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IMPACT OF ARMED CONFLICT IN UKRAINE ON MALE REPRODUCTIVE FUNCTION DURING MARTIAL LAW

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Given that debates persist within the scientific community regarding the magnitude of the impact of stressors on infertility, this study aimed to evaluate the influence of psycho-emotional state under conditions of military aggression on male reproductive function parameters. A retrospective analysis of semen parameters and psycho-emotional status was conducted in 895 clinically healthy men aged 21–42 years over the 2016–2025 period. Anxiety and depression were evaluated using the GAD-7 and PHQ-9 scales, respectively. Semen analysis was performed in strict accordance with WHO recommendations. Beginning in 2022, a statistically significant increase in anxiety levels and the emergence of mild depressive symptoms were observed among the evaluated men. Concurrently, a marked decline was noted in sperm concentration, motility, and the percentage of morphologically normal forms, alongside an accumulation of abnormal and immotile spermatozoa. Over the 2023–2025 period, key semen parameters deviated beyond the acceptable reference intervals. Prolonged psycho-emotional stress under war conditions is strongly associated with the deterioration of semen quality and reduced male fertility. These findings underscore the critical need for further investigation and the development of targeted interventions aimed at preserving male reproductive health.

Key words: stress, fertility, reproduction, endocrine disorders, demographic situation.

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ВПЛИВ ВІЙСЬКОВОЇ АГРЕСІЇ В УКРАЇНІ НА СТАН ЧОЛОВІЧОЇ РЕПРОДУКТИВНОЇ ФУНКЦІЇ ВПРОДОВЖ ВОЄННОГО СТАНУ

Враховуючи, що у науковій спільноті досі ведуться дискусії щодо того, наскільки сильним є вплив стресових факторів на безпліддя, метою роботи стала оцінка впливу психоемоційного стану в умовах військової агресії на показники чоловічої репродуктивної функції. Для цього проведено ретроспективний аналіз показників спермограми та психоемоційного стану у 895 клінічно здорових чоловіків віком 21–42 років за період 2016–2025 рр. Оцінку тривожності та депресії здійснювали за шкалами GAD-7 та PHQ-9. Аналіз еякуляту проводили відповідно до рекомендацій ВООЗ. Встановлено, що з 2022 року у чоловіків спостерігається достовірне підвищення рівня тривожності та поява ознак легкої депресії. Паралельно відзначено зниження концентрації сперматозоїдів, їх рухливості та частки морфологічно нормальних форм, а також зростання кількості патологічних і нерухомих сперматозоїдів. У 2023–2025 рр. показники спермограми виходили за межі референтних значень. Таким чином, тривалий психоемоційний стрес в умовах війни асоційований із погіршенням показників спермограми та зниженням фертильності чоловіків. Отримані результати вказують на необхідність подальших досліджень і розробки заходів щодо збереження чоловічого репродуктивного здоров'я.

Ключові слова: стрес, фертильність, репродукція, ендокринні порушення, демографічна ситуація.

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In European countries, as well as in Ukraine, male infertility accounts for 50% of cases where couples fail to conceive [1, 2, 6]. The impact on male reproductive function is driven by numerous factors, including hormonal, environmental, infectious, and genetic variables, as well as lifestyle choices and exposure to toxic substances [2, 11]. Each of these can significantly impair sperm quality, hormonal profiles, and the overall function of the reproductive system. Among these factors, stress occupies a prominent place and is an increasingly pressing issue in the modern world [3–5].

Under martial law in Ukraine, the burden on the mental and physical health of the population has escalated dramatically, particularly among men involved in combat operations or living under high-stress conditions [1].

It is hypothesized that sustained, rising stress levels can induce hormonal imbalances that disrupt reproductive function, particularly affecting hormonal shifts and semen quality parameters [3, 7, 10]. Investigating these changes is highly important, as it provides a deeper understanding of how extreme circumstances affect reproductive health, a vital factor in preserving the country's demographic potential [1].

The events of the war already have severe demographic consequences for Ukraine, driven in particular by forced migration and casualties among the male population [1]. The deterioration of male reproductive function against the background of stress further exacerbates the demographic situation. Understanding these shifts is essential for planning fertility support programmes and ensuring population recovery.

