involving pulling and support one arm loses stability more quickly.

Cluster 2: Body Composition (Morphology)
4. (No.27) In weight-bearing leg positions one leg controls movement less effectively.
5. (No.23) I perceive a greater volume or weight of muscles on one side.
6. (No.10) One arm has a superior ability to support or push.
7. (No.44) I feel spasms only on one side of the lower back after leg raises.

Cluster 3: Postural Symmetry (Posture)
8. (No.1) I feel that one shoulder is positioned higher than the other.
9. (No.5) My back appears more arched or flattened on one side.
10. (No.2) I notice a tilt of the torso toward the dominant or non-dominant side.

Cluster 4: Neuromuscular Activation (Surface EMG)
11. (No.20) Touch or support with one hand feels less distinct.
12. (No.29) Transitions between elements are easier on one side.
13. (No.35) I observe that the ribs protrude asymmetrically on the left and right.

Cluster 5: Neuromuscular Excitability (Stimulation EMG)
14. (No.41) During dynamic combinations one side of the back begins to tremble sooner.
15. (No.40) Sometimes, the signal to the muscles in one of my legs arrives with a delay.

Fig. 7. Questionnaire for Self-Assessment of Functional Asymmetries (Shortened Version)

Discussion

The main objective of this study was to develop and validate a specialized questionnaire that could serve as an effective and cost-efficient alternative to expensive instrumental monitoring of the functional state of female pole acrobatics athletes. The results obtained are compelling and open new prospects for the practical application of this tool in sports medicine and rehabilitation.

The central finding of our study is the empirical validation that the subjective feelings of athletes, captured by the questionnaire, are grounded in a strong objective basis. This conclusion is supported by extensive reviews showing that subjective self-reports often reflect acute and chronic training loads with greater sensitivity and consistency than many objective instrumental measures [43]. Studies demonstrate that well-designed questionnaires are not just a low-cost alternative but are also a reliable independent tool for monitoring [61]. The cluster analysis procedure clearly grouped 108 variables into five meaningful domains that fully replicated the logic of a comprehensive instrumental assessment. This indicates the high construct validity of the questionnaire: its items genuinely measure the physiological aspects (strength, morphology, posture, etc.) they were designed to evaluate.

The results of the correlation analysis, in turn, demonstrated high convergent validity. The strong correlations identified, particularly the significant coefficient of ρ=0.88 between the question about shoulder asymmetry and the objective HDI-S index, are extremely important. They show that a well-formulated question can serve as a reliable and accurate proxy marker for a parameter that typically requires specialized photogrammetric equipment to measure. Similar strong relationships were found in other domains, confirming that the questionnaire reliably captures variations in all key physiological areas affected by asymmetric loads.

The findings have significant practical implications. The proven validity of the questionnaire allows it to be recommended for several tasks:

1. *Effective monitoring during rehabilitation*. Instead of conducting multiple expensive instrumental assessments to track recovery progress, coaches and physical therapists can use the questionnaire at practically no cost. This allows for more frequent and prompt data collection without significant expense, thereby improving control over the rehabilitation process.

2. *Screening and early diagnosis*. The questionnaire can be used as a primary screening tool to identify at-risk athletes with pronounced asymmetries. Exceeding certain threshold values on the

questionnaire can serve as a signal to conduct a more in-depth instrumental assessment.

3. *Optimization of the training process*. Regular administration of the questionnaire allows for tracking the body's response to training loads and timely adjustment of the program to prevent the worsening of imbalances.

The study was **limited** to a small sample size (n=20), which did not reveal strong correlations. Furthermore, the study was focused exclusively on a female sample of pole acrobatics athletes. Further validation of the questionnaire in other populations, particularly males, is necessary, as is its adaptation and testing for effectiveness in other asymmetric sports.

Conclusions

This study led to the development and validation of a specialized questionnaire for monitoring the functional state of female athletes in pole acrobatics.

1. It was demonstrated that the 50 questionnaire items, through cluster analysis, group into five meaningful domains: strength balance, body composition, postural symmetry, neuromuscular activation, and neuromuscular excitability. This structure fully corresponds to the five areas of a comprehensive instrumental assessment, confirming the high construct validity of the questionnaire.

2. Spearman's rank correlation analysis revealed 15 stable and strong relationships ($|\rho|=[0.60–0.88]$; $p<0.05$) between the questionnaire responses and objective instrumental parameters. This indicates the high convergent validity of the tool: the athletes' subjective assessments reliably reflect their actual functional state.

3. Based on the analysis, the most informative items for each domain were identified. This allows for the use of a shortened, 15-item version of the questionnaire for rapid monitoring without compromising its prognostic value.

4. The high validity indicators support the conclusion that repeated comprehensive instrumental assessment when monitoring rehabilitation progress can be entirely replaced by the questionnaire. Instrumental methods should be reserved for cases where the questionnaire results indicate critical deviations from the norm.

Thus, the developed questionnaire is a reliable, valid, and cost-effective tool that can be recommended for wide implementation in the practice of sports medicine and physical therapy.

Our **future research** will focus on investigating the posture, symmetry, and muscle strength of pole-acrobatics athletes with the use of the shortened 15-item questionnaire.

DECLARATIONS

Disclosure Statement

The authors declare that there is no conflict of interest that could have influenced the study’s results.

Data Transparency

All data generated during the study can be made available upon reasonable request from the corresponding author.

Ethics Statement

No ethical standards were violated in the course of this research. All participants took part voluntarily on a volunteer basis and provided written informed consent.

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Consent for Publication

Both authors confirm their consent to publish this article and guarantee that there are no violations of copyright.

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LIRAGLUTIDE AS A MEANS OF MODIFYING CARDIOMETABOLIC RISK IN PATIENTS WITH ARTERIAL HYPERTENSION AND CONCOMITANT OBESITY

Dunaieva I.P.

Kharkiv National Medical University, Kharkiv, Ukraine

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ABSTRACT

Background. Arterial Hypertension (AH), in combination with OBesity (OB), significantly increases cardiometabolic risk, leading to the development of cardiovascular events, chronic kidney disease, and metabolic disorders. In such patients, the effectiveness of standard antihypertensive therapy may be insufficient, which requires the use of drugs with pleiotropic action.

Aim. To assess the effectiveness of liraglutide, Glucagon-Like Peptide-1 Receptors Agonist (GLP-1RA), as a component of combination therapy in patients with AH and OB, with the determination of its effect on cardiometabolic status, functional state of the kidneys, heart and neurohumoral regulation.

Materials and Methods. The study involved 62 patients with AH and OB who received liraglutide at a dose of up to 3.0 mg/day for 12 months. The dynamics of anthropometric, biochemical, hormonal, hemodynamic, and echocardiographic parameters were assessed. Statistical processing was performed using the Statistica 13.0 package (StatSoft Inc., USA).

Results. During the treatment, a significant decrease in systolic and diastolic blood pressure, body mass index, insulin levels, leptin, Cardiotrophin-1 (CTF-1), N-terminal propeptide of brain natriuretic hormone (NT-proBNP), as well as an improvement in the lipid profile were observed. According to echocardiography, regression of myocardial hypertrophy and improved systolic and diastolic function of the left ventricle was recorded. Positive but insignificant dynamics of functional renal parameters were noted.

Conclusions. Liraglutide demonstrates a pronounced multicomponent efficacy in patients with hypertension and obesity, reducing leptin resistance and improving neuroendocrine regulation and metabolic and hemodynamic profile. Our findings suggest that it can be used in complex therapy to modify cardiometabolic risk.

Keywords: *leptin, GLP-1RA, N-terminal propeptide of brain natriuretic hormone, cardiohemodynamics.*

Abbreviations

AH – Arterial Hypertension;
BMI – Body Mass Index;
CTF-1 – Cardiotrophin-1;
Cys C – Cystatin C;
DBP – Diastolic Blood Pressure;
DM2 – Type 2 Diabetes Mellitus;
GFR – Glomerular Filtration Rate;
GLP-1 – Glucagon-Like Peptide-1;
GLP-1RA – Glucagon-Like Peptide-1 receptor agonist;
HDL – High Density Lipoproteins;
HDL-C – High-Density Lipoprotein Cholesterol;
IVST – Interventricular Septum Thickness;
LA – Left Atrium;
LAESD – Left Atrial End-Systolic Dimension;
LDL – Low Density Lipoproteins;
LVEDD – Left Ventricular End-Diastolic Dimension;
LVEF – Left Ventricle Ejection Fraction;
LVESD – Left Ventricular End-Systolic Dimension;
LVMM – Left Ventricule Myocardium Mass;
LVMMI – Left Ventricle Myocardium Mass Index;
LVMMI1 – Left Ventricle Myocardium Mass Index (relative to body area);

Corresponding Author:
Dunaieva Inna – MD, PhD, Docent, Associate Professor of the Department of Clinical Pharmacology and Internal Medicine, Kharkiv National Medical University, Ukraine.
✉ Ukraine, 61022, Kharkiv, Nauky ave., 4.
E-mail: ip.dunaieva@knmu.edu.ua

LVMMI2 – Left Ventricular Mass Index ` (adjusted for height to the power of 2.7);
LVPWT – Left Ventricular Posterior Wall Thickness;
LVRWT – Left Ventricle Relative Wall Thickness;
NT-proBNP – N-Terminal pro-Brain Natriuretic Peptide;
OB – Obesity;
RA – Right Atrium;
RAD – Right Atrium Diameter;
RV – Right Ventricle;
RVD – Right Ventricle Diameter;
SBP – Systolic Blood Pressure;
TC – Total Cholesterol;
TG – Triglycerides;
VA – Velocity Atrial, Late Diastolic Filling Velocity, A-wave);
VE – Velocity, Early, Peak Early Diastolic Filling Velocity, E-wave;
VE/VA – Early to Late Diastolic Filling ratio (E/A ratio).
VLDL – Very Low Density Lipoproteins.

Introduction

The combination of AH and OB is one of the most common forms of cardiometabolic comorbidity, which is accompanied by a significant increase in the risk of cardiovascular complications, chronic kidney disease, and premature mortality [1–3]. OB produces a pathogenetic effect on blood pressure by activating the renin-angiotensin-aldosterone and sympathoadrenal systems, increasing insulin resistance, and developing systemic inflammation and endothelial dysfunction [4]. In conditions of excessive body weight, the effectiveness of antihypertensive therapy is often reduced, which necessitates the search for drugs with a multi-component mechanism of action.

One of the promising areas of pharmacotherapy in this category of patients is the use of drugs that affect not only individual symptoms but also key links in the pathogenesis of cardiometabolic disorders [5; 6]. Liraglutide is a human Glucagon-Like Peptide-1 (GLP-1) receptor agonist approved for treating DM2 and OB, demonstrating powerful pleiotropic effects. The mechanism of action of liraglutide consists of stimulation of insulin secretion in a glucose-dependent manner, inhibition of glucagon secretion, gastric emptying deceleration, and appetite reduction by affecting the satiety centers in the hypothalamus [7–9].

Clinical studies have shown that liraglutide contributes to a significant reduction in body weight, blood pressure, and both SBP and DBP, as well as improves the lipid profile and inflammation markers. Its effect on blood pressure is due to a decrease in sympathetic activity, increased sensitivity to sodium, improved endothelial function, and reduced arterial stiffness. It is important that liraglutide does not cause hypotension in patients with normal or moderately elevated blood pressure, which makes it safe for use in patients with comorbid pathology [8].

In addition, liraglutide demonstrated cardioprotective properties in the LEADER (Liraglutide Effect and Action in Diabetes: Evaluation of Cardiovascular Outcome Results) study, reducing the incidence of cardiovascular events in patients with DM2. These effects are partly associated with weight loss, improved glycemic control, and direct effects on the myocardium and blood vessels [10; 11].

The relevance of studying the effectiveness of liraglutide in patients with a combination of AH and obesity is due to the need for an individualized approach to treatment and the desire to reduce overall cardiometabolic risk. This drug has the potential to be integrated into a comprehensive therapeutic strategy aimed at both lowering blood pressure and modifying the metabolic profile of patients.

The study **aimed** to determine the effectiveness of liraglutide in the complex therapy of patients with arterial hypertension and concomitant obesity by assessing its effect on cardiometabolic status, renal function, neurohumoral regulation, and systemic hemodynamics.

Materials and Methods

The study involved 62 patients (35 men and 27 women) with combined AH and OB who were under outpatient observation at the polyclinic of the State Institution "National Institute of Therapy named after L.T. Mala, NAMS of Ukraine". The mean age of the patients was [53.52±9.24] years.

Diagnostic criteria for AH verification were based on the recommendations of the European Society of Cardiology (ESC, 2021); OB was defined according to the World Health Organization (WHO, 1997) classification by BMI ≥30 kg/m².

Exclusion criteria were the presence of acute infectious or inflammatory conditions, systemic autoimmune or oncological diseases, symptomatic AH, pathology of the hypothalamic-pituitary system, severe renal function impairment (GFR <35 ml/min/1.73 m²), established diabetes mellitus, drug or alcohol addiction, COVID-19, acute cardiovascular events (myocardial infarction,

stroke) in the history within the recent 6 months, pregnancy or belonging to vulnerable social groups.

The clinical study was conducted in accordance with the ethical standards of biomedical research involving humans as set out in the Declaration of Helsinki and was approved by the Bioethics Committee of Kharkiv National Medical University. Each study participant provided written informed consent to participate.

The treatment strategy involved the administration of Liraglutide as a component of combination therapy. The drug was administered subcutaneously, starting at a dose of 0.6 mg with subsequent titration to 3.0 mg/day depending on individual tolerability and achievement of target BMI. In addition, the patients received basic antihypertensive therapy (perindopril 2–8 mg once daily) and hypolipidemic therapy (rosuvastatin [10–20] mg/day).

Before starting the study, none of the patients received GLP-1 drugs or medications for OB treatment. The choice of liraglutide was justified by the discrepancy between body weight and expected indicators when using only non-drug agents, as well as the need to modify cardiometabolic risk following the recommendations of the European Society of Cardiology (ESC, 2023) and the American Diabetes Association (ADA, 2023).

The patient examination program before the start and 12 months after therapy included determining the following indicators: glycated hemoglobin (HbA1c), insulin, BMI, TC, HDL and LDL, VLDL, TG, serum creatinine, leptin, insulin, CTF-1, NT-proBNP and Cys C. Commercial test systems were used according to the manufacturer's instructions for biochemical measurements. GFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula, taking into account creatinine and Cys C, according to the recommendations of Kidney Disease: Improving Global Outcomes (KDIGO, 2021):

$$eGFRcr-cys = 135 \times \times \min\left(\frac{Scr}{\kappa}, 1\right)^{\alpha} \times \times \max\left(\frac{Scr}{\kappa}, 1\right)^{-0.544} \times \times \min\left(\frac{Scys}{0.8}, 1\right)^{-0.323} \times \times \max\left(\frac{Scys}{0.8}, 1\right)^{-0.778} \times \times 0.9961^{Age} \times 0.963 \text{ (for women)} \quad (1),$$

where

Scr – standardized creatinine level (mg/dl),

κ – coefficient (0.7 – for women; 0.9 – for men),

α – exponent (–0.219 – for women; –0.144 – for men),

Scys – cystatin C concentration (mg/l),

Age – patient age.

In addition, all patients had their blood pressure measured, SBP and DBP, under standard conditions.

An echocardiographic examination was performed according to the protocols of the European Association of Cardiovascular Imaging (EACVI, 2016). The parameters assessed included LVMMI, LA and RA dimensions, LA end-systolic dimensions, LVEDD and LVESD, RV dimensions, IVST and LVPWT, LVMM, LVMMI2, LVRTW, LVEF, early diastolic filling velocity (VE), late diastolic filling velocity (VA) as well as their ratio (VE/VA).

Statistical data processing was performed using Statistica 13.0 (StatSoft Inc., USA). Quantitative indicators were presented as mean ± standard deviation (M±SD). Distribution normality was tested using the Shapiro-Wilk test. To assess changes before and after treatment, paired Student's t-test or Wilcoxon test (in case of deviation from normal distribution) was used. Correlations were assessed by Spearman's coefficient. Changes were considered statistically significant at $p<0.05$.

Results

The study assessed the changes in the main clinical, laboratory, and instrumental parameters in patients with AH and concomitant OB. The analysis included a comparison of data before the start of treatment and after 12 months of therapy. The findings obtained allow for characterizing the effectiveness of the selected therapeutic approach in terms of metabolic profile, cardiovascular adaptation, and functional state of the kidneys (*Table 1*).

Table 1 shows that 12-month therapy with liraglutide in patients with combined AH and OB resulted in significant positive changes in most of the evaluated parameters. First of all, a significant decrease in both SBP from [144.74±10.08] mm Hg to [132.58±8.92] mm Hg ($p<0.001$) and DBP from [89.76±9.32] mm Hg to [83.12±8.14] mm Hg ($p<0.001$) was noted, which indicates an antihypertensive effect of the drug, probably due to its effect on the sympathoadrenal system, natriuretic mechanism and improvement of endothelial function.

Table 1. Effect of a 12-month course of liraglutide treatment on cardiometabolic and renal parameters in patients with arterial hypertension and obesity (n=62)

Indices	Before treatment	After treatment	p
SBP, mm Hg	144.74±10.08	132.58±8.92	<0.001
DBP, mm Hg	89.76±9.32	83.12±8.14	<0.001
BMI, kg/m^2	34.25±2.85	29.75±2.41	<0.001
TC, mmol/l	5.43±1.6	4.62±1.22	<0.01
HDL-C, mmol/l	1.28±0.35	1.45±0.32	<0.05
TG, mmol/l	1.87±0.7	1.37±0.54	<0.01
VLDL, mmol/l	0.81±0.3	0.68±0.28	>0.05
LDL, mmol/l	3.2±1.46	2.41±1.27	<0.01
Leptin, ng/ml	27.68±14.46	19.42±12.34	<0.001
CTF-1, ng/ml	1021.76±130.83	887.42±121.46	<0.01
Insulin, mIU/ml	17.77±9.63	13.03±8.18	<0.01
HbA1c, %	5.95±0.92	5.49±0.74	<0.05
Creatinine, μmol/l	92.45±16.26	86.21±14.38	>0.05
GFR, ml/min/1.73m^2	68.91±11.02	74.35±10.11	>0.05
NT-proBNP, ng/ml	456.88±152.59	388.26±137.64	<0.05
Cys C, ng/ml	145.31±40.83	129.74±36.27	>0.05

An important clinical achievement is a significant decrease in body mass index from [34.25± ±2.85] kg/m² to [29.75±2.41] kg/m² (p<0.001), indicating the effectiveness of liraglutide as a means of correcting body weight in obese patients, even in the absence of diabetes. The positive dynamics of body weight was accompanied by an improvement in lipid metabolism indicators: a decrease in TC from [5.43±1.6] mmol/l to [4.62±1.22] mmol/l (p<0.01); a decrease in LDL-C from [3.2±1.46] mmol/l to [2.41±1.27] mmol/l (p<0.01); a decrease in TG – from [1.87±0.7] mmol/l to [1.37± ±0.54] mmol/l (p<0.01); and an increase in HDL-C – from [1.28±0.35] mmol/l to [1.45±0.32] mmol/l (p<0.05). The decrease in VLDL-C concentration did not reach a significant level (p> >0.05), which may be due to the variability of the indicator in the patients.

Hormonal changes reflecting a decrease in leptin resistance and an improvement in insulin sensitivity are indicative: leptin concentration decreased from [27.68±14.46] ng/ml to [19.42± ±12.34] ng/ml (p<0.001), and insulin level decreased from [17.77±9.63] mIU/ml to [13.03± ±8.18] mIU/ml (p<0.01). The decrease in HbA1c from [5.95±0.92] % to [5.49±0.74] % (p<0.05) also confirms the effect of the drug on carbohydrate metabolism, even in individuals without a diagnosis of DM2. Another important aspect is the effect of the therapy on neurohumoral and cardiometabolic markers. The decrease in CTF-1 levels from [1.021.76±130.83] ng/ml to [887.42± ±121.46] ng/ml (p<0.01) and NT-proBNP from [456.88±152.59] ng/ml to [388.26±137.64] ng/ml (p<0.05) indicates a decrease in myocardial load and improved neurohumoral adaptation, which is important in patients with hypertension and overweight.

Against the background of therapy, a positive, albeit statistically insignificant, dynamics of renal function markers was observed: creatinine level decreased from [92.45±16.26] μmol/l to [86.21± ±14.38] μmol/l (p>0.05) and the GFR according to the CKD-EPI formula increased from [68.91± ±11.02] ml/min/1.73 m² to [74.35±10.11] ml/min/ 1.73 m² (p>0.05). Similarly, the decrease in Cys C concentration from [145.31±40.83] ng/ml to [129.74±36.27] ng/ml (p>0.05) indicates a trend of improving renal filtration capacity, which requires further studies with a larger sample size.

Thus, the results obtained confirm the multifactorial positive effect of liraglutide on the clinical and metabolic status of patients with AH and concomitant OB. The detected changes include not only correction of BP, body weight, lipid and carbohydrate metabolism but also a decrease in the levels of hormonal and neurohumoral markers associated with high cardiometabolic risk. At the same time, an important aspect of the comprehensive assessment of the effectiveness of therapy is the study of the structural and functional state of the heart. For this purpose, changes in cardiohe-

modynamic parameters were analyzed according to the echocardiography results presented in *Table 2*.

Our findings suggest that 12-month therapy with liraglutide in patients with AH and OB resulted in significant positive changes in cardiohemodynamic parameters, indicating remodeling of heart structures and improving its functional state.

In particular, a significant decrease in the size of the left atrium was recorded from [4.04±0.46] cm to [3.86±0.41] cm ($p<0.05$), and the right atrium from [4.00±0.47] cm to [3.81±0.43] cm ($p<0.05$), which is probably due to a decrease in the volume and pressure load on the atrium as a result of blood pressure normalization and improvement in the vasodilation capacity of the vessels.

The dynamics of the left ventricle dimensions were less pronounced: LVEDD decreased from [5.05±0.56] cm to [4.88±0.49] cm, but this change did not reach statistical significance ($p>0.05$), while the decrease in the LVESD from [3.46±±0.35] cm to [3.32±0.32] cm was significant ($p<<0.05$), which may indicate an improvement in ventricular systolic function.

There was also a decrease in the IVST and the LVPWT, with the latter being statistically significant from [1.32±0.18] cm to [1.27±0.16] cm ($p<<0.05$). These indicators reflect a decrease in the degree of concentric cardiac remodeling against the background of long-term therapy.

A significant result is the decrease in LVMMI from [250.19±40.28] g to [232.5±35.2] g ($p<<0.05$), as well as LVMMI1 and LVMMI2, which indicates the regression of hypertrophy, characteristic of patients with hypertension and metabolic disorders. The decrease in LVRWT from [0.52±±0.05] to [0.48±0.04] ($p<0.05$) additionally indicates positive changes in ventricular geometry.

Systolic function indicators also underwent positive changes: LVEF increased from [51.63±±3.57]% to [54.1±3.44]% ($p<0.05$), which may indicate an improvement in the pumping function of the heart.

Left ventricular diastolic function also improved: VE increased from [63.99±7.94] to [67.12±7.15] cm/s, while VA velocity decreased from [67.47±6.6] to [64.39±5.91] cm/s, which resulted in an increase in VE/VA from [0.95±0.12] to [1.04±0.1], ($p<0.05$). This indicates a normalization of the diastolic phase ratio and an improvement in myocardial relaxation capacity.

Thus, the data presented confirm that the use of liraglutide in patients with hypertension and obesity not only contributes to weight loss and correction of metabolic disorders but also has a beneficial effect on the morphofunctional state of the heart. The results obtained justify the feasibility of including this drug in the complex therapy of patients with increased cardiometabolic risk and can also serve as a basis for forming a favorable phenotype in this cohort of patients.

Thus, the results obtained in our study showed that long-term use of liraglutide in patients with a combination of AH and OB was accompanied by a significant decrease in leptin levels, which was

Table 2. Effect of a 12-month course of liraglutide treatment on cardiohemodynamic parameters in patients with arterial hypertension and obesity (n=62)

Indices	Before treatment	After treatment	p
LAESD, cm	4.04±0.46	3.86±0.41	<0.05
RAD, cm	4±0.47	3.81±0.43	<0.05
LVEDD, cm	5.05±0.56	4.88±0.49	>0.05
LVESD, cm	3.46±0.35	3.32±0.32	<0.05
LV, cm	1.96±0.22	1.92±0.2	>0.05
IVST, cm	1.24±0.07	1.2±0.06	>0.05
LVPWT, cm	1.32±0.18	1.27±0.16	<0.05
LVMM, g	250.19±40.28	232.5±35.2	<0.05
LVMMI1, g/m^2	118.16±18.51	109.78±16.32	<0.05
LVMMI2, g/m^2	59.49±9.61	55.64±8.74	<0.05
LVRTW	0.52±0.05	0.48±0.04	<0.05
LVEF, %	51.63±3.57	54.1±3.44	<0.05
VE, cm/s	63.99±7.94	67.12±7.15	<0.05
VA, cm/s	67.47±6.6	64.39±5.91	<0.05
VE/VA	0.95±0.12	1.04±0.1	<0.05

accompanied by an improvement in the mass-insulin profile, glycemic control, and a decrease in neurohumoral activation. Such leptin dynamics is considered not only a secondary consequence of a decrease in fat mass but also a marker of overcoming leptin resistance, which plays a key role in the formation of high cardiometabolic risk in patients with OB.

It is important to note that our data are entirely consistent with the results of numerous randomized clinical trials that investigated the effect of liraglutide on the hormonal activity of adipose tissue, particularly on leptin secretion. Thus, in the large-scale SCALE Obesity and Prediabetes study (n=3731), it was demonstrated that therapy with liraglutide at a dose of 3.0 mg was accompanied by a significant decrease in leptin levels compared to placebo. At the same time, leptin dynamics correlated with clinical improvement in the glycemic profile, body mass index, and restoration of central regulation of appetite [12].

The weight-reducing effect of liraglutide on weight loss was confirmed by the results of a randomized, double-blind study lasting 52 weeks, which demonstrated that the reduction in leptin occurs not only due to weight loss but also through direct modulation of leptin sensitivity, which was accompanied by a decrease in left ventricular hypertrophy and improvement in diastolic function [13]. In a crossover randomized trial conducted among women with OB, it was found that liraglutide therapy was accompanied by a significant decrease in leptin and the leptin/adiponectin index after 16 weeks of treatment. The authors of the study emphasize that these changes are not necessarily dependent on body weight and may indicate a neuroendocrine restructuring of hunger and satiety signals [14; 15]. It was also confirmed that liraglutide not only improves energy balance but also suppresses pro-inflammatory signaling pathways involved in the formation of leptin resistance, including the JAK-STAT (Janus Kinase-Signal Transducer and Activator of Transcription), SOCS3 (Suppressor of Cytokine Signaling 3) and TNF-α (Tumor Necrosis Factor-α) pathways. This creates favorable conditions for the restoration of leptin receptor communication with the hypothalamus, which confirms the concept of a multifactorial effect of the drug [14; 16].

Thus, both our results and data from randomized multicenter trials indicate that liraglutide is an effective means of modifying cardiometabolic risk, in particular by reducing leptin, improving hormonal activity of adipocytes and reducing leptin-dependent sympathoadrenal activation. This emphasizes the importance of considering leptin not only as a biomarker but also as a target for therapeutic influence in treatment strategies for comorbid conditions, in particular, AH combined with OB.

Conclusions

1. Liraglutide is an effective means of complex therapy in patients with arterial hypertension and obesity, contributing to a significant reduction in body weight, blood pressure, improvement of lipid and hormonal profiles without developing hypoglycemia.

2. Liraglutide therapy normalizes leptin levels and reduces leptin resistance, which indicates a positive effect of the drug on the metabolic activity of adipose tissue, appetite control, and systemic neuroendocrine regulation.

3. The inclusion of liraglutide in the treatment regimen helps reduce overall cardiometabolic risk, reduce hormonal and inflammatory burden, and improve hemodynamic parameters and the functional state of the cardiovascular system, which is confirmed by both our data and the results of multicenter randomized studies.

DECLARATIONS:

Disclosure Statement

The author have no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

Statement of Ethics

The author has no ethical conflicts to disclosure.

Data Transparency

The data can be requested from the author.

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MAIN IMMUNOGENETIC, PATHOGENETIC, AND CLINICAL FEATURES OF EPSTEIN-BARR VIRUS INFECTION (literature review)

Chemych M., Saienko O., Svitailo V., Klymenko N., Chemych O.

Sumy State University, Sumy, Ukraine

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ABSTRACT

Epstein-Barr Virus (EBV), or human herpesvirus type 4, is a common pathogen that infects [90–95]% of the adult population worldwide. Over the past 10 years, research has significantly expanded our understanding of the etiological characteristics of EBV infection, its role in the development of malignant and autoimmune diseases, and its mechanisms of interaction with the immune system. EBV is a complex herpesvirus that has the ability to infect B lymphocytes and epithelial cells, ensuring lifelong persistence in the human body. It has two phases in its life cycle – lytic and latent in which different genetic programs and immune mechanisms are activated. Depending on the functional state of the cell and the type of latency, the virus can change gene expression patterns to avoid immune surveillance. The immune response to EBV infection includes humoral and cellular components. Cytotoxic $CD8^+$ T lymphocytes play a decisive role, but the virus is able to effectively modulate or suppress their activity. To ensure long-term persistence, the virus employs a number of immune evasion strategies, including disruption of antigen presentation via major histocompatibility complex I and II molecules, induction of regulatory T cells, and suppression of proinflammatory responses. EBV infection can manifest in various clinical forms, from infectious mononucleosis to severe chronic diseases: chronic active EBV infection, post-transplant lymphoproliferative disorders, and EBV-associated neoplasms. There is a close relationship between EBV and the development of certain autoimmune diseases, including rheumatoid arthritis, Sjögren's syndrome, and systemic lupus erythematosus. The virus is capable of causing immune dysregulation through molecular mimicry, expression of viral proteins, activation of cytokine pathways, and loss of immune tolerance.

Keywords: *pathogenesis, clinical presentation, autoimmune processes, oncogenicity, robust health and well-being.*

Introduction

Epstein-Barr Virus (EBV) is one of the most common viruses in the world. It is estimated that over 90% of the adult population worldwide is infected with this virus [1; 2]. Seropositivity increases with age: [0–6] months – high seropositivity (~79%) due to the presence of maternal antibodies, [6–12] months – decrease to 14% due to the disappearance of maternal antibodies [3], in children [6–8] years old – approximately 54%, while in adolescents [18–19] years old – already 83%. The prevalence of EBV varies by region. Asia: in China, seropositivity among children reaches 81 %, and among people over 40 years of age, it is almost 95% [4]. Europe: in France, over the past 15 years, seropositivity among children has decreased to 60% [5]. North America: In the US, seropositivity among children and adolescents aged [6–19] years is 67% [4].

As mentioned above, EBV shows high seropositivity worldwide, especially among adults. In Ukraine, there has been an increase in the incidence of infectious mononucleosis among children, but detailed data on the overall seroprevalence of the population are lacking. Further epidemiological studies are needed in Ukraine to more accurately determine the prevalence of EBV and develop effective prevention and treatment strategies.

Corresponding Author:
Saienko Oleksandr – PhD, Associate Professor of the Department of Infectious Diseases with Epidemiology, Sumy State University, Ukraine.
✉ Ukraine, 40007, Sumy, Kharkivska st., 116.
E-mail: o.saienko@kinf.sumdu.edu.ua

The COVID-19 pandemic has affected the epidemiology of EBV: in 2020, the number of seropositive EBV cases decreased by 30% compared to 2019 [3]. Some studies indicate a possible reactivation of EBV after SARS-CoV-2 infection [6].

EBV belongs to the gammaherpesvirus subfamily of the Herpesviridae family, is a common oncogenic agent discovered during the study of biopsy material from a patient with Burkitt's lymphoma [7]. It is the first identified human lymphotropic herpesvirus that the World Health Organization (WHO) has officially recognized as carcinogenic. According to epidemiological studies, more than 95% of the population is infected with EBV [8]. The main route of transmission is through saliva, although infection is also possible through other biological fluids, breast milk, and organ transplants containing the virus [9].

Among the known subtypes of the virus are EBV-1 and EBV-2. The first is globally distributed and is characterized by a high ability to transform B-lymphocytes into immortalized lymphoblastoid cell lines in vitro. In contrast, EBV-2 is more common in Africa and shows tropism mainly to T cells in culture [10].

The EBV infection process goes through three stages: primary infection with lytic replication, latency, and lytic reactivation [11]. In most cases, the initial infection occurs in early childhood. For example, in northern China, the seroprevalence of EBV antibodies among children exceeds 80% [12]. In childhood, the infection is usually asymptomatic or manifests itself with symptoms of acute respiratory viral infection, but in adolescence or adulthood, it can lead to Infectious Mononucleosis (IM) [13].

After the initial infection, the virus enters a latent phase, remaining in memory B cells, the main reservoir for long-term persistence [14]. In most people, the latent form of EBV infection proceeds without clinically significant signs. However, in conditions of immunodeficiency, reactivation of the virus may occur, accompanied by the development of diseases.

EBV is associated with several pathological conditions: IM, Chronic Active EBV Infection (CAEBV), EBV-related autoimmune disorders, and EBV-induced tumors. These pathologies can pose a serious threat to health, therefore scientists are actively researching the mechanisms of viral persistence and possible ways to eliminate it from the host's body.

Aim. To review scientific publications on the study of immunological features of EBV infection and pathophysiological mechanisms leading to multiple organ and autoimmune damage.

Materials & Methods

Scientific articles and studies published in the PubMed database, the Public Health Center of the Ministry of Health of Ukraine, Karger, Robert Koch Institute, Onlinelibrary, Centers for Disease Control and Prevention, and European Centre for Disease Prevention and Control were used. Particular attention was paid to studies on the immunological characteristics and pathophysiological mechanisms of EBV infection. Articles published between 2015 and 2025 were analyzed using systematic literature review methods and comparative analysis of clinical results to ensure the relevance and accuracy of the conclusions.

Results

EBV has a spherical morphology and consists of three main structural components: an outer envelope, a tegument, and a nucleocapsid [15]. The envelope contains several glycoproteins, eight of which play a key role in the process of virus penetration into the host cell. The tegument is represented by unevenly distributed proteins, a distribution pattern characteristic of herpesviruses. Inside is the nucleocapsid, an icosahedral structure consisting of capsid proteins that surround a double-stranded DNA genome approximately 172,000 base pairs in size [16]. The EBV genome has over 100 genes encoding approximately 85 proteins and up to 50 non-coding RNAs [15].

The virus is transmitted mainly through saliva. In the early stages of infection, the virus affects B-lymphocytes and epithelial cells of the oropharynx. Viral glycoproteins bind to the complement receptor type 2 (CD21, Cluster of Differentiation 21) on B cells, which mediates viral attachment. Subsequently, interaction with Major Histocompatibility Complex (MHC) type II molecules promotes the virus's approach to the cell membrane and triggers the fusion mechanism [17]. Since epithelial cells do not express CD21 and MHC-II, EBV uses alternative entry mechanisms to infect them, including lipid raft-dependent endocytosis and micropinocytosis.

After fusion of the viral envelope with the cell membrane, the tegument and nucleocapsid are released into the cytoplasm. Further release of genetic material and activation of viral DNA polymerase occur in the cell nucleus during the lytic phase. In this phase, the EBV genome expresses more than 80 gene products necessary for viral replication and synthesis of structural components [18].

EBV also activates cellular transformation mechanisms, stimulating the proliferation of infected B cells and their differentiation into memory cells within the germinal center reactions. During the immune response, antigen-presenting cells present viral antigens to T lymphocytes, in particular Cytotoxic T Cells (CTLs, Cytotoxic T-Lymphocytes), which destroy infected cells, controlling the viral load. Some of the infected memory B cells enter the peripheral blood, where they can remain in a latent state or undergo lytic replication. EBV actively replicates in both epithelial cells and B cells, contributing to the constant release of viral particles into the oral cavity. This process promotes the circulation of infected cells between the oropharynx and the general vascular system [19].

EBV is capable of remaining in a latent phase in the human body, which complicates its complete elimination and contributes to the long-term persistence of the virus. After primary infection, linear EBV DNA transitions to a circular form (episome) in the nucleus of the host cell [20]. These episomes attach to the chromatin of the cell with the help of the EBV Nuclear Antigen (EBNA-1), replicate synchronously with the cell cycle, and are transmitted to daughter cells [21].

In the latent phase, EBV expresses only a limited set of proteins and non-coding RNAs. The virus can implement different patterns of latent gene expression (latent types 0, I, II, III), depending on the type of infected cells and their functional state [19]. For example, in the latency phase I, the EBV genome is stored in memory B cells, during latency II their differentiation is stimulated, and latency III is associated with the proliferation of naive B cells. In latent state 0, the expression of viral genes is completely suppressed, allowing the virus to "hide" in the immune system [22].

Under certain conditions, infected B cells can be activated, transformed into plasma cells, and initiate lytic reactivation of EBV. In this phase, special proteins bind to the sites of DNA replication initiation, activating the transcription of viral genes and initiating the lytic cycle. After replication of the viral genome, the newly formed DNA is converted from a circular to a linear form by the terminase complex, packaged into a capsid, wrapped in tegument proteins, and then enveloped by the Golgi apparatus. The cycle ends with exocytosis, when mature viral particles are released from the cell into the extracellular space [9; 23].

Adaptive immunity plays a key role in the recognition and elimination of foreign antigens, including viral antigens, and involves the participation of both B and T cells in the response to EBV infection. B cells produce specific antibodies against viral antigens. In particular, IgM and IgA to the Virus Capsid Antigen (VCA) appear in the early stages of infection, while IgG to VCA peaks after [2–4] months and persists for a long time. Antibodies to gp350, gp42, and gHgL are also produced, which block EBV binding to B cells and inhibit virus fusion, limiting its spread [24; 25].

