

O.V. Seliuk, A.A. Voronko, M.M. Kozachok, M.M. Seliuk,  
V.V. Sobetskyi, A.I. Havretskyi, A.I. Buzhenko  
Ukrainian Military Medical Academy, Kyiv  
National Military Medical Clinical Center "Main Military Clinical Hospital", Kyiv

## FEATURES OF COMORBIDITY OF INTERNAL DISEASES WITH ARTERIAL HYPERTENSION IN MILITARY SERVICEMEN WITH MODERN COMBAT TRAUMA

e-mail: seliuk89@gmail.com

The mutually aggravating influence of arterial hypertension and modern combat trauma significantly reduces the professional longevity of military personnel. A comparison of comorbidity was carried out (total number of diagnoses, number of causal and competing diseases, comprehensive assessment of comorbidity according to the CIRS cumulative scale of diseases) in military personnel-participants in modern armed conflicts with arterial hypertension, depending on receiving a closed head injury in the course of these conflicts. Dependence of the severity of arterial hypertension on receiving a closed head injury was not found, which indicates the leading etiopathogenetic role of stress in the morphogenesis of arterial hypertension in them. The established increase in the score of comorbidity according to the cumulative scale of CIRS diseases in combatants with arterial hypertension who received a closed head injury during hostilities is caused by an increase in the number of competing diseases.

**Key words:** arterial hypertension, comorbidity, closed head injury, combatants, modern armed conflicts.

**О.В. Селюк, А.А. Воронко, М.М. Козачок, М.М. Селюк, В.В. Собецький,  
А.І. Гаврецький, А.І. Буженко**

## ОСОБЛИВОСТІ КОМОРБІДНОСТІ ВНУТРІШНІХ ЗАХВОРЮВАНЬ У ХВОРИХ НА АРТЕРІАЛЬНУ ГІПЕРТЕНЗІЮ ВІЙСЬКОВОСЛУЖБОВЦІВ З СУЧАСНОЮ БОЙОВОЮ ТРАВМОЮ

Взаємний обтяжуючий вплив артеріальної гіпертензії і сучасної бойової травми суттєво скорочує професійне довголіття військовослужбовців. Проведено порівняння коморбідності (загальна кількість діагнозів, кількість каузальних і конкурентних захворювань, комплексна оцінка коморбідності за кумулятивною шкалою захворювань CIRS) у хворих на артеріальну гіпертензію військовослужбовців – учасників сучасних збройних конфліктів залежно від отримання закритої черепно-мозкової травми в процесі цих конфліктів. Залежності тяжкості артеріальної гіпертензії від отримання закритої черепно-мозкової травми виявлено не було, що свідчить про провідну етіо-патогенетичну роль стресу в морфогенезі артеріальної гіпертензії у них. Встановлене збільшення бальної оцінки коморбідності за кумулятивною шкалою захворювань CIRS у хворих на артеріальну гіпертензію комбатантів, які під час бойових дій отримали закрити черепно-мозкову травму, зумовлено збільшенням кількості конкурентних захворювань.

**Ключові слова:** артеріальна гіпертензія, коморбідність, закрыта черепно-мозкова травма, комбатанти, сучасні збройні конфлікти.

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The complex of preventive, medical, diagnostic and rehabilitation measures for military personnel, taking into account modern challenges, primarily combat operations in Ukraine, is one of the important medical and social problems of today [6]. Preservation and maintenance of the high combat capability of the Armed Forces (AF) of Ukraine and other military formations are impossible without modern medical support of service members within a single medical space [10].

The problem of arterial hypertension (AH) problem is highly relevant to Ukraine's AF. For many years, it has held leading positions in the structure of morbidity, disability, mortality and dismissals based on the health status of service members of the Armed Forces of Ukraine [12].

Patients with hypertension of military personnel participating in the Anti-Terrorist Operation/Joint Forces operation (ATO/JFO) often have a comorbid pathology. Differences in comorbid conditions were revealed in them, compared to servicemen who did not participate in hostilities: the consequences of a closed head injury, the implications of a mine-explosive injury. According to the Cumulative Illness Rating Scale (CIRS), the overall comorbidity assessment in service members with hypertension - participants of ATO/JFO was  $8.7 \pm 0.1$  points. This is significantly higher compared to the group of servicemen who did not participate in combat operations by  $4.3 \pm 0.1$  points ( $p < 0.05$ ), which is due to a more significant number of comorbid diseases and their more severe course [4].