Despite numerous studies, debates persist within the scientific community regarding the exact magnitude of the impact of stressors on infertility. Some researchers argue that stress directly affects hormonal profiles and spermatogenesis [12, 13, 14, 16], whereas others dispute this impact, viewing it as less decisive than genetic or environmental factors.

The effect of chronic emotional stress on spermatogenesis has been evaluated in a study of unemployed men: in cases of inadequate and deficient nutrition, a significant decrease in sperm motility is observed, along with an increase in the number of non-progressively motile and immotile spermatozoa, and accelerated senescence of germ cells [4, 6, 8, 15]. In men working in creative professions and telecommunications personnel, sperm motility is moderately reduced due to a decline in actively motile forms, while a high proportion of non-progressively motile forms consists of pathological cells.

A reduction in blood testosterone levels under the influence of emotional stress has been documented in men working in creative professions. The mechanism by which emotional stress affects reproductive function is highly complex: on the one hand, general pathways of oxidative stress development are triggered; on the other hand, central regulatory mechanisms at the level of the hypothalamic-pituitary complex are engaged, inducing endocrine disruptions within the pituitary-testicular axis [9, 10, 16]. Elevated prolactin levels suppress testosterone production, which adversely affects spermatogenic function. Thus, under chronic emotional stress, the inhibition of spermatogenesis is multifactorial. It is also well established that chronic stress increases cortisol levels, which, in turn, can suppress the synthesis of testosterone, a hormone responsible for spermatogenesis [10, 12]. Simultaneously, it exacerbates oxidative stress, which damages spermatozoa [8, 9, 11]. Despite these findings, debates continue within the scientific community as to whether stress is a primary factor in declining fertility or if its impact is secondary to other variables.

Therefore, this study aims to analyze and evaluate ejaculate quality in men exposed to stressors, particularly during wartime. The analysis of these findings will deepen the understanding of the role of stress in male reproductive dysfunction.

The relevance of this study is underscored by the fact that its results may help clarify the impact of stress on infertility and aid in developing strategies to protect reproductive health under similar conditions. This undoubtedly enhances the scientific value of investigating this topic specifically under the extreme stress conditions posed by the war in Ukraine.

The purpose of the study was to investigate the specific alterations in semen parameters among clinically healthy men of reproductive age exposed to stress under conditions of military aggression.

Materials and methods. The study was conducted at the Department of Laboratory Medicine of Zaporizhzhia State Medical and Pharmaceutical University. The study adhered to the standards of Good Clinical Practice (GCP) and the principles of the Declaration of Helsinki (2002). All men participating in the study provided written informed consent, and the study was approved by the Bioethics Committee of Zaporizhzhia State Medical and Pharmaceutical University and complied with the ethical, moral, and legal requirements of Order No. 281 of the Ministry of Health of Ukraine, dated 01.11.2000.

An analysis of primary ejaculate parameters was conducted over a 10-year period (2016 to 2025). A total of 895 men aged 21 to 42 years were examined; none presented complaints regarding reproductive system dysfunction, and all underwent evaluation as part of family planning. The exclusion criteria were the presence of severe somatic pathology, tuberculosis, viral hepatitis B and C, HIV infection, or allergic, autoimmune, and oncological diseases. Men who presented with azoospermia or acute inflammatory processes of the reproductive organs at the time of the study, as well as those with drug dependence, were excluded from the study.

In all examined men, ejaculate collection and analysis were performed in accordance with WHO guidelines [17]. Following complete liquefaction of the ejaculate, its physical properties were evaluated: volume, liquefaction time, pH, colour, odour, consistency, and viscosity. Microscopic examination of native specimens included determination of the initial kinesisgram (after 1 hour), a dynamic assessment at 2 hours post-collection, and detection of lipoid granules, amyloid bodies, spermine crystals, and spermatozoal agglutination and aggregation. Microscopic examination of cytological ejaculate smears stained using the Pappenheim method was used to evaluate the morphological characteristics of spermatozoa and spermatogenic cells. All microscopic evaluations were performed using a EUROMEX BioBlue.Lab trinocular microscope (Netherlands).

Throughout the specified ten-year period, primary semen parameters were processed annually, with a comparative statistical analysis against the preceding year.

To evaluate anxiety symptoms in the men, the Generalized Anxiety Disorder 7 (GAD-7) questionnaire was applied [13], while the severity of depression was determined using the Patient Health Questionnaire (PHQ-9), developed by Drs Robert L. Spitzer, Janet B. Williams, and Kurt Kroenke.