The cellular response includes the activation of specific $CD8^+$ and $CD4^+$ T cells. $CD8^+$ cytotoxic T lymphocytes recognize viral peptides presented through MHC-I and destroy infected cells. The proportion of lytic antigen-specific $CD8^+$ T cells can reach up to 2% of the total $CD8^+$ population, while latent responses account for about 1% [26]. These cells show the greatest activity towards the products of early lytic genes, with less activity towards Early (E) genes and low activity towards Late (L) genes. Among latent antigens, the immune response of $CD8^+$ T cells is most pronounced to proteins of the EBNA3 family, which limit the proliferation of transformed B cells [26; 27]. Weakening of T-cell immunity, for example after transplantation, can lead to the development of EBV-associated Post-Transplant Lymphoproliferative Disease (PTLD), which can be treated with adaptive transfer of EBV-specific T cells [8; 28].

$CD4^+$ T cells are activated through interaction with MHC-II on EBV-infected B cells. They promote antibody production, support $CD8^+$ T cell function, and can act as effector cells, destroying infected or transformed B cells. Their response to latent antigens is more stable than to lytic antigens, although the activity of $CD4^+$ T cells against IE-, E-, and L-products is relatively uniform [26; 29].

To achieve long-term survival in the host and establish persistent infection, EBV has also developed many strategies to evade immune surveillance. In particular, the virus can suppress the activation of certain receptors on myeloid cells (e.g., Toll-like receptors) and directly influence the expression of MHC-I and MHC-II molecules. Finally, EBV modulates the function of T lymphocytes, NK cells, and antigen-presenting cells, reducing the effectiveness of the immune response [30].

EBV also effectively evades adaptive immune surveillance using a number of mechanisms. In particular, it can disrupt antigen presentation via MHC-I molecules, which prevents infected cells

from being recognized by $CD8^+$ T lymphocytes. Normally, peptides formed by the proteasome are transported to the endoplasmic reticulum, where they bind to MHC-I and are presented on the cell surface to T cells [31].

In addition, EBV can also block antigen presentation via MHC-II. For example, lytic phase proteins can interfere with antigen recognition by $CD4^+$ T cells by binding to the MHC-II complex on the surface of B lymphocytes [32].

It has also been established that EBV can promote the growth of a population of specific regulatory T cells, which potentially suppresses the antitumor immune response and promotes the survival of tumor cells [33].

EBV can cause a wide range of clinical manifestations, from asymptomatic infection to the development of malignant neoplasms. One of the most common manifestations is IM, which develops in [35–50]% of adolescents during primary EBV infection [34]. Its main symptoms are sore throat, fever, lymphadenopathy, and atypical lymphocytosis, which occur as a result of the activation of $CD8^+$ T cells against viral antigens, in particular proteins of the EBNA3 family and products of lytic genes [1; 27].

The diagnosis of acute EBV infection is based on the detection of specific antibodies to EBV or heterophilic antibodies. The virus primarily infects B cells, and the disease usually regresses after the activation of $CD8^+$ T cells, which destroy infected cells [35]. Antiviral therapy, particularly with acyclovir, is effective only against the lytic phase and does not affect latent infection, therefore it does not shorten the course of the disease or reduce the frequency of complications [36]. In most cases, symptomatic treatment is prescribed, although sometimes the disease can progress.

CAEBV is a prolonged (>3 months) course of the disease with high levels of viral DNA in the absence of immunodeficiency [37]. The main symptoms are persistent or recurrent signs similar to IM, as well as liver damage, lymphadenopathy, hepatosplenomegaly, Hemocytic LymphoHistiocytosis (HLH), retinitis, interstitial pneumonia, mosquito bite allergy, etc. [38]. Such complications are associated with the infiltration of organs by EBV-infected lymphocytes. According to a prospective study, EBV mainly infects T cells (60%) and NK cells (40%), with $CD4^+$ cells dominating among the infiltrate. At the same time, the infection proceeds as a latent type II with expression of the EBV Nuclear Antigen (EBNA1), Latent Membrane Proteins (LMP1/2), and short RNA molecules encoded by EBV (EBER, Epstein-Barr Encoded RNA) [30].

The only effective treatment currently considered is hematopoietic stem cell transplantation, although antiviral agents, chemotherapy, and immunotherapy are also used [39].

Recent studies indicate a close link between EBV infection and the development of autoimmune diseases, such as Multiple Sclerosis (MS), Rheumatoid Arthritis (RA), Sjögren's Syndrome (SS), and Systemic Lupus Erythematosus (SLE). EBV can activate and stimulate the immune system, thereby increasing the risk of autoimmune diseases. Defective EBV-specific T cells, increased viral load and expression of lytic phase proteins, as well as high levels of antibodies to EBV in patients with RA, SS, and SLE confirm the etiological role of EBV in the development of autoimmune diseases [29; 30; 40]. There are several mechanisms by which EBV causes autoimmune diseases. First, it can infect lymphocytes and express immune regulatory proteins involved in evading the immune response, which can affect the human immune system. Second, it can induce the production of many cytokines and inflammatory factors. The virus-encoded EBER can form complexes with the cellular EBER-binding protein La (SSB, Sjögren's Syndrome antigen B) and can release large amounts of pro-inflammatory factors, mediating the TLR3 signaling pathway, thereby enhancing the autoreactivity of nuclear ribonucleoprotein La in patients with SS and SLE [24; 41]. Finally, EBV can cause loss of immune tolerance and promote the progression of autoimmune diseases through molecular mimicry [42]. Most patients with RA produce characteristic autoantibodies, including Rheumatoid Factor (RF) and Anti-Citrullinated Protein Antibodies (ACPA). Studies have shown that latent EBV transcripts and latent and lytic EBV proteins are found in ectopic lymphoid structures resembling germinal centers in the synovial membrane of RA, and antibodies against EBNA2 citrullinated peptides are found in patients with RA. Thus, EBV can induce an immune response in the body, which can then be redirected to self-antigens through cross-reactivity and epitope spreading [43].

EBV is an oncogenic virus associated with the development of various malignant neoplasms, capable of provoking the development of various types of lymphomas, including Burkitt's Lymphoma (BL) and Hodgkin's Lymphoma (HL) [2]. BL is one of the first EBV-associated lymphomas to be identified, predominantly in children, with

a high degree of malignancy and rapid progression [44]. According to the WHO classification, BL is divided into endemic, sporadic, and immunodeficiency-associated forms. Endemic LB (eLB), prevalent in equatorial Africa, is associated with EBV and is characterized by translocation of the proto-oncogene MYC, caused by overexpression of AID in B cells infected with latent EBV [45]. Malaria caused by Plasmodium falciparum also promotes AID-induced mutations by increasing the number of B cells and their sensitivity to EBV [46]. In addition, EBV induces the expression of a triad of proteins that promote the survival, proliferation, and immune mimicry of transformed B cells: EBNA1, BamHI Rightward Reading Frame 1 (BHRF1) protein, LMP1 (Latent Membrane Protein 1) (Inhibits Proapoptotic Protein (BIM), preventing apoptosis), and EBER. Clinically, LB may manifest as enlarged lymph nodes, abdominal masses, jaw lesions, and leukemia-like symptoms. The main treatment is intensive chemotherapy, as the standard Cyclophosphamide-Doxorubicin-Oncovin-Prednisone (CHOP, Cyclophosphamide, Hydroxydaunorubicin, Oncovin, and Prednisone) regimen is ineffective. The addition of rituximab improves the prognosis, and in severe cases, allogeneic Hematopoietic Stem Cell Transplantation (HSCT) is effective [2; 47].

Back in 1987, it was established that EBV DNA is detected in 20–50 % of cases in Hodgkin and Reed-Sternberg (HRS) cells [48]. The WHO distinguishes two types of HL: Classical (cHL), which is often associated with EBV, and Nodular Lymphocytic Variant (NLPHL). In cHL, EBV is in type II latency mode, with expression of EBNA1, LMP1/2A, and EBER [49]. LMP1 activates the NF-κB, JAK/STAT, and PI3K signaling pathways, mimicking CD40, which promotes the transformation of B cells into HRS cells. The expression of B-cell markers is also reduced, and LMP2A compensates for the loss of BCR in some HRS cells [50]. In 90% of cases, the first symptom is enlarged lymph nodes; later stages are accompanied by damage to the liver, spleen, and bone marrow. Some patients may experience general symptoms such as fever, weight loss, and itching. Treatment includes chemotherapy and radiation therapy, followed by HSCT or biological agents in cases of recurrence [51].

EBV is closely associated with the development of NasoPharyngeal Carcinoma (NPC), especially in endemic regions of southern China and Southeast Asia. The WHO classifies NPC into three histological types, of which undifferentiated (type III) is most closely associated with EBV. Due to its asymptomatic onset, the cancer is often diagnosed at a late stage [52]. The virus infects epithelial cells in a latent type II pattern, expressing EBNA1, LMP1/2, EBER, and viral microRNAs [53]. LMP1 promotes cell growth, prevents apoptosis, activates MMP9, mucin-1, ezrin, and the VEGF-C/VEGFR-3 axis, which facilitates metastasis. BART microRNAs also contribute to the evasion of T-cell immunity. The most common manifestation is metastasis to the cervical lymph nodes, sometimes accompanied by nasal discharge, nasal congestion, ear discomfort, and headache. The mainstay of treatment is radiation and chemotherapy [54].

The global prevalence of EBV in cases of gastric adenocarcinoma is 8 % [55]. In 2020, EBV-associated cancers caused between 239,700 and 357,900 new cases and between 137,900 and 208,700 deaths worldwide [56].

In 2014, the TCGA first classified gastric cancer into four molecular subtypes, one of which is associated with EBV (EBVaGC, (Epstein-Barr Virus-associated Gastric Carcinoma). EBVaGC is characterized by type I or II latency with expression of EBNA1, LMP1, and LMP2A. Such tumors often have PIK3CA mutations, DNA hypermethylation, and amplification of the JAK2 and PD-L1/2 genes [57; 58]. This type is more common in men and is associated with pronounced lymphoid infiltration and a relatively favorable prognosis [59]. The main approaches to treatment include surgical resection, supplemented by chemotherapy and radiation therapy.

Serological tests are the basis for the diagnosis of EBV infection, especially IM. They allow the stage of infection to be determined and differentiated from other diseases. Antibodies to VCA: VCA-IgM appear in the early stages of infection and disappear after 4–6 weeks; VCA-IgG are detected at the onset of infection, peak after 2–4 weeks, and remain for life. Antibodies to class G nuclear antigen (EBNA-IgG, Epstein-Barr Nuclear Antigen-Immunoglobulin G) appear [6–8] weeks after the onset of infection and indicate a past infection. Antibodies to early antigen (EA-IgG, Early Antigen-Immunoglobulin G) may be detected during acute infection or virus reactivation (*Table*).

Serological tests are used for most patients, but in some cases, especially in immunosuppressed individuals, the results can be difficult to interpret.

Molecular diagnostics, in particular Polymerase Chain Reaction (PCR), allows the detection

Table. Interpretation of serological test results to determine the stage of infection

Stage of infection	VCA-IgM	VCA-IgG	EBNA-IgG	EA-IgG
Acute infection	+	+	–	±
Previous infection	–	+	+	–
Reactivation	–	+	+	+
Not infected	–	–	–	–

Notes: "+" – antibodies are present, "–" – absent, "±" – may be present or absent.

and quantification of EBV DNA in various biological samples. It is used to monitor viral load, especially in immunosuppressed patients, such as transplant recipients. Cerebrospinal fluid PCR is used to diagnose EBV encephalitis and other neurological complications.

In Situ Hybridization (ISH) is used to diagnose EBV-associated tumors and CAEBV by detecting EBV-infected cells in tissue samples using an EBER probe.

Immunohistochemistry is the "gold standard" for confirming EBV infection in tissues by detecting LMP1 EBNA and other proteins.

The Monospot test allows for rapid detection of heterophile antibodies characteristic of IM, but it has low sensitivity in children under 4 years of age and may produce false-positive results in other diseases, so it is not recommended for general use, especially in pediatric practice [60].

Conclusions

The Epstein-Barr virus is a complex herpesvirus that can infect both B lymphocytes and epithelial cells, ensuring lifelong persistence in the human body. It has two phases in its life cycle – lytic and latent in which different genetic programs and immune mechanisms are activated. Depending on the functional state of the cell and the type of latency, the virus can change gene expression patterns to evade immune surveillance.

The immune response to the Epstein-Barr virus includes both humoral and cellular components. Cytotoxic $CD8^+$ T lymphocytes play a decisive role in controlling the infection, but the virus is able to effectively modulate or suppress their activity. To ensure its long-term presence in the body, the virus employs a number of immune evasion strategies, including disruption of antigen presentation via MHC I and II molecules, induction of regulatory T cells, and suppression of proinflammatory responses.

Epstein-Barr virus infection can manifest itself in a wide range of clinical forms: from infectious mononucleosis to severe chronic diseases such as chronic active Epstein-Barr virus infection, post-transplant lymphoproliferative disorders, and EBV-associated neoplasms.

There is a close relationship between EBV and the development of certain autoimmune diseases, including rheumatoid arthritis, Sjögren's syndrome, and systemic lupus erythematosus. The virus is capable of causing immune dysregulation through molecular mimicry, expression of viral proteins, activation of cytokine pathways, and loss of immune tolerance.

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Disclosure Statement

The authors have no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

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COMPREHENSIVE REHABILITATION OF OLDER ADULTS FOLLOWING ACUTE STROKE: EMPHASIS ON THERAPEUTIC EXERCISES AND THE MULTIDISCIPLINARY APPROACH

Salii A.O.[1], Danylchenko S.I.[1], Golovchenko I.V.[1], Tarasova O.O.[1], Morozenko D.V.[2], Honchar O.O.[3, 4]

[1]Kherson State University, Kherson-Ivano-Frankivsk, Ukraine
[2]State Institution "Sytenko Institute of Spine and Joint Pathology of the National Academy of Medical Sciences of Ukraine", Kharkiv, Ukraine
[3]Municipal Enterprise "Poltava Regional Clinical Medical Cardiovascular Center of Poltava Regional Council", Poltava, Ukraine
[4]Poltava State Medical University, Poltava, Ukraine

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ABSTRACT

Background. Stroke remains one of the leading causes of long-term disability worldwide, especially among older adults. Given the increasing incidence of CerebroVascular Accidents (CVAs) in the aging population, there is a growing need for comprehensive, individualized rehabilitation programs that address the specific physical, cognitive, and emotional needs of elderly patients.

Aim. To evaluate the effectiveness of therapeutic exercise as part of a multidisciplinary rehabilitation approach in elderly patients following an acute stroke.

Materials and Methods. The study included 21 patients aged 62 to 79 years who were undergoing rehabilitation following an acute CVAs in a district hospital setting. The rehabilitation process featured a seven-stage individualized program consisting of physical therapy, occupational therapy, speech and language therapy, cognitive training, and psychosocial support. The effectiveness of the interventions was evaluated using standardized scales: the Modified Rankin Scale, Barthel Index, Montreal Cognitive Assessment, Visual Analogue Scale, and Borg Rating of Perceived Exertion.

Results. 76% of the participants (n=16) showed significant improvement in their overall condition, including reduced neurological symptoms (aphasia, hemiplegia), enhanced motor skills, better balance, improved emotional well-being, and increased independence in daily activities. The remaining 24% of patients (n=5) also demonstrated positive changes but required additional rehabilitation cycles due to limited recovery potential and complex comorbidities.

Conclusions. Individualized therapeutic exercises, integrated within a multidisciplinary rehabilitation framework, are effective in improving the physical and cognitive outcomes of elderly patients after stroke. Early initiation of rehabilitation, combined with continuous assessment and support from a multidisciplinary team, enhances functional recovery and improves the overall quality of life in this vulnerable population.

Keywords: *elderly patients, functional recovery, cerebrovascular accident*.

Corresponding Author:
Danylchenko Svitlana – PhD, Associate Professor of the Department of Physical Therapy and Occupational Therapy, Kherson State University, Kherson-Ivano-Frankivsk, Ukraine.
✉ Ukraine, 76018, Ivano-Frankivsk, Shevchenka str., 14.
E-mail: svetlanaadanilch@gmail.com

Introduction

The problem of stroke holds significant medical and social relevance, particularly in the context of global population ageing. According to epidemiological studies, the risk of developing an acute CerebroVascular Accident (CVA) increases with age, leading to a higher incidence of stroke among elderly individuals. Consequently,

there is a steady rise in the number of patients requiring long-term medical, rehabilitative, and social support. According to the European Stroke Organization (ESO), the total annual cost of treatment and rehabilitation for stroke patients in European Union countries exceeds €60 billion, with the proportion of elderly individuals among these patients continuing to grow [1–3].

In Ukraine, the situation is further complicated by the high prevalence of risk factors such as arterial hypertension (affecting approximately 28.3% of the population), type 2 diabetes, and coronary heart disease. Behavioral factors (such as tobacco use, alcohol abuse, physical inactivity, and poor dietary habits) also contribute significantly. In addition, psychosocial factors present a particular threat, notably chronic stress linked to economic instability, high unemployment rates, ongoing military conflict, and the increasing prevalence of post-traumatic stress disorder [4; 5].

In view of these challenges, rehabilitation of elderly patients after an acute CVA becomes particularly relevant. It represents a key stage in post-stroke care, significantly influencing prognosis, the level of functional recovery, and the overall quality of life. Considering age-related factors, comorbidities, reduced physical activity, cognitive impairments, and psycho-emotional difficulties (such as depression, anxiety, and decreased motivation), rehabilitation programs must be tailored to the specific needs of geriatric patients [3; 6].

Contemporary international guidelines (AHA/ASA [7], ESO [8], WHO [9]) emphasize the importance of a multidisciplinary approach involving neurologists, physicians in physical and rehabilitation medicine, physical therapists, occupational therapists, speech and language therapists, psychologists, rehabilitation nurses, and social workers. This format allows for an individualized rehabilitation process, ensuring both physical and psychosocial recovery for patients [10; 11].

Therefore, investigating the effectiveness of therapeutic physical exercises in elderly patients after stroke is a vital direction in modern medical science. It has practical value for improving functional status, reducing the degree of disability, and promoting greater autonomy in this vulnerable population group [3; 12].

The **aim** of this study was to evaluate the effectiveness of a proposed program of therapeutic exercises as part of the physical rehabilitation system for elderly patients after stroke.

Materials and Methods

The object of this study comprised elderly individuals who had experienced an acute CVA and underwent a rehabilitation course. The study involved 21 patients aged between 62 and 79 years, who received treatment at the Municipal Enterprise "Blyzniuky Central District Hospital" (Blyzniuky, Kharkiv Region, Ukraine).

The study was conducted in accordance with the fundamental principles of the Declaration of Helsinki (1964–2013), ICH GCP Guidelines (1996), EU Directive 86/609/EEC (November 24, 1986), and the orders of the Ministry of Health of Ukraine No.690 (September 23, 2009), No.944 (December 14, 2009), and No.616 (August 03, 2012). Participation in the study was entirely voluntary. Each patient provided signed informed consent, being personally informed of their rights and obligations, including the possibility to withdraw from the study at any time without any consequences or the need to justify their decision.

A comprehensive approach was applied to evaluate the effectiveness of physical rehabilitation in elderly patients after acute stroke. The methodology included clinical and functional assessment, psycho-emotional and cognitive evaluation, and statistical analysis methods.

Clinical and Functional Assessment. Clinical and functional assessment was carried out using standardized scales:

- NIH Stroke Scale (NIHSS) – to determine the severity of neurological deficit;
- Functional Independence Measure (FIM) – to assess the level of self-care and daily living independence;
- Modified Rankin Scale (mRS) – to evaluate the degree of disability;
- Visual Analog Scale (VAS) – for subjective assessment of pain intensity;
- Borg Rating of Perceived Exertion Scale – to assess the patient's perceived level of physical exertion.

Cognitive screening was conducted using the Montreal Cognitive Assessment (MoCA).

The psycho-emotional status was evaluated by a psychologist through clinical interview, behavioral observation, and assessment of motivation dynamics regarding participation in the rehabilitation process.

The effectiveness of the rehabilitation program was analyzed based on the dynamics of clinical indicators before and after the 14-day therapeutic intervention period.

Statistical analysis of changes in functional indicators pre- and post-rehabilitation was performed using descriptive statistics (mean, standard deviation) and the paired t-test to determine the significance of differences between pre- and post-intervention values ($p<0.05$ considered statistically significant).

The processing of statistical data was carried out using SPSS 10.0 (IBM, USA).

Results

The analysis of the results demonstrated a positive dynamic in the majority of patients undergoing rehabilitation according to the developed program. In 76% of cases (16 patients), an improvement in overall functional status was observed, including a reduction in neurological deficits (aphasia, hemiplegia), improved motor skills, balance, emotional state, and increased levels of independence in daily living and social activity. The remaining 24% of participants (5 patients) also showed positive progress. However, considering individual rehabilitation potential, an extension or repetition of the rehabilitation course was recommended.

Rehabilitation interventions were carried out following an individualized rehabilitation program developed by the authors, structured into seven consecutive stages:

1. *Diagnostic Stage*

A comprehensive assessment of patients' condition was conducted using standardized scales (*Table 1*):

- Visual Analog Scale (VAS) for pain assessment;
- Borg Scale for subjective evaluation of physical exertion;
- Montreal Cognitive Assessment (MoCA) for detecting cognitive impairments.

Additionally, comorbidities, psycho-emotional state, and speech disorders were analyzed with the involvement of a psychologist and a speech-language therapist.

2. *Early Rehabilitation Stage.* This stage included passive kinesiotherapy aimed at preventing contractures and maintaining muscle tone, use of anti-decubitus mattresses, and regular repositioning of the body. Vital signs such as heart rate, blood pressure, and respiratory rate were continuously monitored.

3. *Activation Stage.* Gradual achievement of vertical body positioning was implemented: balance training, acclimatization to sitting and standing, and simulation of walking while lying or sitting. Manual therapy based on the Maitland concept was applied, along with breathing exercises, speech therapy, and swallowing training.

4. *Middle Rehabilitation Stage.* An individualized therapeutic exercise program was introduced for the affected upper and lower limbs.

The exercise set for the upper limbs included:

- fist clenching (10–20 repetitions);
- circular movements in the radiocarpal joints (15 repetitions each direction);
- elbow flexion and extension (20 repetitions);
- arm raising and lowering (20 repetitions);
- arm abduction in the lying position (20 repetitions).

The exercise set for the lower limbs included:

- toe flexion/extension (20 repetitions);
- foot pulling ("pedal pressing") (15 repetitions);
- knee flexion and return to the starting position (15 repetitions);

Table 1. Scales and methods for assessing patients' functional status

Scale / Method	Purpose	Description
Visual Analog Scale	Subjective pain assessment	0 – no pain; 10 – worst possible pain
Borg Scale	Perceived physical exertion	6–20 points: from "very light" to "maximal exertion"
Montreal Cognitive Assessment (MoCA)	Cognitive status assessment	Maximum – 30 points; >26 – normal, <25 – cognitive impairment
Modified Rankin Scale (mRS)	Level of disability after stroke	0 – no symptoms; 6 – death
Functional Independence Measure (FIM)	Independence in daily living and care	Range 18 to 126 points; higher scores indicate greater independence
National (U.S.) Institutes of Health Stroke Scale	Degree of neurological deficit	0–42 points; higher scores indicate more severe condition

- hip joint abduction (10 repetitions).

Occupational therapy included training in self-care skills.

5. *Late Rehabilitation Stage.* This stage involved restoring daily living independence, cognitive therapy, and psychosocial support. Individualized social integration programs were developed, including occupational therapy and participation in support groups.

6. *Home Stage.* This stage involved independent speech therapy practice and performing facial exercises ("horse", "smile", "kiss"). Occupational therapy was continued at home under periodic supervision by specialists.

7. *Monitoring and Outcome Assessment.* All rehabilitation activities were conducted with gradual increases in workload according to the patients' functional status. The total duration of the course was 14 days (see *Table 2*).

The Role of Speech Therapy in the Rehabilitation Process. Speech impairments are common consequences of stroke and significantly reduce patients' quality of life. The study confirmed that timely involvement in speech therapy sessions contributed to improved communication abilities, increased motivation to participate in other stages of rehabilitation, and enhanced psycho-emotional status. Speech rehabilitation was conducted by specialists in speech and language therapy who performed initial diagnostics of speech disorders and developed individualized treatment programs [12].

In the early stages, short sessions (10–15 minutes) were used, including emotionally significant stimuli (photos, videos, objects) aimed at activating speech activity. Therapy effectiveness was higher when started early. Patients who began speech therapy within the first days after stabilization showed better recovery rates. Meta-analyses have demonstrated that early and intensive speech therapy significantly improves communication functions, reading, writing, and expressive language. The advantage was observed with ≥[20–50] hours of therapy, including home exercises [13; 14].

Occupational Therapy and Ergotherapeutic Interventions. Ergotherapeutic support significantly improved self-care skills and household independence. Occupational therapy was conducted considering the patient's functional status and included training of everyday skills, elements of household activities, and preparation for potential vocational adaptation.

Patients with pronounced functional limitations underwent preparation for activities in adapted environments (e.g., day care centers, volunteer activities, supported home activities). The occupational therapy component also involved exercises using assistive devices (massage, mechanotherapy, therapeutic complexes). Participants in the group receiving daily 3-hour occupational therapy sessions over 8 weeks showed significant improvements in Activities of Daily Living (ADL) compared to the control group without OT (p=0.02) [15; 16].

Monitoring and Adjustment of the Rehabilitation Process. Throughout the entire program, continuous monitoring of patients' functional status was conducted. Standardized functional assessment scales and clinical evaluations by the multidisciplinary team were used. In cases of slowed progress or changes in functional status, individual rehabilitation programs were adjusted accordingly.

Table 2. Changes in patients' functional status after a 14-day course

Indicator	Before rehabilitation (mean ± SD)	After rehabilitation (mean ± SD)	Δ (change)
NIHSS	11.4±2.2	6.8±1.9	−4.6
MoCA	21.2±3.1	25.1±2.9	+3.9
FIM	56.5±7.3	78.7±6.9	+22.2
VAS	6.2±1.5	2.8±1.3	–3.4
Borg Scale (after baseline load)	15.1±1.8	12.4±1.5	–2.7

Notes: NIHSS – National (U.S.) Institutes of Health Stroke Scale;
MoCA – Montreal Cognitive Assessment;
FIM – Functional Independence Measure;
VAS – Visual Analog (pain) Scale.

Pharmacological Support. All patients received supportive pharmacological therapy aimed at improving cerebral circulation, neuroprotection, and thrombosis prevention, as well as pain relief and anti-inflammatory medications when necessary to facilitate participation in rehabilitation activities.

Psychological Support. Psycho-emotional support was provided with the involvement of a psychologist or psychiatrist. The main areas included management of depressive and anxiety symptoms, motivation enhancement, psychoeducation, and support of social interaction (group sessions, involvement of relatives, social adaptation).

Final Stage. The concluding phase involved assessment of achieved results and formulation of individualized recommendations for further lifestyle: maintaining physical activity, preventing recurrent stroke, psychohygiene, balanced nutrition, and medical-social support.

Criteria for Evaluating Rehabilitation Effectiveness:

- reduction in NIHSS scores by at least 4 points;
- increase in FIM by ≥20%;
- improvement in MoCA scores by ≥3 points;
- decrease in subjective pain level (VAS) by ≥3 points;
- improvement in communication skills (as assessed by speech therapist);
- increase in daily living independence (according to mRS scale);
- positive dynamics in mood and motivation (as assessed by psychologist).

The obtained data indicate the high effectiveness of a comprehensive rehabilitation program that includes therapeutic physical exercises, speech therapy, occupational therapy, pharmacological support, and psycho-emotional care. Significant improvements in cognitive, motor, and psychosocial status were primarily observed in patients who began rehabilitation early and were actively engaged in the program's active phase.

Therapeutic exercises during the recovery period after acute cerebrovascular accident (stroke) are not only an important clinical tool but also a social factor that promotes the preservation of independence, quality of life, and social integration in elderly patients. A comprehensive multidisciplinary approach, individualization of interventions, and early initiation of rehabilitation are key to effective functional recovery. The authors emphasize the importance of early rehabilitation onset, a multidisciplinary team, and individualized programs to improve functional outcomes and quality of life in post-stroke patients [2; 17].

Discussion

Thus, the structure of the physical rehabilitation program for elderly patients after stroke is based on the principles of comprehensiveness and individualization. The study results demonstrate the effectiveness of combining therapeutic physical exercises, speech therapy, occupational therapy, psychological support, and social integration in the recovery process. This confirms the feasibility of implementing a multidisciplinary approach in geriatric rehabilitation practice after stroke. Systematic reviews show that multidisciplinary rehabilitation programs significantly improve the physical, cognitive, and social recovery of stroke patients [18–20].

The obtained results confirm the effectiveness of therapeutic exercises as a key element in the rehabilitation of elderly patients after acute cerebrovascular accident. These findings are consistent with current research data emphasizing the importance of early and individualized physical intervention to improve patients' functional status [21; 22].

Regular physical activity after stroke promotes neuroplasticity – the brain's ability to form new neural connections that compensate for lost functions. This is especially important for elderly patients, whose neuroplasticity is diminished due to age-related changes. It has been shown that physical exercises contribute not only to motor recovery but also to cognitive and psycho-emotional rehabilitation [11].

Within our study, improvements were observed in NIHSS, MoCA, and FIM scores, indicating positive dynamics in both physical and cognitive functions. The role of a multidisciplinary approach is important, particularly speech therapy, occupational therapy, and psychological support, which were integrated into the rehabilitation process.

The significance of therapeutic exercises for emotional recovery is no less important. Physical activity helps reduce symptoms of depression and increases motivation to participate in rehabilitation, as confirmed not only by observation but also by psychological assessment over time. A systematic review confirms the effectiveness of comprehensive physical exercises in improving patient independence and social integration, especially with early and regular application after vascular crises [17; 23].

Special attention should be paid to the age-related characteristics of the rehabilitation process. Elderly patients often have comorbidities, cognitive impairments, and reduced physical endurance. Therefore, individualization of programs and phased interventions are crucial to avoid overload and achieve realistic goals. This approach aligns with recommendations from ESO (2023) and AHA (2022) [3; 21].

At the same time, several limitations of the conducted study should be noted. First, the small sample size does not allow for broad generalizations. Second, the rehabilitation period was relatively short (14 days), limiting the ability to assess long-term outcomes. Future research should expand the sample size and apply controlled comparative designs to enhance the validity of conclusions.

Conclusions

1. Early initiation of rehabilitation after stroke, even in elderly patients, is critically important for improving motor, cognitive, and emotional functions. Interventions should begin within the first few days after the patient's condition stabilizes.

2. Therapeutic exercises must be individually tailored, taking into account the patient's age, comorbidities, and functional level. Daily physical activity is recommended with a gradual increase in intensity, under the supervision of a specialist.

3. A multidisciplinary approach (including physical therapist, occupational therapist, speech therapist, psychologist, and physiatrist) should be the standard of care for post-stroke patients. This ensures the integrity of the rehabilitation process and improves long-term outcomes.

4. Patient and family education is a key component of successful rehabilitation. It should include guidance on home exercises, stroke prevention strategies, and the basics of a healthy lifestyle.

5. Establishing conditions for ongoing follow-up and social reintegration – through outpatient rehabilitation programs, telemedicine support, and peer support groups – enhances patient motivation and reduces the risk of rehospitalization.

DECLARATIONS:

Disclosure Statement

The authors have no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

Statement of Ethics

The authors have no ethical conflicts to disclosure.

Data Transparency

The data can be requested from the authors.

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Consent for publication

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COGNITIVE AND EMOTIONAL FEATURES OF DECISION-MAKING BY MILITARY PERSONNEL UNDER COMBAT STRESS (literature review)

Klymkiv R.I.[1], Kulmatytskyi A.V.[2], Bilobryn M.S.[2]

[1]Communal Institution of Lviv Regional Council "Andrey Krupynsky Lviv Medical Academy", Lviv, Ukraine
[2]Danylo Halytsky Lviv National Medical University, Lviv, Ukraine

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ABSTRACT

In the context of combat operations, military personnel are constantly in situations that require psychological resilience. Encountering combat stress is an integral part of military activity, accompanied by significant physical and psycho-emotional strain, and often leads to the deterioration of soldiers' mental health, complicating the decision-making process. This creates an urgent need to develop effective strategies for psychological support and adaptation after combat stress exposure. The aim of this study is to search for and analyse modern scientific literature to systematise data concerning the cognitive and emotional features of decision-making by military personnel under combat stress. In the process of research, the method of system analysis, comparative and bibliosemantic methods were used. The cognitive and emotional characteristics of decision-making under combat stress were examined. The study highlights the complexity and variability of behavioural, cognitive, and emotional reactions to combat stress. It was found that cognitive and emotional factors are key components of the decision-making process, emphasising the importance of timely and effective psychological support following combat stress. It is emphasised that personal traits of military personnel – such as psychological resilience, adaptability, resilience (hardiness), internal potential, emotional regulation, motivation and persistence, as well as high levels of positive emotions and low levels of anger, impulsivity, anxiety, and vulnerability – contribute to effective decision-making in stressful conditions. It was established that the effects of combat stress can vary significantly depending on individual traits and the cognitive and emotional characteristics of the military personnel. Further research will focus on studying the effectiveness of various psychological interventions aimed at reducing the negative consequences of combat stress, as well as analysing their impact on the cognitive and emotional characteristics of military personnel.

Keywords: *post-traumatic stress disorder, stress management, stress resistance, individual characteristics.*

Introduction

War leads to a variety of injuries among both military personnel and civilians in combat zones. These include both physical and psychological harm, and are accompanied by destruction, significant economic and social losses, all of which have long-term negative consequences [1; 2]. Combat injuries and stress can result in serious physical and mental disorders. Soldiers on the front line are exposed to events that may negatively affect their mental health, causing conditions such as stress, depression, anxiety, emotional disorders, and the development of post-traumatic stress disorder [3–7].

Stress arises when an individual feels that the demands of a situation – environmental or social – exceed their adaptive capacity. Stressful situations are often new, uncontrollable, unpredictable, or threatening. Military personnel frequently face the challenge of maintaining cognitive abilities in complex and uncertain conditions. Maximum effectiveness in such situations requires enhanced cognitive control, which enables individuals to stay focused and act in line with their goals. Research

Corresponding Author:
Klymkiv Roksolana – MD, PhD, practical psychologist of the Department of mental and physical health of the Communal Institution of Lviv Regional Council "Andrey Krupynsky Lviv Medical Academy", Ukraine.
✉ Ukraine, 79000, Lviv, P. Doroshenka str., 70.
E-mail: r.klymkiv@gmail.com

shows that moderate or high levels of stress can negatively affect performance on tasks that require executive functions, memory retrieval, and the functioning of the prefrontal cortex of the brain [8].

Service members in stressful situations must exercise extreme caution when making important decisions that concern not only their duties but also their personal lives. In such conditions, objectivity is significantly impaired, as behaviour is mainly driven by emotions rather than logic. Stressful situations often provoke risky decisions that may seem justified at the time.

The **aim** of the study was to conduct a search and analysis of contemporary scientific literature to systematise data regarding the cognitive and emotional characteristics of decision-making by military personnel under combat stress.

Materials and Methods

The study employed analytical methods, including systemic comparative analysis and bibliosemantic methods, which enabled the study of data from modern scientific literature on the cognitive and emotional aspects of decision-making by military personnel under combat stress. The research was conducted through searches in electronic databases, including Web of Science, PubMed, Scopus, and Google Scholar.

Results

During wartime, military personnel must prepare daily for crisis situations that threaten life and must be able to respond effectively. This way of life places a significant burden on service members, especially those who are isolated from support systems and other resources available under combat stress conditions. Combat stress is a response to extreme conditions that may result in the loss of another person's life or even pose a threat to one's own life. Thus, combat stress may result from a range of stressors, including life-threatening events, injuries, or the death of fellow soldiers.

Combat stressors include such traumas as injury, attempted attacks on one's unit, killing, witnessing death, and the death of a unit member. Feelings of guilt, horror, anger, and hopelessness are natural in civilian life, and in a military context, these stresses are compounded by other stressors. Deployment in harsh climates with limited resources leads to problems such as malnutrition and dehydration, physical exhaustion, and separation from family and social support. The military service may cause sensory overload and/or sensory deprivation [9; 10]. Furthermore, soldiers may experience a shift in moral values, leading to emotions such as shame, guilt, anger, and the breakdown of core beliefs, including self-blame, disillusionment, and loss of faith and trust in others. Emotional distress arising from the discrepancy between high moral beliefs and forced low-moral behaviour is defined as moral injury [6; 11].

Numerous studies show that performance under stress is influenced by various human parameters, including physical, cognitive, social, emotional factors, and health status. Stress arises when the novelty, uncontrollability, unpredictability, or threatening nature of a situation exceeds or burdens an individual's adaptive resources [9; 12; 13]. Cognitive abilities include various characteristics that allow individuals to acquire, retain, and flexibly use information. Evidence suggests that these traits affect performance during cognitive and physical stress. For example, people with lower working memory capacity at rest often demonstrate improved working memory after physical exercise, indicating that the impact of physical stress may vary depending on individual cognitive traits. Individual differences in the ability to perform executive functions may explain variations in self-regulation of physical endurance. Cognitive factors contribute to maintaining individual decision-making effectiveness under stress [12].

Military personnel often face the challenge of maintaining cognitive abilities under complex and uncertain conditions. Maximum performance in such stressful situations requires enhanced cognitive control to maintain focus and carry out goal-directed actions. Research shows that moderate or high levels of stress can negatively impact task performance and decision-making abilities, particularly those requiring executive processes, memory retrieval, and prefrontal cortex functioning [9].

Numerous studies have led to the development of the concept of cognitive resilience, which refers to the extent to which cognitive functions can withstand or be resistant to stress. Cognitive resilience is defined as "the ability to overcome the negative consequences of failure and associated stress on cognitive functions or performance". This definition retains the core characteristics of psychological resilience in the face of adversity – or, in this case, stress – and positive adaptation [10].

