ST. PETERSBURG STATE PEDIATRIC MEDICAL UNIVERSITY



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# SCIENTIFIC SUBSTANTIATION OF ORGANIZATIONAL MEASURES TO IMPROVE MEDICAL CARE FOR NEWBORNS BORN SICK AND WITH CONGENITAL DISORDERS

**Scientific specialty 3.2.3. Public health, healthcare organization and sociology, medical and social expertise**

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# INTRODUCTION

## Relevance of the study

Scientific and technological developments, which provided a scientific and technological breakthrough and a new round of development of society, stimulate an increase in the level and quality of life of the population. However, on the other hand, industrialization and globalization as an economic phenomenon have led to the emergence of a number of acute problems [19, 184, 200, 218]. Current environmental conditions, geopolitical upheavals, social and economic instability and demographic issues caused a significant deterioration in health status [8, 9, 12, 174, 187, 206]. In modern conditions, which are characterized by a significant decline in fertility rates in most developed and developing countries of the world, the health and life of every child born are of great importance [8, 70, 84, 90, 152, 170].

The newborn period is a particularly significant period in a child's life and is characterized by morphological and functional organism restructuring, directly ensuring its adaptation to extra-uterine life [11, 47, 54, 55, 81, 104]. It is in it that one should look for the causes of a significant number of diseases that are detected later throughout the rest of a person's life [67, 95, 111, 207]. Now that the critical features of the course of neonatal ontogenesis are supplemented by the action of a number of unfavorable environmental factors, the number of newborns with diseases (pathological conditions) invariably increases [2, 13, 17, 22, 52, 83, 97, 101, 151, 233].

In Russia, every year about one third of children are born sick and with congenital disorders. The most frequent cause of incidence of newborns, as well as their mortality, are certain conditions arising in the perinatal period and congenital anomalies (malformations), the proportion of which varies depending on the child's weight and the degree of prematurity [25, 117, 128, 173]. Diseases and pathological conditions that occur in the perinatal and neonatal periods predetermine a high prevalence of developmental disorders in the structure of children incidence, which indicates the expediency of shifting the vector of scientific and practical activity of doctors to the neonatal period of a child's life [50, 56, 90, 103, 129, 166]. Thus, one of the main

activities of the modern system of maternal and child health care is the provision of medical care to newborns born sick and with congenital disorders.

An important stage that required significant changes in the entire system of obstetric and perinatal care is the transition of the Russian Federation to the live birth registration system recommended by the World Health Organization (WHO) [53]. Since 2013, birth registration of children with body weight under 1000 g has been carried out according to medical criteria, taking into account the reduction of gestation period from 28 to 22 weeks, which led to a significant increase in the number of premature babies [63, 71, 98, 150]. This predetermined active implementation of the three-level system of obstetric and perinatal care through the formation of a network of regional perinatal centers [16, 100]. Technical re-equipment of medical organizations providing medical care in "neonatology" profile, improvement of their resource, drug and personnel support, as well as improvement of patient routing have significantly reduced infant mortality both in Russia as a whole and in most regions [9, 21, 44, 82, 161, 188]. However, despite the dominant role of perinatal centers in providing medical care to women during pregnancy, childbirth, the postpartum period, and newborns, each region of the Russian Federation has its own routing scheme for newborns in case of diseases and emergency conditions [58, 94, 167, 201]. At the birth of a sick child in the maternity hospital (department) according to indications, taking into account his condition, he can be transported to the department of pathology of newborns and premature infants or to the pediatric department of children's multidisciplinary hospital on the profile of the disease.

Thus, under the conditions of the formed three-level system of medical care for newborns against the background of a decrease in the birth rate and an increase in the detection of diseases associated with the improvement of material and technical base for the care of children, it is necessary to further improve medical care for newborns born sick and with congenital disorders, which determined the relevance of the selected topic for the study.

**The degree of elaboration of the research topic**

Aspects of improving the state of health and improving the organization of medical care for newborns born sick and with congenital disorders are the subject of a significant number of studies, which were carried out based on the materials of certain regions of the Russian Federation. T.G. Demyanova (2004) was involved in monitoring the health of profoundly premature infants in the first year of life [69]. The study of E.I. Saidasheva (2010) was devoted to the improvement of ophthalmologic care for newborns in megalopolis [177]. The search for ways to improve the quality of medical care for congenital malformations (CM) was carried out by E.M. Khamatkhanova (2011) [208]. Scientific substantiation of the organizational model of neonatal resuscitation care for newborns in an obstetric hospital was the subject of the work of Y.G. Sychenkov (2013) [193]. The health status of children born with very low and extremely low body weight in the postnatal period was studied by Y.V. Kurnosov (2013) [109]. Medical care for newborns with surgical diseases is covered in the work of O.G. Mokrushina (2013) [126]. Psycho-motor development and health indicators of children born with very low and extremely low body weight in the first year of life were considered in the study by N.N. Kryvkina (2015) [105]. The study by V.A. Postoev (2020) is devoted to the improvement of population-based prevention of neonatal congenital malformations using a regional birth registry [165]. The study of E.R. Nizamova (2021) is devoted to the scientific substantiation of improving the organization of medical care for premature infants [131]. Nevertheless, there have been no comprehensive medical and social studies of the state of health and organization of medical care for children born sick and with congenital disorders, including objective and subjective assessment of the quality of medical care and a study of the quality of life of sick newborns living in St. Petersburg under the new economic conditions, which determined the relevance of the present study.

**The aim of the study** was to develop and scientifically substantiate medical and organizational recommendations for improving the organization of medical care for newborns born sick and with congenital disorders.

**The main objectives of the study**

1. To study the health status of newborns and their need for medical care.

2. To present medical and social characteristics of families with sick newborn children and to assess the peculiarities of the quality of life of these children.

3. To assess the availability, quality and financial provision of medical care for children born sick and with congenital disorders.

4. To determine the medical, social and economic efficiency of medical care provided to newborns in neonatal pathology departments of perinatal centers and multidisciplinary children's hospitals.

5. To develop medical and organizational measures aimed at improving the organization of medical care for newborns born sick and with congenital disorders.

**The object of the study**

Newborns born sick and with congenital disorders.

**The subject of the study**

Assessment of the organization of medical care for children born sick and with congenital disorders in neonatal pathology departments.

**Scientific novelty of the study**

For the first time, the results of the assessment of physical development of healthy, sick and born with congenital disorders newborns by weight and height depending on gender and gestational age were obtained, which made it possible to identify significant differences in the studied groups by individual indicators. The incidence of newborns and their need for hospital admission were calculated. The following new data was obtained:

– information on the medical and social characteristics of families of children born sick and with congenital disorders, which made it possible to establish risk factors for giving birth to a sick child;

– data of comparative assessment of the quality of life of newborns born sick and with congenital disorders and healthy children depending on pathology and health group.

The main problems of accessibility and quality of inpatient medical care provided to sick newborns in obstetric and pediatric medical organizations in the conditions of megalopolis were determined;

The indicators of financial support and efficiency of the department of pathology of newborns and premature infants in medical organizations were calculated and analyzed;

The indicators of financial support and efficiency of the department of pathology of newborns and premature infants in medical organizations were calculated and analyzed. The analysis of tariffs for the provision of inpatient medical care in the "neonatology" profile in the department of pathology of newborns and premature infants and the performance of this department before and after the transition of federal medical organizations to a new type of financing was carried out;

The main directions of improving the organization of medical care for newborns born sick and with congenital disorders in inpatient medical organizations of the megalopolis were developed and scientifically substantiated.

**Theoretical significance of the conducted research** lies in the application of a set of basic methods for assessing the health and organization of medical care for children. The set of methods used in this study to assess neonatal health allowed us to expand our understanding of the physical development and incidence of children in the neonatal period.

Identification of the peculiarities of the medical and social characteristics of the families of children born sick and those who became sick allowed us to establish risk factors that contributed to the birth of a sick child. The use of the methodology for studying the quality of life made it possible to identify its features in children with various pathologies and by health groups.

The assessment of organization of medical care for children born sick and with congenital disorders made it possible to identify the main issues for its provision in medical organizations of the megalopolis, which have department of pathology of newborns and premature infants, in modern conditions.

The conducted assessment of the economic activity of the neonathal and premature infant pathology departments revealed that, with almost equal financial conditions for the provision of medical care, the efficiency of these departments both in the perinatal center and in the children's hospital has a high level of efficiency.

Provisions have been proved that, based on the assessment of health and organization of medical care for children born sick and with congenital disorders, recommendations of medical and organizational nature, contributing to the improvement of the organization of medical care for this category of newborns in inpatient settings were developed and scientifically substantiated.

The practical significance of the research is confirmed by the fact that the obtained results helped to develop a set of practical recommendations to improve the organization and quality of medical care for children in the neonathal and premature infant pathology departments in medical organizations. These recommendations can be extended to other regions of the Russian Federation.