Self-administered questionnaires were utilized to assess symptoms of depression and anxiety. Depressive symptoms experienced over the past two weeks were evaluated using the PHQ-9, which contains 9 self-report items and is a validated tool for screening depression: (1) anhedonia, (2) depressed mood, (3) sleep disturbances, (4) fatigue, (5) changes in appetite, (6) low self-esteem, (7) trouble

concentrating, (8) psychomotor disturbances, and (9) suicidal ideation. A score of 0 to 3 reflects the severity of each symptom. The total PHQ-9 score ranges from 0 to 27, with the following cut-off scores used to classify the severity of depression: 0–4 indicates no depression; 5–9 indicates mild depression; 10–14 indicates moderate depression; and 15 or higher indicates severe depression.

Anxiety symptoms were assessed using the GAD-7 scale, which includes 7 self-report items. Each item is scored from 0 to 3 based on severity, resulting in a total score ranging from 0 to 21. The cut-off thresholds for anxiety severity were 5, 10, and 15, representing mild, moderate, and severe anxiety, respectively.

Statistical processing of the obtained digital data was performed using the STATISTICA software (StatSoft Statistica v.6.0; software licence number STA 862D175437Q) using the Wald-Wolfowitz runs test for the comparison of two independent groups. Differences were considered statistically significant at a significance level of $p < 0.05$. The analyzed data are presented as the median (Me) and interquartile range (RQ), which represents the difference between the values of the 75th and 25th percentiles (RQ = 75% UQ – 25% LQ), where UQ is the upper quartile, and LQ is the lower quartile.

Results of the study. The mean PHQ-9 score between 2016 and 2021 was 2.64, indicating no depression among the men during this period. Analysis of the questionnaires completed by the evaluated men, starting from 2022 and moving forward, demonstrated the presence of mild depressive symptoms, with the mean score rising to 5.92.

During the 2016–2021 period, the mean GAD-7 score was 2.42, which corresponds to a normal anxiety level. However, evaluation of the values recorded between 2022 and 2025 revealed prominent symptoms of anxiety. Fluctuations in the mean GAD-7 score ranged from 7.83 to 12.79, indicating the presence of mild-to-moderate anxiety among the patients during this specified period.

The next phase of the study involved evaluating regional semen parameters among men residing in the Zaporizhzhia region over the ten-year period; these data allow an assessment of dynamic changes in the ejaculate's fertility, taking into account the impact of armed military aggression on the territory of Ukraine.

Thus, when analyzing the dynamics of changes in ejaculate volume, no statistically significant trends were observed over the specified period. However, the median values in certain years exhibited statistically significant fluctuations (ranging from 1.7 mL to 3.5 mL). The evaluation of ejaculate pH parameters demonstrated that between 2016 and 2024, the pH remained stable at 8.0, and a decrease to 7.6 ($p<0.03$) was observed only in 2025, indicating a shift in the studied variational dataset toward reduced alkalinity. Crucially, this parameter did not deviate beyond the lower reference limits recommended by WHO experts; hence, these alterations were compensatory. The analysis of ejaculate viscosity over the specified years revealed no statistically significant increases.

The dynamics of sperm motility alterations were evaluated based on the percentages of actively motile, sluggishly motile, and immotile forms, as well as dynamic kinesisgram parameters.

The analysis of changes in the percentage of actively motile spermatozoa (Table 1) showed that fluctuations in this parameter between 2016 and 2021 remained within the WHO-recommended normal reference ranges. Beginning in 2022, a progressive decline in the number of actively motile forms was observed (an average twofold decrease compared to previous years). In 2025, the number of actively motile spermatozoa dropped sharply: by 35.2% ($p<0.01$) relative to 2022, and by 70.3% ($p<0.01$) relative to 2016.

The percentage of sluggishly motile spermatozoa fluctuated throughout the study period, with a downward trend beginning in 2022.