It has been established that different individuals respond to stress differently and regulate their emotions in various ways. In some cases, an acute stress reaction is observed, followed by rapid reco-

very without changes to one's usual way of life. Meanwhile, others require support and face serious mental health challenges. All of this affects the decision-making process.

The concept of "decision-making" encompasses a fundamental skill or instrumental ability that enables a person to choose an appropriate course of action from several alternatives [14–16]. A growing body of research suggests that individuals have an inherent tendency to rely on either rational or intuitive processes when making decisions [17].

The decision-making process involves both cognitive and emotional components. This conscious process is linked to executive functions and requires high-level cognitive abilities to regulate emotions, thoughts, and behaviour. For military personnel to make decisions, a balance between logic and emotion must be achieved. The ability to manage emotions is a key skill that supports reasoned decision-making in stressful conditions, especially during combat stress. "Emotion regulation" involves strategies such as cognitive reappraisal, reducing reactivity, and mindful observation of one's own emotional processes. "Positive emotions", in turn, contribute to favourable decision-making, foster resilience to challenges, and are associated with personality traits such as extraversion, openness, and agreeableness.

Stress has a variety of consequences for cognitive and emotional functions. One of the professional activities that is particularly susceptible to acute cognitive changes caused by stress is work under high-stress conditions (for example, military service). These individuals often have to maintain maximum cognitive performance, including memory, spatial navigation, and decision-making, in threatening and uncertain conditions [18]. Neuroimaging studies suggest that brain areas involved in decision-making are sensitive to changes caused by stress responses, and behavioural studies support the hypothesis that stress affects decision-making processes [17].

Research shows that the socio-emotional domain is crucial to the decision-making process. It includes emotional competence (such as self-awareness, social awareness, and emotion regulation) and relational/prosocial skills (such as the ability to build relationships and resolve social problems). Individual differences in socio-emotional functioning influence performance outcomes in stressful situations. Additionally, a high level of detail orientation promotes more effective decision-making. Personal characteristics such as the ability to regulate emotions, resilience, achievement motivation, and perseverance, along with high levels of positive emotions and low levels of anger, impulsivity, anxiety, and vulnerability, contribute to enhanced cognitive performance under combat stress [12].

Combat and operational stress reactions are psychological and biological effects that develop over time and may lead to psychological disorders, including post-traumatic stress disorder [9]. Emotional responses to stress, such as in the case of combat stress, may occur automatically, before cognitive appraisal, and negatively impact decision-making. Acute stress enhances protective responses designed to safeguard the body from threats (such as heightened startle reflexes or increased environmental vigilance), while simultaneously impairing higher-level cognitive processes that are less critical for immediate harm avoidance. For example, attention bias and excessive threat vigilance may create competition for attention and sensory resources, leading to impaired performance on tasks involving working memory and cognitive flexibility [8].

Under combat stress conditions, the ability of military personnel to successfully cope with difficulties is associated with levels of resilience, stress-coping skills, emotional flexibility, self-efficacy, as well as levels of aggression and endurance [7; 19, 20]. Resilience is the process by which a person demonstrates positive adaptation despite experiencing significant stress in adverse situations [21]. It can also be defined as a trait that reflects certain personal qualities which support successful adaptation to change [10]. An individual's resilience is formed through a combination of internal "assets" (inherent personality characteristics such as problem-solving skills) and external "resources", among which the quality of social support plays an important role. In the face of serious challenges, particularly under combat stress, resilience serves a protective function by helping to reduce the harmful short-term effects of potentially traumatic events and prevent the development of negative mental health outcomes. It has been proven that personal resources and the ability to solve problems are key predictors of psychological response to stress [21].

Among the personal factors that promote post-traumatic growth, maintaining a positive outlook on life is of critical importance as it facilitates successful overcoming of challenges. In addition, personality traits affect performance during stressful situations. Various cognitive, physical, and socio-emotional characteristics have been shown to

influence the task performance of military personnel. Intolerance of uncertainty, that is the inability to tolerate the discomfort caused by a lack of information, is a dispositional trait that may contribute to the development and maintenance of stress and anxiety disorders. Military personnel operating in high-stress, dangerous, and uncertain conditions exhibit greater intolerance of uncertainty compared to civilians. Research indicates that individual differences in this trait affect how potential threats are perceived and responded to, which may lead to different levels of anxiety even under similar conditions and influence decision-making ability [18; 22; 23].

Intolerance of uncertainty is a component of all anxiety disorders and is defined as "a dispositional incapacity of an individual to tolerate the negative response triggered by the perceived absence of important, key, or sufficient information, reinforced by the perception of uncertainty". It encompasses both an emotional component (an aversive reaction) and a cognitive assessment of certainty in each situation. The experience of emotions largely depends on one's beliefs about them. For example, if a person believes they are unable to control a negative emotion in a given situation, their negative emotional experience may intensify. This, in turn, reinforces the belief that uncertainty is inherently negative and should be avoided, thus maintaining and amplifying the vicious cycle of intolerance of uncertainty [23]. Studies by Giles G.E. et al. [13] showed that indicators such as healthy eating, agility, flexibility, cognitive updating, and positive emotions in military personnel predict improved spatial orientation, confidence, and decision-making ability.

Trait anxiety may act as a vulnerability factor for cognitive functioning in the context of post-traumatic symptomatology. Individuals with high anxiety levels report lower rationality and intuition in decision-making, while post-traumatic symptoms are associated with more intuitive strategies. Such individuals tend to make less rational decisions and more frequently display pronounced post-traumatic symptoms. Such individuals are more likely to opt for safer choices under uncertainty and evaluate situations more pessimistically. In contrast, individuals with lower anxiety levels usually demonstrate higher rationality even when experiencing elevated levels of post-traumatic stress [17].

Overall, the findings suggest that personal resources, traits, and inner potential can affect cognitive abilities during stress, facilitate adaptation to stressful conditions, and support effective decision-making. Some of these resources include a positive attitude and positive emotions, the development of which helps maintain emotional balance, improve communication and relationships, increase self-esteem, support constructive conflict resolution, and promote informed decision-making [3; 13].

Psychological interventions for military personnel play a crucial role, along with the timely provision of professional assistance and the development of specialised programmes. Combat and operational stress control requires a comprehensive approach involving structured programmes and measures implemented by military leadership to prevent, detect, and manage combat stress. These programmes are aimed at individuals in risk groups, specific operational zones, and service members exhibiting behavioural signs of combat stress. The primary goal of these measures is to prevent or minimise the potentially negative consequences of stress on the health and combat readiness of military personnel [24].

Conclusions

Combat stress can cause physical, cognitive, and emotional disturbances in military personnel. Its most serious psychological consequences include an increased risk of developing post-traumatic stress disorder, anxiety and depressive disorders, as well as emotional instability. This, in turn, can negatively affect the decision-making process in military personnel. Personal characteristics and inner potential play an important role in cognitive performance during combat stress. In particular, the ability to regulate emotions, resilience, hope, motivation and perseverance, as well as higher levels of positive emotions and lower levels of anger, impulsivity, anxiety, and vulnerability contribute to better adaptation and more effective decision-making under stressful conditions.

The identified influence of cognitive and emotional characteristics on the decision-making process in military personnel highlights the importance of timely and effective psychological support following combat stress.

Further research should focus on examining the effectiveness of various psychological interventions in reducing the negative consequences of combat stress, as well as analysing their impact on the cognitive and emotional characteristics of military personnel.

DECLARATIONS:

Disclosure Statement

The authors have no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

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PHENOTYPES OF PERSISTENT PULMONARY HYPERTENSION IN NEWBORNS (clinical observations)

Boichenko A., Gonchar M., Shevel D., Chunikhovska E., Stepanova K.

Kharkiv National Medical University, Kharkiv, Ukraine

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ABSTRACT

Background. Persistent Pulmonary Hypertension of the Newborn (PPHN) is a potentially life-threatening condition caused by abnormal postnatal transition from fetal to neonatal circulation. The COVID-19 pandemic and genetic syndromes, such as trisomy 21, have highlighted new challenges in its diagnosis and treatment.

Aim. To analyze clinical observations of the development of persistent fetal circulation of various origins in full-term newborns, to spread awareness among the medical community regarding the features of the diagnosis of this pathological condition after birth by analyzing the causes of cardiovascular system dysfunction, the difficulties of diagnosis in modern conditions.

Materials and Methods. The study was based on clinical and instrumental examinations of neonates diagnosed with PPHN in the early neonatal period. Doppler echocardiography, pulse oximetry, and standard clinical assessment were used. Two clinical cases of PPHN in a newborn from a mother with COVID-19 (COronaVIrus Disease 2019) and in newborn with trisomy 21 were analyzed.

Results and Conclusions. In the first case, maternal COVID-19 infection resulted in impaired maternal-placental circulation, fetal hypoxia, and impaired pulmonary adaptation of the newborn with severe PPHN requiring intensive support. In the second case, PPHN in a neonate with trisomy 21 was prolonged and characterized by poor response to standard therapy. The results of the study emphasize that the pathogenesis of PPHN varies depending on the etiology – infectious or genetic and is accompanied by ventricular dysfunction. An interdisciplinary approach is important for timely assessment of signs of heart failure with early echocardiographic assessment and changes in treatment. Further studies are needed to develop early diagnostic and treatment algorithms.

Keywords: *COVID-19, trisomy 21, fetal hypoxia, right-left shunt, echocardiography, Doppler*.

Abbreviations

Ao diameter – Aorta diameter.
COVID-19 – COronaVIrus Disease 2019.
Doppler EchoCG – Doppler Echocardiography.
FS – linear Fractional Shortening.
HR – Heart Rate.
IVSd – Interventricular Septum thickness, Diastole.
LAD – Left Atrial Diameter.
LVEDd – Left Ventricle End Diastolic diameter.
LVEF – Left Ventricular Ejection Fraction.
LVPWd – Left Ventricular Posterior Wall thickness in diastole.
PAD – Pulmonary Artery Diameter.
PDA – Patent Ductus Arteriosus.
PG – Pressure Gradient.
PG AoV – Pressure Gradient Aortic Valve.
PG Desc Ao – Pressure Gradient in the Descending Aorta.
PG PV – Pressure Gradient Pulmonary Artery Valve.
PPHN – Persistent Pulmonary Hypertension of the Newborn.
RAD – Right Atrial Diameter.
RVEDd – Right Ventricle End-Diastolic diameter.
SARS-CoV-2 – Severe Acute Respiratory Syndrome Coronavirus 2.

Corresponding Author:
Boichenko Alona D. – MD, Associate Professor, Professor of the Department of Pediatrics No.1 and Neonatology of the Kharkiv National Medical University, Ukraine.
✉ Ukraine, 61022, Kharkiv, Nauky ave., 4.
E-mail: ad.boichenko@knmu.edu.ua

Introduction

Persistent pulmonary hypertension of the newborn across various gestational ages remains a critical issue, as it is a potentially life-threatening condition. This underscores the importance of timely recognition and specialist care [1]. PPHN (also known as persistent fetal circulation) results from the abnormal transition from fetal to neonatal circulation in the early neonatal period [2]. This syndrome is characterized by a pathological rise in pulmonary artery pressure due to pulmonary vascular malformations, maladaptation to postnatal circulation, or impaired development or growth of the newborn [1; 2], such as prematurity or intrauterine growth retardation. The condition involves postnatal persistence of right-to-left shunting at the level of the patent foramen ovale and patent ductus arteriosus in the presence of increased pressure in the right ventricle [3; 4].

PPHN can be primary or secondary. In the primary type, morphological changes in the vessels lead to high pressure in the right ventricle and pulmonary circulation. Secondary PPHN is characteristic of newborns with various somatic pathologies, as a result of which hypoxia and acidosis cause pulmonary vasoconstriction and increased pressure in the pulmonary circulation [3; 4].

Etiologies include parenchymal lung diseases (e.g., meconium aspiration syndrome, congenital pneumonia, respiratory distress syndrome, sepsis) [2]. Separately, idiopathic persistent pulmonary hypertension in newborns is considered, the cause of which is excessive thickness of the smooth muscles of the pulmonary vessels. Sometimes different etiological factors are combined.

Despite its multifactorial origin, recent epidemiological studies have demonstrated that PPHN is associated with antenatal events (preeclampsia, chorioamnionitis, and other perinatal causes). These lead to abnormal growth and dysfunction of the pulmonary vessels and may increase the risk of developing pulmonary arterial hypertension in later life [5].

If persistent pulmonary hypertension is suspected, one of the necessary diagnostic methods is Doppler echocardiography, as it can confirm the presence of right-to-left shunting and can assess the severity of pulmonary hypertension. [4; 6].

The consequences of persistent pulmonary hypertension can be diverse (cardiorepiratory failure, chronic lung disease, cerebral infarction), leading to specific motor and/or cognitive deficits or death [1; 4].

The **aim** of the study was to analyze clinical observations of the development of persistent fetal circulation of various origins in full-term newborns, to spread awareness among the medical community regarding the features of the diagnosis of this pathological condition after birth by analyzing the causes of cardiovascular system dysfunction, the difficulties of diagnosis in modern conditions.

Materials and Methods

The study was based on the analysis of our own clinical observations. Clinical and instrumental examinations were performed in newborns with persistent pulmonary hypertension in the early neonatal period. The complex of clinical and diagnostic measures included: clinical research methods, Doppler echocardiography, pulse oximetry. To achieve the set goal, comparative descriptive and analytical methods were used.

The parents of the examined newborns were informed about the clinical and instrumental study and gave their consent to its conduct. The Ethics and Bioethics Commission of Kharkiv National Medical University established that the mentioned studies were conducted in accordance with the ethical norms and principles controlling human medical research.

Results

Clinical case 1.

Newborn O., (birth weight 3050 g, length 52 cm, head circumference 37 cm, thoracic circumference 36 cm, Apgar score 6/7) was born from the second pregnancy with an uncomplicated course, the second physiological birth at a gestational age of 38 weeks. Four days before the birth, the mother fell ill with COVID-19 of moderate severity, and had a fever during childbirth. Prenatally, during ultrasound screenings, no cardiovascular system pathology was detected in the fetus.

After birth, the child's condition was severe due to the development of cardiovascular disorders (marble skin, episodes of desaturation up to 84% with agitation). There was persistent central cyanosis. Oxidant test detected refractory hypoxemiae, the HR was 60 bpm, auscultation above the lungs showed puerile breathing. On auscultation, the heart sounds were rhythmic, and the systolic murmur was detected in the 2nd intercostal space on the left, as well as at the projection point of the mitral and tricuspid valves, $2^{nd}/3^{rd}$ according to the gradation of the intensity of heart murmurs according to Levin's scale [7], The HR was [128–160] bpm, and blood pressure was 70/38 mmHg.

The abdomen was soft and painless. Pulsation on the femoral arteries was present. According to the data on the acid-base balance, metabolic acidosis was revealed.

Doppler echocardiography (*Fig. 1*) showed the following measurements: LVEDd 13.7 mm, IVSd 3.4 mm, LVPWd 4.6 mm, LAD 10.9 mm, RVEDd 12.4 mm, RAD 14.0 mm, LVEF 60%, FS 30%, Ao diameter 9.0 mm, PG Desc Ao 8.5 mmHg, PG AoV 3.5 mmHg, PAD 11.0 mm, PG PV 3.8 mmHg.

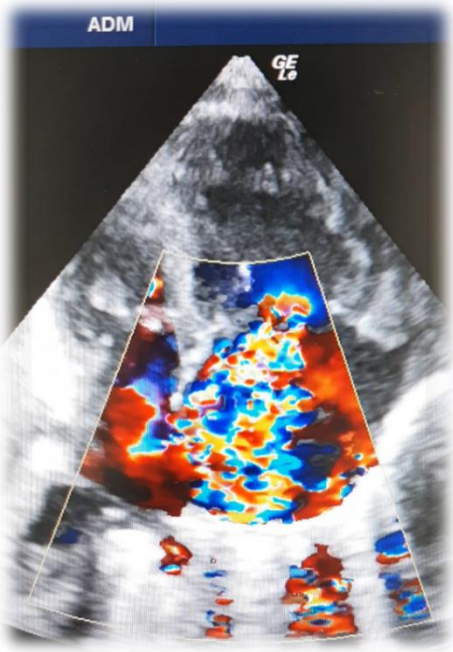

Fig. 1. Newborn O., 1 day of life. Dilatation of the right chambers, mainly the right atrium, tricuspid regurgitation of the 3rd degree, right-left shunt at the level of the patent foramen ovale.

Blood flow in the abdominal aorta was pulsatile, with a maximal flow velocity (V_{max}) of 46.0 cm/s. There was right ventricular dilation; tricuspid regurgitation of the 2nd degree, mitral regurgitation of the 1st degree (PG of the regurgitation jet was 55 mm Hg). The average pressure in the pulmonary artery trunk was [58–60] mm Hg. The PDA was functioning, 2.6 mm; the patent foramen ovale was 2.9 mm, right-left shunt. Diastolic dysfunction of the ventricles was of abnormal relaxation type. Persistent pulmonary hypertension of the newborn, severe pulmonary hypertension with right-to-left shunt through PDA and foramen ovale were diagnosed. Therapy included compliance with the warm chain, control of normovolemia, respiratory support, correction of electrolyte, glucose, calcium, and magnesium levels; administration of diuretics according to weight and water balance, as well as monitoring of acid-base balance, blood pressure, saturation, and indicators of central hemodynamics. On the third day, the child's condition stabilized; Doppler EchoCG showed a decrease in the linear dimensions of the right chambers, a functioning PDA with a diameter of up to 1.2 mm, a patent foramen ovale, 2.8 mm, left-right shunt, LVEF 64%, FS 32%. The average pressure in the pulmonary artery trunk was [32–34] mmHg.

Clinical case 2.

Newborn J. (birth weight was 3200 g, length 51 cm, head circumference 37 cm, thoracic circumference 36 cm, Apgar score 6/7 points) was born from the third uncomplicated pregnancy and third physiological birth at 39 weeks of gestation. No pathologies of the cardiovascular system were detected in the fetus during prenatal ultrasound screenings.

After the birth, the child's condition was severe due to the development of cardiovascular disorders (marble skin, episodes of desaturation up to 76%), and persistent central cyanosis. The child's phenotype is trisomy 21. On clinical examination, saturation was [76–78]%. Oxidant test demonstrated refractory hypoxemia, HR of 60 bpm; auscultatory findings above the lungs, and puerile breathing were detected. On auscultation, the heart sounds were rhythmic, and a systolic murmur was heard in the 2nd intercostal space on the left, at the point of projection of the tricuspid valves, 2nd/3rd according to the gradation of intensity of heart murmurs corresponding to Levin's scale [7], and splitting of the second sound over the pulmonary artery was revealed, with an HR of [130–160] bpm. Blood pressure was 74/37 mmHg. The abdomen was soft and painless. Liver was +2 cm below the costal arch. Acid-base balance was comsistent with metabolic acidosis.

Chest X-ray (*Fig. 2*) revealed cardiomegaly, cardiothoracic index (CT ratio or CTR) – 0.75; and thymomegaly.

Ultrasound examination of the heart (*Fig. 3*) demonstrated LVIDd 16.8 mm, IVSd 3.6 mm, LVPWd 4.6 mm, LAD 12.1 mm, RVIDd 14.8 mm, RAD 14.9 mm, EF [58–60]%, FS [28–30]%, Ao diameter 9.7 mm, PG Desc Ao 9.1 mm Hg, PG AoV 3.9 mm Hg, PAD 11.6 mm, PG PV 3.6 mm Hg. Blood flow in the abdominal aorta was pulsatile, with a maximal flow velocity (V_{max}) of 41.0 cm/s. There was right ventricular dilation; tricus-

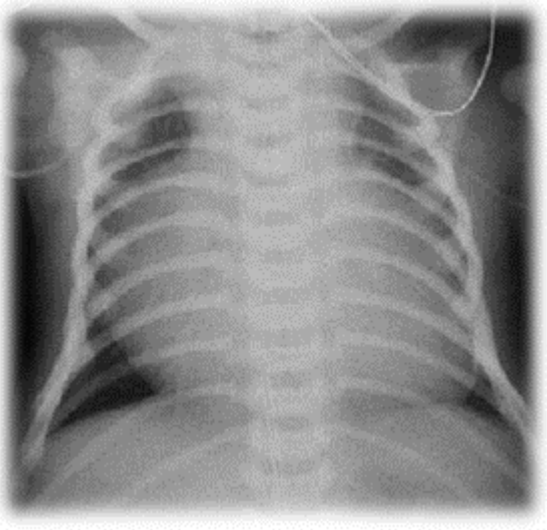

Fig. 2. Newborn J., 1 day of life. Thymomegaly, cardiomegaly. CTR 0.75.

Fig. 3. Newborn J., 1 day of life. Right ventricular dilatation, third-degree tricuspid regurgitation, excision of the MPP into the left atrium (right-left shunt at the level of the patent foramen ovale).

pid regurgitation of the 2nd–3rd degree, PG of the regurgitation jet was 63 mm Hg. The average pressure in the pulmonary artery trunk was [65–70] mm Hg. PDA was 3.1 mm, patent foramen ovale was 3.9 mm, and the right-left shunt. Diastolic ventricular dysfunction was classified by the type of abnormal relaxation. It was found that persistent pulmonary hypertension of the newborn, severe pulmonary hypertension with right-to-left shunt through PDA and foramen ovale. Therapy according to modern standards of neonatal management included maintenance of warm chain, control of normovolemia, respiratory therapy, correction of electrolyte disorders, glucose, administration of diuretics under control of weight and water balance, daily monitoring of acid-base balance, blood pressure, saturation, central hemodynamics, mean pressure in the pulmonary artery trunk and direction of shunting at the level of fetal communications. The disease had a wave-like course with episodes of desaturation, systolic and diastolic dysfunction, with a decrease in EF to 56% and long-term preservation of bidirectional shunting at the level of the patent foramen ovale. On the sixth day, the child's condition stabilized, with a decrease in the linear dimensions of the right ventricles on the Doppler EchoCG, PDA with a diameter of up to 1.4 mm, a patent oval foramen of 3.8 mm, left-right shunt, LVEF 62%, FS 31%, mean pressure in the pulmonary artery trunk [34–35] mm Hg.

Discussion

Our knowledge on the impact of maternal COVID-19 infection on the development of neonatal persistent pulmonary hypertension is limited. An increase in the number of cases of PPHN in full-term and premature infants has been identified during the COVID-19 pandemic. According to the results of the examinations, if a pregnant woman is sick with COVID-19, the risk of premature birth increases, which disrupts an important stage of adaptation of the child, the beginning of pulmonary breathing; due to prematurity, the level of surfactant in the lungs is reduced, which leads to the development of respiratory distress syndrome. Such newborns may also develop complications of respiratory adaptation, such as transient tachypnea [8].

The pathogenesis of COVID-19 is associated with the toxic effect of the virus on the vessels, which is accompanied by the destruction of the vascular endothelium and stimulation of the body's hyperinflammatory response due to impairment of the immune system regulation. The neonatal immune system responds to proinflammatory cytokines transmitted from the mother, contributing to vasoconstriction in the pulmonary circulation. In turn, endothelial damage and hyperergia can contribute to hypercoagulation accompanied by the subsequent formation of micro- and microthrombi, as well as maladaptation of the angiotensin-converting enzyme-2 action. As a result, there is a decrease in the diffusing capacity of the lungs (restrictive ventilation disorders persist for

[3–6] months after recovery, as after acute respiratory distress syndrome) [9; 10].

Thus, placental SARS-CoV-2 infection disrupts uteroplacental blood flow and leads to fetoplacental insufficiency, fetal hypoxia, and delayed development of pulmonary structures, which debuts with clinical manifestations of respiratory disorders. Impaired adaptation of pulmonary circulation can lead to prolonged preservation of the fetal type of circulation because of endothelial dysfunction and reduced nitric oxide production. This condition requires respiratory support, mechanical ventilation, or high-frequency oscillatory ventilation of the lungs with a highly oxygenated inhaled mixture, as well as sedative therapy due to severe hypoxemia.

Hyperoxia test (breathing 100% oxygen for [10–15] minutes) can help distinguish persistent pulmonary hypertension and heart disease from lung parenchymal disease; however, it is not always performed due to the general availability of echocardiography and the potential adverse effects of hyperoxia [1].

It is also important to note the direct effect of the virus on the myocardium, pericardium, and cardiac conduction system due to the tropism for angiotensin-converting enzyme-2 receptors; thus, the immune response can cause cardiomyocyte death and lead to the replacement of desmosomal proteins with fibro-adipose tissue [11–13], which makes it advisable to dynamically monitor the state of the respiratory and cardiovascular systems in children in the first year of life after suffering persistent pulmonary hypertension.

Children with trisomy 21 develop pulmonary hypertension, including immediately after birth as persistent pulmonary hypertension of the newborn, with a frequency of up to 28%, which accounts for [5–17]% of cases registered in international pediatric pulmonary hypertension registries [14]. Studies have shown that patients with trisomy 21 are predisposed to the development of increased pulmonary vascular resistance and pulmonary arterial hypertension. The cause of this pathological condition is abnormal lung development in conditions of reduced pulmonary vascular surface area and the presence of endothelial dysfunction with higher levels of endothelin-1 and lower levels of nitric oxide, increased hemodynamic stress, increased pulmonary vascular resistance, and postcapillary disease, which contributes to the development of persistent pulmonary hypertension and early progression of pulmonary vascular transformation in patients with trisomy 21 [15; 16]. Early pulmonary artery remodeling may occur due to congenital interferonopathy, intrinsic endothelial dysfunction, or other metabolic conditions. Increased hemodynamic stress may occur due to congenital heart disease or a functioning patent ductus arteriosus, causing persistent pulmonary hypertension of the newborn. Increased pulmonary vascular resistance may occur due to acquired lung disease and abnormalities in the capillaries or postcapillaries [16].

It has been proven that the course of pulmonary hypertension in patients with trisomy 21 is usually associated with late closure of fetal communications, the development of persistent pulmonary hypertension, and is transient [17].

Thus, in newborns with trisomy 21, the course of persistent pulmonary hypertension tends to be prolonged, with periods of decompensation and poor response to standard therapy (ventilation, exogenous surfactant, diuretics, cardiotonic drugs).

Conclusion

1. The course of pulmonary hypertension of newborns in the early neonatal period largely depends on its cause.

2. The detection of PPHN cases during the COVID-19 pandemic indicates that the intrauterine impact of maternal COVID-19 infection, impaired maternal-placental circulation, and fetal hypoxia are key triggers for the development of persistent pulmonary hypertension in newborns, which affects the formation of fetal pulmonary hemodynamics, in particular, an increase in pulmonary vascular resistance and a disruption of its normal decrease after birth.

3. Persistent pulmonary hypertension in children with trisomy 21 syndrome is transient, and special clinical vigilance should be paid to the detection and monitoring of myocardial function, since right ventricular dysfunction significantly worsens the prognosis.

4. A multidisciplinary approach is crucial for the timely assessment of signs of heart failure, facilitated by early echocardiographic assessment and timely adjustments of therapy.

Prospects for further research. To prevent the development of adverse long-term consequences of persistent fetal circulation, it is important to continue research, including multicenter studies, with subsequent early development of an algorithm for early monitoring and treatment of persistent pulmonary hypertension in neonatal units during the COVID-19 pandemic.

DECLARATIONS

Statement of ethics

The authors have no ethical conflicts to disclose.

Data transparency

Data can be requested from the authors.

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Consent to publication

All authors give their consent to publication.

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ROLE OF NURSING INTERVENTIONS IN PREVENTING POSTOPERATIVE COMPLICATIONS

Huk A.A., Yeryomenko G.V.

Kharkiv National Medical University, Kharkiv, Ukraine

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ABSTRACT

Background. Postoperative complications refer to pathological conditions that deviate from the normal course of the postoperative period and are not a consequence of the progression of the underlying disease.

Aim. To analyze the number of nursing interventions in the postoperative period aimed at preventing complications, as well as to evaluate the results of a patient survey regarding the nurse's role in postoperative care.

Materials & Methods. This study is based on an analysis of the number of nursing interventions performed in the postoperative period. A total of 2,913 patients underwent surgical interventions on abdominal organs for conditions such as cholelithiasis, appendicitis, acute intestinal obstruction, hernia, acute pancreatitis, and perforated gastric or duodenal ulcers. The survey included 65 patients from the surgical department. Its purpose was to assess the role of nurses in caring for patients after abdominal surgery (35 (53.8%) men and 30 (46.2%) women).

Results. One hundred percent of nurses fulfill doctors' prescriptions, 96.9% prepare patients for diagnostic and treatment procedures, and 95.4% assist with personal hygiene. Additionally, 96.9% of patients expressed satisfaction with the work of nurses. In the future, the focus will be on identifying the main types of postoperative complications and their causes, as well as formulating measures aimed at preventing such complications

Conclusions. It was found that nurses play a very important role in providing care to patients after abdominal surgery. The nurse is the closest assistant to the doctor, and the success of treatment often depends on her. Correct and timely implementation of medical prescriptions, as well as a compassionate attitude towards the patient, create conditions for a speedy recovery. In the future, the focus will be on identifying the main types of postoperative complications and their causes, as well as formulating measures aimed at preventing such complications.

Keywords: *nurse, abdominal surgery, postoperative care*.

Introduction

Postoperative complications refer to pathological conditions that deviate from the normal course of the postoperative period and are not a consequence of the progression of the underlying disease [1]. These complications are usually caused by concomitant pathology, overestimation of the patient's ability to undergo surgery, non-compliance with the hospital regimen, or technical and tactical errors [2]. Complications can arise intraoperatively, including organ and tissue damage, anesthesia-related complications, thromboembolic events, and bleeding. Additionally, postoperative complications may affect the operated organs and systems, leading to purulent infiltration, secondary bleeding, wound dehiscence, and dysfunction of the affected organ or system [3].

Postoperative complications affecting organs and systems are classified into early (occurring during the early and late postoperative stages) and late (arising during the rehabilitation stage) [4].

Early postoperative complications develop during the patient’s hospitalization and result from surgical trauma, the effects of anesthesia, and prolonged immobilization. To minimize the risk of early postoperative complications, the nurse prepares a functional bed based on the nature of the

Corresponding Author:
Yeryomenko Galyna V. – Doctor of Medical Sciences, Professor of the Department of Propedeutics of Internal Medicine, Nursing and Bioethics of the Kharkiv National Medical University, Ukraine.
✉ Ukraine, 61022, Kharkiv, Nauki ave., 4, KhNMU.
E-mail: galyna0512@ukr.net

surgery and type of anesthesia. For instance, to prevent complications related to anesthesia, the patient is placed in a supine position without a pillow, with the head turned to the side for two hours. After local anesthesia, precautions should be taken to prevent vomiting. One of the most serious postoperative wound complications is secondary bleeding. To prevent this, the nurse follows a specific care plan. An ice pack is applied to the wound area, and the patient's condition is assessed every 30 minutes, including skin and mucous membrane color, respiratory rate, blood pressure, and pulse. Additionally, the dressing is monitored for signs of bleeding. All observations are documented in the patient's medical record and promptly reported to the physician. A disposable transfusion system and hemostatic medications should be readily available.

In addition, nursing interventions in the postoperative period aim to prevent infection in the surgical wound area, reduce inflammatory responses (such as fever and elevated body temperature), enhance the body's resistance to diseases, optimize oxygen saturation, and prevent pulmonary congestion. To minimize complications, nurses also monitor the patient's vital signs, including blood pressure, body temperature, respiratory rate, and heart rate [5].

Late postoperative complications may develop after the patient is discharged from the hospital, affecting the organs on which the surgery was performed. These complications include gastric ulcer disease, adhesive disease, and phantom pain following limb amputation. Additionally, complications related to the postoperative wound may occur, such as a ligature fistula, postoperative hernia, or keloid scar. These conditions are typically managed on an outpatient basis by a polyclinic surgeon, although some cases (e.g., postoperative hernia or keloid scar) may require reoperation [6; 7].

Thus, one of the most critical challenges in modern surgery is the prevention of complications and the implementation of advanced methods for their early diagnosis and treatment.

The **aim** of the study was to analyze the number of nursing interventions in the postoperative period aimed at preventing complications, as well as to evaluate the results of a patient survey regarding the nurse's role in postoperative care.

Material and Methods

This study is based on an analysis of the number of nursing interventions performed in the postoperative period in the surgical department of the Municipal Non-Profit Enterprise "Municipal Clinical Multidisciplinary Hospital No.25" of the Kharkiv City Council in 2024. A total of 2,913 patients underwent surgical interventions on abdominal organs for conditions such as cholelithiasis, appendicitis, acute intestinal obstruction, hernia, acute pancreatitis, and perforated gastric or duodenal ulcers.

The study used the sociological method (questionnaire). We used our own questionnaire. The survey included 65 patients from the surgical department. Its purpose was to assess the role of nurses in caring for patients after abdominal surgery (35 men (53.8%) and 30 women (46.2%)). Only the percentage of responses to the questionnaire was statistically calculated. Before the survey, the patients signed an informed consent form.

Results

The professional responsibilities of nurses in the surgical department include prevention of postoperative complications. The most frequently performed nursing interventions were application and replacement of dressings on postoperative wounds (3,057 times) and drainage care and replacement (2,980 times). The application of an ice pack to the postoperative wound was performed for all operated patients (2,913 times). Nurses assisted in early mobilization for 2,270 patients, applied elastic bandages to the limbs to prevent thrombosis in 2,159 patients, and performed urethral catheter replacement in 846 patients.

In response to the question, "Does the nurse perform hygiene procedures?", 62 patients (95.4%) answered "yes," while 3 patients (4.6%) answered "no."

Table. Nursing interventions for the prevention of postoperative complications

Name of intervention	Number
Application and replacement of dressings on postoperative wounds	3,057
Drainage care and replacement	2,980
Application of an ice pack to the postoperative wound	2,913
Assistance in early mobilization of patient	2,270
Application of elastic bandages to the limbs for thrombosis prevention	2,159
Urethral catheter replacement	846

Thus, 95.4% of nurses were reported to assist patients with personal hygiene.

Regarding the question, "Does the nurse place an inflatable rubber ring under the sacrum?", 60 patients (92.3%) responded affirmatively, while 5 patients (7.7%) responded negatively.

In response to the question, "Does the nurse perform massage?", 15 patients (23.1%) answered "yes," 10 patients (15.4%) answered "sometimes," and 40 patients (61.5%) answered "no".

Regarding the question, "Did your nurse prepare you for diagnostic and treatment procedures?", 63 patients (96.9%) answered "yes," and 2 patients (3.1%) answered "no".

In response to the question, "Does the nurse monitor blood pressure, body temperature, pulse, diuresis, and administer medications?", all 65 respondents (100%) answered "yes". This indicates that 100% of nurses fully comply with doctors' prescriptions.

Regarding the question, "Are you satisfied with the work of the nurse?", 63 patients (96.9%) reported being satisfied, while 2 patients (3.1%) were dissatisfied.

It was found that nurses play a significant role in providing care to patients after abdominal surgery. One hundred percent of nurses fulfill doctors' prescriptions, 96.9% prepare patients for diagnostic and treatment procedures, and 95.4% assist with personal hygiene. Additionally, 96.9% of patients expressed satisfaction with the work of nurses.

Conclusions

The nurse is the closest assistant to the doctor, and the success of treatment often depends on her. In the postoperative period, all efforts are aimed at restoring the patient's physiological functions, normalizing the surgical wound, and preventing possible complications. Correct and timely implementation of medical prescriptions, along with a compassionate attitude toward the patient, create the conditions for a speedy recovery.

Prospects for future research

In the future, the focus will be on identifying the main types of postoperative complications and their causes, as well as formulating measures aimed at preventing such complications.

DECLARATIONS:

Disclosure Statement

The authors have no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

Statement of Ethics

The authors have no ethical conflicts to disclosure.

Data Transparency

The data can be requested from the authors.

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Consent for publication

All authors give their consent to publication.

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IMPORTANCE OF INFECTION CONTROL IN INCREASING PATIENT SAFETY AND PREVENTING INFECTIONS DURING HEALTHCARE (literature review)

Krasovska K.O., Globina N.I.

Kharkiv National Medical University, Kharkiv, Ukraine

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ABSTRACT

Background. Today, the topic of combating Healthcare-Associated Infections (HAIs) is becoming increasingly relevant. The World Health Organization has developed the concept of Infection Prevention and Control (IPC), which is a key component of quality control and patient safety in hospitals.

Aim. To analyze modern methods of infection prevention and the role of healthcare workers in the effective implementation of infection control measures, according to the data of modern literature sources.

Materials and Methods. We analyzed the literature on prevention of hospital-acquired infections, as well as the importance of infection control in improving patient safety, the role of medical staff in the provision of medical care. The search for scientific information was carried out using the scientific databases Scopus, PubMed, Web of Science, Google Scholar.

Results & Conclusions. Hospital-acquired infections are a serious public health problem associated with increased patient morbidity and mortality, as well as an economic burden on healthcare systems. Approximately 10% of hospitalized patients in high-income countries are affected by HAIs. Infection control is defined as a set of effective organizational, preventive and anti-epidemic measures aimed at preventing the occurrence and spread of healthcare-associated infections. Healthcare workers play an important role in the effective implementation of infection control measures. The use of Personal Protective Equipment (PPE), hand hygiene, environmental cleaning, screening and isolation, sterilization and disinfection, surveillance and reporting, vaccination and the introduction of innovative technologies in hospital infection control are important elements of the prevention and control of HAIs. Hospital infection control is essential to protect patients, healthcare workers and the wider community from HAIs. These measures are important to protect patients, healthcare workers and all society.

Keywords: *hand hygiene, healthcare-associated infections, infection prevention*.