Modern combat trauma has significant complications and consequences that negatively affect the health of the victims and, accordingly, their suitability for military service due to their health [7]. Modern combat trauma is heterogeneous and includes firearm and non-firearm injuries from various types of weapons.

At present, explosive injuries are allocated to an independent category of combat trauma. In modern armed conflicts, the specific weight of non-fire injuries, including closed ones, is increasing [7, 9, 13].

As a result of hostilities in Ukraine during 2014–2022, by localization, combat head trauma accounted for 31.9 %, closed head injury (CHI) occurred in 43.4 % of combat neurosurgical trauma and 12.8–25.2 % of all combat injuries, [2, 7, 13].

Blast (shock) wave damage is of great and independent importance for therapists. The pathogenesis of this type of damage consists of the direct action of an airwave spreading from the centre of the explosion under high pressure and blunt trauma by secondary projectiles. General syndromes are mainly cerebral and neurotic in nature. Direct (primary), although not proximate, mechanical damage to the brain during CHI causes the concussion-contusion syndrome. Consequences of trauma affect the central structures of the autonomic nervous system. Mono- and polysystem vegetative dystonias, diencephalic crises, and general manifestations of disorders of the tone of the sympathetic and parasympathetic departments of the autonomic nervous system are formed, which have a mutually aggravating effect on comorbid diseases [9].

The current lack of research on the comorbidity of internal diseases in military personnel, which can negatively affect the course of modern combat trauma, as well as combat trauma, can aggravate their system, determined the relevance of this study and determined its purpose.

**The purpose** of the study was to analyze the quantitative assessment of comorbid pathology of internal organs in patients with arterial hypertension of servicemen-participants of ATO/JFO depending on the receipt of a closed head injury.

**Materials and methods.** The design was a passive retrospective single-moment (cross-sectional) study [1], performed at the clinical bases of the Ukrainian Military Medical Academy: in the National Military Medical Clinical Center "Main Military Clinical Hospital" and the Main Military Medical Clinical Center (Central Clinical Hospital) of the State Border Service of Ukraine.

By random sampling, we analyzed the medical records of an inpatient patient of 213 male service members participating in the ATO/JFO, aged 27–59 years, an average age of  $45.0 \pm 6.8$  years, who were treated during 2018–2021 and had a diagnosis of hypertension. The patients were stratified according to the characteristic (variable) of receiving a CHI during hostilities into 2 statistically homogeneous age groups (Table 1).

Table 1

**Age characteristics of military servicemen-participants in ATO/JFO**

Groups of patients	Age characteristics (years)		
	Min–max	M±s	CI
Without CHI (n=149)	27–59	45.1±6.9	44.1–46.3
With CHI (n=64)	31–57	44.7±6.7	43.0–46.3
Reliability of differences	p=0.6124		

Note: CI – confidence interval (–95 % +95 %), Min–max – minimum and maximum value of the indicator, M – mean (arithmetic mean) value of the indicator, s – mean squared (standard) deviation, p – significance level of comparison of 2 groups of studied patients (Student's t-test for independent samples).

Diagnosis of hypertension and comorbid pathology was carried out by the requirements of national medical and technological documents on standardization of medical care, international sources of clinical guidelines, and recommendations of the Ukrainian Association of Cardiologists (2021) [8].

The examination included a wide range of clinical and laboratory, instrumental research methods and consultation of narrow specialists (cardiologist, endocrinologist, pulmonologist, gastroenterologist, neurologist, otorhinolaryngologist, vascular surgeon and others).

Existing comorbid pathology (causal and competing diseases) was taken into account. For a comprehensive quantitative assessment of comorbidity, the CIRS cumulative scale of diseases was used, which provides a separate summary assessment of the state of each organ system on a 5-point scale (Likert scale) [15].

The methods used in the study did not involve an increased risk for the subjects and were used taking into account the existing ethical norms and standards. All patients gave voluntary consent for diagnosis and treatment, which is an integral part of the medical records of an inpatient.

The statistical analysis of the obtained results was carried out in the standard statistical package STATISTICA 10.0 for Windows of the company StatSoft Inc. (USA) using the parametric statistical method - Student's t-test for independent samples when comparing age characteristics and quantitative indicators of comorbidity (the total number of diagnoses, the number of diagnoses of causal, competitive diseases, and point assessment according to the CIRS cumulative disease scale) of examined patients; and the non-parametric method – Probability calculator when comparing the frequency of diagnosis of different stages of hypertension [1].