The practical recommendations developed based on the results of this study were implemented and used in the work of the following health care institutions: perinatal center of the Federal State Budgetary Educational Institution of Higher Education "Saint Petersburg State Pediatric Medical University" of the Ministry of Health of Russia (act of implementation dated 04.12.2023) and St. Petersburg State Budgetary Healthcare Institution "St. Nicholas the Wonderworker Children's City Hospital No. 17" (act of implementation dated 20.12.2023).

Some results and the main provisions of the thesis are used in teaching students of pediatric and medical faculties, clinical residents at the departments of public health (implementation certificate dated 30.08.2023), neonatology with courses of neurology and obstetrics and gynecology on the Faculty of Postgraduate and Further Professional Education of the Saint Petersburg State Pediatric Medical University of the Ministry of Health of the Russian Federation (implementation certificate dated 02.10.2023).

**Research methodology and methods**

The present study was conducted according to a step-by-step scheme. Content analysis, sociological, graphical-analytical and qualimetric methods, method of expert

assessments, excerpting data from medical records, continuous and sampling methods (random sampling, serial sampling, multistage selection, copy-pair) were used in the work. Descriptive statistics data are presented as number of observations, arithmetic mean, standard deviation, standard error of arithmetic mean, extensive and intensive indicators. The choice of criteria for verifying the reliability of differences between indicators was based on the nature of the distribution of the data obtained. The normality of the distribution of the studied samples was checked using the Kolmogorov-Smirnov test. When comparing the two groups, the Student's *t*-test or its non-parametric analogue, the Wilcoxon-Mann-Whitney rank sum test, were used. The frequency analysis was carried out according to Pearson's $\chi^2$ test. Creation of the data set, their statistical processing, as well as analysis and visualization of the study results were carried out using Microsoft Office 2016 software (MS Word, MS Excel) and StatSoft-Statistica 10.0 software.

**The basic provisions for the thesis defence:**

1. Increasing the therapeutic and diagnostic capabilities of the maternal and child health care system, on the one hand, ensures an increase in the proportion of children born alive with a body weight of less than 2500 g, and on the other hand, leads to an increase in the incidence of newborns and their need for medical care.

2. The medical and social characteristics of families with sick children, obstetric history of their mothers and quality of life have reliable differences with the medical and social characteristics of families, quality of life and obstetric history of mothers of healthy newborns.

3. The system of medical care for sick newborns allows achieving a high level of efficiency and quality in its provision, but at the same time there are significant untapped reserves for its further improvement.

**Main scientific results**

The scientific study was carried out on the basis of an indicative sample using epidemiological, statistical, retrospective, analytical and sociological methods in the period from 2015 to 2022. In the formation of the statistical population, continuous and selective methods were used. The results of the survey of mothers revealed the features

of their obstetric history [87], quality of life [89], medical and social characteristics [82] and the main disadvantages of providing medical care to patients in the neonatal pathology department [3, 119, 122, 124, 264, 278] for the subsequent development of management decisions in order to improve quality and accessibility medical care in megalopolis healthcare organizations [86, 123, 125]. Extracting data from medical records and reports made it possible to obtain data on the state of health [5, 121, 265] and physical development of sick newborns and children who died in the neonatal period [120, 250, 251, 252], which formed the basis for practical recommendations based on the results of this work.

The obtained results are used in the process of teaching students of pediatric and medical faculties, clinical residents at the departments of Public health and neonatology with courses in neurology and obstetrics and gynecology of the Federal State-Funded Educational Institution of Higher Education "Saint Petersburg State Pediatric Medical University" of the Ministry of Health of the Russian Federation.

Based on the results of the research, the medical and organizational recommendations aimed at improving the organization of medical care for newborns born sick and with congenital disorders were implemented in the practical activities of neonatal pathology departments in St. Petersburg.

The main results and provisions of the scientific research are presented:

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**The degree of reliability and approbation of the research results**

The degree of reliability of the results obtained during the study is confirmed by the use of a sufficient amount and representativeness of the datset. A total of 328 forms of reporting and accounting medical documentation, 16 statistical materials of the Federal State Statistics Service, 12 statistical materials of the Federal State Budgetary Institution "Russian research Institute of Health" of the Ministry of Health of the Russian Federation, 973 "Questionnaires of a mother of a newborn child" and 379 "Questionnaires for assessing the quality of life of a newborn child", 8 annual reports of

the department of pathology of newborns and premature infants, 3 Appendices to the tariff agreement of the State Guarantee Program and the Territorial State Guarantee Program (TSGP) were analyzed. To process the dataset modern parametric and non-parametric methods of statistical analysis were used. The total number of information units in the study was 1716.

Approbation of the research results. Materials of the thesis were presented and discussed at the Congress with international participation "Healthy Children – the Future of the Country" (St. Petersburg, 2018), III National Congress with international participation "Healthy Children – the Future of the Country" (St. Petersburg, 2019), the Interregional Scientific and Practical Conference "Relevant Problems of Public Health and History of Medicine" (Tver, 2020), the Congress with international participation "Healthy Children – the Future of the Country" (St. Petersburg, 2020), the Congress with international participation "Healthy Children – the Future of the Country" (St. Petersburg, 2022), XVI All-Russian Scientific and Practical Seminar "Reproductive Potential of Russia: Versions and Controversies" (Sochi, 2022), the Congress with international participation "Healthy Children – the Future of the Country" (St. Petersburg, 2023).

**Personal contribution of the author**

The author independently analysed the literature sources on the subject under study, conducted the preparatory stage for the development of the research design, carried out statistical processing of the obtained results, analysed the data, formulated conclusions and developed practical recommendations. A sociological survey of mothers in the neonathal and premetaure infant pathology departments of a perinatal centre and a multi-specialized children's inpatient facility, as well as in child outpatient departments was carried out.

**Publications**

32 scientific papers have been published on the topic of the thesis, including 12 in peer-reviewed scientific publications recommended by the Higher Attestation Commission of the Ministry of Education and Science of Russia, and 7 in publications included in the international database Scopus.

**The structure and scope of the thesis**

The thesis is presented on 162 pages of typewritten text (in Russian) and consists of an introduction, a review of the literature on the research topic, three chapters of the results of the author's own research, conclusion, findings, practical recommendations, prospects for further development of the topic, a list of references and 2 appendices. The list of references includes 277 sources, including 233 of domestic and 44 of foreign authors. The work is illustrated with 18 figures and 54 tables.

# CHAPTER 1. CURRENT STATE OF NEONATAL HEALTH (LITERATURE REVIEW)

## 1.1 Major newborn health issues

The Russian Federation pays close attention to the health of the child population. As noted in the Decree of the President of the Russian Federation dated 02.07.2021 No. 400 "On the National Security Strategy of the Russian Federation", solving the tasks of increasing the birth rate, forming motivation for having many children, increasing life expectancy, reducing mortality and the level of disability of the population ensure the achievement of state policy in the field of saving the people of Russia and human development. The current state of health of the child population, especially after birth, determines the health indicators in the future, and therefore the potential level of demographic, social, labor, defense and economic resources of the state as a whole and indicates the level of stability of the demographic and medical and social situation [14, 27, 115, 185, 1877, 207, 220, 263].

The state's policy is aimed at increasing population indicators; nevertheless, the last seven years of the XXI century in Russia are characterized by a decrease in the birth rate, almost a third of newborns have some kind of health abnormalities, and one in sixteen is born prematurely. The level of perinatal pathology recorded in the neonatal period of life is significant, which has a significant impact on the infant mortality [8, 22, 28, 56, 71, 74, 127, 175, 186, 188, 192, 193, 196, 197, 212, 222, 231, 236, 262].

The Russian Federation is actively implementing measures to protect children's health at both federal and regional levels [20, 23, 40, 43, 57, 73, 81, 93, 110, 112, 113, 128, 142, 151, 162, 164, 179, 190, 228]. However, against the background of declining infant mortality, there is a constant increase in the proportion of children born prematurely, which not only requires significant financial expenditures for their treatment in specialized medical organizations and long-term recovery, but also negatively affects family relations [20, 23, 40, 43, 57, 73, 81, 93, 110, 112, 113, 128, 142, 151, 162, 164, 179, 190, 228].

Neurological disorders, respiratory pathology and intrauterine infection predominate in the structure of incidence and mortality of premature infants, especially those born with extremely low birth weight (ELBW). Properly organized prenatal and postnatal monitoring with the use of modern methods of medical care can reduce the number of complications and mortality of these children [51, 217, 232].

The level of respiratory pathology in newborns is increasing. The main risk factors for its development are prematurity and perinatal hypoxia. The increasing frequency of premature births, especially with ELBW, leads to an increased proportion of children with respiratory disorders [54, 64, 209, 221].