Introduction

Today, methods and means of combating Healthcare-Associated Infections (HAIs) are in high demand due to the growing need in this area. Therefore, there is an urgent need to implement mechanisms for assessing the quality of care provided in this area [1]. The World Health Organization (WHO) has developed the concept of Infection Prevention and Control (IPC), which is a key component of quality control and patient safety in hospitals. Preventing healthcare-associated infections and reducing the transmission of infections are the main goals of IPC [2].

The term "Infection Control" (IC) is defined as a set of effective organizational, preventive and anti-epidemic measures aimed at preventing the occurrence and spread of HAIs based on the results of epidemiological diagnosis. Implementation of the infection control system transfers the main focus of the fight against HAIs to each specific hospital, where staff set goals and determine methods to achieve them, constantly collect data for internal assessment of the situation with HAIs, and shortcomings are considered as flaws in the infection control system implemented in a given hospital, not a specific person [3; 4].

Healthcare workers play an important role in the effective implementation of infection control

Corresponding Author:
Krasovska Katerina O. – PhD, Associate Professor of the Department of Internal Medicine, Propedeutics, Nursing and Bioethics, Kharkiv National Medical University, Ukraine.
✉ Ukraine, 61022, Kharkiv, Nauky ave., 4.
E-mail: ko.krasovska@knmu.edu.ua

measures [5]. Hospital infection control practices should be implemented in hospitals to reduce the adverse effects of HAIs [6]. The use of Personal Protective Equipment (PPE) and good hand hygiene are important elements of HAI prevention and control [7]. The first important step in establishing an effective infection control program is to identify the knowledge, approaches and methods currently available to healthcare staff regarding infection control [8].

Aim

To analyze modern methods of infection prevention and the role of healthcare professionals in the effective implementation of infection control measures, according to the data of modern literature sources.

Results

The term HAI covers a number of infections that a patient can contract during a hospital stay for pathology other than the infection in question [9]. Collectively, these infections pose a serious public health problem associated with increased patient morbidity and mortality, as well as an economic burden on healthcare systems [10]. Approximately 10% of hospitalized patients in high-income countries are affected by HAIs. Developing countries report significantly higher incidence rates (in some cases, more than 25% of all hospitalized infections) [11]. In Europe, the prevalence of HAIs ranges from 4.6% to 9.3% [12]. The financial costs associated with HAIs are estimated to be between US$28 billion and US$45 billion [13]. In the UK, in 2016–2017, public hospitals recorded more than 650,000 HAIs among 13.8 million inpatients, including 22,800 deaths [14]. According to Stewart S. et al., HAIs can lead to a 7.8-day increase in the length of a patient's hospital stay, with an average of 30 days for patients with a HAIs and 3 days for patients without HAIs. The authors of the study concluded that a 10% reduction in the incidence of AMI could free up to 5800 bed days [15]. It is estimated that in 2016–2017, the NHS spent almost £2.1 billion on the treatment of HAIs [14].

The causes of HAIs are also well understood and are mainly related to the transmission of potentially pathogenic microbes from patient to healthcare worker (HCP), which is often associated with contamination of surrounding or adjacent surfaces (e.g. equipment, clothing, sanitary utensils) [16–18]. Efforts to reduce the risk of such transmission have largely focused on Hand Hygiene (HH) [19], as reflected in the World Health Organization's 2009 "5 Moments for Hand Hygiene" document [20].

It should be noted that hand hygiene in Emergency Departments (ED) cannot be significantly improved [21–23]. This is a particularly challenging task, as in most developed countries, the emergency department is the main point of access to life-saving care for critically ill or injured patients [24]. In contrast to inpatient departments, the environment and practices of the ED reflect the increased complexity associated with critically ill or polytrauma patients and overcrowding, which are factors that contribute to the relatively low levels of compliance observed. In particular, Muller M.P. et al. [22] reported that overcrowding in wards contributed to lower levels of hand hygiene compliance in ICU. Paradoxically, the high frequency of invasive procedures performed in ICU provides an opportunity to improve hand hygiene compliance and reduce the rate of HAIs [22].

Nurses can reduce the risk of infection and colonization by using evidence-based aseptic practices that reduce the introduction of endogenous and exogenous microorganisms through invasive medical devices. Appropriate use of personal protective equipment and good hand hygiene are paramount to reducing the risk of exogenous transmission of infection to a susceptible patient. For example, microorganisms have been found in the environment, as well as on surfaces surrounding the patient, and on portable medical equipment used in the ward [25].

Proper donning and doffing of Personal Protective Equipment (PPE) by healthcare staff, followed by hand hygiene, will reduce transient microbial burdens that can be transmitted to themselves or others. Good asepsis and infection control practices have been shown to reduce the spread of microorganisms between patients, prevent re-transmission, which can lead to outbreaks among multiple patients or establish a hospital-endemic flora in the healthcare environment [26].

An important component of the infection control program is a set of preventive and anti-epidemic measures, which includes [27; 28]:

- optimization of measures to combat and prevent HAIs with different routes of transmission;
- rationalization of the basic principles of hospital hygiene, including the implementation of measures that can be generally described as "clean hands";
- improving the effectiveness of disinfection and sterilization measures, maximizing the use of

disposable medical instruments and equipment, and epidemically safe disposal of medical waste.

Surgical Site Infections (SSIs) (formerly referred to as wound infections) are recorded when a postoperative infection occurs within 30 days of surgery (or, in the case of implant surgery, a deep organ/cavity infection that develops within 90 days of surgery). IDHI is the most common complication in postoperative surgical patients, associated with significant morbidity, high mortality and financial burden for national budgets and individual patients [28; 29]. The type of surgery determines the proportion of IDHI. [2–36]% of patients develop IDHI, with the highest risk of developing this complication in orthopedic patients, followed by patients undergoing cardiac and intra-abdominal surgery [12]. Approximately 25% of patients with SSI develop severe sepsis and shock and are transferred to intensive care [15; 30].

Numerous domestic and foreign researchers point to the importance of implementing the IR system to improve the quality and safety of medical care in hospitals [31–33]. In particular, Marra A.R. [34] emphasizes that changing the behavior of medical staff, namely active participation in preventive anti-infective measures, helps to reduce morbidity and mortality from ventilator-associated pneumonia and central venous catheter-related bloodstream infections.

The results of a study conducted in US hospitals show that general recommendations for the prevention of HAIs, based on training of medical staff in hand hygiene before and after any procedure or patient contact, are very effective. They reduce the incidence of catheter-associated urinary tract infections by 38%, ventilator-associated pneumonia by 8%, and surgical site infections by 7% [35]. A study in Malaysia suggests that simple infection control measures, such as hand sanitization with alcohol-based disinfectant, can help prevent HAIs and save a significant number of lives, reduce morbidity and minimize healthcare costs.

Direct or indirect contact with people and contact with contaminated materials are the two main ways in which infectious diseases are transmitted from one person to another [36]. Infection control programs have become standard practice in hospital settings [37; 38]. Healthcare professionals, infection control experts, health authorities and patients are concerned about HAIs [39]. All of them are affected by the transmission of infectious organisms in healthcare facilities [40].

The first important step in establishing an effective infection control program is to identify the knowledge, approaches and methods currently available to healthcare staff regarding infection control [8]. Insufficient funding for healthcare in general, the inability of facilities to implement effective preventive measures and insufficient training of healthcare workers, especially nurses, are just some of the global health constraints that affect infection prevention [41].

Every healthcare worker should practice infection control as it is one of their medical functions [42]. In various healthcare organizations, infection control procedures reduce the incidence of HAIs and, as a result, are now standard practice in most healthcare centers in developed countries [43]. To achieve positive changes in healthcare, it is important to recognize the dangers and limitations associated with emerging infectious diseases and assess how they will affect existing infection control practices [44].

Infection control is essential to minimize the occurrence and spread of HAIs in healthcare facilities. Common factors contributing to the occurrence of a HAI include many elements, including:

- patient susceptibility due to a weakened immune system;
- widespread use of invasive procedures leading to antimicrobial resistance;
- inadequate hand hygiene among healthcare workers;
- contaminated medical equipment and suboptimal environmental hygiene [12].

In addition, non-compliance with proper sterilization methods, overcrowding and insufficient implementation of standard infection control protocols all contribute to the spread of HAIs [45].

The Resolution of the Cabinet of Ministers of Ukraine No.376 on April 21, 2023, amended the List of ensuring the proper level of healthcare services under the contract with the National Health Service of Ukraine [46]. The list was supplemented with minimum requirements for infection prevention, infection control, counteraction to the spread of antimicrobial-resistant pathogens and the quality of bacteriological tests. Accordingly, the contracting of healthcare facilities for 2024 under the medical guarantees program was carried out taking into account these requirements [46].

The role of nurses in infection prevention

Preventing infections is a core responsibility of nurses, who also play a key role in patient education and ensuring that all elements of their nursing practice are based on the latest scientific knowledge. As patients' caregivers, nurses are uniquely

positioned to drive change and raise standards of care. Nurses can use several methods to provide a safe environment for patients. The most important nursing action for infection prevention is handwashing, which is a powerful tool in the nursing arsenal [47–49]. When working with biological fluids, nurses should use PPE. They can provide a safe environment for patients in addition to performing bedside care. This tactic helps the facility identify ways to improve the system and prevent future problems [50–52].

Key approaches and strategies to ensure infection control in hospitals

Maintaining infection control in hospitals is essential for the protection of patients, healthcare staff and visitors [48; 53]. The best methods and tactics for ensuring infection control in hospitals are:

Hand hygiene

Hand hygiene is the most obvious, verifiable and effective measure of infectious control [25; 54; 55] and is essential for preventing and limiting the spread of infection [49; 56; 57]. According to numerous studies conducted at the current stage of medical development, as well as on the basis of historical experience, it has been proven that the hands of medical personnel are the main factor in the transmission of infectious diseases. Thorough hand washing is one of the best methods to prevent the spread of infection. Healthcare workers should wash their hands frequently [58]. Posters with images promoting the importance of hand hygiene should be placed near sinks and antiseptic supplies [59]. According to the WHO "Five Moments" model, healthcare workers should perform hand hygiene before and after touching a patient, after risk of contact with a bodily fluid, before performing a clean or aseptic procedure, and after touching the patient's surrounding objects or belongings [60].

The prevalence of HAIs can be significantly reduced if everyone practices good hand hygiene [51].

Personal protective equipment

To stop the spread of infectious organisms while caring for patients, healthcare workers should wear proper PPE, such as gloves, gowns, masks and eye protection [61]. PPE acts as a barrier between healthcare personnel and potentially infectious materials [62]. Proper wearing and disposal of PPE is essential for safety, and the use of PPE requires proper training, adherence to protocols, and regular evaluation of infection control practices [7; 63].

Cleaning the environment

To stop the transmission of diseases, hospital rooms, equipment and surfaces need to be cleaned and disinfected regularly [64; 65]. The use of appropriate disinfectants and detergents helps prevent cross-contamination [66]. By maintaining a clean and hygienic environment, hospitals can create a safer environment for patients, contributing to their recovery and well-being [67; 68].

Screening and isolation

To prevent the spread of infection to other patients, people infected with MultiDrug-Resistant Organisms (MDROs) should be identified through screening and isolation [69; 70]. Hospitals usually have protocols in place to screen patients on admission. Isolation measures are used to separate patients with known or suspected infectious diseases from others to prevent the spread of infection [71].

Education and training

To ensure that healthcare staff is up-to-date with best practices, they should receive ongoing education and training on infection prevention, including an understanding of the infection chain, transmission routes and prevention strategies. Training should include the implementation of standard precautions, which are the basic infection prevention measures used for all patients [72].

Sterilization and disinfection

To prevent the transmission of infections, all medical equipment, especially reusable equipment, should be sterilized or disinfected before use. Sterilization is typically used for critical medical equipment that comes into contact with sterile body tissue. Disinfection is the process of reducing the number of microorganisms on surfaces, instruments, or in the environment to a level that is considered safe [9; 73; 74].

Surveillance and reporting

Outbreaks of infectious diseases should be detected and reported, and appropriate control measures should be implemented in hospitals [58; 75]. A functioning surveillance system is forward-looking, accurately identifies the risk group and predicts the outcome of infection control efforts [76; 77]. Reporting is the process of communicating surveillance data to the relevant authorities or organizations responsible for monitoring and regulating infection control practices [78].

Vaccination

Healthcare workers must be vaccinated against infectious diseases to stop the transmission of disease. Vaccination of healthcare workers is essential to protect their health and prevent the ac-

quisition and spread of infections. Vaccination methods include both routine and emergency procedures [7; 78; 79].

Technology innovation in hospital infection control

Improvements in hospital infection control have been driven largely by technology and innovation.

Ultraviolet (UV) disinfection systems

Ultraviolet light kills bacteria and viruses by exposing them to ultraviolet radiation. UV disinfection systems are used in hospitals to disinfect patient rooms, operating theatres and other areas where infectious organisms may be present. These systems use UV lamps to reduce the risk of HAIs [80].

Electronic monitoring of hand hygiene

One of the best strategies for stopping the spread of infection in hospitals is to maintain good hand hygiene. This technology can help hospitals identify areas of poor hand hygiene compliance and improve overall compliance. Electronic hand hygiene monitoring systems use sensors to track when healthcare staff enter and leave patient rooms and can track whether they wash their hands or use hand sanitizer [54; 77].

Antimicrobial surfaces

In hospitals, bed rails and door handles are two frequently touched objects that can harbor bacteria and viruses. Antimicrobial surfaces are designed to kill viruses and bacteria as soon as they are touched, reducing the chance of infection transmission. Usually copper or silver is used, which have antibacterial properties [50; 73].

Improved air filtration systems

In healthcare facilities, especially in areas such as operating theatres and intensive care units, infections can spread through the air. Modern air filtration systems can remove germs and viruses, as well as other airborne particles. These systems can reduce the risk of airborne infection [77].

Electronic patient monitoring

By using electronic patient monitoring systems to track vital signs and other medical data, healthcare providers can identify patients who may be at risk of infection. When a patient's condition changes, these systems can notify the relevant healthcare providers, allowing for earlier intervention and reducing the risk of infection [40].

Difficulties in implementing effective infection control in hospitals

The transition to new practices may be met with reluctance or hesitation by healthcare workers, stemming from comfort and familiarity with established procedures. Accepting change in healthcare facilities can be challenging and requires extensive training and support mechanisms. Providing detailed education, demonstration and ongoing guidance is crucial to facilitate a smooth transition and ensure effective implementation of new infection control measures.

Effective infection control depends to a large extent on the availability of adequate resources. These cover a range of needs, such as sufficient PPE, access to high quality cleaning products, financial support for maintenance and procurement, and well educated staff [39]. Ensuring strict cleaning protocols, adequate isolation measures and strict adherence to infection control practices are crucial in managing the constant high flow of patients and visitors [81]. A single and standardized approach cannot effectively meet the diverse needs of patients with different medical problems. Adapting infection control measures to specific conditions is becoming a challenge. Implementation of a flexible approach is essential for full infection control in healthcare facilities [66].

Establishing robust communication strategies and encouraging interdisciplinary collaboration are crucial to ensure cohesive infection control efforts [25; 72]. Without adequate education and ongoing training programs, healthcare workers may lack the skills and knowledge to accurately implement preventive measures. Investing in comprehensive training initiatives and continuing education programs is crucial to ensure that healthcare workers have the knowledge they need to effectively control infections [81]. Despite the efforts of healthcare professionals to educate and encourage patients to follow infection control practices, individual behavior and attitudes towards these practices may vary. Educating patients, clearly communicating the importance of these measures and creating an enabling environment for compliance are important strategies to reduce the risk of patient behavior in spreading infection in healthcare settings [72].

Enforcement and monitoring

Hospital infection control measures designed to stop the spread of infectious diseases among patients, healthcare workers and visitors must be accompanied by compliance and monitoring to be effective, continually updated and reviewed, and based on current evidence-based guidelines [48; 61]. All hospital staff should be trained in infection prevention. Continuous education, multiple training sessions, reminders and feedback on compliance with these guidelines are essential [81; 82].

Open communication with patients, visitors and healthcare professionals can help identify areas for improvement and promote compliance with infection control protocols [83]. By effectively implementing and monitoring infection control measures, hospitals can help prevent the spread of infectious diseases and protect the health of patients, healthcare workers and visitors [84].

The future of hospital infection control

Hospitals are using Artificial Intelligence (AI) and Machine Learning (ML) to proactively detect and contain the spread of infections. AI-based systems monitor staff compliance with hand hygiene rules and detect infections on surfaces, alerting staff to the need for timely intervention [50]. Telemedicine has become a vital tool in the fight against infections, allowing for remote consultations and monitoring. Healthcare workers can remotely receive education and training on infection prevention methods, reducing the risk of infection transmission in healthcare facilities [47; 68].

Hospitals are exploring advanced sanitation techniques such as ultraviolet light, electrostatic spraying and hydrogen peroxide vapor to effectively clean surfaces and equipment. These technologies not only increase cleaning efficiency, but also significantly reduce the need for large amounts of labor, thereby optimizing costs [84]. Environmental monitoring systems provide real-time data on factors such as temperature, humidity and air quality that affect infection control [83]. Antibiotic stewardship programs are critical to preventing the development of infection-resistant infections.

Hospitals are developing comprehensive antimicrobial stewardship initiatives to optimize antibiotic use, thereby reducing the risk of antibiotic-resistant infections [62; 66]. Hospitals are integrating infection control into broader patient safety programs, recognizing its critical role in overall patient safety. Prioritizing infection prevention, early detection and rapid response to outbreaks within these programs is essential for effective control [62]. Hospitals promote collaboration to combat the spread of infections, recognizing that infection control is a shared responsibility.

This involves sharing best practices, information and resources between healthcare facilities. Formalized collaboration and networks are likely to contribute to infection prevention in the future [74]. Providing patients with knowledge about infection prevention methods makes a significant contribution to reducing the incidence of HAIs [79; 85].

Conclusions

Hospital infection control is essential for protecting patients, healthcare workers and the wider community from HAIs. The complexity of the challenges, from high patient turnover to the diversity of patient conditions, underscores the need for robust strategies. These strategies include best practices such as strict hand hygiene, PPE, environmental cleaning, surveillance, and innovative technologies such as artificial intelligence and UV disinfection systems. Overcoming the challenges requires resource allocation, effective communication, continuous education and patient participation.

The future of infection control lies in the adoption of advanced technologies, integrating infection control into patient safety initiatives, encouraging collaboration and empowering patients. Ultimately, by actively involving patients in their own care, promoting education and awareness, a culture of infection prevention can be developed, leading to a safer healthcare environment for all. As hospitals evolve, these trends and opportunities will shape the future of infection control, emphasizing a proactive commitment to patient safety and well-being.

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Disclosure Statement

The authors have no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

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THE ROLE OF THE NURSE IN THE CERVICAL SCREENING PROCEDURE IN WOMEN OF REPRODUCTIVE AGE

Lutsenko K.V., Bolokadze E.O.

Kharkiv National Medical University, Kharkiv, Ukraine

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ABSTRACT

The implementation of systematic cervical screening programs significantly reduces the incidence and mortality of cervical cancer, which is proven by the experience of countries with developed screening systems. This short scientific report highlights the role of a nurse in the process of cervical screening in women of reproductive age as a key link in the system of early detection of cervical cancer. Attention is focused on the importance of nursing intervention not only at the stage of biomaterial collection, but also in the process of informing, counseling, psychological support of patients, keeping records and monitoring repeated screening. Modern approaches to screening are analyzed, in particular, Papanicolaou test, human papillomavirus testing, co-testing, as well as the organizational component of nursing work. It is emphasized that timely detection of precancerous conditions is possible provided that the nurse's work is professionally performed, quality standards are observed and the female population is regularly covered by preventive programs. Thus, nurses perform key functions in the implementation of cervical screening programs, providing organizational support, information and educational work with the population, direct screening procedures and further monitoring of patients. Expanding the powers of nurses and developing their competencies in the field of cervical screening allows solving the problem of staff shortage, increasing the availability of preventive services and ensuring timely detection of precancerous changes in the cervix. Improving the training of nurses and standardizing their activities in the field of cervical screening creates the basis for full use of the potential of paramedical personnel in the prevention of cervical cancer. The implementation of a structured approach to organizing the work of nurses during cervical screening will ensure an increase in the overall effectiveness of screening programs and an expansion of coverage of target population groups.

Keywords: *prevention, cervical cancer, Papanicolaou test, human papillomavirus, women's health.*

Cervical cancer, as one of the most common oncological diseases in women, continues to pose a serious threat to women's health in the world, including in Ukraine, where more than three thousand new cases of this disease are registered annually [1]. Despite the availability of effective methods of prevention and early detection, in particular cervical screening, a significant part of women of reproductive age do not undergo examination due to lack of awareness, fear or unavailability of medical services. Particular attention should be paid to the fact that cervical cancer has a long latent course and may not manifest clinically for years, which reinforces the importance of regular screening as a tool for detecting precancerous changes and pathologies at the preclinical stage. In this system, the nurse plays a leading role, because it is she who ensures the organization of the process, communicates with patients, carries out technically correct collection of material for cytological or HPV (Human PapillomaVirus) examination, builds trust in the health care system and motivates women to participate in screening programs. Such a multidisciplinary approach to nursing activities ensures not only high-quality performance of medical procedures, but also increases the effectiveness of the overall cervical cancer prevention strategy in the country.

Cervical screening is an effective tool for the prevention of cervical cancer, allowing the detec-

Corresponding Author:
Bolokadze Yevgenia O. – Candidate of Medical Sciences, Associate Professor of the Department of Propaedeutics of Internal Medicine, Nursing and Bioethics, Kharkiv National Medical University.
✉ Ukraine, 61022, Kharkiv, Nauky ave., 4.
E-mail: yo.bolokadze16@knmu.edu.ua

tion of pathological changes in the epithelium at an early stage, when treatment is most effective. Women of reproductive age are the main group that needs regular screening, especially between the ages of 25 and 49. The essence of screening is to conduct tests, in particular the PAPanicolaou (PAP) test, the HPV test, as well as visual methods that allow determining the presence of precancerous or early malignant changes. The nurse plays a key role in organizing this procedure, as she is usually the patient's first point of contact. She performs a number of tasks: explains the essence of screening, provides instructions on preparing for the examination, ensures compliance with infectious safety and ethical standards, which is extremely important for building patient trust in the healthcare system [1].

The procedure begins with preparation: the patient is explained that before taking the smear, it is necessary to abstain from sexual intercourse for 48 hours, not to use vaginal products, not to undergo ultrasound or other gynecological examination, not to douche. The nurse also records the date of the last menstrual period, checks for complaints, pregnancy, or hormonal therapy, as these factors may affect the results. Taking the material is a responsible technical procedure. The nurse must clearly know the anatomical features of the cervix and the transformation zone – it is from it that a sample of the epithelium for cytological examination is taken. Violation of the technique can lead to an uninformative smear, and this is the risk of missing dysplasia or cancer. Therefore, nursing competence is the key to high-quality diagnostics [1; 2]. After taking the material, the nurse applies the sample to a slide or places it in a liquid medium, depending on the type of test. In the future, it is important to correctly label the material and draw up accompanying documentation. Lack of clear labeling or errors in data can lead to lost results or confusion, which will negatively affect further treatment.

Equally important is the nurse's role in explaining the results to patients. For example, a negative result does not always mean the complete absence of pathology, especially if the material was taken incorrectly. And a positive result does not mean cancer, but only the need for further diagnostics – colposcopy or biopsy. The nurse also records the date of the examination in the registration card or electronic database, ensuring the formation of a plan for further repeated testing. According to international recommendations [3], the PAP test is repeated every 3 years, and co-testing – every 5 years. Monitoring these deadlines is another duty of the nurse.

In institutions implementing a mass screening program, nurses participate in the formation of lists of women to be tested. They send out invitations, make phone calls, make reminders and conduct surveys, and also participate in the creation of mobile medical points to reach the rural population, where access to gynecological care is limited. A separate area of work is interaction with general practitioners and obstetricians-gynecologists. Nurses transmit results, participate in documentation, and may be present at consultations and follow-up examinations. Their function is to coordinate the process and accompany the patient at all stages [1; 3].

Educational and outreach activities are also important. Nurses conduct conversations in groups, schools, colleges, create information booklets, videos, and social networks. This allows them to form a culture of prevention and raise public awareness about the risks of cervical cancer and the need for vaccination and screening. Vaccination against the human papillomavirus is another vector of activity. A nurse performs vaccinations, keeps records of those vaccinated, informs about adverse reactions, and monitors the condition after vaccination. She also answers questions from parents, adolescents, and adult women, and explains the mechanism of action of the vaccine and its effectiveness [4; 5].

Nurses working in screening programs need not only clinical expertise but also strong ethical qualities, such as empathy, tact, and patience. Women are often shy or afraid of a gynecological examination, so it is the friendly attitude of a nurse that can change their attitude towards the examination and motivate them to undergo regular screening. Professional training of nurses in the field of cancer prevention is one of the priority areas for improving the quality of primary health care. Specialized training, advanced training courses, simulation training help to form the appropriate level of competencies to fulfill this mission. Special attention should be paid to the standardization of nurses' actions at all stages of cervical screening. Universal protocols developed by the Ministry of Health of Ukraine and WHO provide for the consistent implementation of clearly defined procedures – from informing the woman to monitoring the results of the analysis [6]. At the same time, there is variability in the level of training of nursing staff and the organization of the procedure itself in different medical institutions.

This requires constant internal quality audits, staff training, and creating conditions for equal access of patients to quality examinations.

For clarity, below is a summarized *Table* that demonstrates the key stages of screening and the nurse's functions at each of them.

Within the framework of integrated medical care, which involves a personalized approach to the patient, a nurse can act as a coordinator of the screening process. She knows when and who to invite for a repeat examination, who to appoint a consultation with a gynecologist or oncologist, and is also able to navigate the regulatory documents regulating the frequency of examinations. The problem of screening coverage of women from socially vulnerable groups – rural residents, women with disabilities, patients who do not have permanent access to medical services – is especially relevant. A nurse can be the link that will ensure communication between the patient and the health care system: through field visits, telephone reminders, participation in joint social initiatives. An additional component of the effective work of a nurse is the introduction of digital technologies into the screening system. Maintaining electronic databases, integration with laboratory platforms, automatic generation of invitations and reminders – all this greatly facilitates the coordination of the process and minimizes the risks of losing a patient in the surveillance system.

It is also necessary to focus on the legal and ethical component of a nurse's activities. Each manipulation should be accompanied by informed consent, confidentiality, and a safe and comfortable environment for the patient. Violation of these principles can lead not only to legal consequences, but also to a loss of trust in the medical system as a whole. In the context of the general reform of the medical system of Ukraine with an emphasis on primary health care, the role of a nurse is being transformed: from a doctor's assistant to an autonomous specialist capable of independently conducting a number of preventive measures, including screening procedures. This requires both regulatory support and a change in the attitude towards the profession on the part of patients and colleagues. The effectiveness of cervical screening largely depends on the professional training, responsibility, initiative, and ethical maturity of nurses. They perform not only technical work, but also form a culture of preventive examination, become leaders in matters of preserving women's health, which is extremely important in modern medical practice [7–9].

Conclusions

The role of a nurse in the cervical screening procedure is key and multifaceted, since it is she who provides the full cycle of support for a woman – from the first information to repeated control after receiving the results. In the context of

Table. Key stages of screening and the functions of a nurse

Screening stage	Nurse's tasks
Information and preparatory stage	Informing the patient, interviewing, signing informed consent, preparing the office
Preparing for the examination	Clarification of the anamnesis, verification of compliance with recommendations before the procedure
Biomaterial collection	Performing a swab from the transformation zone, observing asepsis and sterility
Documentation preparation	Sample labeling, filling out the accompanying form, registration in accounting forms
Organization of laboratory research	Transfer of material to the laboratory, control of deadlines and obtaining results
Providing clarifications on the results	Explaining to the patient the meaning of the result, recommendations for further actions
Organization of re-examination	Formation of a screening schedule, keeping reminder records
Communication with doctors	Transfer of results, participation in multidisciplinary discussions
Educational and outreach activities	Conducting classes, conversations, participating in public awareness campaigns
HPV vaccination	Conducting vaccinations, recording data, monitoring adverse reactions

modern medical practice, a nurse performs not only technical functions related to the collection of material, compliance with sterility protocols and documentation, but also performs the important mission of an educator, psychologist, coordinator and partner of the patient. Her ability to convey the essence of screening, reduce the patient's anxiety, provide recommendations for prevention and a healthy lifestyle, as well as help navigate further actions when pathology is detected – plays a decisive role in reducing the incidence and mortality of cervical cancer. It is important that the successful implementation of screening programs is based on the systematic and responsible work of nurses, who must have appropriate qualifications, access to continuing education, support from the administration of the healthcare facility and regulatory autonomy in certain decisions. Strengthening the role of nurses in preventive medicine, implementing electronic registries, participating in HPV vaccination, creating personalized patient routes, and using modern communication tools – all of this should become an integral part of a modernized medical system. Only in conditions of interdisciplinary interaction, ethical sensitivity, scientific validity of actions, and high trust in medical personnel can the full functioning of the cervical screening system and a significant improvement in women's reproductive health in Ukraine be ensured.

DECLARATIONS:

Disclosure Statement

The authors have no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

Statement of Ethics

The authors have no ethical conflicts to disclosure.

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The data can be requested from the authors.

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ASSOCIATION OF OVERWEIGHT AND OBESITY WITH PAPILLARY THYROID CARCINOMA

Dinets Andrii[1, 2, 3], Lurin Igor[3, 4], Gorobeiko Maksym[2, 3], Hoperia Victoria[5], Abdalla Karim[1], Lovin Andrii[5]

[1]Verum Expert Clinic, Kyiv, Ukraine
[2]Kyiv Agrarian University, Kyiv, Ukraine
[3]National Academy of Medical Sciences of Ukraine, Kyiv, Ukraine
[4]State Institution of Science "Research and Practical Center of Preventive and Clinical Medicine" of the State Administrative Department, Kyiv, Ukraine
[5]Taras Shevchenko National University of Kyiv, Kyiv, Ukraine

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ABSTRACT

Background. Papillary Thyroid Carcinoma (PTC) is the most frequently diagnosed malignant neoplasm of the endocrine system, accounting for more than 80% of other histopathological types of thyroid cancer worldwide, including Ukraine. Both overweight (Body Mass Index (BMI) [25.0–29.9] kg/m^2) and obesity (BMI >30 kg/m^2) might be considered a risk factor for PTC development. Besides, it may be associated with negative clinical characteristics such as obesity and overweight or biological aggressiveness of PTC such as larger tumor size, invasion to thyroid structures or adjacent neck tissues, metastatic spread etc., which are not sufficiently studied in Ukraine.

Aim. To investigate and evaluate the features of the overweight and obesity in the patients with PTC and compare them with patients with PTC and normal weight.

Materials and Methods. Our study involved 91 patients with the diagnosis of PTC who underwent surgical treatment at Verum Expert Clinic (Kyiv, Ukraine). The study groups consisted of 65 patients with PTC and overweight/obesity (BMI ≥25 kg/m^2), and 26 patients with PTC and normal weight. Written informed consent to participate was obtained from all patients, and the study was approved by the local ethical committee. The non-parametric Mann-Whitney U test was applied to compare quantitative variables between groups. Categorical variables were compared using Fisher's exact test (two-tailed). Statistica 12 (TIBCO Software Inc., USA) and GraphPad Prism 10 (GraphPad Software, LLC, USA) statistical software were used for data analyses. Statistical significance was set at $p<0.05$.

Results. A statistically significant difference was found in the frequency of lateral neck dissection: it was performed in 12 (46%) patients with PTC and normal weight, compared to 22 (34%) patients with PTC and overweight/obesity ($p=0.031$).

Conclusions. Overweight and obesity are highly prevalent among patients with PTC in our cohort. However, the higher rate of lateral neck dissection in the normal-weight group suggests that factors other than BMI, possibly related to preoperative diagnosis, played a more critical role in surgical planning in this study.

Keywords: *cancer risk, lymph node excision, neoplasm invasiveness, body mass index, thyroid neoplasms, risk factors*.

Introduction

Papillary Thyroid Carcinoma (PTC) is the most common type of thyroid cancer, characterized by its generally indolent behavior and excellent prognosis [1]. Recent studies suggest a potential link between overweight, defined as a Body Mass Index (BMI) ≥25 kg/m², and an increased risk of PTC developing [2]. Obesity is associated with hormonal and metabolic changes such as elevated insulin levels, increased adipokines, and chronic inflammation, which may promote carcinogenesis in thyroid tissues [3]. Additionally, excessive body

Corresponding Author:
Dinets Andrii – MD, PhD, Head of Department of Healthcare, Kyiv Agrarian University, Ukraine.
✉ Ukraine, 03022, Kyiv, Vasylkivska str., 37.
E-mail: andrii.dinets@kaunaas.com

weight can influence thyroid hormone regulation and immune responses, potentially contributing to tumor development.

Epidemiological data indicate that individuals with higher BMI are more likely to develop PTC, underscoring the importance of weight management for cancer risk reduction. Although the exact mechanisms remain under investigation, the connection between overweight and PTC highlights the need for integrated approaches in prevention and early detection strategies [4; 5]. It is worth mentioning that obesity is a known risk factor for certain malignant neoplasms, not only type 2 diabetes mellitus. The body waist measuring might be also considered for the obesity diagnosis and management [6].

Obesity and overweight might have an impact on PTC carcinogenesis through the negative actions on cell proliferation, differentiation, apoptosis. Also, when assessing clinical and clinical-morphological parameters, cohorts evaluate various indicators, taking into account modern clinical practices in various medical specialties, which may have an impact on all organs and systems, including in the context of the war in Ukraine [7–9].

Research [10] suggests various drugs against inflammation and oxidative stress in relation to thyroid cancer. Previous publication by Song S. et al. showed that patients with PTC have elevated levels of the inflammatory molecules, suggesting a potential link between obesity-induced systemic inflammation and the development of PTC [11]. Gross signs, such as tumor proliferation into the adjacent tissues, are important prognostic indicators [12; 13]. It is worth mentioning that little is investigated in Ukraine concerning the relationship of overweight and obesity with PTC.

Aim of the study was to investigate and evaluate the features of PTC in obese and overweight patients and compare them with patients with PTC and normal weight.

Materials and Methods

A total of 91 patients diagnosed with PTC, who underwent surgical treatment at the Verum Expert Clinic (Kyiv, Ukraine), were included in the study. Body Mass Index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m²) [2]. To assess the association between elevated BMI and PTC characteristics, the patients were stratified into two groups: the overweight/obesity group (BMI ≥25 kg/m², n=65), which comprised patients with overweight (BMI [25.0–29.9] kg/m²) and obesity (BMI ≥30 kg/m²), and the normal weight group (BMI <25 kg/m², n=26). The clinical and histopathological data were compared between these groups.

Various pathohistological and clinical parameters such as weight, height (BMI constituents), gender, tumor size, neck dissection types were retrieved from the archived medical records. Preoperatively, all patients underwent physical examination, measuring thyroid hormones, assessment of electrolytes, serum glucose, liver enzymes, ionized calcium (Ca^{2+}), and coagulation testing. Ultrasound examination of the thyroid gland was performed in all patients using the Thyroid Imaging, Reporting and Data System (TIRADS) scale. Fine-needle aspiration biopsy was performed for all patients with thyroid nodules, followed by its cytological analyses by Bethesda classification [14]. Dissection of central compartment was not performed in the absence of suspicion of PTC at the preoperative stage TBSRTC (Thyroid, Bethesda, System for Reporting, Thyroid Cytology) category 2, in the absence of macroscopic extension to the locoregional lymph nodes at operation [15].

The diagnosis was verified pathohistologically according to the World Health Organization classification of endocrine tumors [16]. Fluorescence-guided surgery was performed for better verification of parathyroid glands in accordance with previously published protocols and equipment [17]. During thyroid surgery, the surgical team visually identified the parathyroid glands. Subsequently, the surgical field was analyzed using one of the available imaging systems. The confirmation of the visually identified parathyroid glands, along with their Near-Infrared Autofluorescence (NIRAF), was considered for guiding further surgical decisions. NIRAF was assessed using the Fluobeam-800 or Fluobeam LX imaging systems (Fluoptics, France). These systems are equipped with a Near-InfraRed (NIR) camera, a console for adjusting the NIR signal, and a touchscreen monitor. The NIRAF signal was evaluated after turning off the operating lights. Additionally, to enhance fluorescence imaging, an intravenous injection of the fluorophore Indocyanine Green (ICG) was administered. The parathyroid NIRAF signal was assessed by manually holding the NIR camera approximately 20 cm above the surgical field. No quantitative parameters were measured.

Ethical approval for the study was obtained from the local Ethical Committee of the Verum Expert Clinic. The study was conducted according to Helsinki Declaration and Ukrainian ethical standards. An informed consent to participate was received from all patients. This study was conduc-

ted in accordance with the ethical principles of the World Medical Association Declaration of Helsinki (1964–2024) and complied with the legislation of Ukraine, including the Laws "On Protection of Human Rights in Biomedical Research" (2006) and "On Personal Data Protection" (2010). Non-parametric statistical analyses were used for data evaluation processing by applying Mann-Whitney test, Fisher's exact test (two-tailed). The difference between the study groups was considered as significant with $p<0.05$.

Results and Discussion

Analyses of the parameters from the 91 patients revealed that group of the patients with PTC and overweight were 65 (71%) patients and the group of patients with PTC and normal weight were 26 (29%) patients ($p<0.05$). The analyses of clinical and morphological features of the studied groups of patients are shown in *Table*.

26 (29%) patients, in whom PTC was present against the background of normal body weight (BMI [18.0–24.9] kg/m^2). The results of data analysis based on this distribution of patients with PTC by groups are shown in *Table*.