Table 1

Dynamics of changes in sperm motility for 2016–2025

Years	Percentage of actively motile forms of Me (UQ – LQ=RQ)	Percentage of inactive forms of Me (UQ – LQ=RQ)
2016	59.0 (77–56=21)	19.0 (30–12=18)
2017	60.5 (78–48=30)	17.0 (26.5–12=14.5)
2018	62.0 (76–67=9)	17.0 (19–11=8)
2019	69.0 (76–50.5=25.5)	18.0 (29–13=16)
2020	57.3 (72–45.5=26.5)	23.5 (32–16.5=15.5)
2021	65.0 (70–42=28)	23.5 (34–16=18)
2022	27.0 (34–25=9)	11.0 (19–9=10)
2023	21.5 (29–11=18)	16.0 (20 –8=12)
2024	24.0 (25–22=3)	13.0 (18 –6=12)
2025	17.5 (28–15=13)	15.0 (20–9=11)

Thus, a downward trend in the percentage of actively motile spermatozoa was observed beginning in 2022, culminating in a profound, statistically significant decrease in 2025.

Particular attention was directed toward the evaluation of total motility (the sum of actively motile and sluggishly motile forms). Throughout the 2016–2021 period, this parameter consistently exceeded the WHO thresholds. However, starting from 2022, the situation changed dramatically; the total sperm motility of the examined men dropped sharply and fell outside the reference intervals. Specifically, compared to 2016, total motility in 2025 decreased by 58.3%.

The dynamics of changes in the percentage of dyskinetic sperm forms among the examined men were characterized by year-to-year variability and remained low throughout the entire observation period. The highest values for the number of dyskinetic forms (5–7.5%) were recorded in 2022 and 2023, while the lowest values (2–3%) were observed in 2024 and 2025, respectively.

An evaluation of the percentage of immotile spermatozoa demonstrated that between 2016 and 2021, the number of immotile forms fluctuated strictly within the range of 10.5–13.0%. In 2025, a statistically significant ($p<0.01$) 1.5-fold increase in the number of immotile spermatozoa was noted compared to 2024, representing a 1.9-fold increase compared to 2016. Consequently, the percentage of these forms exceeded the reference boundaries recommended by WHO experts, exerting a substantial adverse effect on the fertile properties of the ejaculate.

Under normal physiological conditions, evaluating a dynamic kinesisgram assumes that baseline sperm motility parameters are preserved at 2 hours post-ejaculation. The observed dynamics of the decline in motile spermatozoa over the 2016–2025 period showed monotonic fluctuations within a 2.5–4.8% range, with higher rates observed in 2022, 2024, and 2025. This observed reduction in sperm motility within the dynamic kinesisgram indicated a clear trend toward asthenozoospermia.

The analysis of alterations in sperm concentration per 1 mL of ejaculate (Table 2) revealed variable stability at high values that consistently exceeded the WHO-recommended minimum thresholds. At the same time, a progressive, substantial decline in the sperm count per 1 mL was noted starting from 2022, falling in some instances to levels 2- to 3-fold lower than those recorded during the pre-war years.

Table 2

Dynamics of alterations in sperm count and concentration parameters over the 2016–2025 period

Year	Sperm concentration per 1 mL of ejaculate, (10^6/mL) Me (UQ – LQ=RQ)	Total sperm count per ejaculate volume, (10^6) Me (UQ – LQ=RQ)
2016	81.5 (90–73 =17)	163.3 (229–138=91)
2017	79.0 (92.5–71=21.5)	186.0 (233–117.5=115.5)
2018	80.0 (92–75=7)	172.0 (236–119=117)
2019	108.0 (123–89=34)	267.0 (310.5–210=100.5)
2020	107.0 (112–98=14)	269.0 (335–208=127)
2021	94.0 (109–76=30)	188.0 (299–179.4=119.6)
2022	60.5 (85–47=38)	144.0 (227–128=99)
2023	58.2 (69–57=12)	116.0 (120.1–93.2=26.9)
2024	43.7 (49–42=7)	89.2 (97–79.4=17.6)
2025	31.5 (45–30=15)	74.0 (81 –56=25)

The study of alterations in total sperm count per ejaculate volume demonstrated that throughout the observation period, this parameter remained consistently high, exceeding the thresholds recommended by WHO experts. Particularly elevated values for this parameter were recorded in 2019 and 2020. However, beginning in 2024, a substantial decline in the total sperm count was observed compared to previous years, with the lowest value recorded in 2025.