Perinatal hypoxia often leads to damage to the central nervous system with possible subsequent formation of infantile cerebral palsy, damage to the respiratory and cardiovascular systems, vision and hearing (blindness, deafness), hydrocephalus, symptomatic epilepsy, mental retardation and often leads to infant mortality and disability [41, 67, 72, 106, 129, 130]. A number of authors note that postnatal hypoxia is also one of the risk factors for the development of bronchopulmonary dysplasia [64, 183, 224].

Despite the successes in combating these pathologies, this problem has not yet been resolved in Russia and the risk of disability of newborns from them is extremely high [54, 90, 104, 217, 241, 244].

## 1.2 Factors that have a negative impact on the health of newborns

The authors of many scientific papers note that the intrauterine and early neonatal development of children is greatly influenced by the health of the mother and father, their living conditions and lifestyle, environmental factors and the state of health care organization in the area where families live. Taking care of the reproductive health of the population and preserving the health of children (especially during the newborn period) is one of the main directions of the domestic policy of the Russian Federation [10, 14, 21, 22, 28, 39, 59, 79, 92, 174, 182, 186, 222, 230].

Numerous scientific studies have noted the direct impact of maternal extragenital diseases (anemia, circulatory diseases, kidney disease) and obstetric complications in pregnant women (edema, proteinuria, hypertensive disorders, preeclampsia) on the health of newborns (intrauterine developmental delay, hypoxic damage to the central nervous system, neuropsychiatric disorders) [7, 9, 12, 17, 18, 55, 80, 91, 112, 116, 127, 191, 201, 205, 238, 243, 249, 252].

With the introduction of mass neonatal screening and the improvement of diagnostic capabilities of maternal and child health care institutions, the detection of congenital and hereditary diseases in newborns has increased. The proportion of these diseases ranges from 3 to 7%, increasing in stillbirths to 11-18%. Congenital malformations, deformities and chromosomal abnormalities are among the main causes of infant mortality and childhood disability [24, 26, 45, 60, 65, 66, 107, 132, 199, 229, 237, 266].

Many authors point out that the presence of birth trauma in a newborn worsens the state of his health. Birth injuries are caused by pelvic presentation (the most common cause), abnormalities of labor activity, the use of obstetric forceps and uterotonic agents to reduce the duration of labor. Obstetric aggression entails complications of labor and a decrease in the quality of obstetric care, as well as the development of perinatal pathology [49, 102, 103, 169, 171, 210, 256, 271].

The use of medicines during labor, primarily anesthetics with cardiodepressive effects, adversely affects the respiratory function of the newborn and complicates its postnatal adaptation [63, 215, 216, 219, 247].

Special attention should be paid to the results of numerous scientific works devoted to the study of the influence of social risk factors on the health of the child population, which primarily include household and material conditions of the family, insufficient education, unemployment, single-parent families, age of parents, alcohol abuse, smoking, poor moral and psychological family atmosphere, unwanted pregnancy [6, 9, 61, 168, 195, 202].

British physicians note that mothers’ age plays a significant role in the neonatal mortality. Thus, the neonatal mortality rate for children whose mothers were over 40

years old was 1.3 times higher than for children whose mothers were in the age group of 25-29 years. The same trend is observed with regard to young mothers [245, 247].

Many authors note that in obese women (especially with a body mass index of more than 30 kg/m$^2$), the rate of stillbirth and neonatal mortality increases by 2 times [154, 201, 239, 246].

Smoking, especially during pregnancy, is recognized as a risk factor for premature birth, while one third of children born full-term have a delay in intrauterine development [95, 146, 248].

The levels of perinatal and infant mortality are the most informative indicators of the state's concern for motherhood and childhood in the country [42, 55, 99, 240]. WHO notes that the first two days of life are the most critical for survival [53]. The reduction of infant mortality will reduce losses from respiratory diseases, infectious diseases, and other conditions that should predominantly be under the control of physicians [15, 234, 242].

The greatest contribution to perinatal mortality is the birth of a child with ELBW, intrauterine infection, and decompensated chronic placental insufficiency leading to extreme delay in fetal intrauterine development [254, 261, 272, 276].

One of the major challenges currently being addressed by health authorities around the world is to reduce the number of preventable perinatal deaths. Improved ante- and intranatal diagnosis of fetal condition and implementation of risk strategy can significantly help to solve this problem [1, 148, 255, 257, 258].

The frequency of preterm birth has a significant impact on the incidence and mortality of newborns. Many authors note that premature birth is the most significant risk factor for neonatal mortality. The child born often has respiratory disorders, central nervous system lesions, and intraventricular hemorrhages. Such children are much more likely to have congenital malformations and perinatal infections [157, 176, 253, 259, 268].

A large number of scientific studies are devoted to the study of newborn respiratory distress syndrome (respiratory disorders syndrome), which stands out as one of the main causes of neonatal mortality. This syndrome of respiratory disorders is most

common in premature infants (especially in children born with ELBW) [69, 101, 131, 237, 273, 275]. The authors note that respiratory distress syndrome and asphyxia of premature infants, especially in the presence of intrauterine infection, lead to early neonatal mortality [62, 102, 260].

It should be noted that intrauterine fetal hypoxia is one of the leading causes of perinatal incidence and mortality in the Russian Federation. High-quality medical care provided directly in the delivery room leads to a decrease in the negative impact of hypoxia on the health and life of newborns [11].

A threat to women's health, as well as a negative risk factor for the health of the newborn, is not provided at the appropriate level of qualified medical care to women during pregnancy in the antenatal clinic and in the maternity hospital during delivery [48, 170, 204, 205, 269].

However, it is not only the decline in the level of reproductive health of the population that had a negative impact on the decline in fertility. As we have already noted, the transition of the Russian Federation in 2012 to international criteria for live births affected an increase in the number of children born with ELBW, which negatively affected the medical and demographic indicators in the country [16, 98, 189].

Children born with ELBW are more likely than children with normal weight to have congenital anomalies, asphyxia, intrauterine infections, and respiratory distress syndrome. Developmental care of these children is extremely difficult and, in addition to resuscitative measures and medical treatment, requires long-term rehabilitation and constant careful monitoring [19, 98]. At the same time, preserving the life and improving the health of such children is a global challenge facing the entire system of maternal and child health care. To solve this problem, a three-level system of medical care for women during pregnancy, childbirth and newborns was introduced [32, 198].

In the dissertation research of Y.V. Kurnosov [109], devoted to the study of the health status of children born with very low weight (VLBW) and ELBW in the postnatal period, it is noted that among the long-term health outcomes, morphofunctional changes are observed in 64.2% of these children. Early diagnosis of infantile cerebral palsy is of particular importance for the choice of further treatment

tactics and monitoring of these children, which allows to reduce the negative prognosis for children's health and to start rehabilitation measures on time.

The data obtained generally coincide with the data of foreign authors. Thus, in Japan, with a high survival rate of premature infants with a birth weight of 1500 g or more, 19% of them have neurological disorders [256, 265]. The Swedish authors note that more than half of the surviving newborns born at 22-26 weeks of pregnancy had significant neurological disorders and somatic pathologies [250]. Surviving UK children born at 22-25 weeks of pregnancy had moderate to gross neurological impairment at the age of 6 years [15].

According to foreign authors, despite the fact that as a result of providing children born with low weight (LBW) with qualified medical care in perinatal centers, about 85% of them remain alive and are discharged home, this indicator varies significantly depending on the child's body weight at birth and gestational age. Gestational age up to 22 weeks with a birth weight of up to 500 g is the limit of viability, and such infants are extremely difficult to care for [270]. In the USA, surviving infants born at this gestational age had severe neurological pathology (up to 70%) [96, 97, 178, 265].

Survival of newborns with ELBW with a gestational age of 22 weeks or more and a weight of 500 g or more appears to be the most promising. However, the presence of gross somatic abnormalities and pathology of the nervous system can not be considered a favorable outcome and a criterion for the efficiency of medical care provided. As a result, scientists and doctors face complex issues in developing effective methods that will allow these children to have good health and quality of life as they grow older [100, 111].

## 1.3 Organization of neonatological care for newborns

In the seventies of the XX century, special neonatal pathology departments (NPD) appeared in children's hospitals in Russia, the number of which was constantly increasing. Increased attention to the preservation of children's health led to the opening

in 1981 of the All-Union Research Center for Maternal and Child Health, which later became known as the Russian Research Center for Perinatology, Obstetrics and Gynecology of the Russian Academy of Medical Sciences. In 1985, a perinatology course was first taught at the Department of Pediatrics of the Faculty of Advanced Medicine of the Leningrad Pediatric Medical Institute (LPMI). In 1993 Prof. V.V. Gavryushov created the Association of Perinatal Medicine Specialists. This Association is headed by Academician of the Russian Academy of Medical Sciences, Professor N.N. Volodin [181, 220, 223].