The distribution indicated that overweight/obese patients outnumbered normal weight patients by 42%, indicating obesity as a significant factor associated with PTC. Further analysis of the data showed that the mean age at diagnosis was 46.2 years in PTC patients with BMI ≥25 kg/m^2, which was slightly higher than the similar figure of 41 years in PTC patients with a normal body weight ($U=610$; $p=0.039$). There were no significant changes found among the following morphological that indicators were evaluated: locoregional lymph nodes, multifocal growth of bilateral lesions of the thyroid lobes, the presence of psammoma bodies, invasion of thyroid structures, extrathyroid spread,

Table. Analyses of the clinical characteristics of the of the patients with papillary thyroid carcinoma in relation to the weight of the patients

Parameters	PTC overweight (n=65)	PTC normal weight (n=26)	p-values
Females, abs. (%)	46 (71)	22 (85)	n/s
Males, abs. (%)	19 (29)	4 (15)	n/s
Age, years, abs. (%)	46.2 (22.3–74.6)	41 (20.2–70.6)	0.039
Mean age at diagnosis in years (range)	46.2 (22.3–74.6)	41 (20.2–70.6)	0.039
Mean size of carcinoma, cm (range)	1.18 (0.15–4.0)	0.95 (0.2–2.7)	n/s
Central compartment neck dissection, abs. (%)	60 (92)	25 (96)	n/s
Lateral compartment neck dissection, abs. (%)	22 (34)	12 (46)	0.031

Notes: PTC – papillary thyroid carcinoma; n/s – non-significant at statistical analyses ($p>0.05$).

According to our results, both obesity and overweight are more frequently diagnosed in females as well as other clinical and histopathological parameters, which is in line with previously publicshed reports [6; 18; 19]. Among various pathological features, invasive characteristics of PTC are considered as one of the unfavorable features of PTC [20; 21]. The macroscopic spread of PTC is and remains a significant risk factor for patient prognosis and surgical treatment tactics [6; 18; 19; 22; 23]. Considering the possible associations not only of obesity, but also of the generally negative impact of BMI ≥25 kg/m^2, the hypothesis regarding the generally negative impact of excess weight was tested. The 91 patients with PTC were divided into two study groups – PTC with BMI ≥25 kg/m^2, which included 65 (71%) patients, and a group of

etc. Further analysis of the data was carried out regarding the volume of neck dissection: a significant difference in the frequency of lateral neck dissection was found. Upon further evaluation of this clinical material of 91 patients with PTC and overweight or obesity, a lower frequency of lateral neck dissection was found in 22 (34%) patients with PTC with BMI ≥25 kg/m^2 than in 12 (46%) patients with PTC with normal weight ($U=650$; $p=0.031$). The performance of central neck dissection was practically the same in both study groups – in 92% of patients with PTC with BMI ≥25 kg/m^2 and in 96% of patients with PTC with normal weight ($p>0.05$). Despite the comparable incidence of histologically confirmed metastases in the lateral lymph nodes (29% in the overweight/obesity group vs. 31% in the normal weight group,

p>0.05), lateral neck dissection was performed significantly less frequently in patients with BMI ≥25 kg/m². This discrepancy suggests that factors other than the confirmed nodal disease may have influenced the decision to perform lateral neck dissection. These results are consistent with data from other publications and trends in considering obesity as a negative factor in malignant tumors.

Conclusions

1. Overweight and obesity are highly prevalent among patients with papillary thyroid carcinoma in our study cohort.

2. Patients with normal weight underwent lateral neck dissection significantly more often than patients with overweight/obesity.

3. This difference does not appear to be directly linked to a higher incidence of confirmed lateral compartment metastases, suggesting that factors other than BMI, such as challenges in preoperative assessment of patients with higher BMI, may have influenced the surgical planning.

DECLARATIONS:

Disclosure Statement

The authors have no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

Statement of Ethics

The authors have no ethical conflicts to disclosure.

Data Transparency

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STATISTICAL CHARACTERISTICS OF GROUPS OF ELDERLY PATIENTS WITH GONARTHROSIS AGAINST THE BACKGROUND OF OVERWEIGHT OR OBESITY

Hryhoruk V.V., Davidenko D.A.

Kharkiv National Medical University, Kharkiv, Ukraine

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ABSTRACT

Background. The aging of the population, the prevalence of gonarthrosis, and the epidemic of overweight highlight the relevance of the study.

Aim. To determine the effectiveness of the treatment algorithm for persons of older age groups with gonarthrosis of the II–III degree and functional insufficiency of the I–II degree, excessive body weight in the conditions of martial law by means of statistical processing of the obtained results.

Materials and Methods. The study continued during 2022–2025 in the polyclinic of the Municipal Non-Profit Enterprise of the Kharkiv Regional Council "Regional Clinical Hospital". 100 older patients with gonarthrosis of II–III degree and functional insufficiency of I–II degree, and overweight, who were divided into three groups according to treatment tactics, were examined. Group I and Group II patients received oral chondroprotectors and used articulated orthoses. After 3 months, patients of Group I were injected with hyaluronic acid intra-articularly during a follow-up examination. Patients in all groups received topical and oral non-steroidal anti-inflammatory drugs. All patients signed a consent to participate in the study. Statistical processing of the Lequesne index and Western Ontario & McMaster Universities Osteoarthritis index was carried out using SPSS 27 (IBM, USA).

Results and Conclusions. According to the Kolmogorov-Smirnov criterion, the normal distribution of the studied indicators was confirmed. Combined treatment of patients of Group I (orthoses, chondroprotectors and hyaluronic acid) proved to be statistically and clinically effective in older patients with gonarthrosis of II–III degree and functional insufficiency of I–II degree against the background of overweight. Group II patients needed further optimization of treatment, and Group III – active intervention. The results obtained were similar to some foreign and domestic studies.

Keywords: *degenerative-dystrophic diseases, body mass index, Lequesne index, Western Ontario & McMaster Universities Osteoarthritis index*.

Introduction

The aging of the population is illustrated by the balance between age groups under 5 and over 65 years of age, which is steadily shifting towards older age groups [1–3].

According to many researchers, we are observing an increase in the share of degenerative-dystrophic diseases, among which lesions of the lower extremities predominate, and the knee joint is most often affected. Pronounced debilitating pain syndrome with impaired function of the knee joint, and impaired statics and dynamics of gait reduce the quality of life and can lead to loss of social adaptation and disability in the category of patients older than 55 years. All this, together with an increase in the number of people with excess body weight and obesity, leads to the prevalence of degenerative-dystrophic diseases in the world in general and in Ukraine in particular [4–6].

Taking into account the military situation in Ukraine, the question arose about the possibility of treating elderly patients with gonarthritis against the background of overweight and obesity to improve the quality of life and increase func-

Corresponding Author:
Bezditko Tetiana – Doctor of Medical Sciences, Professor, Department of Propedeutics of Internal Medicine, Nursing and Bioethics, Kharkiv National Medical University, Ukraine.
✉ Ukraine, 61022, Kharkiv, Nauky ave., 4.
E-mail: tvbezdetko@gmail.com

tional capabilities. To control the dynamics of the results, an observation map was developed using questionnaires based on the Visual Analogue (pain) Scale (VAS), Lequesne indexes and the Western Ontario & McMaster Universities Osteoarthritis index (WOMAC), and measurements of movement volumes, joint girth, weight, and the displacement test. To verify the obtained indicators, it was decided to check them statistically.

The **aim** of study was to determine the effectiveness of the treatment algorithm for persons of older age groups with gonarthrosis of the II–III degree and functional insufficiency of the I–II degree, excessive body weight in the conditions of martial law by means of statistical processing of the obtained results.

Materials and Methods

The study continued during 01.2022–04.2025 in the polyclinic of the Municipal Non-Profit Enterprise of the Kharkiv Regional Council "Regional Clinical Hospital". 100 older patients with gonarthrosis of II–III degree and functional insufficiency of I–II degree, and overweight, who were divided into three groups according to treatment tactics, were examined. Women accounted for 60% among all patients.

Group I and Group II patients received oral chondroprotectors and used articulated orthoses. After 3 months, patients of Group I were injected with hyaluronic acid intra-articularly during a follow-up examination. Patients in all groups received topical and oral non-steroidal anti-inflammatory drugs.

General criteria for inclusion in the groups: age over 65 years, gonarthrosis II–III degree, body mass index greater than 25 kg/m^2. Indicators during examinations (initial, after 3, 6 and 12 months) were studied. For data analysis, a consolidated table was created, which was filled out during examinations, consisting of 17 columns and 4 lines for each patient. Each patient was assigned a code: the first Roman numeral indicated the group, and the second number was the patient's ID within the group (from 1 to 30 in the Group I and Group II; and from 1 to 40 – in the Group III), during examinations the following parameters were entered: age (years, months), sex, weight (kg), height (m), amplitude of movements in the knee joint during flexion and extension in degrees, girth knee joint in cm; use of orthoses, visual analog scale questionnaire data, Lequesne index, Western Ontario and McMaster University Osteoarthritis Severity Index (WOMAC), and physical activity.

In addition, clinical data were entered into the consolidated table with the code M17 and clarification of the diagnosis of II–III gonarthrosis with functional insufficiency of the joint I–II degree, disturbance of statics and dynamics of gait, overweight or obesity, indicating the degrees according to the International Classification of Diseases of the 10th revision.

The criteria for inclusion in a certain group are treatment tactics, namely: the use of orthoses and chondroprotectors in the I and II groups, intra-articular injection of hyaluronic acid only in the I group.

All patients signed a consent to participate in the study. Statistical processing of the Lequesne index and Western Ontario & McMaster Universities Osteoarthritis index was carried out using SPSS 27 (IBM, USA).

Results and Discussion

To check the normality of data distribution, the Kolmogorov-Smirnov test was used, which confirmed the normal distribution of the studied indicators.

The groups were compared and the following results were obtained: in the Group I, the ***WOMAC index*** at the initial reception was on average M=49.43±0.504, after 3 months this indicator was M=43.07±3.581, after 6 months after the start of treatment this indicator changed to M=38.20±±3.718, and after 12 months – M=30.13±1.852; in Group II, the WOMAC index at the initial reception was on average M=49.43±0.504, after 3 months this indicator was M=44.67±2.998, after 6 months after the start of treatment this indicator changed to M=40.73±4.127, and after 12 months – M=31.27±1.999; in Group III, the WOMAC index at the initial reception was on average M=±50.13±4.708, after 3 months this indicator was M=45.78±2.577, after 6 months after the start of treatment this indicator changed to M=42.85±±2.424, and after 12 months – M=40.05±1.319.

The average Lequesne index in Group I at the initial reception was on average M=13.30±0.596, after 3 months this indicator was M=11.73±0.521, after 6 months after the start of treatment this indicator changed to M=10.93±0.640, and after 12 months – M=7.40±0.498; in Group II the index at the initial reception was M=13.30±0.596, after 3 months this indicator was M=11.83±0.461, after 6 months after the start of treatment this indicator changed to M=11.17±0.379, and after 12 months – M=9.87±0.860; in Group III the Lequesne index at the initial reception was M=13.28±0.554,

after 3 months this indicator was M=11.93±0.35, after 6 months after the start of treatment this indicator changed to M=11.28±0.452, and after 12 months – M=11.23±0.423.

To compare the mean values between two dependent samples, the Student's t-test was used, which allows you to determine whether there is a statistically significant difference between the mean values of two groups. This method is based on the assumption of a normal distribution of samples and approximate equality of variances, and is one of the most common ways of analyzing differences between groups in biomedical research. It is a reliable statistical method for analyzing differences between independent samples in medical research, provided the necessary assumptions are met. Its use allows evaluating the effectiveness of interventions and facilitates evidence-based clinical decision-making.

Levene's test is used to test the hypothesis of equality (homogeneity) of variances in two or more samples. This test is important when using the Student's t-test for independent samples, since the classical t-test assumes equal variances in the compared groups [8; 9].

The results of treatment were evaluated dynamically during control examinations in groups I and II and retrospectively according to the data entered in the outpatient cards of Group III.

Using the Student's t-test, independent samples were compared in the context of medical research. The Student's t-test for independent samples is used to test the null hypothesis that the mean values of the general populations are equal based on the sample data.

From the results obtained when comparing the studied groups, it can be seen that during the initial examination, the first and Group II according to the WOMAC index have M=49.43±0.504, the Group III – the WOMAC index has M=50.13± ±4.708. The difference is statistically significant between Group I and Group III, and between Group II and Group III (p≤0.05). However, there is no difference in means between Group I and Group II. Levene's test for equality of variances indicates that the variance of the WOMAC index in all groups does not differ statistically significantly (p=0.249) according to the initial examination indicator, therefore, the use of the t-test is correct.

A similar situation was observed during the follow-up examination after 3 months according to the WOMAC index, where Group I and Group II had M=43.07±3.581, and Group III – M= =45.78±2.577. There is no difference between the Group I and Group II. Levene's criterion of equality of variances indicates that the variances in the groups do not differ statistically significantly (p= =0.512).

When comparing the Group I and Group III, significant average differences were found in the indicators for the follow-up examination 6 months after the start of observation according to the WOMAC index: in Group I, M=38.20±3.718, in Group III – M=42.85±2.424 (p≤0.001), according to Levene's criterion, variances do not differ significantly (p=0.645); the Lequesne index in Group I M=10.93±0.640, in Group III – M=11.28±0.452 (p≤0.050), according to Levene's criterion, the variances do not differ significantly (p=0.160). During the follow-up examination after 12 months: according to the WOMAC index in Group I M=30.13±1.852, in Group III – M=40.05±1.319 (p≤0.001), according to Levene's criterion, variances do not differ significantly (p=0.073); Lequesne index where in the Group I M=7.40±0.498, in Group III – M=11.23±0.423 (p≤0.001), according to Levene's test, the variances do not differ significantly (p=0.085).

When comparing patients Group I and Group II, significant average differences were found in the indicators during the examination after 6 months: the WOMAC index in Group I was M=38.20±3.718, in Group II – M=40.73±4.127 (p≤0.05), according to Levene's criterion, variances do not differ significantly (p=0.516). After 12 months, the WOMAC index in Group I was M= =30.13±1.852, in Group II – M=31.27±1.999 (p≤ ≤0.05), according to Levene's criterion, variances do not differ significantly (p=0.316); the Lequesne index in the Group I was M=7.40±0.498, in Group II – M=9.87±0.860 (p≤0.001), according to Levene's criterion, the variances do not differ significantly (p=0.269).

When comparing Group II and Group III, significant differences in averages were found: in the indicators after 6 months, the WOMAC index in Group II was M=40.73±4.127, in Group III – M=42.85±2.424 (p≤0.05), according to Levene's criterion, the variances do not differ significantly (p=0.076). After 12 months, the WOMAC index in Group II was M=31.27±1.999, in Group III – M=40.05±1.319 (p≤0.001), according to Levene's criterion, variances do not differ significantly (p= =0.103); the Lequesne index in Group II was M=9.87±0.860, in Group III – M=11.23±0.423 (p≤0.001), according to Levene's test, the variances do not differ significantly (p=0.084).

Therefore, from the performed therapy, according to the Leken and WOMAC indices, we have a verified improvement in the patient's condition, more pronounced in the Group I and moderate in the Group II.

Therefore, throughout the observation period, group I demonstrated better results according to the WOMAC and Leken indices compared to Group II and Group III. Significant improvements were already observed after 6 months (WOMAC: 38.20±3.718) and significantly increased up to 12 months (WOMAC: 30.13±1.852; Leken: 7.40± ±0.498). In Group II, the results were better than in Group III, but worse than in Group I. Statistically significant differences with Group III confirm the effectiveness of therapy (WOMAC: 31.27±1.999 vs. 40.05±1.319 at 12 months, $p \leq \leq 0.001$). In all cases, the homogeneity of variances was tested according to Levene's test ($p>0.05$), which provides grounds for the correct use of the Student's t-test. Significant differences between groups confirm the hypothesis about the effectiveness of treatment in the Group I.

The obtained results of the study confirm the effectiveness of targeted treatment in the elderly, which meets the needs of patients in the context of the global increase in morbidity. The use of combined therapy in the Group I (ortheses, chondroprotectors, hyaluronic acid) was clinically effective. This is confirmed by World Health Organization data, which emphasizes the importance of a comprehensive approach in the treatment of osteoarthritis of the knee joint, including pharmacological and non-pharmacological methods [1].

The obtained results are consistent with the study of Lementowski P.W. & Zelicof S.B., who prove that excess weight increases the risk and progression of gonarthrosis due to additional mechanical load on the joints [4].

According to Long H. et al. (2022), the prevalence of gonarthrosis is steadily increasing, especially among the elderly, which is associated with global demographic changes and the obesity epidemic [3].

Osadchuk T.I. et al. demonstrates similar results regarding the effectiveness of differentiated approaches to the treatment of gonarthrosis in Ukraine [7].

Thus, the research data convincingly demonstrate the effectiveness of a multifactorial approach in the treatment of gonarthrosis, especially in patients with accompanying obesity, which is consistent with current international and national recommendations.

Conclusions

1. The combined treatment of Group I (ortheses, chondroprotectors and hyaluronic acid) was statistically and clinically effective in older patients with II–III degree gonarthrosis and I–II functional insufficiency against the background of excess weight.

2. Group II requires further optimization of treatment, and Group III requires active intervention.

3. The obtained results are similar to similar foreign and domestic studies due to timely diagnosis, correctly selected conservative treatment of elderly and venerable patients, and regardless of the nuances of military status.

DECLARATIONS:

Disclosure Statement

The authors have no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

Statement of Ethics

The authors have no ethical conflicts to disclosure.

Data Transparency

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DYNAMICS OF CARDIOVASCULAR DISEASES AMONG KHARKIV RESIDENTS DURING THE WAR IN 2022 AND 2023

Pryima N., Bezditko T.

Kharkiv National Medical University, Kharkiv, Ukraine

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ABSTRACT

Background. The full-scale invasion in Ukraine has become a serious challenge for the healthcare system, in particular for the diagnosis, treatment and prevention of cardiovascular diseases.

Aim. To investigate the peculiarities of the prevalence of cardiovascular disease in Kharkiv residents during wartime, in 2022 and 2023.

Materials and Methods. The study used medical-statistical and comparative methods. Data from the Center for Medical Statistics of the Public Health Center of the Ministry of Health of Ukraine on cardiovascular pathology were analyzed. The comparison was based on absolute rates of morbidity due to the lack of reliable data on the number of the existing population during the war.

Results and Conclusions. The number of registered cases of hypertension increased from 192,919 to 211,214 cases from 2022 and 2023, which corresponds to an absolute increase of 18,295 cases (9.5%). Angina pectoris demonstrated an increase in the number of reported cases from 46,844 in 2022 to 54,850 in 2023, which is an increase of 8,006 cases (17.1%). The analysis of the prevalence of acute myocardial infarction also showed a negative trend. In 2022, 977 cases were registered, while in 2023 there were already 1,176 cases, which is an increase of 199 cases (20.4%). The prevalence of strokes also shows an upward trend – in 2022; 1,630 cases were reported, and in 2023; 1,857 cases were reported, an increase of 227 cases (13.9%). We attribute the increase in the number of cases of cardiovascular diseases to the influence of stress factors, changes in lifestyle, worsening access to medical care, worsening socio-economic living conditions of the population in war-affected regions, insufficient physical activity, sleep disorders (apnea). In addition, an important factor could be the restriction of preventive measures and medical examinations due to wartime conditions, which led to untimely detection and treatment of pathologies in the early stages.

Keywords: *martial law, hypertension, angina pectoris, acute myocardial infarction, strokes.*

Introduction

The full-scale invasion in Ukraine has become a serious challenge for the healthcare system, in particular for the diagnosis, treatment and prevention of CardioVascular Diseases (CVD) [1]. Increased stress levels, impaired access to healthcare, forced displacement of the population, and the negative impact of environmental factors such as noise and chemical pollution create conditions for increased morbidity and mortality from CVD [2]. In such circumstances, analyzing the prevalence of cardiovascular disease in the population of Ukraine is extremely important for the development of effective prevention and treatment measures that take into account current challenges [3; 4].

Martial law has significantly affected the quality of life, stress levels, and access to medical care, which has led to an increase in cardiovascular disease. Prolonged exposure to constant danger, air raids, physical and emotional exhaustion significantly increases the risk of developing hypertension, coronary heart disease and other cardiovascular diseases [5].

Corresponding Author:
Bezditko Tetiana – Doctor of Medical Sciences, Professor, Department of Propedeutics of Internal Medicine, Nursing and Bioethics, Kharkiv National Medical University, Ukraine.
✉ Ukraine, 61022, Kharkiv, Nauky ave., 4.
E-mail: tvbezdetko@gmail.com

Aim. To investigate the peculiarities of the prevalence of cardiovascular disease in Kharkiv residents during wartime, in 2022 and 2023.

Materials and Methods

The study used medical-statistical and comparative methods. Data from the Center for Medical Statistics of the Public Health Center of the Ministry of Health of Ukraine on cardiovascular pathology [6] were analyzed. The comparison was based on absolute rates of morbidity due to the lack of reliable data on the number of the resident population during the war.

Microsoft Excel 2019 (Microsoft, USA) was used for data processing.

Results and Discussion

Kharkiv is one of the largest cities in Ukraine, the administrative center of the Kharkiv region, as well as an important industrial, scientific, and cultural center. As of 2021, Kharkiv had a population of approximately 1.4 million people. However, due to the military conflict, the city's population has undergone significant changes.

According to the Kharkiv City Council, in the first half of 2022, there was a [20–30]% decrease in the population. Part of the population left the city due to the fighting and danger, while others left for other regions of Ukraine or abroad in search of safety. At the same time, the city hosted Internally Displaced Persons (IDPs), which also affected the demographic picture. According to official data, in 2022, more than 150 thousand people from different regions of Ukraine moved to Kharkiv, which temporarily increased the city's population [7].

Analyzing the structure of the prevalence and incidence of cardiovascular diseases among different age groups in Kharkiv in 2022 and 2023, several important aspects should be noted. Firstly, among the adult population (18 years and older), there is a noticeable increase in the number of registered diseases, which increased from 57,684 in 2022 to 78,370 in 2023 (*Table 1*).

This increase can be interpreted as a consequence of several factors, such as the deterioration of adult health, in particular in conditions of stress, unstable economic situation and war, which can worsen the condition of the cardiovascular system.

In general, the increase in the prevalence of cardiovascular diseases among all age groups is a serious sign that requires a comprehensive approach to addressing the problem, including through improved preventive measures, improved medical technologies, and improved public health, both among adults and children.

An analysis of the prevalence of cardiovascular diseases among the population of Kharkiv during martial law showed a significant increase in the number of cases in 2023 compared to 2022 (*Fig. 1*, *Fig. 2*).

In particular, the number of registered cases of hypertension increased from 192,919 cases in 2022 to 211,214 in 2023, which corresponds to an absolute increase of 18,295 cases (9.5%). The prevalence rate increased by 1,305.33 cases per 100,000 people, which indicates a negative trend in the dynamics of morbidity. A similar situation is observed among newly registered cases of hypertension: the number of new cases in 2023 increased by 3,433 cases (25.4%), which may indicate a deterioration in the health status of the population or improved diagnosis (*Fig. 3*, *Fig. 4*).

Coronary heart disease also showed an upward trend. The total number of cases increased from 157,803 in 2022 to 181,563 in 2023, which corresponds to an increase of 23,760 cases (15.0%). The prevalence rate increased by 1,695.26 cases per 100,000 persons. The number of newly registered cases of coronary heart disease also increased by 2,139 cases (21.6%), which may indicate an increase in the level of diagnosis or a deterioration in the health status of the population, particularly in CVD.

Angina pectoris demonstrated an increase in the number of reported cases from 46,844 in 2022 to 54,850 in 2023, which is an increase of 8,006 cases (17.1%). The prevalence of angina pectoris per 100,000 population increased by 571.22 cases. The number of new cases of the disease increased by 623 cases (20.7%), indicating an increase in the detection of this disease.

Table 1. Structure, prevalence and incidence of cardiovascular diseases among different age groups in Kharkiv in 2022 and 2023

	Registered diseases		Prevalence per 100,000 population	
	2022	2023	2022	2023
Adults (18 years and older)	57,684	78,370	2,667.92	3,624.66
Children (0–17 years old)	17,509	17,910	4,157.03	4,252.24

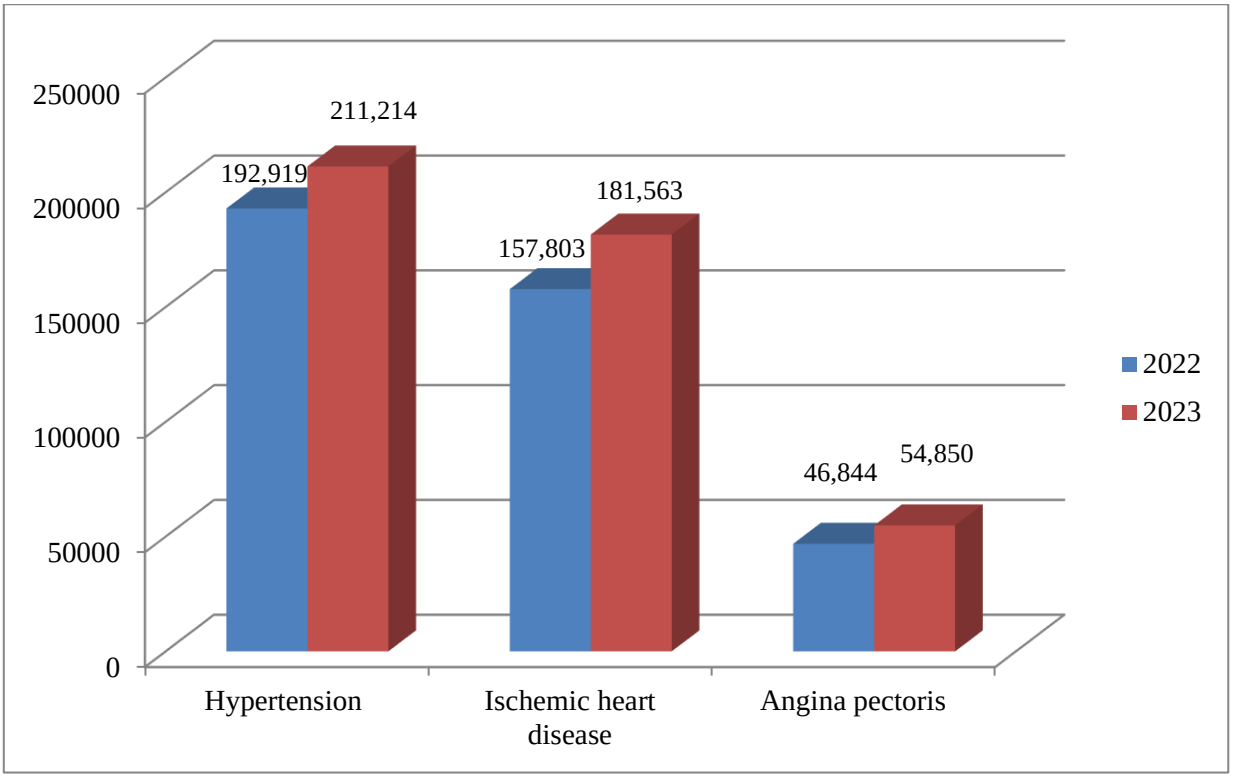

Fig. 1. Prevalence of hypertension, coronary heart disease, and angina pectoris in Kharkiv during the war period, 2022 and 2023, among the general population.

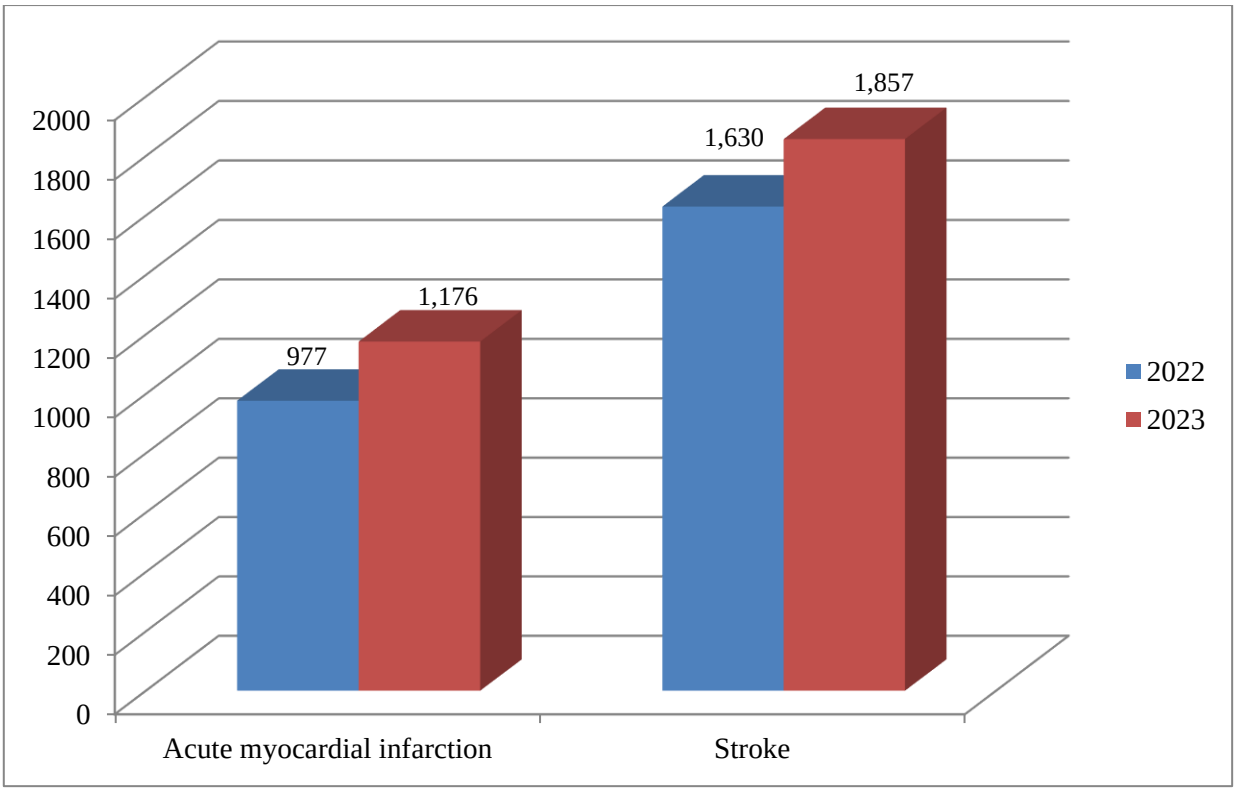

Fig. 2. Dynamics of the prevalence of acute myocardial infarction and stroke in Kharkiv during the war period, 2022 and 2023, among the total population.

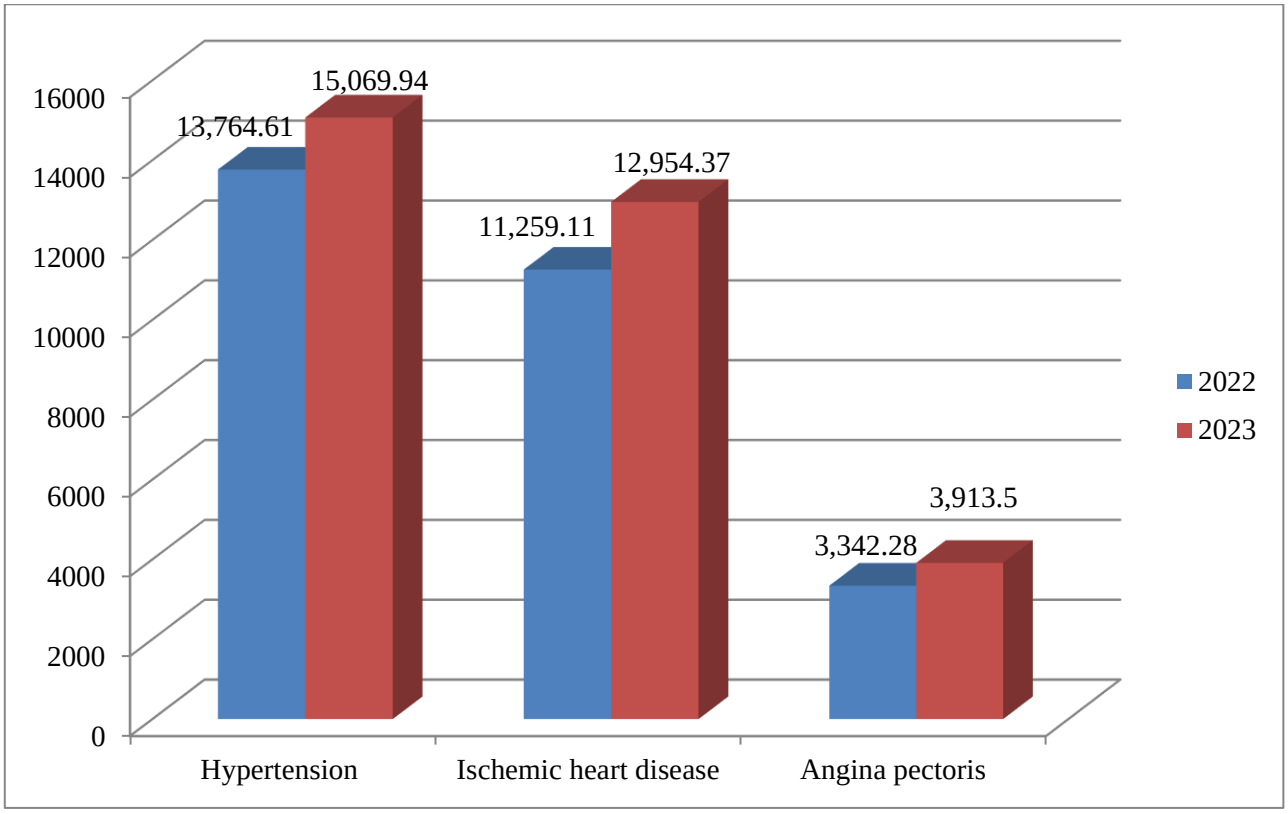

Fig. 3. Dynamics of the incidence of hypertension, ischemic heart disease and angina pectoris per 100,000 population in Kharkiv during the war period, 2022 and 2023, among the total population.

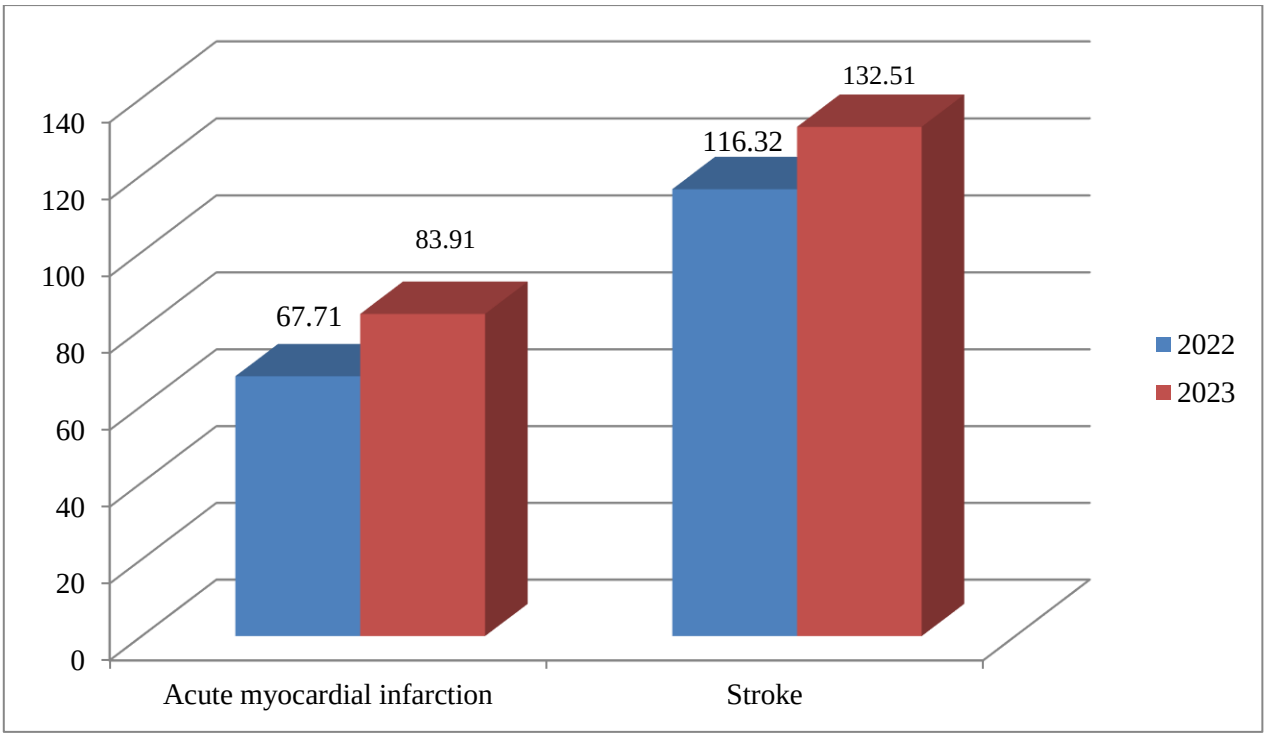

Fig. 4. Dynamics of the incidence of acute myocardial infarction and stroke per 100,000 population in Kharkiv during the war period, 2022 and 2023, among the total population.

The analysis of the prevalence of acute myocardial infarction also showed a negative trend. In 2022; 977 cases were registered, while in 2023 there were already 1,176 cases, which is an increase of 199 cases (20.4%). The prevalence per 100,000 population increased by 14.2 cases. Similarly, the number of newly registered cases of acute myocardial infarction increased by 20.4%, indicating an increase in pressure on the health care system.

The prevalence of strokes also shows an upward trend. 1,630 cases were reported in 2022, and 1,857 cases – in 2023 (an increase of 227 cases (13.9%)). The prevalence per 100,000 population increased by 16.2 cases, which is a significant indicator. The number of newly registered cases of stroke also increased significantly, indicating a deterioration in the overall health of the population of Kharkiv.