The determination of the percentage of morphologically normal spermatozoa in stained smears (Fig. 1) showed that from 2016 to 2021, this percentage fluctuated between 78% and 80%. In 2022, the number of normal forms decreased by 64% compared to the 2016–2021 baseline. Over the 2023–2025 period, morphologically normal spermatozoa averaged 4%, which was 95% lower than during the 2016–2021 period and 86% lower than in 2022. Thus, starting in 2023, the number of spermatozoa with normal morphology declined markedly compared with previous years and failed to meet the strict criteria recommended by WHO experts.

An evaluation of morphologically altered spermatozoa demonstrated that between 2016 and 2021, their percentage fluctuated strictly within the range of 20–22%. In 2022, a progressive increase in the number of morphologically altered spermatozoa was observed, rising by nearly 3-fold on average compared to the 2016–2021 period. Over the 2023–2025 period, the number of morphologically altered spermatozoa increased 1.5-fold compared to 2022, representing an average 5-fold increase compared to the 2016–2021 baseline.

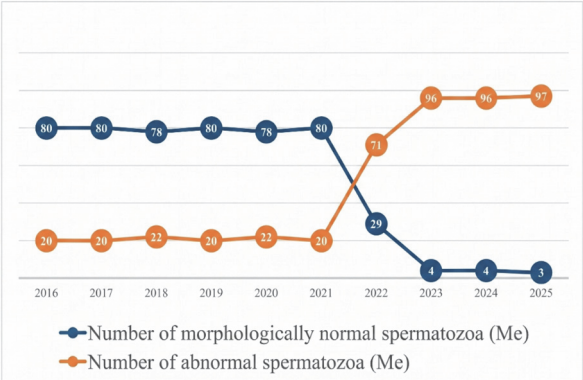

Fig. 1. Dynamics of changes in sperm morphology indicators.

The fluctuations in the number of morphologically altered spermatozoa revealed a progressive accumulation from 2022 to 2025; crucially, the values obtained deviated far beyond the WHO reference limits, indicating severe

teratozoospermia and evidently exerting a profound negative impact on the fertility of the ejaculate.

An analysis of the percentage of spermatozoa with multiple defects showed that from 2016 to 2020, only isolated forms were detected in rare fields of view. Conversely, during the 2023–2025 period, the percentage of spermatozoa with multiple defects fluctuated between 32% and 47%. The teratozoospermia index ranged from 1.8 to 2.0, providing definitive evidence of a profound deterioration in the fertile properties of the ejaculate.

The presence of spermatogenic cells in the stained ejaculate smears during the specified ten-year period remained within the acceptable limits recommended by WHO experts. The percentage of immature spermatozoa fluctuated between 2% and 7%. Concurrently, a statistically significant increase in immature spermatozoa was noted in 2019, 2020, and 2025 ($p<0.02$), which correlated with the presence of varicocele in 98% of cases.

The observed trend toward declining fertile properties in the ejaculate of reproductive-aged men from 2022 onward – manifesting as a decreased sperm count, an elevated number of morphologically altered forms alongside a reduction in morphologically normal spermatozoa, and a decline in the percentage of actively motile forms—is explained by the fact that beginning in 2022, the adverse effects of environmental variables were compounded by emotional stress caused by the armed conflict on the territory of Ukraine. Thus, these downward shifts indicate the negative impact of stressors, specifically war, on male reproductive health, as reflected in the deterioration of semen quality. The decline in mean values across all three key semen parameters confirms this impact, warranting further investigation to elucidate the underlying mechanisms and potential consequences for male fertility.

Discussion. Existing literature indicates that among the variables affecting the quality of spermatogenesis, stress plays a critical role. By inducing disharmony within the humoral-hormonal regulatory pathways, stress disrupts the neurotrophic function of the testes and serves as one of the most vital triggers for male reproductive tract disorders. Semen parameters can serve as a rapid, reliable criterion for monitoring maladaptation when the organism is exposed to damaging factors [2, 9, 10, 16].

Today, semen analysis remains the most significant diagnostic tool for evaluating male infertility. Semen analysis is a laboratory method used to evaluate the ejaculate's fertilising capacity. Its primary parameters include the absolute sperm count, the percentage distribution of motility categories, sperm viability, and normal cellular morphology [2, 11].