Currently, the procedure for providing medical care to newborns is regulated by the Order of the Ministry of Health of the Russian Federation dated November 15, 2012 No. 921n "On approval of the procedure for providing medical care in neonatology" [236]. In 2019, the Order of the Ministry of Health and Social Development No. 808n "On approval of the order of obstetric and gynecological care" introduced a three-level model of obstetric and perinatal care in the Russian Federation [148].

In 2012 [149], the Order of the Ministry of Health of the Russian Federation No. 572n "On approval of the procedure for the provision of medical care in obstetrics and gynecology (except for the use of assisted reproductive technologies)" improved the quality and accessibility of medical care for women during pregnancy, childbirth, and the postpartum period, and medical care began to be provided on the basis of routing sheets. Based on the mentioned above, all obstetric care organizations operating in the Russian Federation were divided into three groups. Maternity hospitals (maternity departments) and interdistrict perinatal centers of Group 2 have neonatal intensive care units (NICU) in their structure. In medical organizations of Group 3, which is divided into subgroups "A" and "B", the structure includes NICU department, neonathal and premature infant pathology department (stage II nursing) (NPD), and specialized, including high-tech medical care (HTMC) for newborns is provided in subgroup "B" [149]. This has improved not only the system of obstetric care, but also neonatal care for newborns, resulting in a decrease in perinatal mortality and neonatal incidence [136].

Third-level obstetric care organizations include perinatal centers, which are designed mainly to provide medical care to pregnant women with a high degree of obstetric risk and children born to these mothers. These medical organizations have modern equipment and are staffed with highly qualified medical personnel. The establishment of such centers in Russia began in 1989 [46, 133, 143, 149, 203]. The structure of the perinatal center includes: outpatient department (office) for infants in need of dynamic observation and rehabilitation as part of the consultative and diagnostic department; pediatric hospital with neonatal departments of obstetric physiological and obstetric observation departments; NICU with express laboratory; remote consultation center with visiting anesthesiology and resuscitation neonatal emergency teams; NPD (stage II nursing) [133]. Perinatal centers have resulted in significant positive changes in the fight against perinatal, infant mortality and incidence of newborns. The availability and quality of obstetric and gynecological care for women have increased, which has had a positive impact on maternal and perinatal mortality rates. The survival rate of children born with ELBW has increased [94, 152, 167, 62, 209].

Along with perinatal centers, the work of neonatal pathology departments with intensive care units, which are structural subdivisions of multidisciplinary children's hospitals and specialized hospitals, significantly contributes to the fight against neonatal mortality [223].

The modern system of emergency care for newborns in St. Petersburg was organized in 1978 at Children's City Hospital No. 1, where NICU was first opened. The first specialized pediatric emergency medical aid substation was opened there, which included pediatricians providing resuscitation and consultative care for newborns. This substation was in direct contact with NICU. After 7 years, a newborn resuscitation and consultation center was formed on its basis, the work of which was to monitor newborns with threatened conditions not only in the city, but also in the region, as this center simultaneously performs the functions of a regional bureau for hospital admission of these patients. In modern conditions, the tasks of this Center, along with the analysis of the work on emergency care for newborns are: obtaining information about the newborn

and filling out a medical history; direct assessment of the patient himself (the severity of his condition, transportability, pathology profile and urgency of arrival of the visiting team); providing advice to neonatologists of medical organizations of obstetric care on the management of the newborn until the arrival of specialized emergency care; management of visiting teams; compilation of a list of newborns in a threatened condition; remote monitoring of infants in borderline conditions. The specialized ambulances of this Center are equipped with everything necessary to provide qualified medical care and transportation of newborns.

St. Petersburg has a network of pediatric hospitals with specialized NICU and beds in department of pathology of newborns and premature infants. This bed fund comes with modern equipment that meets the license requirements, the departments personnel is highly qualified.

The decrease in early neonatal, neonatal mortality rates in St. Petersburg testifies to the high efficiency of the system of emergency and urgent care for newborns [220].

It should be noted that medical evacuation of newborns has a significant impact on the reduction of neonatal losses. Improved transportation of newborns requiring emergency and critical care provides a positive impact on its quality [126].

To ensure the possibility of transporting a newborn requiring treatment (nursing) in a higher-level medical organization, physicians of obstetric organizations should provide all the necessary therapeutic care before the neonatal resuscitation team arrives in accordance with clinical recommendations (protocols) [153, 274]. The earlier the transfer of newborns requiring a higher level of diagnosis and treatment, which can be provided in medical organizations of the appropriate level, the higher the positive effect of treatment and evacuation tactics of emergency neonatology [114, 276].

An acute problem of the health care system of the Russian Federation is the insufficient provision of medical organizations with medical personnel. At the same time, the supply of medical specialists in different territories of our country is uneven. On average, the provision of neonatologists in the country is slightly more than 60% [44, 163, 177, 213]. There is a shortage of neonatologists in many regions of the Russian Federation [84, 161, 180, 211, 213, 214] along with a high proportion of

doctors of retirement age and a low proportion of young specialists, whose local retention is extremely poor [160, 180, 211, 213, 214]. According to official statistics, 36.8% of doctors do not have a qualification category at all. 7.3% have the second category, 21.5% have the first category and only 34.4% have the highest category [213, 214].

One of the important functions of medical specialists, both doctors and secondary medical personnel, is to promote and encourage breastfeeding, especially in maternity hospitals and perinatal centers. Natural feeding is necessary for healthy, premature and sick newborns. Special attention should be paid to the organization of natural feeding of premature and sick children who are in NICU, as well as transferred to NPD. Breast feeding is essential for the effective nursing of newborns who are in serious or critical condition. Therefore, breast milk pumping rooms are organized in these units [141, 194].

Thus, the analysis of scientific domestic and foreign literature has shown that the issue of improving the organization and quality of neonatological care for infants who were born sick or fell ill in the first days after birth is extremely relevant, especially in the current demographic, economic and social conditions.

# CHAPTER 2. MATERIALS AND METHODS OF RESEARCH

The research was conducted in St. Petersburg, which is a part of the Northwestern Federal District (NWFD) and is divided into 18 districts, which in turn are subdivided into 111 municipalities. According to Rosstat, 5600 million people lived in St. Petersburg in 2023, it is the second largest megalopolis in terms of population after Moscow. Of the total population, the number of children and adolescents (0-17 years old) is 1 221 million, including 50 437 children under one year old (boys 51.4% and girls 48.6%). St. Petersburg belongs to the subjects of the Russian Federation with high population density – the average density is 3 832.3 people/km$^2$. The area occupied by the city is 1 439 km$^2$. The main nationalities are Russians (86.5%), Germans (4.1%), Poles (2.9%), Finns (1.7%), Estonians (1.0%), Jews (0.9%).

Four medical organizations were taken as the the base for this study: 2 medical organizations with neonathal pathology departments and 2 city children's polyclinics in St. Petersburg.

As a stage of nursing of newborns and premature babies, the NPD is available in two types of medical organizations: perinatal centers and pediatric multidisciplinary hospitals. In St. Petersburg, there are 2 NPDs in federal perinatal centers, 1 – in the city perinatal center and 4 – in multidisciplinary children's hospitals. Therefore, the NPD of perinatal center of the Federal State Budgetary Educational Institution of Higher Education "Saint Petersburg State Pediatric Medical University" of the Ministry of Health of the Russian Federation and the NPD of the SPb State Budgetary Healthcare Institution "St. Nicholas the Wonderworker Children's City Hospital No. 17" were selected for the present study. For the study of healthy newborns (comparison group), two children's polyclinics (child outpatient departments, COD) located in different districts of the city were selected: St. Petersburg State Budgetary Institution "City Polyclinic No. 27" Child Outpatient Department and St. Petersburg State Budgetary Institution "City Polyclinic No. 19" Child Outpatient Department No. 43.

The subject of the study was the assessment of the organization of medical care for children born sick and with congenital disorders in neonatal pathology departments.

The object of the study is newborns born sick and with congenital disorders.

The unit of observation is a sick newborn child admitted to neonatal pathology department.

Statistical materials of the Federal State Statistics Service (Rosstat), statistical collections of the Federal State Budgetary Institution "Central Research Institute of Health Care Organization and Informatization" of the Ministry of Health of the Russian Federation were used in the conducted research [85, 75, 76, 77, 78, 154, 155, 156].

The total number of information units in the study was 1 722.

The study was conducted in 4 stages. At the first stage, the aim and objectives of the study were formed, the research design was developed, research instruments were selected and criteria for the selection of newborns were determined, and a regulatory and legal assessment of the current system of organizing medical care for children born sick and with congenital disorders was carried out. To analyze the state of the problem, sources of domestic and foreign literature on the organization of medical care for this category of children were studied.