**Results of the study and their discussion.** Peculiarities of the stages of diagnosed AH in the examined servicemen-participants of the ATO/JFO, depending on the receipt of a CHI during hostilities (stratification by CHI), are presented in Table 2.

Table 2

**Peculiarities of diagnosis of the AH staging in participants of ATO/JFO (stratification according to CHI)**

Stage of hypertension	Groups of examined patients				p <sub>2</sub>
	without CHI (n=149)		with CHI (n=64)		
	abs. units	proportion	abs. units	proportion	
I	82	55 %	44	69 %	0.1264
II	67	45 %	20	31 %	0.2653
p <sub>1</sub>	0.2246		0.0044		

Note: p<sub>1</sub> is the significance level of comparing the frequency of diagnosis of various stages of hypertension within each group of studied patients (Probability calculator), p<sub>2</sub> is the significance level of comparing the frequency of diagnosis of a particular stage of hypertension in 2 groups of studied patients (probability calculator).

In patients with hypertension, military personnel participating in the ATO/JFO with CHI during military operations, stage I hypertension was more often diagnosed ( $p < 0.05$ ). Among military servicemen-participants of the ATO/JFO, who did not receive a CHI during combat operations, stages I and II hypertension were diagnosed with almost the same frequency ( $p > 0.05$ ). No statistically significant differences were found in the frequency of diagnosis of stages I and II hypertension, depending on receiving CHI during hostilities ( $p > 0.05$  in both cases).

The analysis of antihypertensive therapy of blood pressure in servicemen-participants of the ATO/JFO with comorbid pathology revealed that 16 % of the 213 studied patients did not receive antihypertensive therapy before admission to inpatient treatment, respectively, 84 % (179/213) received it earlier ( $p < 0.05$ ). All studied patients who did not receive antihypertensive therapy before hospitalization had to stage I hypertension. 34 out of 126 (27 %), respectively, 73 % (92/126) of patients with stage I hypertension received it ( $p < 0.05$ ). All service members-participants of the ATO/JFO with hypertension of the II stage received antihypertensive therapy before admission to inpatient treatment. 53 % (18/34) of the studied patients did not receive antihypertensive therapy before hospitalization and did not receive CHI while participating in combat operations. 47 % of patients received such an injury ( $p > 0.05$ ).

Features of the comprehensive assessment of comorbid pathology in hypertension in participants of ATO/JFO (total number of diagnoses of comorbid diseases, number of diagnoses of causal and competitive diseases, quantification of comorbidity according to the CIRS cumulative scale of conditions) depending on receiving a CHI during hostilities is presented in Figs. 1–4.

The total number of diagnoses of comorbid diseases in servicemen-participants of the ATO/JFO, who received a CHI in the course of hostilities, was from 3 to 13, with an average of  $7.0 \pm 2.1$  diagnoses (CI of the mean 6.4 – 7.5), and in military personnel who did not receive CHI during the fighting – from 2 to 14, on average  $6.2 \pm 2.4$  diagnoses (CI of the mean 5.8 – 6.6),  $p = 0.0304$ .

Causal diseases are considered diseases united by a single mechanism of development. The total number of those with hypertension is shown in Fig. 2.

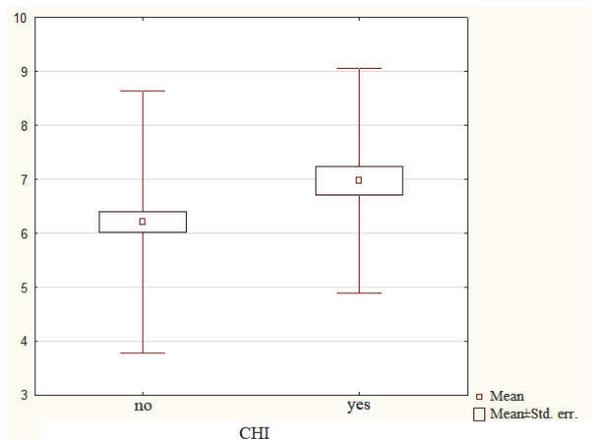


Fig. 1. The total number of diagnoses of comorbid diseases in servicemen-participants of the ATO/JFO with hypertension. Here and on the following graphs: Mean – (arithmetic mean) value, Std. error – standard error of the mean, Std. deviation – mean square (standard) deviation.