Stress caused by the war is one of the main reasons for the deterioration of health in people with pre-existing cardiovascular disease. Elevated levels of cortisol and other stress hormones can impair blood circulation, increase heart rate, cause vascular spasms, and contribute to the development of hypertension. This, in turn, can lead to heart attacks or strokes in people at high risk. In addition, mental stress and constant exposure to danger can lead to the development or exacerbation of cardiovascular diseases such as coronary heart disease, hypertension, and heart failure [8].

People living in Kharkiv may also experience an increased prevalence of symptoms such as shortness of breath, chest pain, and tachycardia, as well as more frequent complications due to stress and poor access to healthcare. Unstable supplies of medicines and medical resources also affect patients' ability to receive proper treatment. For many people, it is difficult to get the medicines they need or undergo routine medical examinations, which leads to cardiovascular diseases not being diagnosed or treated in a timely manner [9].

Conclusions

Thus, the data obtained indicate a significant increase in the number of cases of cardiovascular diseases in Kharkiv during martial law. This may be due to the impact of stress factors, lifestyle changes, worsening access to medical care, worsening socio-economic living conditions of the population in war-affected regions, insufficient physical activity, sleep disorders (apnea). In addition, an important factor could be the restriction of preventive measures and medical examinations due to wartime conditions, which led to untimely detection and treatment of pathologies in the early stages.

DECLARATIONS:

Disclosure Statement

The authors have no potential conflicts of interest to disclosure, including specific financial interests, relationships, and/or affiliations relevant to the subject matter or materials included.

Statement of Ethics

The authors have no ethical conflicts to disclosure.

Data Transparency

The data can be requested from the authors.

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Consent for publication

All authors give their consent to publication.

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VASYL YAKOVYCH DANYLEVSKYI'S LECTURE ON A DOCTOR AT WORK, HIS WORLDVIEW, RESPONSIBILITY AND PROFESSIONAL FREEDOM (1921): ANNOTATED TRANSLATION

Biletska O.M.[1], Shevchenko A.S.[1, 2], Korneyko I.V.[1], Gubina-Vakulik G.I. [1], Latohuz S.I. [1], Polonnik I.A. [1], Voroshylova Ye.I. [1], Hurbych O.S. [1]

[1]Kharkiv National Medical University, Kharkiv, Ukraine
[2]Kharkiv Regional Institute of Public Health Services, Kharkiv, Ukraine

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ABSTRACT

A physician must possess certain qualities of intellect and character, certain natural qualities, firm principles and bitter life experience in order to choose the right paths of work and behavior. In an era of social and political upheavals, the number of weak-willed people with antisocial behavior increases. A physician as a practicing psychologist often has to act both in public life and in his daily work with a patient. No less important is the physician's work in the field of hygiene and prevention. An enlightened mind is the basis of social happiness. To restore the disturbed balance of spirit, there is a need for intellectual or artistic pleasure. For a practicing physician, it is necessary to form a general scientific worldview in order not to scatter and fragment knowledge. The deontological attitude of a physician includes many complex and delicate issues, in addition to the physical, moral and mental side. The most difficult problems that a physician faces are the patient's attitude to death, issues of eugenics, abortion, euthanasia. A physician has to bear responsibility not only for his actions, but also for his words. But only doctors can judge a doctor not only from a professional point of view, but also from a moral and social point of view. For the future of medical activity, the solution to the question is of great importance: will it remain a free profession or will it turn entirely into a mandatory service occupation. The progress of medicine cannot be separated from the general course of cultural development of society. A doctor stands above all political, social, economic trends, for he deals with a person without distinction of tribes, dialects, conditions. We are so accustomed to the everyday actions of a doctor that we stop noticing and appreciating his outstanding merits, selfless help to the wounded and sick. Go boldly on the path of serving truth, justice and goodness, fulfill the covenants of humanist doctors and in the consciousness of the rightness of your cause you will draw strength for your difficult and responsible work.

Keywords: *deontology, education, personality, society, medical art*.

Introduction

Academy member Vasyl Yakovych Danylevskyi (*Fig.*) was a physician, writer, publicist, and popularizer of science. The introductory lecture by Danylevskyi V.Ya. on the versatile professional activities of a doctor, his worldview, responsibility, and professional freedom is a logical conclusion to all the questions raised in the previous five introductory lectures to form a conscious motivation of students in order to successfully master the profession of a doctor. In the first five lectures that Danylevskyi V.Ya. gave to first-year medical students to help them understand their future profession, the issues of health and illness [1], science, university, and choice of faculty [2], the doctor, patient, and successes of medicine [3], medical education and its reform [4], and the doctor, society, culture, and medicine [5] were highlighted. Aiming to convey to the modern reader the advanced views and achievements of Vasyl Ya. Danylevskyi, which have not been recommended

Corresponding Author:
Biletska Olga – MD, DMedSc, Professor, professor of the Department of sports, physical and rehabilitation medicine, physical therapy and occupational therapy of the Kharkiv National Medical University, Ukraine.
Postal address: Ukraine, 61022, Kharkiv, Nauky Ave., 4, KhNMU.
E-mail: om.biletska@knmu.edu.ua

for a century, we also bow to the outstanding literary talent of the great scientist: "The style of presentation, the immense erudition, which captivates with sincerity and a wide range of questions make the undeniable attractiveness of the book from its first pages" (Review of V.Ya. Danylevskyi's book "The Doctor, His Vocation and Education" by Rokhlin L.L., 1921). In his works, Vasyl Danylevskyi's great literary gift and brilliant lecturing skills throughout his life helped popularize science as the highest spiritual achievement of humanity: "Feelings and Life" (1895, 1910), "People's Home and Its Social and Educational Significance" (1898) "Life and Nerves" (1902), "Social Significance of Feelings" (1904), "People's Encyclopedia of Scientific and Applied Knowledge of Kharkiv Literacy Society" (1908, 1910), "Physiology and Social Life" (1910, 1911), "Essay on the Physiology of Social Illnesses" (1914), "Intelligent Entertainment and Their Scientific Substantiation" (1915), "People's Home, Its Tasks and Social Significance" (1915; supplemented in 1918), "The Doctor, His Vocation and Education" (1921) [6], "Work and Rest" (1921), "Work and Life" (1922), "Life and the Sun" (1923), "On the Question of the Physiological Substantiation of Hippocraticism: "The Healing Power of Nature" (1930), "Endocrinology and Emotions" (1934), "Memoirs of an Old Professor" (2018), "A Few Remarks on the Correlations of Affects and Endocrine System" (1938).

Fig. Danylevskyi V.Ya.

Adapted sentences and editorial comments in the text of the lecture are placed between [square brackets].

Iatros philosophos iso teos.[1]

Hippocrates

Vasyl Yakovych Danylevskyi's lecture on a doctor at work, his worldview, responsibility and professional freedom (1921)

<...> The requirements for a doctor, taking into account the depth and diversity of his specialized knowledge and the multifaceted nature of his professional activities, are very high. This alone is enough to recognize the profession of a doctor as one of the most difficult and serious forms of scientific applied work. It involves much more difficulties than the occupations of a teacher, judge, engineer, agronomist, etc.

<...> First of all, let us recall that knowledge and technical skills alone are not enough to be a doctor. <...> After all, the influence of the mental sphere on the physical sphere is so enormous. <...> A doctor must possess certain qualities of intelligence and character in order to be able to navigate in each case and harmonize his attitude towards patients (and society in general) with the rules of science and ethics, with the reasonable requirements of their well-being. <...> Will the prestige of a doctor who does not have stable principles and his public service be great? Can he be highly valued if in the struggle of life, in his practical activities, he easily succumbs to violence from some superiors, influential people, the opinions of the "crowd", easily gives up his personal and professional interests, changes his opinions "under the pressure of circumstances", etc.?

<...> A doctor has to constantly deal with social, ethical and psychological moments, with the secret properties and experiences of his patients and big groups of the population. To understand all this and not allow himself to be misled, neither textbooks nor lectures from professors will help the doctor. Only his natural properties, firm principles and bitter life experience will indicate to him the correct paths of activity and behavior.

<...> At the bedside of a patient, a doctor should never forget that he is a representative of medical science, and not of artisanal professionalism. Because of this, each case in practice can awaken in him a lively scientific interest in the peculiar symptoms of the disease, the special conditions of its occurrence, the method of treatment, etc. Such features and deviations from the established typical patterns deserve special attention.

[1]*The Doctor-Philosopher is Equal to God.*

The doctor diligently studies this novelty without regard to the patient, but for the sake of an ideal interest, purely scientific. Of course, this is possible only when doctors receive a serious scientific education at the University. This interest in scientific truth enlivens their professional activity and constitutes that "God's spark" that the University is obliged to engender in the soul of the doctor.

A teacher without a scientific vocation is not himself involved in the progress of knowledge and, of course, will not be able to inspire his students with love and interest in science.

The attractiveness of a person in live communication with him is determined by his natural properties, and is not given by scientific merits alone. The brilliant Helmholtz G.L.F. [Hermann Ludwig Ferdinand Helmholtz (1821–1894), a German physiologist and physicist, one of the founders of the science of physiology of the senses and the theory of energy conservation] did not create a school of physiologists, but the works of more than a hundred of his students eloquently testify to the school of Ludwig K.F.V. [Karl Friedrich Wilhelm Ludwig (1823–1895), a German physiologist and one of the founders of experimental physiology and biochemistry].

<...> Above we have already addressed the doctor more than once as a practicing psychologist regarding his public service. The same applies to his daily work at the patient's bedside. Physical and moral suffering weakens a person's memory, intellect, willpower, and ideal aspirations. A person becomes selfish, his spirit declines, and apathy is observed. <...> However, one cannot deny such cases when the danger posed by the disease causes moral rebirth for the better, some enlightenment, and self-purification. On the other hand, much more often the softening of character and obedience are most easily explained by the fear of death, physical weakness, or the severity of suffering. The sick person agrees to do anything to be cured. He becomes superstitious, ready to believe anything - a homeopath and amulets, "bewitched" water, and a village sorcerer.

<...> The medical literature on nervous and mental illnesses undoubtedly highlights the enormous harm to health caused by prolonged affective states, especially in cases of unfavorable heredity, the consequences of previous illnesses, overwork, poor nutrition, weakness of the heart, etc. The doctor is obliged to inspire and explain the requirements of a "mental diet", to point out the danger of frequent, prolonged, strong feelings, and excitement, regardless of the cause of their occurrence. For people with unstable mental balance, such states cause weakening of working capacity, a senseless dissipation of energy, and a decrease in social value. For them, psychohygiene sets particularly strict rules of life, which concern, among other things, certain discernment in relation to familiar people, books and newspapers for reading, even musical entertainment, not to mention caution in visiting the dramatic theater and cinema.

In some cases, during diseases, a strong obstacle to treatment arises due to a depressive emotional state, which is accompanied by a weakening of the most important functions of the nervous system, heart, muscles, etc. If the main cause is in bodily processes, it is necessary to find it and eliminate it. Then the psyche will also recover. If the main condition is based on mental acts, then the doctor has to act as a practicing psychologist.

It is important to take into account that the high cultural and educational level of the patient is not always a favorable moment for mental influence. Practicing doctors can confirm that in many cases a moral uplift can be inspired in an uneducated person even to a greater extent than in one who has scientific knowledge. The former is treated with great trust, while the latter is hindered by critical thought and ordinary skepticism. On the other hand, a cultured patient will have strong motives such as love for art, science, devotion to a public cause, a philosophical or irrational search for the meaning of life, and the struggle for social truth. His motives can serve as a no less powerful "anchor of salvation" for suggestion than religious feeling, love for children, patriotism, and the dream of a happy life.

In his practical work, a doctor has to determine the mental state of some individuals who are distinguished by their too pronounced individuality and attract the attention of everyone around them. The peculiarities of their character and behavior include, for example, excessive selfishness, indifference to other people's grief, frequent mood swings, absent-mindedness, immorality, an extremely frivolous attitude to serious issues and matters, often hysterical exaltation, talkativeness, dreaminess, a passion for making speeches, drawing up all kinds of projects, etc. It is interesting that among the ancient Greeks, the same word "mania" meant both prophetic and poetic inspiration and madness.

Brain defect is manifested, among other things, in the fact that along with an outstanding mind, eloquence and a great memory in the same person

there is an inadmissible moral depravity, dishonesty, gross egoism. Such a mental anomaly most often arises due to psychopathic heredity. Often the doctor will be able to find physical disharmony here, in the form of morphological asymmetry or ugliness, indicating the decline of embryogenetic energy.

In these cases, as in others similar to them, the psychologist has to take into account the influence of the environment. A personality that is strong, if not in character, then at least in the stability of convictions, who is accustomed to critically considering his actions and subordinating them to the requirements of reason, of course, is less exposed to the danger of losing common sense and moral sense. On the contrary, psychopathic affective moods of the environment for a mentally and morally unstable person, is undoubtedly a threatening contagion.

It is not surprising that in an era of social and political upheavals, the number of "psycho-abnormals" who are distracted by suggestion and imitation in the direction of certain trends is increasing. At such moments, weak-minded people with an immature psyche are, of course, an antisocial element. Hence, it is clear how difficult the task of a doctor working in conditions of complicated social life is. The best medical specialist will not be at the level of his vocation if he cannot take into account the influence of the socio-psychological order, but will limit himself only to individual life.

This issue is no less important from the point of view of hygiene and prevention. We have already seen what great importance a doctor acquires in school practice and in general in the matter of raising children. Simplicity of life, its strict order, self-discipline, abstinence from everything exciting and from any excesses, elimination of strong impressions, strict choice of entertainment (theater, sports, literature, etc.) and along with this – "life closer to nature" (outside the city bustle and unnaturalness), physical labor, healthy games, getting used to hardships (to various inconveniences of housing, sleep, to hunger and cold, etc.), fresh air, bathing, simple food, rough clothing, etc. – such requirements are set by the doctor-psychologist to educators for the above-mentioned purpose of prevention, for the sake of achieving the stability of the physical and moral health of children. Long time ago, John Locke [John Locke (1632–1704), an English philosopher, one of the founders of empiricism and theorist of liberal political philosophy] insisted on the need for physical, moral and mental hardening as the main task of education. Only under this condition can one avoid that degradation, depravity, that weak-mindedness, which constitutes the basis so fertile for any mental disorders, immorality and crime. We must not forget that social morality is based on universal human ideals, which in a mentally weak, undeveloped person are so easily distorted under the influence of suggestion, imitation, clever sophisms, excited passions and crude instincts.

<...> The constantly growing specialization, the great variety [diversity] of the program of medical education, the continuous development of science – all this, of course, is important and necessary, but, on the other hand, threatens to disperse, to fragment the mental structure, and therefore it is necessary for a practical doctor to create for himself a certain general *scientific worldview*. It should be the foundation for his behavior, all his ideas and conclusions. It should serve as a guiding beacon or the main criterion for all his doubts, disputes and considerations.

<...> The need for a broad worldview has long been recognized by doctors. Most often, they adhered to the natural philosophical teachings of Schelling F. [Friedrich Wilhelm Joseph Schelling (1775–1854), a German philosopher, one of the leading representatives of German idealism, the founder of the natural philosophical teachings that sought to unite nature and spirit in a single philosophical system]. The old medicine itself, with its generalizing "systems", reflected certain philosophical influences and, in the absence of positive knowledge, resorted to contemplation, to a priori constructions. It even very diligently adhered to the ancient Platonic saying: "He who works, realizing the unity of knowledge, has a scientific mind". Hence the "philosophical nature" of ancient medical views, which their representatives were so proud of.

The serious need for a generalized idea of the world order in the guiding philosophical worldview is recognized even now by the best representatives of medicine. Here the fatal natural desire of man for perfection is manifested. He is not satisfied with one specific knowledge, information about components. He is drawn to generalizations, to knowledge that illuminates both peaks and depths... Such is the very nature of our intellect, which, despite our will, develops towards abstract knowledge and unites thinking in general, where the progress of scientific knowledge is also going. "However diverse the trends in different branches of science may be, it appears to us as a theory of the external world, which we consider through ab-

stract concepts obtained by us through abstractions from experience and brought together to derive laws that allow us to systematize phenomena and predict them" (Picard C.E. [Charles-Édouard Picard (1883–1959), a French mathematician, known for his works on analysis, mechanics and philosophy of science]).

Of course, you understand that to master a well-known philosophical worldview does not mean at all to study it from a textbook, sitting at a school desk. This is a more complicated matter, not a simple, educational one. A lot depends on the innate makeup of the mind, on one or another tendency to criticism or to abstract thinking, or to mysticism, or on satisfaction with the tangible, visible, etc. From this it is clear why it is possible to create or choose and adopt a certain worldview or otherwise join a particular philosophical system only in adulthood, after completing all schooling, when a natural crystallization of the intellect will occur, when sufficient personal experience is accumulated.

<...> The problem of worldview becomes even more complicated and more difficult for a doctor if he adds here the moral order of life, if these guiding views should encompass not only the cognitive sphere, but also the relationships of people, their inner, subjective world of feelings, desires, and drives...

<...> If, due to their constant contact with the inner world of a sick person, doctors generally draw a bleak conclusion about the morality of life, then they need a broad worldview, a scientific, strictly objective one, which should warn them against premature conclusions of a subjective order. A doctor, like a philosopher, is best suited to "Hic ridere, nec lacrimari, sed intelligere" ("not to laugh, not to lament, but to understand" Spinoza B. [Benedict (Baruch) Spinoza (Benedictus de Spinoza, 1632–1677), a Dutch philosopher, one of the most prominent representatives of modern rationalism]). It is characteristic of a layman to obey his impressions and moods; it is difficult for him to distance himself from subjectivism. But an educated doctor should act only according to objective criteria, critically verified facts, scientific principles. <...> Before being indignant, one must check, clarify, establish causal relationships, the connection of phenomena and conditions. To do this means to understand. A doctor is not a judge and not a moralist. He is a naturalist, studying pathological biology, without touching on the assessment of human actions from the point of view of life wisdom and morality. The scientific principle of objectivism forbids him to "live with his heart" while performing his duties, but this, however, does not mean at all that "a doctor should not obey his heart at all".

<...> No matter how limited and unconditional our knowledge, based on the results of material experience, is, for our mind they open up an endless horizon of searches and generalizations not only in the sphere of experience, but also in abstract thinking. It is enough to recall the doctrine of energy, electrons, the law of entropy, the principle of relativity, ideas about the structure of atoms, the causes and essence of chemical transformations, the principle of progressive evolution, the unity of biological laws, the doctrine of monism and much more.

For a long time now, Montesquieu C.L. [Charles-Louis de Montesquieu (1689–1755), a French philosopher, jurist and educator, one of the founders of the theory of separation of powers] said that laws are necessary relations that arise from the nature of things. This applies not only to relationships within the human community, but also to other conditions of its existence.

<...> The doctor's philosophy is not satisfied with the moral well-being of the human community; its highest goal is intellectual progress. The enlightened mind is the basis of social happiness. Only it alone can raise the "center of gravity" of life above the crude materialism of its practical interests and give human activity the highest purpose.

Of course, scientists readily admit that they still know very, very little about the world around them, that much remains unrecognized, unexplored. *Hic unum scio me nihil scire!* ("One thing I know, that I know nothing" [a phrase attributed to Socrates, the ancient Greek philosopher (c. 469 BC – 399 BC), who founded the Western philosophical tradition, emphasizing ethics, self-knowledge, and dialogue]). But they consider the basic results of natural science to be beyond doubt. "It has put the Law in the place of the Miracle. As before the coming day, spirits and ghosts have dispersed before it... It has extinguished the fires intended for witches and heretics... It has subdued the arrogance of speculative thought. It has opened the boundaries of knowledge and given its students the power to look without dizziness from the heavenly height of comprehensive skepticism. How easy and free one breathes at this height"... (E. du Bois Reymond [Ernst Heinrich Weber du Bois-Reymond, 1818–1896, a German physiologist and philosopher of science, known for his

contribution to the study of the nervous system and the popularization of the skeptical scientific approach to knowledge]).

Any artificially invented system will sooner or later cause opposition from the side of natural forces, which are automatically mobilized every time violent disorders of natural instincts, feelings, aspirations, and orders are created in mono- or polybiosis. I will allow myself to read you one passage from my "Essay on the Physiology of Social Illnesses": "Any unnatural perversion that goes "against reason" and against the laws of progressive development already carries within itself the source of self-disintegration and self-destruction. No adaptation can save the unnatural, the artificial for a long time if it contradicts the natural course of things. Living nature ruthlessly eliminates and destroys everything unnatural, defending its laws and its harmonious order with combative healing forces, the fight against which is already doomed to defeat" … "As nature in the physical world, so historical destinies in the social world are already quickly beginning to take revenge for contempt for natural laws, for ill will or for ignorance, which leads to a distortion of normal development" ... (1913).

The essential meaning of human life is *the creative power of reason and labor*. And therefore morality, right, law, economy, social order – all these are only conditions that should provide their activity with the minimum possible external, extraneous obstacles. The less effort, energy and time spent on overcoming the latter, the more fruitful a person's work, the more productive his plans and efforts, and therefore, the more assured his progress, which together with creative energy and labor constitutes the "center of gravity" of his entire life.

Cultural improvement of a person frees him from passive submission to the conditions of external nature, develops the powers of his intellect, forces him to boldly follow the path "towards the best", following the instructions of his own mind and his knowledge. He has known since ancient times that "the world forms a progressive kingdom of growing perfection" and that without intelligent labor it will remain unattainable for him. The greatest energy value of a person is the higher, the more he is adapted to active participation in general progress. Of course, human life is too short to personally verify the general progressive movement forward. Moreover, this movement does not proceed in a straight line, but in zigzags, sometimes complicated by an obvious regression in one direction or another. At least, progress remains undeniable in the sense of the gradual liberation of man from gross material concerns and vice versa – the emergence of motivations and the growth of spiritual needs in the sense of his gradual emancipation from the leadership and imperatives of the environment. This includes both nature and the human community in the sense of the gradual accumulation of internal ideological imperatives, which replace external, extraneous, exogenous ones. The influence of the corporeal world, external and internal, so irresistible at first, fatally gives way to personal initiative and the imperatives of the intellect itself. Instead of the crude prose of life, which draws its motives from its lower formations, the awakening interests of the spirit are established. The physical or bodily egoism of primitive origin is gradually replaced by altruism or the interests of the community as a source for the harmonious improvement of life of an already higher order. The directives of common material life become no longer a higher, but a lower level, above which the almost limitless superstructure of the freely developing personal "I" continues upwards. Its spiritual development takes place in communication with all of humanity in its past and present. The liberation of personal reason and will from external violence and guidance is a general psycho-biological law that can be traced through all components of human life, personal and social.

<...> Realizing his ideal intents in the highest works of philosophy, science, poetry, literature, art, a person thereby creates for himself sources of pure pleasure and spiritual uplift. For the doctor himself, such an idealistic mood with its positive influence on the soul, which is confused by the constant contemplation of grief and suffering, is often a huge need. For the disturbed balance of the spirit, a force is needed that distracts it in the opposite direction, towards intellectual pleasure. <...> Therefore, it is not surprising that among doctors there are so many lovers of theater, music, literature, and especially among doctors who already have many years of practical experience. Let us recall that such famous doctors as Pyrogov M.I., Billroth T., Charcot J.M., Botkin S.P. were great admirers of refined art (poetry, music, painting). Incomparably less often such a need for a favorable reaction concerns studying philosophy, reading historical investigations, etc. This is understandable, because every busy mind from time to time requires, in the name of the same law of balance, a deviation towards the emotions of joy, pleasure, enjoyment, towards art and even irratio-

nality. Healthy entertainment helps to accumulate and save the energy of the intellect for its work, without fatigue and monotony. After all, our natural desire for a harmonious balance of mental forces and needs always naturally protests against the latter. "No profession requires such a degree of higher spiritual satisfaction as the profession of a doctor, before whom from morning to evening illness and death, grief and care pass in an uninterrupted chain" (clinician Tiemsen [Carl Tiemsen, 1796–1877, a German doctor and clinician, known for his works on internal medicine and a humanistic attitude to the medical profession]).

<...> As you have seen, there are two components in the work of a doctor that ennoble it and give it a special fascinating purity of motives: 1) scientific idealistic interests in the matter of treatment, and 2) the moral side with its humanity and selflessness. Already in the middle of the century [19th century] it was written that the matter of treatment concerns the matter of serving the God, because the health of the body is necessary for fulfilling the requirements of virtue and God's covenants. From this it is clear why in medical practice, or rather, in helping the sick, even religious service was given importance. This is also indicated by the history of hospitals that were founded at monasteries in those distant times. Treatment of diseases and care for the sick were considered a noble, highly moral art, which promotes the achievement of happiness, victory over harmful passions and over bodily suffering, which helps to fulfill the rules of life.

<...> No matter how perfect the social organization of medical care may be in the future, it will never be deprived of its moral essence, which is most clearly manifested under the condition of the free professional activity of the physician, and not the automated performance of official duty with various orders, restrictions, rewards...

<...> The book Ayur-Veda of the ancient Hindus [an ancient Indian system of traditional medicine, based on the harmony of body, mind and spirit, and is one of the oldest holistic medical sciences in the world] insists that "a doctor should be a person of the highest degree of truth, moderation and decency, a compassionate and benevolent person"... Hippocrates also places almost the same requirements on a doctor, he demands from the doctor "selflessness", modesty, chastity, simplicity in clothing, common sense, composure, peace of mind, kindness, neatness, serious speech, knowledge of useful and necessary for practical life things, avoidance of unclean deeds, absence of superstition and fear of the gods, greatness of the divine soul" ... The Hippocratic aphorism states: "Where there is love for people, there will also be love for the art of medicine!" [comes from the work "Aphorisms" (Lat. *Aphorismi*), which is a collection of sayings and instructions of Hippocrates].

If we wished to give some examples of the mercy professed by medicine, we would not need to list the truly countless feats of doctors at the bedside of the sick, on the battlefield, in prisons, during epidemics. It is enough to recall the great act of humanism of the psychiatrist Ph. Pinel', who was the first to remove the chains from the unfortunate mentally ill and abolish flogging. [Philippe Pinel (1745–1826), an outstanding French psychiatrist-humanist, who initiated the reform of psychiatry, freeing patients from physical violence and inhumane treatment].

Now we come to delicate issues. <...> …if compassion is the guiding principle in the activities of a practicing doctor, does he sometimes have the right to refuse his help to a patient? Suffice it to say that a reasonable organization of medical care for the population should ensure that a doctor, one way or another, arrives at any moment. But at the same time, it is obliged to guarantee the doctor himself peace of mind when he needs it. Both his conscience and his knowledge will be able to tell him when, due to purely moral and life conditions, he has no right to refuse his help and must sacrifice his rest and his personal activities for the sake of urgent help to his neighbor.

<...> The second question arising from the moral sphere of the doctor is the following: is the doctor always obliged to tell the patient the truth about his condition, despite the fact that it may harm him with strong mental excitement of a depressive nature? Hope for improvement, hope for the doctor's art raises the physiological energy of the body, its resistance in the fight against the disease, improves nutrition, sleep, muscle and vasomotor tone, etc. Therefore, it is necessary to protect him from any harmful shocks, as far as this is within the competence of the doctor at the patient's bedside.

We read about the doctor's morality in the "Guide to Physicians" by the prominent Arab doctor Isaac El Israeli (about 900 AD): "...most diseases are cured without a doctor, with the help of nature. If you can cure a patient with a diet, do not give him medicine. During treatment, do not resort to any miraculous remedies, because they are

based on stupidity and superstition. Tell the sick about the possibility of healing, even if you yourself are not sure about it. Never speak bad things about other doctors, because everyone has his own happy and unhappy hour. Let your deeds, not your tongue, glorify you!"

One of the most difficult problems that a doctor always faces is the question of *death*. If a person is so afraid of pain, suffering, torment, tries in every way to avoid them, sacrificing much that is dear to him for this, then the fear of death is an incomparably stronger feeling. This "leap into the unknown" instinctively seems to be something more terrible than the most severe physical suffering, about which a human being has a completely realistic idea. If bodily pain causes "fire and brimstone", if it can literally crush a person, his will, feelings, thoughts, then how much more terrible for his consciousness is death itself? It is clear why the patient so begs the doctor for salvation from death. A doctor has no right to comfort a dying patient with appeals to the irrational, this is not his business, but he is obliged to support the hope of continuing life.

<...> The progress of the "meaning and value of life" of a person moves naturally from economics to mental imperatives, from the concrete to the ideological, generalized. In such aspirations for the high and sublime, a natural instinct, inherent in the properties of our brain, is manifested. <...> But the point is that, like Goethe's Faust, "two souls live" in a person ...

"The earth is sweet for one
and here it is free in this world.
The heavenly fields, where perfumes
are carried in the ether
is sweet for another".

Every conscious person takes a greater or lesser part in the common collective life, in the common aspirations to move forward, in joint activity on the path to achieving higher goals. <...> The consciousness of the value of one's life gives moral strength to a person. With one's work, goodness, and help, one consciously participates in the common cause, even on a small scale. The deliberate conscientiousness of one's work and the comprehension of one's efforts give one the same moral satisfaction as the great feat of a great man.

Now it becomes clear to us why, in addition to the instinctive fear of death, one is so afraid of it. One has not yet done everything that one could and had planned, one still has a cheerful spirit, one's energy has not yet subsided, and the danger of breaking the thread of life by the hand of Parka is already close. He knows that there will be no return to earthly life, that he will have to part forever with everything and everyone who were so dear to him, and he himself will turn into nothing or into something incomprehensible... All this causes moral suffering, which can be stronger than physical. Hence the passionate desire to preserve a "living" connection with earthly existence as a belief in the immortality of the personal "ego", which, as spiritualists claim, can even materialize.

<...> A person has a completely different attitude towards death when it comes in a timely, correct manner, is likened to sleep, when a person has exhausted his strength, is tired and needs rest. Desires and aspirations have subsided, thoughts and muscles have weakened. Work stops by itself, due to the depletion of energy reserves. The person himself feels the futility and aimlessness of his further existence. He can no longer provide any benefit or help to the younger and more vigorous, and he does not want to, because he is satiated with life.

<...> Another question is connected with the general worldview of the doctor, which, it must be admitted, sounds paradoxical and even more than strange: should all the sick be treated? It would seem that there can be no question here. Simple humanity itself forces us to provide all possible help to everyone who suffers in all cases. <...> As far as we know, in certain cases the body's own defense mechanisms are undoubtedly more effective than our artificial medicines and measures. But if in some cases the doctor is obliged only to help the "healing forces of nature", then in others, much more numerous, he has to act boldly, quickly and decisively with artificial medical measures and means.

<...> We place the doctor above the successful professional worker or "official" because everywhere, on all the difficult paths of his so responsible vocation, he is a free representative of free science, firmly standing on the basis of scientific progress and a positive worldview. There is no and cannot be any superior above the doctor at the bedside of the patient. He is obliged to obey only the orders of his science. In the fight against human ailments, his weapon is only scientific knowledge and the scientific method. <...> He must have a broad mental horizon in order to always remain at the proper level of his calling as a practical professional figure. In this regard, he is the direct opposite of the office scientist, who can close himself in a narrow circle of his special works and remain blind and deaf to the whirlwind of life's bustle.

The more cultured and educated society becomes, the more it values the doctor.

<...> However, there have emerged formidable signs of social atavism, the pernicious seeds of which gave such a lush growth of human bestiality in 1914 and the following years. <...> Poverty brings selfish thoughts and impulses to the fore, and intelligent, long-term social education is needed to overcome these primitive instincts and save man from the danger of complete savagery.

<...> We have already had to touch on the question of the responsibility of doctors for their actions more than once, and you have seen that, on the one hand, the judge is their conscience, and on the other, the whole society. However, there are cases when a doctor is held accountable before a real court. In some cases, it is easy for him to prove the absence of evil will. In others, even a doctor who is completely innocent of anything becomes very difficult to prove his innocence. This is not the place to analyze such possibilities. There is only one thing that is certain: only doctors can understand such matters, and not only in a purely professional sense, but also in moral and social terms.

<...> There is hardly any other important issue, except for the problem of Euthanasia ("ease of death"), in which the moral principles of a doctor would be subjected to such a severe test. On the one hand, humanity requires alleviation and reduction of the suffering of the patient, and on the other hand, the basic principle: not to lose hope until the last minute, not to lay down arms in the fight against death, to take care of the continuation of life by all means.

<...> The question of the responsibility of doctors arises every time when it comes to medical secrecy. In our "Faculty Pledge" every doctor promises "to keep sacred the family secrets entrusted to me and not to abuse the trust given to me... not to tarnish the honor of the community" (of doctors). <...> By the way, let us recall that in England a doctor has no right to hide from the court anything related to his practice. There is no medical secrecy there as in France. Here, undoubtedly, the difference between the two countries in terms of socio-moral worldview is evident. The French give priority to the interests of the individual, and the English – on the contrary. In Italy, the state of this issue is close to the English one.

<...> For the future of medical activity, the solution of an essential question is undoubtedly of great importance: whether it will remain a free profession or will completely turn into a mandatory official occupation. The decision will depend on the direction in which the common question of the free professions will be resolved in connection with general social reforms. <...> An official, under constant control and subject to official responsibility, gradually becomes a clerk, who performs his official duty under the supervision of his superiors, on whose whims and discretion his entire work may largely depend. Instead of inner freedom, the doctor will feel coercion from the outside, and this will necessarily lead to the doctor's depreciation.

<...> The freedom of the profession of a doctor can be placed next to the work of a scientist, artist, writer, poet, philosopher. In this case, the rights and freedom of the individual should not and cannot be completely absorbed by the interests of society and its claims without significant losses for the cause itself. It is unlikely that the most ardent collectivist would even think of reducing everything to a "barracks equation" here... But, on the other hand, there should also be an indisputable right of a practicing doctor to material support, in addition to a personal fee from the patient, which would save him from seeking practice as an artisan and from the demoralizing influence of a personal fee on the relationship between the doctor and the patient.

<...> What could be said about the value and fate of such a social order that can easily suppress individual aspirations for free creativity, for the free development of talents and gifts? <...> There can be no talk of any viability in a society in which external compulsion to work must replace internal, conscious motivations. In this case, the nonfunctioning abilities for initiative and creativity will sooner or later, but inevitably, atrophy. <...> Imperatives must proceed from a free, educated intellect, from an inner conviction, from the idea of duty. The ways and tasks of work that come from outside the authorities will always introduce some deviations and aberrations, because any higher authority stands far from life, like a "too high superstructure", associated with the obligatory distortions of perspective...

<...> Of course, alongside doctors who stand at the height of their calling, even now there are occasionally bad doctors, about whom the great Roman physician Galen (in the 2nd century BC) said that their minds are directed not at science, but only at useful recipes and at flattering their patients.

As for modern doctors, it is enough to point out that some doctors are in the service of healers, or

"naturopaths". By the way, let us recall the case when, in order to increase his earnings, a certified doctor pretended to be a healer (this seems to have been the case in Germany).

<...> However, relying on modern achievements, starting with microbiology and ending with biophysics and psychophysics, the art of medicine is gradually becoming an applied science and promises to quickly flourish and develop.

<...> We are used to looking for heroes among fighters for the homeland, for the common good, for the idea, heroes with brilliant feats, with extraordinary merits and courageous aspirations. Monuments are erected to such heroes everywhere, they are called models worthy of all kinds of imitation. But where are the monuments to those "heroes of the spirit" who, not sparing their strength, only in the name of love for their neighbor, in the name of their moral duty, selflessly go day and night to the sick, alleviate their suffering, preserve their strength, health and life itself, risking to bring the infection into the family? We are so accustomed to such everyday actions of doctors that we cease to notice and appreciate their outstanding merits. Neither mortal danger near the battlefield, nor the horrors of the excited dark mass during an epidemic stop a doctor from selflessly helping the poor wounded and sick. Do I need to remind you how many doctors have become victims of epidemics and enemy bullets?

The doctor stands outside or, more precisely, above all parties, all kinds of political, social, economic trends, because he deals with a human being without regard to his tribe, language and position. For him "there is neither Greek nor Jew, neither slave nor free"... [from the Bible, namely from the Epistle of the Apostle Paul to the Galatians, chapter 3, verse 28]. He knows only the eternal laws of humanity, he shuns all sophisms and fabrications of narrow-minded doctrinaires <...> Future doctors, medical students in their address to our famous professor Hirshman L.L. (1895) [Leonid L. Hirshman (1839–1921), an outstanding ophthalmologist, professor, founder of the eye clinic in Kharkiv, author of numerous works on ophthalmology, known for his humanism and pedagogical activities] addressed such deeply sensitive words: "Teacher, teach us the difficult science to remain human among people, teach us to see our brother in the sick person without distinctions in religion and social status; teach us to love the truth and bow only before it... Teach us for many more years, dear teacher, so that, giving our strength and thoughts to serving our sick brother, we do not profit from the misfortune of our neighbor, do not make a craft out of our sacred calling.

<...> No one knows better than a doctor that the longer humanity lives, the wider and deeper the rule of reason becomes. More and more the primacy of matter gives way to the influence of ideas. The rights of the physical are decreasing, while the human spirit is growing uncontrollably.

<...> So, boldly go on this path of serving the truth, righteousness and goodness, steadfastly fulfill the covenants of the humanist doctors, your teachers, and in the consciousness of the goodness and rightness of your cause you will draw strength.

Afterword and Conclusions

Thereby, having familiarized ourselves with the full cycle of introductory lectures by Danylevskyi V.Ya. for future doctors, we first of all see before us the majestic figure of an outstanding versatile personality of a scientist and public figure at the turn of the 19^{th}–20^{th} centuries. During this period of rapid development of science and culture, the role of the intelligentsia in the implementation of general public education, public criticism and reform of society is growing, international cooperation with participation in congresses, progressive ideas, philosophical views is spreading. Our acquaintance with the calling of Danylevskyi V.Ya. to youth also reveals to us the great talent of the teacher for instilling motivation in future doctors for multifaceted intellectual and spiritual development.