The second stage involved interviewing (face-to-face survey) of mothers, copying data from medical records and official statistics. At the third stage, a comparative assessment of the health status of newborns and the medical and social characteristics of families with children born sick and with congenital disorders was carried out, the need for hospital admission of the studied contingent was studied, a study of the quality of life of sick newborns in comparison with healthy ones was conducted and the efficiency, accessibility and quality of medical care for this age group were evaluated.

The analysis and statistical processing of the obtained results, their literary and graphic design were also carried out at the third stage.

At the fourth stage, based on the generalization of the data and the results obtained, practical medical and organizational recommendations were developed aimed at improving medical care for newborns born sick and with congenital disorders.

The present study was conducted according to a specially designed program, the theoretical and methodological basis of which were the works of domestic and foreign

scientists in the field of public health and health care organization, obstetrics, perinatology and neonatology, as well as regulatory and legal documents.

In accordance with the first task, physical development and incidence of newborns were studied. To assess the physical development of newborns at the population level, the distribution of children by birth weight in the Russian Federation, the Northwestern Federal District and St. Petersburg in dynamics for 2015-2022 was studied. The basis was the division of newborns by weight in accordance with the order of the Ministry of Health and Social Development of the Russian Federation No. 1687n dated December 27, 2011 "On medical criteria of birth, the form of the birth document and the procedure for its issuance" (as amended in 2019) [134]. Based on this division of children by birth weight, they were grouped into three weight groups: low (up to 2500 g: ELBW, VLBW, LBW), medium (from 2500 to 4000 g) and high (more than 4000 g). The research program is presented in Table 2.1.

Table 2.1 - Research program

| **The aim of the study** is to develop and scientifically substantiate medical and organizational recommendations for improving the organization of medical care for newborns born sick and with congenital disorders. | | | |
|---|---|---|---|
| **No.** | **Research objectives** | **Research methods** | **Records and scope of observations** |
| 1. | To study the health status of newborns and their need for medical care | Epidemiological, statistical, retrospective analysis, sociological, analytical | - Statistical materials "Demography"; N=16<br>- Statistical materials of the Federal State Budgetary Institution "Russian research Institute of Health" of the Ministry of Health of the Russian Federation; N= 12<br>- Extract from "History of childbirth" (form 096/u); N=154<br>- Extract from "Protocol of pathological and anatomical autopsy of a fetus, stillborn or newborn" (form 013-1/u); N=154<br>- "Questionnaire for mother of a newborn"; N=973 |
| 2. | To present medical and social characteristics of families with sick newborn children and to assess the peculiarities of the quality of life of these children | Statistical, sociological, analytical | - "Questionnaire for mother of a newborn"; N=973<br>- "Questionnaire for assessment of the quality of life of a newborn"; N=379 |

Continuation of Table 2.1

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| 3. | To assess the availability, quality and financial provision of medical care for children born sick and with congenital disorders | Statistical, sociological, analytical | - Statistical materials of the Federal State Budgetary Institution "Russian research Institute of Health" of the Ministry of Health of the Russian Federation; N= 6<br>- "Questionnaire for mother of a newborn"; N=973<br>- Extract from the report "Information on medical organization" Form 30 (annual); N= 4<br>- Extract from the "Annual reports on the work of the Perinatal Center of St. Petersburg State Pediatric Medical University" in 2019-2022; N=4<br>- Extract from annual reports of the department of pathology of newborns and premature infants of SPb State Budgetary Healthcare Institution "St. Nicholas the Wonderworker Children's City Hospital No. 17" in 2017-2022; N=4 |
| 4. | To determine the medical, social and economic efficiency of medical care provided to newborns in neonatal pathology departments of perinatal centers and multidisciplinary children's hospitals | Statistical, mathematical | - Appendices to the tariff agreement of Programs of state guarantees and territorial programs of free medical care for citizens (TSGP) of St. Petersburg for 2015-2022; N=8<br>- Materials and results of the conducted research<br>- Summary statement of the movement of patients and bed stock (form 016/u-02) for 2019-2022; N=8 |
| 5. | To develop medical and organizational measures aimed at improving the organization of medical care for newborns born sick and with congenital disorders | Analytical | - Materials and results of the conducted research. |

Comparative assessment of the physical development of sick newborns in comparison with healthy children was based on the data obtained by questioning mothers. The main group consisted of children who were born sick and with congenital disorders, who were treated in NPDs of the perinatal center and children's hospital. Only children admitted during the newborn period (0-28 days) whose parents were permanent residents of St. Petersburg were included in the study. The control group consisted of healthy children (health groups I and II), whose parents also belonged to

the resident population, who underwent routine preventive medical examinations in the 1st month of life in the COD of urban polyclinics in accordance with the Order of the Ministry of Health of Russia No. 514n dated August 10, 2017 [137].

Due to the fact that a sample study was planned, the minimum required volume of representative samples $n_p$ was calculated (formula (1)):

$$n_p = \frac{N \cdot t^2 \cdot \bar{p} \cdot (1 - \bar{p})}{N \cdot \Delta\bar{p}^2 + t^2 \cdot \bar{p} \cdot (1 - \bar{p})}, \quad (1)$$

where $N$ – number of the general population;

$t$ – critical value of Student's test for a given confidence probability; we set 95%, at this value $t$ will be equal to 1.96;

$\bar{p}$ – approximate frequency (fraction), taken at the rate of 0.5;

$\Delta\bar{p}$ – maximum frequency error (5%).

The calculation revealed that in order to maintain the representativeness of the sample, the minimum threshold of respondents who need to be surveyed in the NPD was 296 people, and in the COD – 374. The number of discharged NPD patients of the perinatal center and children's hospital (1294) and the number of newborns admitted to the COD care (1513) for the year 2022 were taken as the general population.

With a specially designed questionnaire forms "Questionnaire for mother of a newborn", an anonymous survey was conducted among 973 mothers of newborns who received medical care under compulsory health insurance (CHI) in medical organizations of St. Petersburg in 2019-2020. The selection of mothers to participate in the study was carried out by random method in compliance with all the rules of representativeness. They independently filled out questionnaires prior discharge from a medical organization or during the child's preventive medical examinations at one month of life. Completion of the questionnaire form was taken as consent to participate in the study. The questionnaire consisted of two parts and contained 33 questions (Appendix 1). The first part of the questionnaire contained general questions characterizing the family, as well as questions to assess the obstetric and gynecological history of the mother and the child's health status (filled out by all mothers). The second part of the questionnaire contained questions to assess the quality of medical care

provided to a newborn in the NPD (filled out only by mothers whose children were treated in the NPD during the newborn period).

As a result of the survey, 495 completed questionnaire forms were received from the NPD, among which 481 completed questionnaire forms were selected (2.8% culled) and 511 forms in the COD, of which 492 questionnaires were selected (4.8% culled). Main group: 228 mothers (47.4%) in the perinatal center NPD and 253 mothers (52.6%) in the pediatric hospital NPD, who participated in the study. Control group: 234 mothers (47.6%) participated in the study in the "City Polyclinic No. 27" COD and 258 mothers (52.4%) participated in the COD No. 43. The formation of the statistical population was carried out by a sampling method [158]. The representativeness of the samples was checked according to the method of Prof. A.M. Merkov (formula (2)):

$$\Delta = t \cdot \sqrt{\frac{\sigma^2}{n} \cdot \left(1 - \frac{n}{N}\right)}, \quad (2)$$

where $\Delta$ – measure of precision;

$t$ – confidence coefficient (if $t$ = 2, the probability is 0.954);

$\sigma^2$ – dispersion of the sample population ( $\sigma^2$ = 0.25 is taken);

$n$ – sample: in the main group amounted to 481, in the control group - 492;

$N$ – general population (number of patients discharged from the NPD (1294) and number of newborns admitted for observation to the COD (1513) in 2019).

Carrying out calculations according to formula (2), we determine that the error in this study will not exceed for the main group 3.6% and for the control group 3.7%, which is allowed.

In order to assess the physical health of deceased newborns, medical records were excerpted for 154 first-month of life deaths in 2019-2020. 308 medical documents were analyzed, including: 154 "Birth histories" (form 096/u); 154 "Protocols of pathological anatomical autopsy of a fetus, stillborn or newborn" (form 013-1/u). The calculated minimum required volume of a representative sample showed that the number of units in the study should be at least 32 (formula (1)). The representativeness of the data was checked according to the method of Prof. A.M. Merkov (formula (2)). The study error will not exceed 3.2%, which is acceptable.

The weight and birth height of deceased newborns depending on gestational age were estimated by the sigma method using the tables of G.M. Dementyeva and E.A. Korotkaya [68].