Conclusion

The study revealed alterations across several semen parameters characterized by dynamic variability, indicating a clear downward trend in the fertile properties of the ejaculate over the specified ten-year period. A constellation of pathological changes in the semen profiles was identified beginning in 2022 (including hypokinesis, dyskinesia, teratozoospermia, a decreased percentage of motile spermatozoa in the dynamic kinesisgram, and a trend toward oligospermia). These findings demonstrate a marked deterioration in the fertilising capacity of the ejaculate, evidently driven by the impact of adverse emotional stressors. Psycho-emotional strain, depression, and chronic stress can substantially compromise male fertility parameters; in particular, the war has become a profound source of distress for the population, carrying severe compounding consequences for male reproductive health.

Prospects for further research. To evaluate the specific patterns of changes in sperm DNA fragmentation levels among clinically healthy men of reproductive age who are exposed to stress under conditions of military aggression.

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National Center of Ophthalmology named after Academician Zarifa Aliyeva, Baku, Azerbaijan

FREQUENCY OF REFERRALS AND CLINICAL PROFILE OF CHILDREN WITH STRABISMUS AT THE TERTIARY LEVEL OF OPHTHALMOLOGICAL CARE IN AZERBAIJAN

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The highest frequency of referrals was observed among children aged 5–9 years (94.0±3.8 per 100,000). The second highest frequency was in children aged 0–4 years (85.9±3.9 per 100,000). A comparatively lower frequency of referrals was found in children aged 10–14 years (80.2±3.3 per 100,000). The frequency of hospitalization of children at the tertiary level for surgical treatment of strabismus was relatively low. In the 0–4 and 10–14 age groups, the hospitalization rates were almost the same, while in the 5–9 age group they were nearly twice as high. Despite the high level of primary referrals of children with strabismus to tertiary ophthalmological care (86.4±2.1 per 100,000 children), the frequency of hospitalization for surgical treatment was significantly lower (7.3±1.2 per 100,000 children). Referrals and hospitalizations of children with strabismus at the tertiary level are significantly higher in the 5–9 age group, with a persistent gender difference (male patients predominate). The clinical profile of patients with strabismus does not change significantly depending on age. The most characteristic features of the clinical profile are the type of strabismus, the age of diagnosis, and the probability of risk factors for strabismus.

Key words: strabismus, children, frequency of referrals, tertiary ophthalmological care, surgical treatment.

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ЧАСТОТА ЗВЕРНЕНЬ ТА КЛІНІЧНИЙ ПРОФІЛЬ ДІТЕЙ З КОСООКІСТЮ НА ТРЕТЬОМУ ЕТАПІ ОФТАЛЬМОЛОГІЧНОЇ ДОПОМОГИ В АЗЕРБАЙДЖАНІ

Найбільша частота звернень спостерігалася в дітей віком 5–9 років (94,0±3,8 на 100 тис.). Друге місце за частотою звернень займають діти віком 0,4 років (85,9±3,9 на 100 тис.). Порівняно менша частота звернень спостерігається серед дітей віком 10–14 років (80,2±3,3 на 100 тис.). Порівняно низька частота госпіталізації дітей третьому етапі для хірургічного лікування косоокості. У віці 0,4 та 10–14 років частота госпіталізації практично однакова, лише у віковій групі 5–9 років вона на 2 рази вища. За високого рівня первинного поводження дітей із косоокістю на третинному етапі офтальмологічної допомоги (86,4±2,1 на 100 тис. дитячого населення) спостерігається значно низька частота госпіталізації для хірургічного лікування (7,3±1,2 на 100 тис. дитячого населення). Звернення та госпіталізація дітей з косоокістю на третинному етапі суттєво більше у віці 5–9 років, зберігається гендерна відмінність (серед пацієнтів переважають хлопчики). Клінічний профіль хворих з косоокістю суттєво не змінюється залежно від віку. Найбільш характерними особливостями клінічного профілю пацієнтів є тип косоокості, вік під час діагностики та ймовірність наявності факторів ризику розвитку косоокості.

Ключові слова: косоокість, діти, частота звернень, третинний рівень офтальмологічної допомоги, хірургічне лікування.

Diseases of the eye muscles and disorders of friendly eye movement, combining various forms of strabismus, are common pathologies all over the world [12]. Premature infants have a significantly high risk of strabismus [1]. The epidemiological characteristics of strabismus have been studied quite well, and there are materials on its global and regional prevalence [12]. Methods of strabismus treatment have been developed and widely implemented [5]. Surgical methods for the treatment of strabismus are