A significant role in the development of domestic medicine was played by Kharkiv Medical Scientific Society, which was founded immediately after the abolition of serfdom and in the prerevolutionary years (1913) already had 428 members (for comparison: Warsaw Medical Society followed it in terms of the number of members after its foundation – 245 members). Among the outstanding scientists of Kharkiv school, an honorable place deservedly belongs to Academician Danylevskyi V.Ya.

The text of the sixth lecture reveals the multidimensionality and depth of the medical profession, emphasizing that a doctor is not only a specialist in the field of biomedical knowledge, but also a moral, social, psychological and philosophical authority. The core idea is that a true physician cannot be limited to technical skills alone – they must be an individual with high intellectual abilities, strong ethical principles, profound humanism, and a philosophically balanced worldview, as well as possess critical thinking and empathy.

Medicine in the text is presented as an activity that carries a huge moral burden. On the one hand, the doctor must be guided by scientific theories and clinical algorithms, on the other hand, he must understand the human psyche, his suffering, spiritual fluctuations, and even the social context in which he lives. The doctor appears as a kind of guide between science and humanity, between empirical knowledge and empathy, between objective reality and the subjective existence of the patient.

These thoughts are especially relevant in the context of modern bioethics, evidence-based psychosomatics, medical humanitarianism and patient-oriented medicine. In the context of constant scientific and technical evolution, digitalization of medical practice and dispersion of knowledge due to narrow specialization, the author rightly warns about the danger of losing a holistic scientific and moral worldview. Without a philosophical foundation, without a common vision of man as a unity of body, soul and social being, medicine can turn into a soulless technocratic craft.

The doctor of the future, according to this vision, should be not just a specialist in the field of health care, but also an educator, enlightener, social leader. This is especially true of psychohygiene, prevention and pediatric medicine, where medical intervention is closely intertwined with moral and pedagogical influence. The 20th century philosophers, Paulo Freire and John Dewey, support the idea that the doctor of the future should be not only a technical specialist, but also a moral authority, educator and leader in society.

Paulo Freire (1921–1997), a Brazilian educator and philosopher known for his work *Pedagogy of the Oppressed* [7], believed that education should be a process of mutual learning, where the teacher and the student are partners. He emphasized the importance of critical thinking and social justice in teaching, which is also relevant to medical education. His approach can be applied to the training of doctors, who must not only possess medical knowledge, but also understand the social and ethical aspects of their profession.

John Dewey (1859–1952), an American philosopher and educator who developed the concept of progressive education, believed that education should be focused on the experiences of students, promoting the development of their critical and creative abilities. Dewey emphasized the importance of active involvement of students in the learning process, which can be applied to medical education, where doctors should not only acquire knowledge, but also develop their ethical and social skills [8].

The ethical ideas of Danylevskyi V.Ya., namely, caution in the attitude towards life and death, as well as the inviolability of medical secrecy, remain relevant today and are in harmony with the leading philosophical and professional positions in modern medical ethics. Danylevskyi's V.Ya. concern about the doctor's moral choice between preserving life and respecting the patient's will resonates with modern ethical dilemmas related to palliative care, personal autonomy and the right to a dignified death. The well-known researcher of these issues, Pellegrino E.D., claims that the doctor's morality is based not only on science, but also on a deep awareness of the duty to the patient as a suffering person [9]. In the context of medical secrecy, it is emphasized that maintaining confidentiality is not only a legal, but above all an ethical duty [10]. The debate on euthanasia continues: supporters emphasize the right to autonomy, while opponents emphasize the value of life under all circumstances. In the countries where medically assisted death is allowed, the doctors face deep moral conflicts [11]. A cautious attitude towards alternative medicine methods also remains relevant [12].

In his sixth lecture, Danylevskyi V.Ya. addresses the problem of the doctor's personality: his emotional endurance, ability to resist the pressure of circumstances, influential people or populist "crowds". In times of social upheaval and moral uncertainty, it is the doctor, being a stable, critically thinking, ethically responsible person, can play the role of a moral guide.

Thus, the ideas presented in this text remain relevant in modern medical discourse. They are in tune with the concepts of integrative medicine, a personalized approach to the patient, the moral responsibility of the doctor, as well as the need for philosophical depth of medical knowledge. This is a reminder that true medicine is not just science or technology, but primarily a spiritual service to Human.

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VALEOLOGICAL ASPECTS OF EMOTIONAL REGULATION AND PRACTICES FOR GETTING OUT OF KARPMAN'S "TRIANGLE OF SUFFERING"

Shevchenko A.S.[1–3], Shumskyi O.L.[4], Nesterenko V.G.[1], Burbyha V.A.[3], Kucherenko S.M.[3], Kucherenko N.S.[3], Shayda V.P.[5], Gavrylov E.V.[6]

[1]Kharkiv National Medical University, Kharkiv, Ukraine
[2]Kharkiv Regional Institute of Public Health Services, Kharkiv, Ukraine
[3]V.N. Karazin Kharkiv National University, Kharkiv, Ukraine
[4]Simon Kuznets Kharkiv National University of Economics, Kharkiv, Ukraine
[5]National Technical University "Kharkiv Polytechnic Institute", Kharkiv, Ukraine
[6]Hameln-Pyrmont Adult Educational Center, Hameln, Germany

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ABSTRACT

Background. Karpman's "Triangle of Suffering" is a model of social interaction of people who are in "toxic", conflict relationships in the roles of mainly the Victim, Persecutor and Rescuer, experience negative emotions (fear, resentment, guilt, anger, aggression) and generate such emotions in other participants in Karpmanian relationships. These negative emotions can cause mental disorders, social maladjustment and psychosomatic pathology; therefore, when teaching valeological disciplines, it is necessary to show how to find a way out from Karpman's triangle through the self-regulation of emotions. There is a lack of empirical research that proves the success of such training.

Aim. Studying the practices of coming out of Karpman's "Triangle of Suffering" and efficiency of emotional self-regulation in non-medical students when learning valeological disciplines.

Materials and Methods. The study was carried out using the method of system analysis, sociological and bibliosemantic methods (97 literary sources were analyzed). The study included a sample of 124 students, equally divided by gender (62 males and 62 females), with an average age of 20.4 years. Participants were divided into control (n=17) and main groups according to the criteria for their participation in the Karpman's triangle, the chosen strategies for exiting the triangle and the implementation of the exit intention. We proposed two strategies to exit the Karpman triangle, namely defensive (termination of communication with so called "Karpman's team members") and Emotional-Energy Transformation (EET, reaching a new energy level in a triangle with a change of roles and transformation of emotions). Emotional interaction was assessed using the Difficulties in Emotion Regulation Scale twice with an interval of at least 1 month between surveys. Statistical analysis included descriptive statistics (M±SD), comparative analysis (t-test), correlation studies, and calculation of effect magnitude (Cohen's d). The study was approved by the ethics committees of two scientific institutions.

Results and Conclusions. Among the 124 participants in the study, 24 students chose the EET strategy, of which 16 people fully implemented it. EET produced the best emotional regulation scores (average DERS reduction of [42.5±4.7] points at 87.5%). The defensive strategy chosen by 5 participants (of whom only 1 person implemented) showed an average decrease in DERS of only [19.8±3.2] points.

Keywords: *strategies for getting out of toxic relationships, Victim, Rescuer, Persecutor, transformation of emotions.*

Corresponding Author:
Shevchenko Alexander S. – MD, MM,E&P, Director of the Kharkiv Regional Institute of Public Health Services.
✉ Ukraine, 61057, Kharkiv, Rymarska str., 8.
E-mail: as.shevchenko@knmu.edu.ua

Introduction

The Karpman's Drama Triangle, or "Triangle of Suffering" – a model of social interaction introduced by psychiatrist Stephen Karpman in 1968 [1]. It describes three destructive roles that people often fall into in toxic, conflict relationships: the

Victim, Rescuer, and Persecutor. All participants in these relationships suffer, experience negative emotions, and generate negative emotions in other participants of "Karpman's team members".

In his subsequent research [2], Karpman S. developed his theory of "triangular" relationship models into the "Compassion Triangle", where instead of the roles of Victim, Rescuer, and Persecutor, the roles of openness, honesty, and responsibility are at play. The author focuses on personal growth, the awareness of one's behavioral scripts, and the ability to establish healthy boundaries in interaction with others. This approach aims to develop emotional maturity and build authentic, fulfilling relationships. However, this positive triangular model has been less popular with other researchers, psychologists, psychiatrists and educators who study ways to overcome conflicts and negative emotions, carry out behavior correction or provide psychological assistance.

To provide a comparison, the following *Table 1* outlines the key differences between the Drama Triangle and the Compassion Triangle.

In the study of the Triangle of Suffering, Karpman S. (1968) [1] shows how the roles of the Victim, Rescuer, and Persecutor arise and change in family conflicts. The Victim believes that their problems are caused by external circumstances, the Rescuer tries to control the situation through excessive caregiving, and the Persecutor blames others for their failures. This creates a vicious cycle where each person exacerbates the negative emotions of the others. All the three roles are destructive, undesirable, associated with such negative emotions as pity, resentment, anger, guilt, and lead to aggression.

The author also analyzes the connection between the roles in the triangle and anxiety disorders, noting that people who frequently fall into the Victim role are prone to depression, whereas Rescuers often suffer from emotional burnout [3], which is also confirmed in the works by other authors [4–6]. Thus, studies by Bianchi R. et al. (2018) and Koutsimani P. et al. (2019) demonstrate links between burnout and depression, which is important in the context of the negative impact of prolonged participation in the "Triangle of Suffering", in which one and the same person can take turns playing different roles. And the study by Trifiletti E. et al. (2017) examines burnout and impaired anxiety defenses among nurses who are constantly trying to help others, that is are in the role of the Rescuer.

The theory of "Triangle of Suffering" has been developed both in classical psychology and in its alternative teachings (in particular, in Neuro Lin-

Table 1. Comparison of Stephen Karpman's "triangular" models, the Triangle of Suffering and the Triangle of Compassion

Characteristic	Drama (Suffering) Triangle	Compassion Triangle
Author	Stephen Karpman, 1968	Stephen Karpman, 2014
Model type	Destructive, reactive	Constructive, conscious
Main roles and actions	Victim – Feeling helpless, looking for salvation	Creator – takes control of his/her life, rather than passively waiting to be rescued
	Rescuer – helps from a position of superiority, even without asking	Coach – provides resources and motivates without rescuing
	Persecutor – criticizes, punishes, controls	Challenger – honestly points out problems, but without aggression
Goal	Sustaining emotional drama, reinforcing dependent patterns	Building authentic, healthy relationships
Interaction style	Reactive, emotionally manipulative	Conscious, responsible, respectful of self and others
Psychological impact	Conflict, emotional exhaustion, codependency	Emotional maturity, autonomy, mature empathy
Popularity in practice	Very high, a classical model in transactional analysis	Limited spread, less known even among professionals
Core principles	Avoidance of responsibility, manipulation, emotional reactivity	Openness, honesty, personal responsibility

guistic Programming, NLP). In cognitive-behavioral therapy, as described in Beck's foundational work "Cognitive Therapy and the Emotional Disorders" [7], the triangle concept is used to analyze dysfunctional thought patterns, particularly in the chapters on interpersonal relationships. Beck shows how the roles of Persecutor, Rescuer, and Victim create specific cognitive distortions that sustain depressive and anxious conditions.

In modern psychotherapeutic practice, particularly within the transactional analysis, the Karpman's model has been further developed in T.A. Harris's classic work "I'm OK – You're OK" [8]. In the chapter "Transactional Analysis in Therapy", the author thoroughly examines how the Karpman's triangle manifests in therapeutic relationships and everyday communication, offering specific strategies for breaking out of dysfunctional games. Specifically, he emphasizes awareness of one's roles and transitioning to an autonomous lifestyle, where individuals take responsibility for their feelings and actions without resorting to passivity or aggression. Harris T.A. pays special attention to the "script rewriting" technique, when individuals consciously change their habitual responses, for example, instead of automatically rescuing others, learning to say: "I believe you can handle this yourself". An alternative to the Rescuer's self-destructive behavior may be the attitude "it's not my responsibility".

The triangle theory has gained particular relevance in organizational psychology, as illustrated in Berne's work "Games People Play" [9]. In the chapter "Psychological Games in Organizations" (pp. 89–117), the author demonstrates how the roles of Karpman's triangle emerge within corporate structures, influencing teamwork effectiveness and leadership dynamics. The author gives examples when a Persecutor-boss constantly criticizes employees, a Rescuer-manager takes on excessive responsibilities, and a Victim-employee avoids accountability. The author particularly emphasizes that such dynamics reduces team productivity, as energy is spent not on work processes but on maintaining dysfunctional roles. Berne E. suggests a "game exit" strategy through awareness of these patterns and conscious change of communication behavior.

The latest research keeps on developing these ideas, as illustrated in Widdowson's book "Transactional Analysis: 100 Key Points and Techniques" [10], which investigates practical methods for working with the Karpman S. triangle in therapy and coaching. Ukrainian NLP trainer Litvinov R.M. writes (2019) [11; 12] that each role of the Karpman's triangle has its own emotions and patterns of behavior, namely "The Victim – pity (for him/herself) and feeling of guilt, the Rescuer – pity (for the Victim), and then Resentment (for the fact that his/her help was not appreciated), the Persecutor – anger and aggression". The author describes several energy levels at which the "Triangle of Suffering" can exist. Depending on these levels, roles can change: The Victim (at level –1) becomes a Hero at level +1, and a Winner at level +2; The Persecutor (at level –1) becomes a Philosopher at level +1, and a Contemplator at level +2; The Rescuer (at level –1) becomes a Motivator-Provocateur at level +1, and a Strategist at level +2. The change of roles determines the change of predominant emotions. The vector of this change lies in the direction: negative emotions → neutral emotions → positive emotions → rejection of emotions (at Sage level +3, contemplation without judgment) (*Fig. 1*).

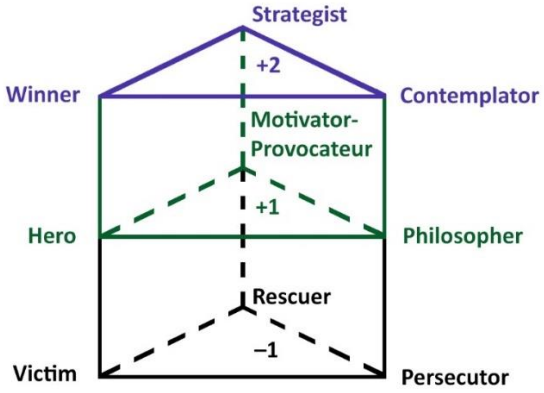

Fig. 1. Changing roles of the Karpman triangle depending on the "energy level".

According to BPDFamily.com (2020–2021) [13] and Lawson A. (2024) [14], Karpman's scenario of the entire "Triangle of Suffering" occurs in the vast majority of family conflicts. According to Litvinov R.M. (2019) [12], 3 out of 4 people in the world are constantly in Karpman's relationships. In the conditions of constant stress of war, the negative emotions generated by Karpman's triangle can lead to a breakdown in compensation with the occurrence of mental disorders and psychosomatic pathology [15].

Thus, Karpman's relationships are widespread; they are associated with generation of negative emotions that can cause mental and psychosomatic disorders, interfere with adherence to heal-

thy lifestyle models [16; 17], which makes them the subject of valeological research. The issues of managing negative emotions are insufficiently studied according to modern valeological literature [18–20]. Thus, in a systematic review of 15 studies of group interventions on emotion regulation, performed by Moore R. et al. (2022), the authors note the lack of methodological objectivity, the weak theoretical basis of most of them, and the lack of standardization, especially for use in health-saving programs. These facts were the reason for doing our research.

The **aim** of the research was to study the practices of getting out of Karpman's "Triangle of Suffering" and success of emotional self-regulation in non-medical students during the study of valeological disciplines.

Materials and Methods

The study was carried out as part of a pedagogical experiment using system analysis, sociological and bibliosemantic methods. As part of the pedagogical experiment, the results of the participation of 124 Ukrainian and German non-medical students who studied at National Technical University "Kharkiv Polytechnic Institute" (NTU "KhPI") and Ukrainian Engineering Pedagogics Academy (UEPA) during 2016–2023 were studied (see *Table 2*). The average age of students was [21.7±2.6] years, with a median of 20.4 years. Students of NTU "KhPI" were trained within the valeological discipline "Fundamentals of Medical Knowledge and Health-Saving", developed by the Kharkiv Regional Institute of Public Health Problems (2004–2025). UEPA students were trained within the valeological discipline "Health Pedagogy" developed by UEPA (2019–2024). The purpose of studying these valeological disciplines is to form students' valeological competence [21–24], an important part of which is the ability to restore psychological balance and control one's own emotions.

Distance learning for UEPA students in 2020–2023 was used forcibly due to the COVID-19 pandemic and the war. Distance learning has made it impossible to conduct full-fledged psychological workshops [25]. Nevertheless, this fact did not become an obstacle to the study, because the students needed control of emotions during the exit from Karpman's relationships, which are formed mostly at home and in work teams. The student population was divided into two groups of equal size based on gender: 62 men and 62 women. The inclusion criterion in the study was the successful acquisition of theoretical information on the topic "Mental and psychological health of the individual. Professional burnout of teachers" based on the results of testing and successful formation of the cognitive component of valeological competence ("knowledge"), as well as passing two consecutive questionnaires with an interval of at least one month. The criteria for exclusion from the study were the formation of the cognitive component of valeological competence with a theme at the level of less than 60% and the student's refusal to participate in the study.

The pedagogical experiment was conducted in compliance with confidentiality, according to the principles described in the scientific publication [26], namely only the teacher had data on the answers about the health of students and their family members, they were subject to medical secrecy. All study participants signed an informed consent to participate. The overall design of the study was approved by the ethics committee of the Kharkiv Regional Institute of Public Health Services (Protocol No.2 of January 20, 2016; and Protocol No.3 of January 12, 2020). The verification of psychological assessment methods was carried out in accordance with the principles described in the publication [27] and in compliance with Difficulties in Emotion Regulation Scale, DERS, according to which it is possible to conduct an individual and

Table 2. Characteristics of non-medical students trained in the transformation of emotions and way out of Karpman's "Triangle of Suffering" within valeological disciplines in two Kharkiv universities in 2016–2023

Higher education institution	Years of study	Countries of students' origin	Form of study	Number of students, abs.	including:	
					males, abs. (%)	females, abs. (%)
NTU "KhPI"	2016–2019	Ukraine	classroom	58	30	28
UEPA	2020–2023	Ukraine, Germany	remote	66	32	34
			Total	124	62 (50.0)	62 (50.0)

group assessment of 6 key aspects of emotional dysregulation: inability to accept emotions (rejection of negative experiences), difficulties in controlling impulsive actions under the influence of emotions, limited regulation strategies, insufficient awareness of emotions, difficulties in achieving goals due to emotional loading, lack of clarity of emotions [28]. The test lasts 5–10 minutes; in a group context it helps to assess the effectiveness of emotion regulation training. The questionnaire contains 36 items. Each answer is evaluated on a 5-point Likert scale (from "almost never" (1 point) to "almost always" (5 points)). The subscale of rejection of emotions made it possible to get 6-30 points, where 6 is complete acceptance, 30 is a sharp rejection of one's experiences. The scoring of the other subscales was as follows: difficulties in achieving goals – [5–25] points (where 5 – ease of work under the influence of emotions, 25 – complete disorganization of activity), impulsivity – [6–30] points (where 6 – complete control, 30 – frequent uncontrolled actions), insufficient awareness – [6–30] points (where 6 – clear understanding, 30 – complete lack of reflection), limited strategies – [8–40] points (where 8 – a rich arsenal of methods, 40 – a feeling of helplessness), fuzziness of emotions – [5–25] points (where 5 – clarity, 25 – complete confusion). The overall score can be 36–180 (where 36 is good regulation, 180 is pronounced maladaptation), and a value of more than 115 indicates serious difficulties.

Within the framework of the sociological method of research, 2 surveys of students were conducted, with an interval of at least a month, which was required to analyze own Karpmanian relationships, the emotions they cause, the development of a strategy for getting out of such relationships and reflection on emotions and other consequences of such actions. According to the results of self-analysis, 17 students (13.7%) reported the absence of Karpmanian relationships in their lives. They made up the Control Group (CG). CG students also underwent a second questionnaire on the DERS at least a month after the first questionnaire. CG students remained in CG provided that there was no deviation of the indicators of the second questionnaire compared to the first one by more than 10% according to the overall assessment, and by more than 5% for each of the separate categories. The validity of choosing the stability of the DERS test within 10% is confirmed by the study of Danasasmita F.S. et al. (2024) [29], which had good internal coherence ($\alpha \approx [0.89–0.91]$) and validity.

In the theoretical aspect, for forming the cognitive component of valeological competence on the theme, students were explained that in Karpman's triangle of suffering, the intensity of negative emotions is distributed by roles in the following sequence (from the strongest to the weakest): anger (Persecutor), anxiety (Victim), irritation (Rescuer), guilt (Persecutor), helplessness (Persecutor), hidden aggression (Rescuer), illusory control (Rescuer). This gradation reflects the emotional dynamics between the participants in dysfunctional relationships, where the Persecutor expresses the most intense negative emotions, and the Rescuer expresses relatively smaller, but more hidden.

The second important theoretical aspect is the methods for getting out of Karpman's triangle:

1. Protective (refuse to communicate with "Karpman's team members": create one's own family, change the group in which the student studies, change the place of work);
2. Emotional-Energy Transformation (EET) (move to new energy levels with a change of roles and transformation of emotions).

The ways of possible exit from the Karpman's "Triangle of Suffering", or mitigation of the destructive effect of the negative emotions caused by it, are shown in *Figure 2*.

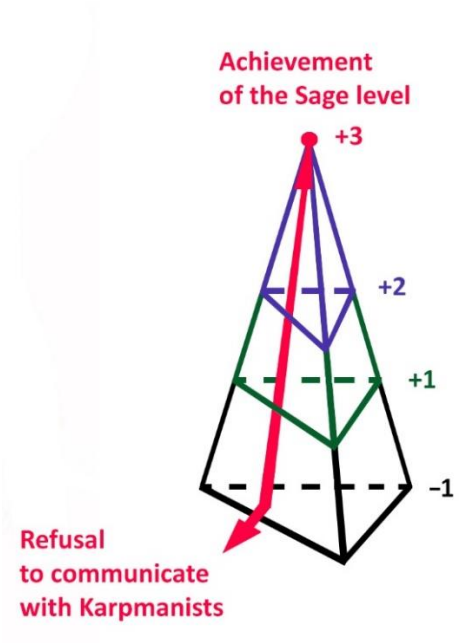

Fig. 2. Ways out of Karpman's "Triangle of Suffering".

In addition to regulating emotions, students were asked to answer a number of questions:

1. how immersed they are in Karpmanian relationships;

2. where exactly Karpmanian relationships arose: in the family, in the team where the student studies, or in the team where he/she works;

3. what kind of negative emotions does the student show in him/herself and other participants in Karpmanian relationships (fear, anger, aggression, resentment, guilt, pity – from strongest to weakest);

4. how destructive negative emotions are for the student due to the existing Karpmanian relationships (cause constant anxiety and discomfort, cause fear and exhaustion, cause suicidal thoughts, cause outbursts of anger and aggression, cause somatic diseases);

5. what strategy for exiting Karpmanian relationships (defensive or EET) did the student choose;

6. whether the student has implemented the chosen strategy for exiting Karpmanian relationships between the first and second questionnaires.

Depending on the attitude to being in Karpmanian relationships (intentions to get out of them) and depending on the implementation of such intentions based on the results of the repeated survey of students, they were divided into the following groups:

- Main Group I (MG I) – recognize participation in Karpman's relations, but have not chosen a strategy for exiting them;
- Main Group II (MG II) – recognize participation in Karpmanian relationships, have chosen a defensive strategy, but did not implement it during the study;
- Main Group III (MG III) – recognize participation in Karpmanian relationships, have chosen a defensive strategy, and implemented it during the study;
- Main Group IV (MG IV) – recognize participation in Karpmanian relationships, have chosen the EET strategy, but did not implement it during the study;
- Main Group V (MG V) – recognize participation in Karpmanian relationships, have chosen an EET strategy, and implemented it during the study.

The number of students in these groups will be shown in the next section of the article.

When studying the theory, students were asked to understand the emotions that the participants in Karpmanian relationships experienced themselves and that generated in other participants of the "Triangle of Suffering" (see Table 3), as well as strategies for transforming emotions:

- pity must be turned into mercy, and then – into help;
- resentment must be realized, then discussed so that it does not turn into revenge;
- aggression needs to be released, and anger should be discharged in a way that is safe for others (through meditation, physical exhaustion, screaming in a place where no one can hear, etc.).
- guilt must be acknowledged, and the situation that caused it – "smoothed out" (rebalanced) [12].

The search for literature sources within the bibliosemantic method used in the study was carried out on PubMed and Google Scholar using the keywords "Karpman's triangle", "transformation of emotions", "destructive emotions of conflicts", "emotional self-regulation in valeology". A total of 97 sources were analyzed, of which 61 sources were discarded on the criteria of vague research design and low evidence [30].

Results and Discussion

The obtained result of the absence of Karpmanian relationships in the lives of 17 out of 124 students (13.7%) and the formation of the control group requires explanation. Student statements were checked by us in accordance with the description of their relationships, when conflicts arise on indirect signs of the duration and strength of negative emotions after conflicts at home, at work or at the place of study. The check was ne-

Table 3. Emotions that the participants in Karpman's "Triangle of Suffering" feel, and which they evoke in other participants in Karpmanian relationships.

Role in the triangle	Emotions that are experienced	Emotions that arise from other participants
Victim	fear, resentment, guilt	pity
Rescuer	fear, resentment	guilt
Persecutor	fear, anger, aggression	fear, guilt

cessary because Lac A. & Donaldson C.D. (2022) [31] clearly showed that participants in the triangle of suffering tend to underestimate or deny participation in "negative" roles, especially in the role of the Persecutor. Reluctance to admit negative behavior can reach [20–50]% of respondents [32].

The age of the students who received the training is important. Modern neuropsychological research emphasizes that the period of early adulthood (18–25 years), which corresponds to the median of the age of the surveyed students (20.4 years), is critical for forming effective strategies of regulation of emotional reactions [33; 34], which is crucial for getting out of dysfunctional interaction patterns, in particular Karpman's triangle.

Karpman's triangle as a psychological model demonstrates how maladaptive emotional patterns maintain cyclical dynamics between three roles. The Victim is stuck in states of helplessness and fear, the Rescuer is stuck in hidden aggression and the illusion of control, the Persecutor is in open anger and accusations. It is important to realize that it is these emotional states that are the main "fuel" for maintaining a toxic relationship system. Students of early adulthood, despite the ability to identify basic emotions, often demonstrate limited opportunities for their transformation. A typical scenario is when the person, once in the role of the Victim, has difficulty reformulating the feeling of helplessness into a more constructive state. Gender characteristics also play a significant role – men are more likely to suppress emotions of fear or confusion due to social stereotypes, which can exacerbate their suspension as the Persecutor. This was the reason for the customization of the sample by sex, which was not significantly impaired by the formation of CG.

The process of getting out of Karpman's triangle requires consistent work with emotional states. The first stage involves a deep awareness of the emotional "hooks" typical of each role. For example, for the Victim it can be an automatic reaction of fear to conflict situations, for the Rescuer it can be a sense of duty to solve the problems of others. Valeological practices are aimed at developing students' ability to instantly recognize these emotional patterns [35; 36].

The next critical step is mastering techniques for transferring intense negative emotions into a neutral state. Studies have proved the effectiveness of mindful breathing [37; 38], cognitive distancing [39; 40], and mental observation techniques [41]. When an emotion loses its captivating power, it becomes possible to analyze it from the observer's perspective, which is key to further transformation.

The final stage involves rethinking neutralized emotions in a constructive way. For example, the fear of the Victim can be turned into awareness of one's own boundaries, and the anger of the Persecutor can be turned into energy to establish a healthy distance. Cognitive reframing methods are particularly effective, which can change the perspective of perception of the situation [42]. The duration of these phases was due to the minimum interval between the two surveys of students.

Regular practice of such exercises contributes to the formation of new neural connections in the prefrontal cortex, which is responsible for self-control and decision-making [43]. This creates a physiological basis for more mature forms of emotional response, which is the key to getting out of the Karpman's triangle. An important aspect is the integration of these practices into valeological programs, which allows students to master the tools of emotional self-regulation in a safe learning environment [44; 45].

According to the results of the first and second surveys, students were divided into 6 groups (see *Table 4*). The protective strategy of exiting Karpmanian relationships, which requires more decisive actions (breaking off burdensome toxic relationships), was chosen by 4 students (3.2% of the total number of students), but only one of them (25.0%) managed to implement that strategy. That student already lived separately from the family in which Karpmanian relationships developed. He stopped communicating with conflict relatives. A more time-consuming EET strategy was chosen by 54 students (43.5% of the total number of students), but only 9 students (16.7% of them) managed to implement it. For these 9 students, on average, the transition to +1 energy level of communication took 1 month and 13 days. At the level of +2 and +3, the transition did not take place. The results of the DERS survey are shown in *Table 5* and *Figure 3*.

The results of the study clearly demonstrate the significant influence of Karpmanian relationships on the emotional regulation of students. The CG that was not in such relationships performed best on the DERS scale, with an average overall score of 60.5–62.3. These students had the lowest scores across all subscales: rejection of emotions (7.9–8.2), difficulty achieving goals (11.8–12.4), impulsivity (13.2–14.0), lack of awareness (9.5–10.1), limited strategies (15.9–16.6), and fuzziness

Table 4. Division of students into groups based on the results of two questionnaires depending on the presence of Karpmanian relationships in their lives, intentions to get out of them and the implementation of such intentions.

Groups		MG I	MG II	MG III	MG IV	MG V	CG	Total
Number of students	abs.	50	3	1	45	9	17	124
	%	40.3	2.4	0.8	36.3	7.3	13.7	100.0

Table 5. Results of two DERS surveys

Group	Survey	Total Score (M±SD)	Nonacceptance	Goals Difficulty	Impulsivity	Awareness Deficits	Strategies Limited	Clarity Deficits
CG (n=17)	1	62.3±8.1	8.2±2.1	12.4±3.0	14.0±3.5	10.1±2.4	16.6±4.2	11.0±2.9
	2	60.5±7.8	7.9±1.9	11.8±2.8	13.2±3.1	9.5±2.1	15.9±3.9	10.2±2.7
MG I (n=50)	1	98.7±12.4	18.5±4.3	20.1±4.7	22.3±5.1	16.8±3.9	28.4±6.5	17.6±4.2
	2	97.2±11.9	18.1±4.1	19.7±4.5	21.8±4.9	16.3±3.7	27.9±6.2	17.2±4.0
MG II (n=3)	1	112.4±14.6	22.6±5.0	23.9±5.4	26.1±6.0	19.4±4.5	32.8±7.5	21.6±5.1
	2	110.8±14.2	22.0±4.8	23.3±5.2	25.4±5.8	18.9±4.3	32.1±7.2	21.1±4.9
MG III (n=1)	1	124.7±16.2	26.8±6.2	27.5±6.5	29.4±7.1	22.1±5.3	37.2±8.9	25.7±6.3
	2	105.3±12.8*	18.9±4.4*	20.4±4.8*	22.0±5.2*	16.7±3.9*	28.3±6.7*	17.0±4.1*
MG IV (n=45)	1	108.9±13.8	21.3±4.9	22.7±5.3	24.8±5.9	18.6±4.4	31.5±7.3	20.8±5.0
	2	107.5±13.4	20.8±4.7	22.1±5.1	24.1±5.7	18.1±4.2	30.8±7.0	20.3±4.8
MG V (n=9)	1	119.6±15.4	25.1±5.8	26.3±6.2	28.2±6.8	21.0±5.0	35.6±8.4	24.4±6.0
	2	92.4±11.2*	15.7±3.7*	17.2±4.1*	18.9±4.6*	14.2±3.4*	24.8±5.9*	15.6±3.8*

Notes: CG – control group; MG – main group; (M±SD) – (Mean±Standard Deviation);
* – significant difference between surveys.

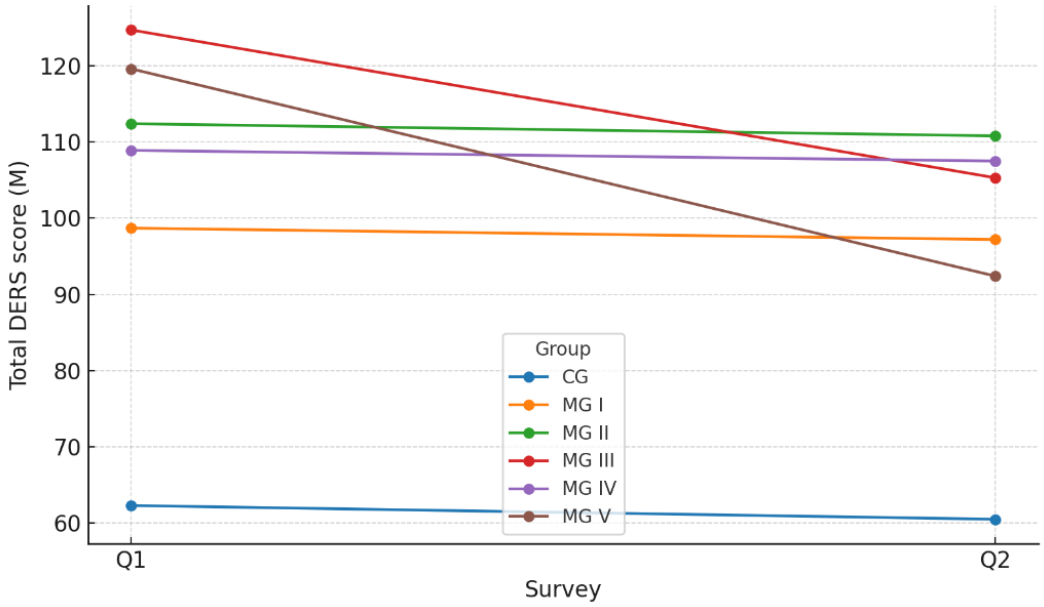

Fig. 3. Dynamics of the total DERS score in groups.

Notes: Q1 – first Questioning; Q2 – second Questioning; M – Mean.

of emotions (10.2–11.0). Such results indicate stable emotional regulation and confirm that the absence of Karpmanian relationships contribute to psychological well-being.

In contrast, students from MG I who acknowledged their involvement in Karpmanian relationships but had no intention of changing them performed significantly worse. Their average overall DERS score was 97.2–98.7, approaching the critical level (>115.0 points). Impulsivity (21.8–22.3) and limited regulatory strategies (27.9–28.4) were particularly high. This indicates that it is the fact of being in Karpmanian relationships without trying to change the situation that significantly impairs emotional regulation.

The results of groups that chose exit strategies but did not implement them (MG II and MG IV) indicate insufficient emotional regulation. MG II students who chose a defensive strategy but did not take action had high rates of dysregulation ([110.8–112.4] points total). Similarly, MG IV students (who chose the EET strategy without implementation) showed only a slight improvement: the decrease was about 1–2 points). This confirms that the very fact of realizing the problem and intentions to solve it without real action does not lead to a significant improvement in the emotional state.

The most illustrative were the results of groups that not only realized the problem, but also actively acted to solve it. The MG III (Defensive Strategy with Implementation) showed a dramatic improvement, with the overall DERS score dropping by 19.4 points (from 124.7 to 105.3). Even more impressive were the results of MG V (EET-strategy with implementation), where there was a drop in score by 27.2 points (from 119.6 to 92.4). These data clearly show that it is active actions to change the situation, especially using structured approaches like EET, that lead to the greatest improvement in emotional regulation.

The DERS scores of CG students in this study not only became a benchmark for comparison, but also clearly demonstrated that the absence of Karpmanian relationships correlates with significantly better emotional regulation. The stability of the results in CG students between the two surveys (no significant changes) confirms that it is the Karpmanian relationship that is the key factor in emotional dysregulation in other groups.

Thus, Karpmanian relationships significantly worsen the emotional regulation of students; at those only active actions to change the situation (and not just awareness of the problem or intentions) lead to significant improvements. The EET strategy turned out to be the most effective, which confirms the importance of structured approaches to solving the problem. The results obtained emphasize the need to develop special psychological programs for students who are in Karpmanian relationships, with an emphasis on practical tools for getting out of such relationships.

The study revealed significant gender differences in overcoming Karpmanian relationships (see *Table 6*). Among 62 males, 42 persons (67.7%) successfully implemented exit strategies, while among 62 females there were only 32 (51.6%). This difference of 16.1% indicates that males are more effective in overcoming toxic relationships.

Emotional regulation has also been shown to be more effective in males. Their average overall DERS score was 89.2±10.4, which is 13.5 points lower than that of females (102.7±12.1). The most noticeable differences were observed in the area of emotion rejection ([15,3±3,8] in females vs. [20,1±4,5] in males) and impulsivity ([18,7±4,2] vs. [22,4±5,1], respectively).

Relapses after leaving relationships were significantly less common among males – only 6 cases (9.7%) compared to 13 (21.0%) in females. These data confirm that males were not only more

Table 6. Comparative indicators of overcoming Karpmanian relationships by gender

Indicator		Males (n=62)	Females (n=62)
Successful exit	abs. (%)	42 (67.7%)	32 (51.6%)
Average score DERS	M±SD	89.2±10.4	102.7±12.1
Rejection of emotions		15.3±3.8	20.1±4.5
Impulsivity		18.7±4.2	22.4±5.1
Relapses	abs. (%)	6 (9.7%)	13 (21.0%)

Notes: DERS – Difficulties in Emotion Regulation Scale; (M±SD) – (Mean±Standard Deviation).

likely to successfully exit Karpmanian relationships, but also showed more stable results after stopping them.