Since, according to the current regulatory framework, neonatologists at obstetric hospitals establish a health group for newborns and it is determined only during patronages or medical examinations at the stage of the children's polyclinic, then for children who did not have a health group determined, it was established in accordance with the following classification: I – healthy children subject to medical supervision; II – healthy children with functional abnormalities requiring attention and consultation of specialists; III – children with persistent health disorders and chronic diseases in the stage of compensation; IV – children suffering from chronic diseases and congenital malformations with functional decompensation; V – children with disabilities [50, 172].

The assessment of the morbidity of newborns was carried out in dynamics for 2015-2022 using the analysis of indicators, the data for the calculation of which were taken from the official statistics of the Central Research Institute of Health Care Organization and Informatization and Rosstat. The structure and incidence of newborns born sick and those who became ill were calculated based on the data of a survey of mothers. The need for hospital admission of newborns was also calculated on the basis of the official data.

To solve the third task of identifying differences in the medical and social characteristics of families with sick and healthy children, the survey data of mothers in the NPD and COD were also used. To assess the quality of life of children born sick and with congenital disorders, in addition to the above-described questionnaire, the same respondents were interviewed (face-to-face survey). The criterion for inclusion in the study was the child age of 30-35 days of life. This was a prerequisite, as the mother assessed the child's quality of life during the last 7 days preceding the questionnaire. The copy-pair method was used to generate the sample. As a result, 379 people were selected, including 183 newborns born sick and with congenital disorders (main group) and 196 healthy children (control group). Inclusion in the study was based on the consent of the mothers, who filled out a questionnaire form. Type of study:

observational study – data for the study were collected by simple interview, and no effects, interventions, experiments during the study were conducted; descriptive-analytical study – the quality of life of sick newborns and healthy children was studied, the quality of life was assessed (descriptive stage of the study), and the quality of life indicators of sick newborns with three types of pathology (congenital heart disease, anemia and hydrocephalus) and healthy children were compared; cross-sectional study – each respondent was interviewed only once, and was not observed or interviewed afterwards; non-randomized study – the distribution of participants into groups was at the will of the researcher in accordance with a pre-determined plan, rather than in a random order.

Quality of life was assessed using the PedsQL questionnaire (Appendix 2), which was included in the "Questionnaire for assessing the quality of life of a newborn child". The questionnaire contains 8 questions, the results of processing of which form 5 scales of assessment: physical activity, physical symptoms, emotional state, social activity, cognitive activity. The standardized response options for the questions were compiled for scoring using the summated rating method and are presented as Likert scales. After scaling, the results are expressed in points from 0 to 100: the higher the final value, the higher the quality of child's life. Data scaling was performed according to copyrighted procedures with specialized software.

Instruction of the study participants (social survey). Prior to the study, each parent was informed of the purpose and methods of the study and how the information obtained would be used. The respondents were explained in detail the structure of the proposed questionnaire and the procedure for filling them out, and were informed about the confidentiality and anonymity. The survey of patients was conducted in the daytime in a comfortable environment. The questionnaire duration was 25-35 minutes.

To solve the third task of assessing the availability and quality of medical care for children born sick and with congenital disorders, the level and dynamics of indicators of the NPD bed availability and hospital mortality of newborns with ELBW and 1000 g or more at the age of 0-6 days in the territory of the Russian Federation, the NWFD and St. Petersburg were analyzed. In order to study the quality of medical care, we used

questionnaire data only from mothers of newborns who were born sick and those who became sick and were treated in the NPD. To assess the quality of inpatient medical care for this category of children, the "Questionnaire for mother of a newborn" included 14 additional questions (part 2). The quality of medical care was assessed and compared with the perinatal center NPD (228 mothers (47.4%)) and the children's hospital NPD (253 mothers (52.6%)).

The calculation revealed that in order to maintain the representativeness of the sample, the minimum number of respondents to be surveyed in the perinatal center is at least 38 units, and in the children's hospital – at least 40 units. The number of discharged patients from the perinatal center NPD (550) and the children's hospital (744) for the year 2019 was taken as the general population. The sample size corresponded to studies of average precision with a confidence ratio of 2 and a probability of 0.954. The verification of the representativeness of the samples was performed according to the methodology of Prof. A.M. Merkov (formula (2)). The study error does not exceed 4.9% in perinatal centers and 4% in pediatric hospitals, which is acceptable.

Since the Federal Fund for Compulsory Health Insurance (FFCHI) [146, 147] recommends choosing 2-4 medical organizations of each type as a base for conducting sociological surveys, taking into account the number of treated patients, this condition is met in the present study. Parents' satisfaction with the quality of medical care in the NPD was assessed with a questionnaire that included questions from the FFCHI recommended questionnaire. The study assessed the following characteristics of the NPD work: technical condition and repair of the ward premises; comfort of the ward and places of stay of the newborn; work of auxiliary services; provision of the ward with medicines and consumables; quality of medical care received. To assess the satisfaction of parents of newborns with the attitude of medical personnel, the questionnaire included questions to examine the following criteria: politeness and attentiveness of neonatologists and nurses; the amount of time and attention paid to the children. In addition, the assessment of the work of medical personnel in the NPD was carried out according to a five-point system.

Satisfaction was measured based on the methodological recommendations of the FFCHI [147]. The following modification of the scale was taken for evaluation: the specific weight of "completely satisfied" ratings (for the attitude of medical personnel "always with attention and participation" and "always gives the child enough time and attention") 0-25% – low level; 25-50% – satisfactory; 50-75% – average; 75-100% – high.

To solve the fourth task, tariffs for the provision of medical care to newborns in the NPD of medical organizations were analyzed, and an assessment of the financial support for the activities of neonathal pathilogy departments was carried out. Further, the indicators of medical, social and economic efficiency of medical care provided to newborns born sick and with congenital disorders were calculated. The following methodology was used to calculate medical efficiency (formula (3)):

$$K_{\text{M}} = \frac{\text{number of cases of medical results achieved}}{\text{total number of assessed cases of medical care}}, \quad (3)$$

where $K_{\text{m}}$ – coefficient of medical care efficiency.

To assess the social efficiency of medical care for sick newborns, the mother's satisfaction coefficients for individual criteria were calculated and then the integral satisfaction coefficient $K_{\text{s}}$ or coefficient of social efficiency was calculated (formula (4)):

$$K_{\text{y}} = \frac{0,25N_{0,25} + 0,5N_{0,5} + 0,75N_{0,75} + N_{1,0}}{N_{\text{в}}}, \quad (4)$$

where 0.25; 0.5; 0.75; 1.0 – points based on the results of the patient survey;

$N_{0.25}$; $N_{0.5}$; $N_{0.75}$; $N_{1.0}$ – number of questionnaire cases that received this score based on the results of the respondents' survey;

$N_{\text{v}}$ – total number of questionnaire cases, including zero estimates.

The scale of evaluation of the provided medical care was constructed as follows: 1.0 – fully satisfied; 0.75 – more satisfied than not satisfied; 0.5 – not fully satisfied; 0.25 – found it difficult to answer; 0 – not satisfied.

Next, the integral coefficient of satisfaction, or the coefficient of social efficiency $K_s$ (formula (5)) was calculated:

$$K_s = (K_1 + K_2 + ... + K_9) / 9, \quad (5)$$

where $K_1$, $K_2$, $K_9$ – ……..

To calculate the economic efficiency formula (6) was used – calculation of the coefficient of economic efficiency $K_e$ of bed fund utilization [146], which is defined as an integral indicator reflecting the degree of rational ($K_{rational}$) and targeted use of the bed fund ($K_{target}$):

$$K_e = K_{rational} \cdot K_{target}, \quad (6)$$

where

$$K_{rational} = O_{fact} / O_{norm}, \quad (7)$$

where $O_{fact}$ – actual bed turnover;

$O_{norm}$ – normative turnover, for which the planned bed turnover ($F$) calculated according to formula (8) was taken:

$$F = 365 – t_{rep} / T + t_{turn}, \quad (8)$$

where $t_{rep}$ – average time of bed downtime for repair (approximately 10-15 days per year), days; to calculate this indicator it is necessary to divide the total number of bed-days of closure for repair by the average annual number of deployed beds;

$T$ – average terms of treatment (the recommended standard from the letter of the Ministry of Health of Russia No. 11-7/I/2-2-275 dated 13.01.2022 "On the formation and economic justification of territorial programs of state guarantees of free medical care for citizens for 2022-2024" for neonatology is 12.1 days);

$t_{turn}$ – bed downtime due to bed turnover (1.0 for all profiles, except for phthisiatric – 3; obstetric – 2.5-3; infectious – 3; abortion beds – 0.5, etc.), days;

Thus, $F = 365 – 12.5 / 12.1 + 1 = 27$ (days).