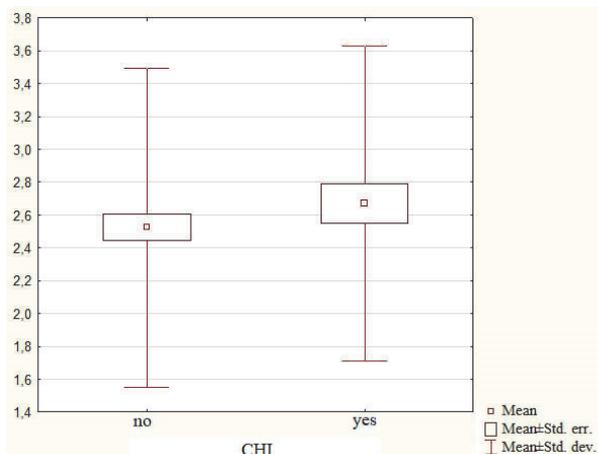


Fig. 2. The total number of diagnoses of causal diseases in servicemen-participants of the ATO/JFO with hypertension.

The number of diagnoses of causal diseases in servicemen-participants of the ATO/JFO with hypertension who received CHI in the course of hostilities was from 1 to 4, with an average of  $2.7 \pm 1.0$  diagnoses (CI of the mean 2.4–2.9), and service members who did not receive CHI during hostilities also had from 1 to 4, on average  $2.5 \pm 1.0$  diagnoses (CI of the mean 2.4–2.7),  $p=0.3057$ .

Diseases that are unrelated to each other are considered competitive, the total number of hypertension in participants of ATO/JFO is shown in Fig. 3.

The number of diagnoses of competitive diseases in servicemen-participants of the ATO/JFO with hypertension who received CHI in the course of hostilities was from 1 to 9, with an average of  $4.3 \pm 1.6$  diagnoses (CI of the mean 3.9–4.7), and service members who did not receive CHI during hostilities – from 0 to 10, an average of  $3.7 \pm 2.0$  diagnoses (CI of the mean 3.4–4.0),  $p=0.0324$ .

The point assessment of comorbidity according to the cumulative scale of CIRS diseases in hypertension in servicemen-participants of ATO/JFO is presented in Fig. 4.

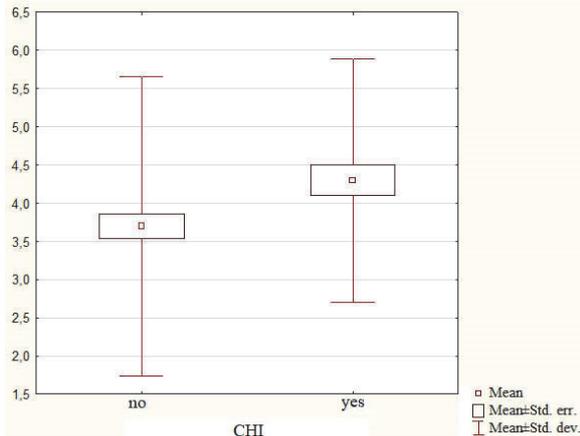


Fig. 3. The total number of diagnoses of competitive diseases in servicemen-participants of the ATO/JFO with hypertension.

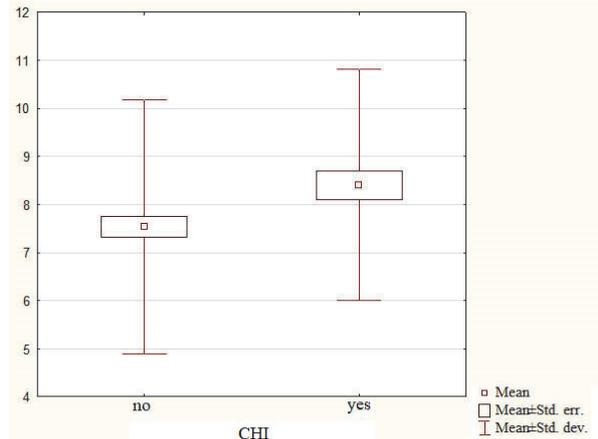


Fig. 4. CIRS values in military servicemen-participants in ATO/JFO with hypertension

The overall assessment of comorbidity according to the CIRS cumulative scale of diseases in service members-participants of the ATO/JFO with hypertension who received CHI in the course of hostilities was from 4 to 14 points, on average  $8.4 \pm 2.4$  points (CI of the mean 7.8–9.0), and in service members who did not receive CHI during hostilities – from 3 to 16 points, on average  $7.5 \pm 2.6$  points (CI of the mean 7.1–8.0),  $p=0.0247$ .