The results of our study on gender differences coincide with a number of other results. So, the results of the study by Graham K. et al. (2011), conducted among 24,778 participants from 18 countries, showed that males were statistically significantly less likely to remain in destructive relationships related to substance abuse compared to females. In particular, only 38.2% of males continued such relationships, while among males this figure was 52.7%, which shows a significant difference of 14.5% ($p<0.001$). This pattern was particularly evident among heavy alcohol consumers, where the difference between sexes reached 21.6%. A multivariate analysis confirmed that even after taking into account factors such as age, education, and country of residence, males had a 32.0% lower risk of remaining in destructive relationships (OR=0.68; 95% CI: 0.61–0.75). The authors attribute these differences to a combination of social, economic, and psychological factors, including male's greater social support, less economic dependence, and more effective stress coping strategies. These data show a general trend of males having a greater ability to get out of toxic relationships.

Research by McRae K. et al. (2008) [46] using functional magnetic resonance imaging revealed significant gender differences in the mechanisms of emotional regulation. In the experiment involving 28 healthy adults (14 males and 14 females), it was found that males were significantly more effective in using cognitive reappraisal to reduce negative emotional responses. When viewing emotionally negative images, males showed 23.0% more activity in the dorsolateral prefrontal cortex ($p<0.01$), a key area of cognitive control, which correlated with their ability to reduce subjective feelings of negativity more quickly (the Self-Assessment Manikin (SAM) score was 18.0% lower than that of females) [47]. Females, in turn, were more likely to involve the limbic system, which led to a longer emotional response. The authors explain these differences both by biological factors (different levels of activation of the prefrontal cortex) and by socialization influences, which is confirmed by the correlation between the results of tomography and data of psychometric tests on emotion regulation strategies.

Gender differences in the tendency to relapse of returning to toxic relationships are demonstrated by a study by Vennum A. et al. (2014) [48], which showed that females were 25% more likely to return to their former partners, (OR=1.25, 95% CI 1.01–1.54).

Conclusions

We consider the goal of the study to be achieved, namely the data obtained clearly proved that the proposed strategies allow to effectively get out of dysfunctional relationships. Among the 124 participants in the study, 24 students chose the EET strategy, of which 16 people fully implemented it. The analysis showed that Emotional-Energy Transformation (EET) gives the best results in the implementation of the strategy for exiting the Karpman's triangle: 87.5% of participants who applied it showed a significant improvement in emotional regulation (average decrease in DERS by [42.5±4.7] points) and a change in behavioral patterns. Cases of complete remission were especially impressive: 9 students (37.5% of OG V participants who chose and implemented the EET strategy) achieved zero indicators in the key DERS subscales. The defensive strategy chosen by 5 participants (of which only 1 implemented) showed significantly more modest results – an average decrease in DERS only [19.8±3.2] points.

Gender analysis revealed significant differences in the effectiveness of interventions. In the second survey, males demonstrated higher academic performance (94.1% vs 71.4% for females with average DERS [67.3±5.1] points vs [67.3± ±5.1] points for females.

The results obtained indicate the need for a differentiated approach to psychological assistance. For males, clear strategies of action turned out to be more effective, while females needed more attention to aspects of emotional regulation and relapse prevention. Comprehensive work with emotional transformation can be a powerful tool not only for getting out of dysfunctional relationships, but also for the formation of sustainable psychological maturity.

The prospects for further research are the development of differentiated approaches to the transformation of emotions and the way out of Karpman's "Triangle of Suffering", taking into account individual characteristics (strength of character, temperament, the presence or absence of depressive or anxiety disorders, signs of emotional burnout).

DECLARATIONS:

Disclosure Statement

The author has no potential conflicts of interest to disclosure, including specific financial in-

terests, relationships, and/or affiliations relevant to the subject matter or materials included.

Statement of Ethics

The author has no ethical conflicts to disclosure.

Data Transparency

The data can be requested from the author. FAIR data is prepared for publication and contains anonymous data from surveyed students. Student questionnaires are linked to data from the same students surveyed on other issues (confidential survey mode).

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Consent for publication

The author gives her consent to publication.

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Requirements for the design of manuscripts of scientific articles in journals of the Kharkiv National Medical University

(in force from July 01, 2025)

Appendix to the editorial article on the procedure for working with manuscripts

1. The editorial board of scientific journals of KhNMU accepts manuscripts of original and review articles on theoretical and clinical medicine, clinical cases, methodological articles/lectures, reviews that have not been previously published or submitted for publication in other journals. All manuscripts submitted to the editorial office are checked for plagiarism, double-blinded peer review with the participation of at least two reviewers and editing.

2. If there are several authors, the manuscript is submitted on behalf of the responsible (corresponding) author, who communicates with the editorial board on all issues of improving the manuscript in accordance with the comments of reviewers and editors, obtaining authors' consents and concluding agreements between the authors and the editorial board, corresponds with readers regarding the published article. The editorial board reserves the right to contact all other authors of articles on any questions regarding publication.

3. Submission of the manuscript to the editorial board means that all co-authors are familiar with and agree with its content, agree with the requirements of the editorial board, ethical rules and possible penalties, processing of their personal data in accordance with the legislation of Ukraine. All changes made to the manuscript during the preparation of the article for publication as a result of peer review and editing must also be agreed by all authors.

4. The manuscript to the journals ECM and MTT is submitted in Ukrainian or English (at the choice of the authors). The manuscript to the IC journal is submitted in English. The title of the article, the list of authors, the abstract of the article and keywords should be submitted in Ukrainian and English. If the author(s) do not speak Ukrainian, the editors provide assistance in translating this part of the manuscript.

5. The volume of the manuscript should not exceed 40 pages of A4 text.

6. Manuscripts are submitted to the editorial office in several ways:
1) through the websites of journals, through the form "Submit new material" on the pages "Submission" (the author must be authorized to submit):
https://msz.knmu.edu.ua/submission/wizard
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https://inter.knmu.edu.ua/about/wizard;
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7. The information of the manuscript should not violate the Order of the Ministry of Education and Science of Ukraine "On approval of the list of official information that is the property of the state":
https://zakon.rada.gov.ua/rada/show/v0319729-15

8. The article should be formatted in the format of the MS Word editor (*.docx), have a title with the last name of the first author (for example, Petrenko.docx). All the material of the article should be contained in one file. Materials that should not be published, but will help to get a positive decision on publication and remove reviewers' questions, can be added to the article as separate files. For example, the databases that were processed.

9. The text of the manuscript should be printed in black font Times New Roman, font size 14, line spacing – one and a half, paragraph indentation – 1.0 cm; margins on all sides - 2.5 cm. The orientation of the pages is vertical. Text, tables, and figures should not go outside the text box.

10. Paragraph indentation must be done using the following tools:
1) "Ruler", "First Line Indent";
2) Home >>> Paragraph group dialog box launcher >>> Indents and Spacing tab >>> Indentation section >>> Special dropdown >>> select First line >>> By: 1 cm.
Wrong ways:
1) several spaces in a row;
2) tabulation.

11. The style of presentation of the material (the text part of the manuscript) should be narrative – not synopsis, scientific – not colloquial. The units of measurement must comply with the SI system:
https://uk.wikipedia.org/wiki/ International_System of Units_(SI)
After each numerical value in the text of the article, the abstract should contain units of measurement:
1) correct: "the concentration increased from 10.25 mmol/l to 14.32 mmol/l";
2) incorrect: "the concentration increased from 10.25 to 14.32 mmol/l".

12. Numerical intervals with units of measurement should be written with dashes (not hyphens), numbers should be taken in square brackets:
1) correct: "[2–6] mg", "pH [7.35–7.45]";
2) incorrect: "2-6 mg", "pH 7.35-7.45".

13. Time intervals should also contain a dash rather than a hyphen: "2020–2022".

14. In homogeneous arrays of numerical data in numbers, the number of decimal places (in English texts – after a period) should be the same, at least in one paragraph of the text, in one table, in one figure:
1) correct: "2.00 g and 6.35 g";
2) incorrect: "2 g and 6.35 g".

15. There should be no automatic lists in the text and tables: numbering should be manual. The manuscript with autolists is returned to the authors for revision even before reviewing.

16. Writing Dates in Text and Summary: "January 12, 2025".

17. Writing authors in the text of the article, tables of articles in English:
1 author: Smith N.D. (2020) [1]
2 authors: Smith N.D. & Brown T.L. (2020) [1]
more than 2 authors: Smith N.D. et al. (2020) [1]

18. Tables and figures should be placed after their first mention in the text. Illustrative material of the article, tables should be in the same file with the text, have names and legend, sequential (for each type) numbering starting with "1". If there is only one table or figure in the text, numbering is not required.

19. Tables should contain text in Times New Roman font, font size 14, line spacing – one and a half, without paragraph protrusion. In the tables, the information is presented briefly. Repetition of words should be avoided. Repeated words must be placed in the name of the table, title line or notes. All abbreviations in tables and figures must be deciphered in the "Notes", after each table and figure separately (except for the case when all abbreviations are deciphered in the "Abbreviations" section).

20. Tables should have: vertical orientation and be created using the Table Wizard ("Table" option >>> "Insert Table" of the MS Word editor), a one-line header ("Table 1. Name..."), number (if there are at least two tables). Table names should not contain abbreviations without deciphering. All abbreviations and abbreviations of tables that are not deciphered in the name must be deciphered in the notes. If you need to put superscript marks *, ", or others next to the numbers or words of the table, they must be the same in all tables of the article.

21. All abbreviations must be deciphered at the first mention in the abstract, as well as again in the text of the article. With the exception of articles that have a section "Abbreviations". If the abbreviation occurs only once in the "Annotation" or in the text of the article, it is not needed. The aim of the study and conclusions, the names of tables and figures should not contain abbreviations. Abbreviations in tables should be deciphered in the notes to each table. Abbreviations in figures should be deciphered in the name of the figure, the legend of the figure, or in the notes to the figure.

21. Words before abbreviations in capital letters must also contain capital letters that formed abbreviations. A non-literal translation into Ukrainian is possible if there is another stable translation for the term. For example:
1) COVID-19 (COronaVIrus Disease 2019)";
2) "the questionnaire SF-36 ("Short Form-36" – a questionnaire of quality of life for 36 questions).

22. Taking into account the polythematic nature of scientific journals of KhNMU, each scale, classification or method should be briefly described (what and how is evaluated, classified, which assessment corresponds to a certain number of points), or it is necessary to link to a source with such a description.

23. The resolution of figures must be at least 300 dpi (dots per inch), formats – *.jpg, *.png. Images should not be blurry. All elements of the images must be grouped, or the pictures must be single-layered.

24. All article charts should contain the same black font of the same size for all elements and a white background. If the diagram is built in MS Excel editors, the editors can request a file in the format of this editor to edit it. Numerical values must be written above the chart columns, or a table with the legend and numeric values must be enabled below the chart. Graduated scales should contain numerical values, names of displayed parameters and units of measurement.

25. Any images used in the article should be:
1) own;
2) borrowed with an indication of the source (this is the minimum sufficient only for lectures);
3) borrowed with an indication of the source and written permission for use from the owners of the image.
26. The type of license regulating the use of a borrowed image is the same as that of the articles: Creative Commons Attribution – Noncommercial – Share Alike (CC BY-NC-SA), unless otherwise specified by the written permission of the owners of the image.

27. Disclaimer: the editors are not responsible for the use of other people's images by the authors. In case of claims of authors/owners of images about the illegal use of these images in the article, the editorial board cancels the publication of the article, which is reported in the next issue of the journal in a separate publication. The edges of the canceled article are replaced on the journal website with similar ones crossed out in red.

28. Formulas are created using the built-in MS Word editor. Formulas are written, deciphered and numbered according to the pattern:

$$E=m\times c^2 \quad (1),$$

where: E (Energy) – the total energy of the object;
m (mass) – mass of an object (at rest);
c (Latin – celeritas) is the speed of light in a vacuum (~299.792.458 m/s).

29. Additional requirements effective from 01.07.2025:

29.1. FAIR data (e.g. clinical, sociological or demographic datasets) may be added to the manuscript and will be published together with the article.

29.2. In literature reviews, it is necessary to adhere to the principles of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses).

29.3. Names of medicines must be International Nonproprietary (Chemical) Names (INN), and not commercial (trade) names.

30. In the manuscript, a hyphen (-) and a dash of medium length (–) can be used, but not a long dash (—).
We use double top quotes ("text"). No. and % with numbers we write together ("No.1", "25%").
Every three digits separated by a comma, tenths and hundredths are separated from the whole by a dot ("1,520.72").

31. Articles are written according to the following scheme:

31.1. The section to which the manuscript is submitted is selected from the list:
• original research;
• literature review;
• clinical case;
• lecture;
• review (per published article).

31.2. UDC (not required for the IC).

31.3. The title of the article. It should not exceed 15 words. It should not contain abbreviations. The type of article that is not original (empirical) research can be indicated in the title ("literature review", "clinical case" or "case study", "lecture"), or in the "Abstract" in a single sentence. The title of the article is written in bold. The titles of the article in Ukrainian and English must be identical.

31.4. Authors (surnames, initials) – in Ukrainian and English.

31.5. Affiliations of each author (university, institute, academy, hospital, city, country) – in Ukrainian and English. Must be written without abbreviations.

31.6. Abstract, with the display of all its sections:

In Ukrainian	*In English*	*Content*
Relevance	Background	1–2 sentences repeating the "Introduction" of the article not verbatim.
Aim	Aim	It can be identical to the purpose of the article, it can contain tasks.
Materials and methods	Materials & Methods	May contain information about the total number of patients, laboratory animals, their division into groups, names of equipment (title, model, manufacturer, country of origin), scales, methods, classifications. If statistical data processing was carried out – methods and software (title, version, developer, country of origin).
Ethics	Ethics	International and national declarations, standards for patients and laboratory animals, informed consent, protocols of ethics commissions should be indicated. For literature

In Ukrainian	*In English*	*Content*
		reviews, it should be noted that studies were selected whose authors adhered to ethical standards.
Results	Results	The most significant results should be indicated.
Conclusions	Conclusions	It must be indicated whether the research objective has been achieved.

Abstract must contain main results and conclusions, 2.200–2.500 characters with spaces. Manuscripts with a larger or smaller resume are returned to the authors for revision even before reviewing. The resume cannot contain references to literary sources. The abstract should not contain new data that is missing in the article. The abstract should be structured.

31.7. Keywords – 3–6 words or phrases that should not repeat the words of the title of the article, correspond to MESH (Medical Subject Headings). Must be identical in Ukrainian and English. The first 1–2 keywords must be selected from the list:

- alternative and complementary medicine,
- andrology,
- anesthesiology and intensive care,
- articles of congresses and conferences,
- cardiology and cardiac surgery,
- dentistry,
- dermatology,
- emergency medicine,
- endocrinology,
- epidemiology,
- experimental medicine,
- forensic medical examination,
- gynecology,
- hematology,
- history of medicine,
- hygiene,
- infectious and parasitic diseases,
- medical ecology,
- medical psychology,
- medical radiology,
- microbiology,
- military medicine,
- narcology,
- nephrology,
- neurology,
- neurosurgery,
- nursing,
- obstetrics,
- occupational pathology,
- oncology,
- ophthalmology,
- organization of health care,
- orthopedics and traumatology,
- otorhinolaryngology,
- pediatrics and neonatology,
- phthisiology,
- physical therapy and rehabilitation,
- psychiatry,
- public health care,
- ship medicine,
- social medicine,
- sports medicine,
- surgery,
- teaching issues,
- technologies of medical diagnosis and treatment,
- theoretical medicine,
- therapy,
- urology

31.8. Authors (surnames, initials), title of the article, abstract and keywords in another language (Ukrainian or English).

31.9. "Abbreviations" ("Introduction") if there are 10 or more abbreviations in the text of the article. The list is compiled in alphabetical order.

31.10. "Introduction" should contain a description of the problem that is solved in the article; analysis of literary sources. Contradictions have been identified. References to literary sources in the "Introduction", "Results" and "Discussion" should go in the order of their mention, in turn (1, 2, 3...). Manuscripts with a violation of the citation order are returned for revision even before reviewing. The citation should be formatted, for example, as follows: [1; 3–5; 6, p. 21, 24–25]. If the source is larger than 20 pages, you must specify a page.

31.11. The "Aim" or "Aim & Objectives" (if the aim detailed) should be a logical continuation of the "Introduction" and suggest a way to solve the problem or eliminate contradictions. The section may contain a research hypothesis. The section should not contain abbreviations and references to literary sources.

31.12. "Materials & Methods" must contain a description of the design of the study, ways to obtain results, information about the number of patients or laboratory animals included in the study, their division into groups, equipment used for the study (title, model, manufacturer, country of origin), research methods, classifications, scales (with a brief description thereof or a link to a source with such description), methods of statistical processing, the software used (title, version, developer, country of origin). To describe research methods, it is allowed to refer to any (but not russian or belarusian) textbook, manual, encyclopedia, monograph, article, website.

31.13. In accordance with the principles of evidence-based medicine, materials and methods should be described in such a way that any other researcher, having reproduced the conditions of the study, experiment, could obtain the same result (the principle of reproducibility of the experiment). When resolving contradictions between authors and reviewers, the editorial board, which makes the final decision on the publication or rejection of the article, is guided by the arguments of sources with the highest evidentiary level studies, meta-analyses and systematic reviews, guidelines by Cochrane, NICE (National (UK) Institute for Health and Care Excellence), WHO (World Health Organization).

31.14. "Research Ethics" must contain information on compliance with the ethical standards of medical research involving humans and laboratory animals specified in the Nuremberg Code (1947); the Declaration of Helsinki (1964, last revised in 2013), developed by the World Medical Association; the Convention on Human Rights and Biomedicine (Oviedo, 1997); the International Recommendations of CIOMS (Council for International Organizations of Medical Sciences, Council for International Organizations of Medical Sciences) and ICH (International Council for Harmonisation (of Technical Requirements for Pharmaceuticals for Human Use)); EU Directive 2010/63/EU; Council of Europe Convention for the Protection of Laboratory Animals (ETS 123, 1986); Declaration "3R" ("Replacement, Reducetion, Refinement"), which is aimed at replacing animals in experiments with other methods, reducing their number and improving the conditions of experiments; and for research conducted in Ukraine or with the participation of Ukrainian researchers – Article 28 of the Constitution of Ukraine, Article 43 of the Law of Ukraine "Fundamentals of the Legislation of Ukraine on Health Care" (1992), Article 12 of the Law of Ukraine "On Medicines" (1996), Order of the Ministry of Health of Ukraine No.690 of September 23, 2009. It is also necessary to note the signing of informed consent of patients to participate in the study, to hospitalization, treatment, clinical trials of drugs and methods of treatment, ensuring the anonymity or confidentiality of surveys, and the availability of protocols of ethics commissions.

31.15. "Results". Your own empirical data or theoretical reasoning must be described. The results of the study can be illustrated and systematized using tables, diagrams, photographs, and must contain textual explanations.

31.16. "Discussion". It should contain a comparison of its own results with the results of similar studies. Their coincidences or differences must be explained.

31.17. "Conclusions" should explain whether the aim of the study has been achieved, whether the expected results of the research tasks have been obtained, whether the problem has been solved, whether the contradictions that were identified during the analysis of literature sources have been eliminated, whether the research hypothesis has been tested. Conclusions should not contain abbreviations and references to literary sources. The conclusions should not be a simple repetition of the results. It is necessary to minimize the amount of numerical and statistical data in the conclusions, to show only basic data. The conclusions cannot contain new data that have not been previously described in the article. They should only summarize the results.

31.18. "Funding and Acknowledgments" is a mandatory section that may contain information about grants or state research topics with registration, for example, on https://clinicaltrials.gov or on https://nddkr.ukrintei.ua). If the research is not carried out within the framework of the state scientific topic or grant program, it is necessary to indicate the implementation of the research component of the work of the teacher-researcher, etc.

31.19. "Authors' Contributions" – a mandatory section that must contain a list of authors indicating the letters reflecting their contributions:
A – concept;
B – design;
C – data collection;
D – statistical processing and interpretation of data;
E – writing or critical editing of the article;
F – approval of the final version for publication and agreement to be responsible for all aspects of the work.
The contribution, marked as F, is mandatory for each author.
Each contribution marked with the letters A–E must be indicated for at least one author.

31.20. "Prospects for further researches" is an optional section that allows you to declare plans for the continuation of the described research.

31.21. "Conflict of interest" – a mandatory section. The absence of a conflict of interest must be indicated by the phrase: "Conflict of interest is absent".

31.22. "Literature" (for journals ECM and MTT; for articles in Ukrainian) contains a list of bibliographic descriptions of sources in the original language.

31.23. "References" (for articles in Ukrainian and English) contains a list of bibliographic descriptions of sources with original English, as well as translated Cyrillic bibliographic descriptions.

31.24. "Information about the author(s)". The list should indicate the author responsible (for communicating with the editors).

31.24.1. Surname, first name and patronymic (in Ukrainian and English). Information about all authors should be of the same type as possible: either all authors with only the first name in English, or all authors with the name and patronymic in English);

31.24.2. academic title (for example, Associate Professor, Professor, Academician of the Academy of Sciences of Ukraine) and degrees (for example, Doctor of Philosophy, Candidate of Sciences, Doctor of Sciences);

31.24.3. place of work (institution, organization, clinic, their subdivisions – departments, laboratories, departments) and position (for example, assistant of the department, associate professor of the department, professor of the department, lecturer of the department, graduate student, doctor, head of the department, etc.);

31.24.4. postal address (work, home or PO box) for correspondence in the order: street, house, city, postal code, country;

31.24.5. E-mail;

31.24.6. ORCID;

31.24.7. telephone (not published or transferred to third parties);

31.24.8. consent to the processing of personal data in accordance with the requirements of the legislation of Ukraine;

31.24.9. consent to the publication of the article under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License;

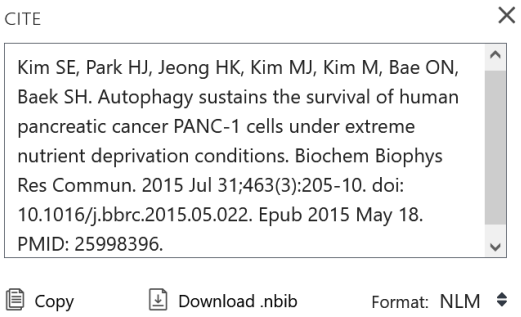
31.24.10. consent to comply with the requirements of the public agreement between the authors and the publisher regarding publication, its payment, compliance with ethics and sanctions against the author in case of violation of the requirements of this agreement, processing of personal data in accordance with the legislation of Ukraine.

32. Bibliographic references should be designed in the Vancouver style, adapted to the requirements of the editorial board. The minimum number of sources for original research, clinical cases and lectures is 10, for literature reviews – 20; the list of sources is compiled without the use of an autolist, i.e. with manual numbering of sources; in the order of reference to sources in the text. Examples of correct formatting of sources:

32.1. *Article from PubMed* (in English):

32.1.1. Take the article on the https://pubmed.ncbi.nlm.nih.gov website by clicking the

copy from the window (in NLM format)



There are 7 authors in it (we write all of them). Remove the month and day of publication, replace "doi: " with "DOI: ", remove Epub.

Kim SE, Park HJ, Jeong HK, Kim MJ, Kim M, Bae ON, Baek SH. Autophagy sustains the survival of human pancreatic cancer PANC-1 cells under extreme nutrient deprivation conditions. Biochem Biophys Res Commun. 2015 ~~Jul 31~~; 463(3):205-10. ~~doi:~~ DOI: 10.1016/j.bbrc.2015.05.022. ~~Epub 2015 May 18.~~ PMID: 25998396.

Writing according to the requirements of the editors:

Kim SE, Park HJ, Jeong HK, Kim MJ, Kim M, Bae ON, Baek SH. Autophagy sustains the survival of human pancreatic cancer PANC-1 cells under extreme nutrient deprivation conditions. Biochem Biophys Res Commun. 2015; 463(3):205-10. DOI: 10.1016/j.bbrc.2015.05.022. PMID: 25998396.

32.1.2. the article has 8 authors or more (reduce their number to 6 and write "et al."), remove the month and date, replace "doi: " with "DOI: ", remove Epub and PMCID:

Sahasrabuddhe NA, Huang TC, Kumar P, Yang Y, Ghosh B, Leach SD, ~~Chaerkady R, Pandey A.~~ et al. Ablation of Dicer leads to widespread perturbation of signaling pathways. Biochem Biophys Res Commun. 2015 ~~Jul 31~~; 463(3):389-94. ~~doi:~~ DOI: 10.1016/j.bbrc.2015.05.077. ~~Epub 2015 May 30.~~ PMID: 26032504; ~~PMCID: PMC4696065~~.

Writing according to the requirements of the editors:

Sahasrabuddhe NA, Huang TC, Kumar P, Yang Y, Ghosh B, Leach SD, et al. Ablation of Dicer leads to widespread perturbation of signaling pathways. Biochem Biophys Res Commun. 2015; 463(3):389-94. DOI: 10.1016/j.bbrc.2015.05.077. PMID: 26032504.

32.1.3. *Article in a foreign language other than English*, described according to the requirements:

Bliddal H, Christensen RD. Osteoartrose og adipositas. Prognose og behandlingsmuligheder [Osteoarthritis and obesity. Prognosis and treatment possibilities]. Ugeskr Laeger [Weekly journal for doctors]. 2006;168(2):190-3. PMID: 16403349. [In Danish].

The correctness of abbreviations of English-language journal names can be checked in NLM Catalog:
http://www.ncbi.nlm.nih.gov/nlmcatalog/journals

32.2. *Article from the Ukrainian scientific peer-reviewed journal* (translated bibliographic description):

Zaremba NI, Zimenkovsky AB. Attitude to the process of self-medication of applicants of higher medical education at pre- and postgraduate stage (according to results of the sociological survey). Pharmaceutical Review. 2018;(3):94-9. DOI: 10.11603/2312-0967.2018.3.9323. [In Ukrainian].

32.3. References to any literary russian and belarusian sources are prohibited. Writing the titles of these countries in articles in Ukrainian and English is lowercase. The titles of literary sources in russian during the Soviet times (1917–1990) should be translated into Ukrainian or English. The names of cities of the former USSR before the names of publishing houses should be replaced with "USSR". Disagreement with these rules leads to the rejection of the article.

32.4. All parts of the bibliographic description of the source must be in one language: either all in Ukrainian or all in English. Transliteration is prohibited.

32.5. Doubled pages in the page interval are shortened. For example, instead of "964-967" they write "964-7". If there are up to 7 authors, all of them must be indicated. If there are 8 or more authors, indicate the first 6, then write "etc."

32.6. *Authored book:*

Lisovy VM, Olkhovska LP, Kapustnyk VA. Fundamentals of Nursing: Textbook. 3rd edition, revised and supplemented. Kyiv: VSV "Medicine"; 2018. 912 p. Available on: https://is.gd/ssaAtO

Please note: to link to the Internet page, the link shortening service https://is.gd
The manuscript should not contain active sources (blue font, underlined text).
Not "https://is.gd/ssaAtO", but "https://is.gd/ssaAtO"
The words "textbook", "3rd edition, revised and supplemented" are written in full, without abbreviations.

When referring to a book in the text of the article, if the source has more than 20 pages, the pages where the cited text is located should be indicated: "text [4, p. 127] text".

32.7. *Edited book:*

O'Campo P, Dunn JR, eds. Rethinking social epidemiology: towards a science of change.
Dordrecht: Springer; 2012. 348 p. Available at: https://link.springer.com/book/10.1007/978-94-007-2138-8

Please note: after full interactive links (with https://), the period is not placed.

32.8. *Book by authorship and edit:*

32.8.1. in two volumes (volumes without pages)

Fauci AS, Kasper DL, Hauser SL, Longo DL, Jameson JL, Loscalzo J. Harrison's Principles of Internal Medicine. 20th ed. Vols. 1, 2. Jameson JL, Longo DL, Fauci AS, eds. New York: McGraw-Hill Education; 2018.

32.8.2. The first of two volumes:

Fauci AS, Kasper DL, Hauser SL, Longo DL, Jameson JL, Loscalzo J. Harrison's Principles of Internal Medicine. 20th ed. Vol. 1 of 2. Jameson JL, Longo DL, Fauci AS, eds. New York: McGraw-Hill Education; 2018. 1,472 p.

32.9. *Part of the book:*

Speroff L, Fritz MA. Clinical gynecologic endocrinology and infertility. 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2005. Chapter 29. Endometriosis. P. 1103-33.

32.10. *Foreign dissertation:*

O'Brien KA. The philosophical and empirical intersections of Chinese medicine and western medicine [dissertation]. Melbourne, AU; Monash University; 2006. 439 p.

32.11. *Ukrainian Dissertation:*

32.11.1. in Ukrainian for the section "Literature"

Lobas MV. Medical and social justification of the optimized functional-organizational model of medical care for the rural population of Ukraine. [Diss Cand Med Sc, spec. 14.02.03 – Social Medicine]. Kyiv: Ukrainian Institute for Strategic Studies of the Ministry of Health of Ukraine; 2018. Kharkiv: Kharkiv National Medical University; 2019. 278 p. [In Ukrainian].

Please note: the place of execution of the dissertation and the place of its defense may be indicated.

32.12. *Abstract of the Ukrainian dissertation:*

Godovanets OI. Optimization of the principles of diagnosis, treatment and prevention of dental diseases in children with concomitant thyroid pathology. [Abst Diss Doc Med Sc, spec. 14.01.22 – Dentistry]. Ivano-Frankivsk: Ivano-Frankivsk National Medical University; 2016. 30 p. [In Ukrainian].

32.13. *Conference abstracts:*

Nesterenko V, Shevchenko A, Zhuravel Ya. Prevention of neurodegenerative diseases' complications in palliative patients at home hospice: organizational principles. Proceedings of the International scientific conference "The greatest humankind achievements in healthcare and veterinary medicine" (Latvia, Riga, 7–8 Feb 2024). P. 96-9. DOI: 10.30525/978-9934-26-401-6-26. [In Ukrainian].

32.14. *Abstracts of the conference and at the same time the chapter of the book:*

Shevchenko AS, Shevchenko VV, Prus VV. Competencies in Higher Education Standards of Ukraine: Definition, Content and Requirements for the Formation Level. Chapter in: Auer ME, Cukierman UR, Vendrell Vidal E, Tovar Caro E, eds. Towards a Hybrid, Flexible and Socially Engaged Higher Education. ICL 2023. Lecture Notes in Networks and Systems, vol. 911. P. 421-8. Springer, Cham; 2024. DOI: 10.1007/978-3-031-53382-2_41.

32.15. *Ukrainian Website:*

Doctors about diabetes mellitus. Public Health Center of the Ministry of Health of Ukraine. [Internet]. Available at: https://diabetes-site.phc.org.ua/likariam [accessed 30 Jun 2025]. [In Ukrainian].

32.16. *English Website:*

Clinical Guidance for Diabetes. U.S. Department of Health & Human Services. Centers for Disease Control and Prevention, 15 May 2024. [Internet]. Available at: https://www.cdc.gov/diabetes/hcp/clinical-guidance [accessed 30 Jun 2025].

Cancer. World Health Organization, 3 Feb 2025 [Internet]. Available at: https://www.who.int/news-room/fact-sheets/detail/cancer [accessed 30 Jun 2025].

32.17. *International patent:*

International Patent "Nanoparticles for cancer treatment: compositions containing polykinase inhibitors with checkpoint inhibitors". WO 2023/283380 A1, 28 Dec 2023. International Appl. PCT/EP2022/067314, 24 Jun 2022. Inv.: Chen L [CN], Müller RH [DE], Keck CM [DE], Sarisozen C [TR], Hesse D [DE], Tiefenbacher R [DE], Fricker G [DE]. Owner: PharmaTrope GmbH. Valid in: US, EP, JP, CN, IN, CA. No confirmed grant or national-phase validation in US or EP publicly recorded as of 30 Jun 2025. Available at: https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2023283380 [accessed 30 Jun 2025].

32.18. *European patent:*

European Patent "Ventilator with biofeedback monitoring and control for improving patient activity and health", reg. 18 May 2016 No. EP 2,344,791 B1. EU publ. 18 May 2016, Bull. 2016/20. Inv.: Wondka AD [US], King A [US], Cipollone J [US]. Proprietor: Breathe Technologies, Inc., Irvine, CA 92618 (US). International appl. No.PCT/US2009/059272. International publ. No.WO 2010/039989 (08.04.2010 Gazette 2010/14). Designated Contracting States: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LI, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR. Available at: https://is.gd/3vFYqJ [accessed 30 Jun 2025].

32.19. *National foreign patent:*

US Patent "Systems and methods for determining functionality of dialysis patients for assessing parameters and timing of palliative and/or hospice care", reg. No.US 2019 /031881 A1, 17 Oct 2019. Inv.: Sheetal Chaudhuri, Arlington SC [US], Usyyat L [US], Maddux DW [US], Maddux FW [US], Han H [US], Demaline JS [US], Butler KG [US]. Appl.: Fresenius Medical Care Holdings, Inc., Waltham, MA (US). Available at: https://is.gd/8YxSyn [accessed 30 Jun 2025].

Australian Patent "A system for use by a medical professional, for diagnosing a cause of a patient medical condition and for providing a patient medical condition report, including a diagnosis and treatment", registrated by Australian Patent Office on 01 Jul 2021 No.2021203679. Inv. [AU]: Dew D, Halpern S, Engler H, Steward D, Dew D, Dew D, Stratton S. Available at: https://is.gd/SsP8oh [accessed 30 Jun 2025].

32.20. *Patent of Ukraine:*

Plakida OL, Yushkovska OG, inventors. Patent of Ukraine for invention No. 123412 "Method for assessing the level of physical performance of a person". Odessa National Medical University, owner. In force from 31 Mar 2021, terminated. Ukrpatent, Bull. No.13. Available at: https://sis.ukrpatent.org/uk/search/detail/1585813 Archived on: https://ku-rort.gov.ua/patenty/patenty-za-2021

32.21. *Certificate of Ukraine on registration of copyright for the work:*

Nesterenko VG (author, owner). Certificate of Ukraine on registration of copyright for work No.132116 of 16 Dec 2024. Functional and organizational model of an optimized system for providing palliative and hospice care to the population of Ukraine. Kyiv: State Organization " Ukrainian National Office for Intellectual Property and Innovations". Available at: https://sis.nipo.gov.ua/uk/search/detail/1840184 [accessed 30 Jun 2025]. Published: Bulletin "Copyright and Related Rights" No.85 of 31 Jan 2025. P. 523. Available at: https://surl.li/tmvknh [accessed 30 Jun 2025]. [In Ukrainian].

32.22. *The Law of Ukraine:*

Law of Ukraine No.2801-XII of 19 Nov 1992 "Fundamentals of the Legislation of Ukraine on Health Care". Published in the Bulletin of the Verkhovna Rada of Ukraine (1993, No.4, art. 19), in force of 30 Jun 2025, with amendments and additions from 19 Nov 1992–18 Jun 2025. Verkhovna Rada (Parliament) of Ukraine. Legislation of Ukraine. [Internet]. Available at: https://zakon.rada.gov.ua/laws/show/2801-12 [in Ukrainian].

32.23. Among the sources of normative acts, the most authoritative ones have priority: the websites of the Verkhovna Rada (Parliament) of Ukraine, the Cabinet of Ministers of Ukraine (Government Portal), the President of Ukraine, the Ministries of Ukraine, the State Expert Center of the Ministry of Health of Ukraine, the Public Health Center of the Ministry of Health of Ukraine, etc.

33. At least 50% of references must be to literary sources published within the last 10 years. Self-citation should not exceed 10% of the list of sources. Citation of conference abstracts should not exceed 30% of the list of sources.

34. Transliteration of surnames and names from Ukrainian into English should be performed in accordance with the Resolution of the Cabinet of Ministers of Ukraine dated January 27, 2010 No.55 "On streamlining the transliteration of the Ukrainian alphabet into the Latin alphabet". It is recommended to use https://slovnyk.ua/translit.php or other similar resources for it.

35. To shorten long links, it is recommended to use https://is.gd/create.php, https://bitly.com or other similar resources. Link shortening should be used if the original link is longer than one line, or if it contains Cyrillic text, which is converted when copied to ASCII code.

For example, if the https://uk.wikipedia.org/wiki/ kidney link is
converted to https://uk.wikipedia.org/wiki/%D0%9D%D0%B8%D1%80%D0%BA%D0%B8 when copied from the address bar of the browser, the bibliographic descriptions in "References" should not contain Cyrillic characters.

36. It is recommended to use https://teacode.com/online/udc for the formation of the UDC. If you do not have experience in compiling the UDC yourself, contact libraries for help.

37. Authors are not allowed to use artificial intelligence to write or edit a manuscript (borrowing ideas from robotic systems, forming conclusions, selecting references to literary sources, etc.).

38. All articles sent to the editorial board are checked for plagiarism by the StrikePlagiarism.com system, are subject to peer review according to a double-blind procedure by three reviewers and editing. The article can be returned to the authors for revision or answers to questions that have arisen from reviewers and editors. Agreement, the text of which is sent by the editors to the corresponding author by e-mail. The agreement can be signed using electronic signatures, or signed and scanned with a resolution of at least 300 dpi. All scanned pages of the agreement are required together with the last signed page in a file of *.pdf format.

39. The editorial board publishes peer-reviewed and edited articles in press (with activated DOI and without page numbers). Pages are added to articles after the release is complete. Before the completion of work on the article, the authors can inform the editors about inaccuracies in the future final publication. The authors receive an e-mail notification from the editors about the completion of work on the article and on the entire collection.

40. The preferred way of working with the editors:

1) e-mails of journals
Medicine Today and Tomorrow – msz.journal@knmu.edu.ua
Experimental and clinical medicine – ekm.journal@knmu.edu.ua
Inter Collegas – ic.journal@knmu.edu.ua

2) e-mails of editors – as.shevchenko@knmu.edu.ua, si.danylchenko@knmu.edu.ua

3) phone, Viber and Telegram +38 063 069 9000 of the editorial coordinator Shevchenko Alexander.

If the number does not answer, you will be called back during this or the next business day.
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