Accordingly, the planned bed operation will be 327 days.

The coefficient ..... $K_{target}$ was calculated (formula (9)):

$$K_{target} = Utarget / U_o, \quad (9)$$

where $U_{target}$ – number of patients admitted in the presence of reasonable indications for inpatient treatment; estimated by experts from other hospital institutions, medical insurance organizations and the territorial health insurance fund;

$U_o$ – total number of patients admitted to the hospital.

The coefficient of targeted use of the bed fund $K_{target}$ reflects the occupancy of beds for justified hospital admission of inpatients, is determined by expert judgment and cannot be more than 1. We take it equal to 1 in our calculations, assuming that all admissions were justified.

Next, the integral efficiency ($K_i$) of medical care for newborns born sick and with congenital disorders was calculated (formula (10)):

$$K\,i = K_m + K_s + K_e, \quad (10)$$

To assess the indicators of medical, social, economic and eventually integral efficiency of NPD work, the following methodology of scaling indicators was adopted: 0-0.24 – very low level; 0.25-0.49 – low level; 0.5-0.74 – medium level; 0.75-1.0 – high level; more than 1.0 – very high level.

Content analysis, sociological, graphical-analytical and qualimetric methods, method of expert assessments, excerpting data from medical records, continuous and sampling methods (random sampling, serial sampling, multistage selection, copy-pair) were used in the work. Descriptive statistics data are presented as number of observations, arithmetic mean, standard deviation, standard error of arithmetic mean, extensive and intensive indicators. The choice of criteria for verifying the reliability of differences between indicators was based on the nature of the distribution of the data obtained. The normality of the distribution of the studied samples was checked using the Kolmogorov-Smirnov test. When comparing the two groups, the Student's *t*-test or its non-parametric analogue, the Wilcoxon-Mann-Whitney rank sum test, were used. The frequency analysis was carried out according to Pearson's $\chi^2$ test. Creation of the data set, their statistical processing, as well as analysis and visualization of the study results were carried out using Microsoft Office 2016 software (MS Word, MS Excel) and StatSoft-Statistica 10.0 software.

# CHAPTER 3. HEALTH STATUS OF NEWBORNS AND THEIR NEED FOR MEDICAL CARE

The NWFD is among the Russian regions with one of the lowest birth rates in the country, which in 2022 amounted to 8.1%. In total, 113 095 children were born alive in the district in 2022. At the same time, in the NWFD, as well as in the country as a whole, there was a clearly pronounced downward trend in the birth rate since 2016 (Figure 3.1), which naturally led to a decrease in the absolute number of births. Thus, in 2022, compared to 2015, the birth rate decreased by 35.2% and the absolute number of live births decreased by 45 930 children [252].

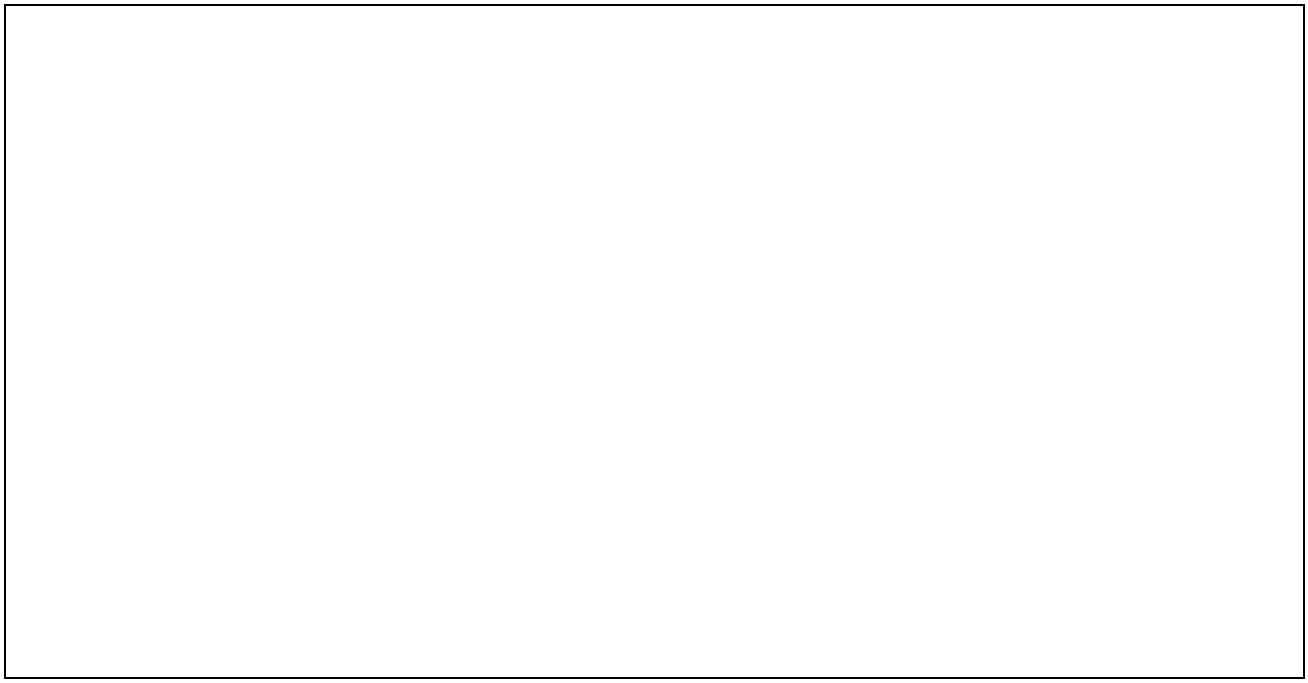

Figure 3.1 – Birth rate dynamics in the Russian Federation, Northwestern Federal District and St. Petersburg in 2015-2022 (per 1000 live births)

The assessment of St. Petersburg's contribution to the birth rate in the NWFD revealed that 50 437 children were born alive in the city in 2022, and this accounted for 44.6% of all children born in the federal district. The highest rates of fertility decline over the period under study were observed (Table 3.1) in the Vologda region (-40.6%), Kaliningrad region (-38.3%), Novgorod region (-37.8%) and the Komi Republic (-36.0%).

Table 3.1 – Fertility rate dynamics in selected subjects of the Northwestern Federal District in 2015-2022 (per 1000 live births)

| NWFD subjects | Years | | | | | | | | Decline rate, % |
|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | |
| Republic of Karelia | 12.2 | 11.9 | 10.3 | 9.7 | 9.0 | 8.5 | 8.5 | 8.2 | -32.8 |
| Komi Republic | 13.6 | 13.1 | 11.5 | 10.2 | 9.6 | 9.3 | 8.9 | 8.7 | -36.0 |
| Arkhangelsk region | 12.4 | 12.0 | 10.6 | 9.8 | 9.0 | 8.4 | 8.1 | 8.1 | -34.7 |
| Vologda region | 13.8 | 13.3 | 11.4 | 10.5 | 9.7 | 9.2 | 9.1 | 8.2 | -40.6 |
| Kaliningrad region | 12.8 | 12.5 | 11.1 | 10.4 | 9.3 | 9.2 | 8.8 | 7.9 | -38.3 |
| Leningrad region | 9.1 | 9.2 | 8.4 | 7.8 | 7.3 | 7.1 | 6.8 | 6.0 | -34.1 |
| Murmansk region | 11.9 | 11.2 | 10.3 | 9.8 | 8.9 | 8.8 | 8.3 | 8.5 | -28.6 |
| Novgorod region | 11.9 | 11.8 | 10.2 | 9.7 | 8.7 | 8.2 | 7.8 | 7.4 | -37.8 |
| Pskov region | 11.1 | 11.1 | 9.5 | 9.3 | 8.5 | 8.0 | 8.2 | 7.3 | -34.2 |
| St. Petersburg | 13.6 | 13.9 | 12.6 | 12.0 | 11.0 | 10.3 | 9.9 | 9.0 | -33.8 |
| District as a whole | 12.5 | 12.5 | 11.1 | 10.5 | 9.6 | 9.1 | 8.8 | 8.1 | -35.2 |

## 3.1 Physical development of newborns

WHO considers physical development indicators as one of the basic criteria for assessing the health of the newborn and set one of its goals to reduce the number of babies born with LBW by 30% by 2025.

The assessment of physical development of the newborn is given in the current Order of the Ministry of Health and Social Development of Russia dated 27.12.2011 (as amended on 15.04.2021) No. 1687n "On medical criteria of birth, the form of the birth document and the procedure for its issuance" [134]. Children born with LBW are more likely to have functional disorders, higher incidence, often unfavorable prognosis in terms of neurological outcomes, and higher risk of neonatal mortality. Health disorders in such children tend to be more severe, complex and diverse. The birth of children with ELBW is characterized by particularly adverse consequences. In 2022, 0.40% of children born alive in the NWFD had a body weight of up to 1000 g, 1000-1499 g – 0.62% and 1500-2499 g – 4.95% (Table 3.2). In St. Petersburg, the proportion of children born alive with ELBW was 0.37%, with a body weight of 1000-1499 g – 0.62%, with 1500-2499 g – 4.78% [226, 252].