Therefore, the dependence of the severity of hypertension on receiving a CHI was not established in the participants of ATO/JFO. This testifies to the fact that the severity of hypertension in servicemen-participants in modern armed conflicts is caused by stress effects and not by organic (traumatic) lesions of the brain. Participants in modern armed conflicts, among other things, are exposed to significant stressful effects, confirmed by the considerable prevalence of post-traumatic stress disorders [14]. However, these data are preliminary and require further research in time after receiving CHI.

A high percentage of ATO/JFO participants with stage 1 hypertension who did not receive antihypertensive therapy before hospitalization, 27 % (34/126), indicates that they were diagnosed with hypertension for the first time after participating in hostilities. Such hypertension is defined by many scientists as stress-induced.

With stress-induced hypertension, there are differences in the neurohormonal status, characterized by more active indicators of renin-angiotensin-aldosterone and the sympathetic link of the autonomic nervous system. Stress-induced hypertension is characterized by rapid progression. Its course in participants of modern armed conflicts is characterized by a high frequency of the development of destructive complications and the presence of severe accompanying psychosomatic pathology, which indirectly indicate the decompensation of stress-limited systems in this category of patients [14].

Effective treatment of patients with comorbid diseases and prevention of polypharmacy is a fundamental aspect of the problem. The individualization of therapy taking into account the requirements of evidence-based medicine is gaining more and more importance – a patient-oriented approach, the components of which are three groups of priority measures – Dimensions of health, Depression and Drugs [5]:

- Dimensions of health – individual assessment of the patient's priorities and needs, assessment of the quality of life and functional status and determination of the main direction in the treatment of diseases;
- Depression – screening and treatment of depressive disorders;
- Drugs – optimization of the treatment regime (application of simple schemes, improvement of adherence, provision of recommendations in written form, etc.).

Given the high prevalence of post-traumatic stress disorders in ATO/JFO participants, psychological rehabilitation is of particular importance, the main goals of which are [14]:

1. Restoration of fighting capacity and working capacity of ATO/JFO participants.
2. Prevention of disability.
3. Social adaptation of military personnel.

Rehabilitation of participants of ATO/JFO should be carried out as early as possible, continuously, and consistently and have an individual approach to a therapeutic treatment. In the acute period, inpatient treatment is necessary, which is aimed at restoring the health of the serviceman and returning him to socially valuable activities, preventing complications of the disease and support with outpatient therapy in the future [14].

A statistically significant increase in the total number of comorbid diseases and the score of comorbidity according to the CIRS cumulative disease scale is observed in military personnel with hypertension-participants of the ATO/JFO who received CHI during hostilities compared to the same service members who did not receive CHI during hostilities. These differences are caused by an increase in the number of competing diseases ( $p > 0.05$  in all cases).

Using the CIRS system involves a separate overall assessment of the state of each of the organ systems on a 5-point scale (Likert scale) [15]:

- 0 – corresponds to the absence of diseases of the selected system,
- 1 – slight deviations from the norm or disease suffered in the past,
- 2 – a disease that requires drug therapy,
- 3 – a disease that caused disability,
- 4 – severe organ failure that requires immediate treatment.

The CIRS system evaluates comorbidity by the sum of points, which can vary from 0 to 56.

Comparing the obtained results with the results of other studies, the following can be noted: in military personnel who did not participate in ATO/JFO, the total CIRS comorbidity score is  $4.3 \pm 0.1$  points [11], participants in the liquidation of the consequences of the Chernobyl disaster –  $10.3 \pm 2.9$  points [3], and in the general population –  $2.7 \pm 0.3$  points [5]. At the same time, the cumulative disease index of  $CIRS \geq 3$  % in patients with hypertension increases the risk of a fatal SCORE prognosis by 1.5–1.8 times [5].

### Conclusions

1. In servicemen-participants of ATO/JFO, there was no dependence of the severity of hypertension on receiving CHI ( $p > 0.05$ ), which indicates the leading etiopathogenetic role of stress in the morphogenesis of hypertension in them.

2. The increase in the score of comorbidity according to the cumulative scale of CIRS diseases in servicemen-participants of ATO/JFO who received CHI during hostilities is caused by an increase in the number of competing conditions.

3. The influence of organic (traumatic) lesions of the brain over time on the morphogenesis of hypertension and the determination of the organs and systems of the body that are most often affected by comorbid pathology in service members-participants of ATO/JFO, depending on receiving CHI, require further research.

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A.V. Sliusarieva, O.M. Kovalova, V.I. Pokhylko  
Poltava State Medical University, Poltava

## THE IMPACT OBESITY HAS ON EARLY PERINATAL OUTCOMES AND NEONATAL MORBIDITIES IN PREMATURE INFANTS

e-mail: sliusarieva.nastka@gmail.com

In an epidemiological retrospective study, which included 4.874 women, the frequency of obesity of various degrees among pregnant women, increased risks of adverse pregnancy complications and obstetric outcomes, in particular hypertension disorders, preeclampsia, uterine inertia, use of emergency cesarean section, excessive fetal growth. At the same time among women with stage III obesity compared to women of the stage I, the risks of having hypertensive conditions are 3.5 times higher, the uterine inertia is twice as high, preeclampsia is 56.8 % and excessive fetal growth is 21.3 %. It has been shown that there is no impact of obesity on the premature birth of babies. Large-for-gestational-age babies born prematurely to obese (non-diabetic) mothers have been shown to have an increased risk of jaundice (RR 3.08) and neonatal hypoglycemia (RR 9.11) and no such risk compared with those of normal weight regarding the occurrence of other diseases (intraventricular hemorrhages, birth asphyxia, respiratory distress, hemodynamic significance patent ductus arteriosus, retinopathy). No significant differences were noted between the children of both groups in the frequency of noninvasive/invasive ventilatory support, oxygen support, and parenteral nutrition.

**Key words:** pregnant, maternal obesity, perinatal outcomes, premature, large for gestational age, morbidity.

**А.В. Слюсарєва, О.М. Ковальова, В.І. Похилько**

## ВПЛИВ ОЖИРІННЯ НА РАННІ ПЕРИНАТАЛЬНІ НАСЛІДКИ У ЖІНОК ТА ЗАХВОРЮВАНІСТЬ ЇХ ПЕРЕДЧАСНО НАРОДЖЕНИХ ДІТЕЙ

В епідеміологічному ретроспективному дослідженні, що включало 4874 жінок, встановлено частоту ожиріння різних ступенів серед вагітних, підвищені ризики виникнення несприятливих ускладнень вагітності та акушерських наслідків, зокрема гіпертонічні стани, преєклампсії, слабкості пологів, застосування екстремного кесаревого розтину, надлишкового росту плода, при цьому у жінок з ожирінням III ст. порівняно з жінками I ступеня ризики мати гіпертензивні розлади є вищими в 3,5 рази, слабкість пологів – вдвічі, преєклампсію – на 56,8 %, надлишковий ріст плода – на 21,3 %. Показано відсутність впливу ожиріння на передчасне народження немовлят. У немовлят завеликих до гестаційного віку, народжених передчасно від матерів з ожирінням (без діабету), порівняно з такими дітьми, маса яких відповідала гестаційному віку, показано підвищені ризики розвитку жовтяниці (RR 3.08) і неонатальної гіпоглікемії (RR 9.11) та відсутність таких ризиків щодо виникнення інших захворювань (внутрішньошлункових крововиливів, асфіксії при народженні, дихального дистресу, значущої відкритої артеріальної протоки, ретинопатії). Не відмічено достовірних відмінностей між дітьми обох груп у частоті застосування штучної вентиляції легень, кисневої терапії та парентерального харчування.

**Ключові слова:** вагітні, ожиріння, перинатальні наслідки, передчасно народжені, завеликі до гестаційного віку, захворюваність.

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Prevention of obesity among women of reproductive age is a global public health priority, as today there are convincing data on the connection of obesity during pregnancy with early and long-term adverse outcomes for both the woman and her child [2]. Obese pregnant women have higher risks of early pregnancy loss, spontaneous and medically indicated premature birth, gestational diabetes and preeclampsia, which are associated with long-term postpartum morbidity, and higher risks of developing