Table 3.2 – Distribution of live-born children by body weight in the Russian Federation, the Northwestern Federal District and St. Petersburg in 2022 (% of the number of live births)

| Administrative unit | Body weight, g | | | | | Total |
|---|---|---|---|---|---|---|
| | up to 1000 | 1000–1499 | 1500–2499 | 2500–3999 | 4000 and more | |
| Russian Federation | 0.38 | 0.58 | 4.94 | 84.32 | 9.78 | 100.0 |
| NWFD | 0.40 | 0.62 | 4.95 | 83.1 | 10.93 | 100.0 |
| St. Petersburg | 0.37 | 0.62 | 4.78 | 82.57 | 11.66 | 100.0 |

Throughout the entire study period (2015-2022), the share of low birth weight newborns (up to 2500 g) in St. Petersburg was below the national and the NWFD average (Figure 3.2). Analysis of the dynamics of the specific weight of newborns born alive with a body weight up to 2500 g showed that until 2019 both in the NWFD and in the Russian Federation as a whole there was an increase in the indicators, but in 2020 the share of children with LBW significantly decreased. In St. Petersburg, the change in this indicator during the period under study was multi-directional.

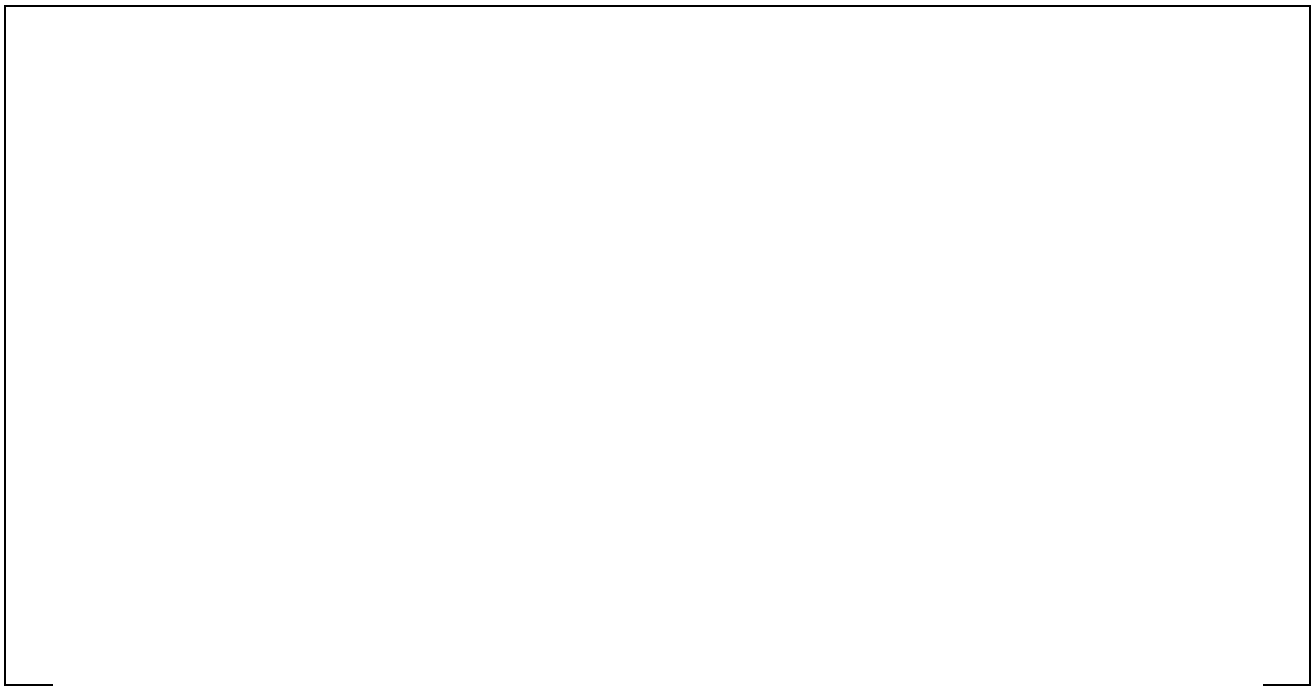

Figure 3.2 – Dynamics of the share of children born alive with low birth weight in the Russian Federation, the Northwestern Federal District and St. Petersburg in 2015-2022 (% of the number of live births).

As Figure 3.3 shows, the share of newborns weighing less than 1000 g in St. Petersburg in 2015-2021 was above the national average, but in 2022 it became below the national average. The comparison of the specific weight of children born with

ELBW in the NWFD and the megalopolis revealed that since 2019, the indicator in the city began to exceed the average county values.

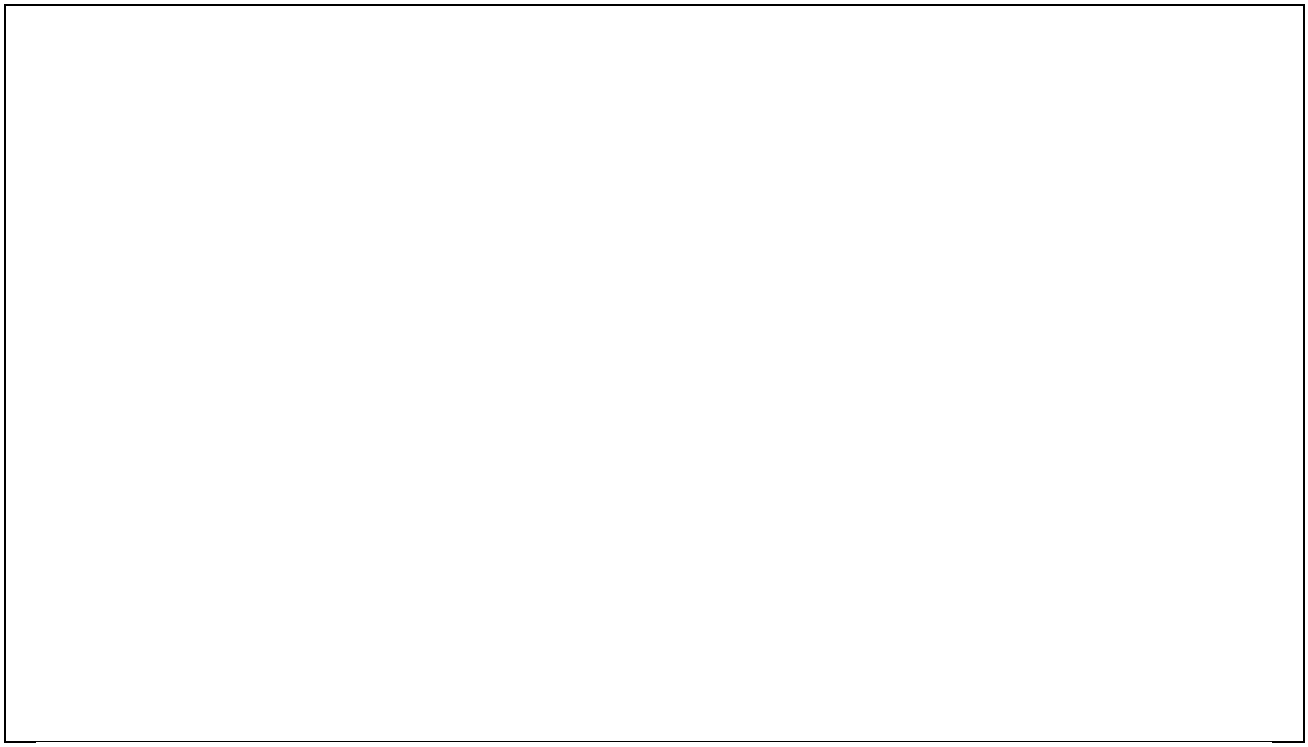

Figure 3.3 – Dynamics of the share of children born alive with extremely low birth weight in the Russian Federation, the Northwestern Federal District and St. Petersburg in 2015-2022 (% of the number of live births).

The birth of a child with a high birth weight is considered in ICD-10 as P08, class XVI, "Selected conditions occurring in the perinatal period." If the birth weight amounts to 4500 g or more, the child is classified as overweight (P08.0). Other infants whose birth weight exceeds the gestational age-appropriate values, irrespective of gestational age, are classified as P08.1 "Other "large-weight" to term children". In 2022, the proportion of large-born children in the NWFD amounted to 10.93% of live births (Figure 3.4), which exceeded the average level for the Russian Federation by 1.1 times (9.78%).

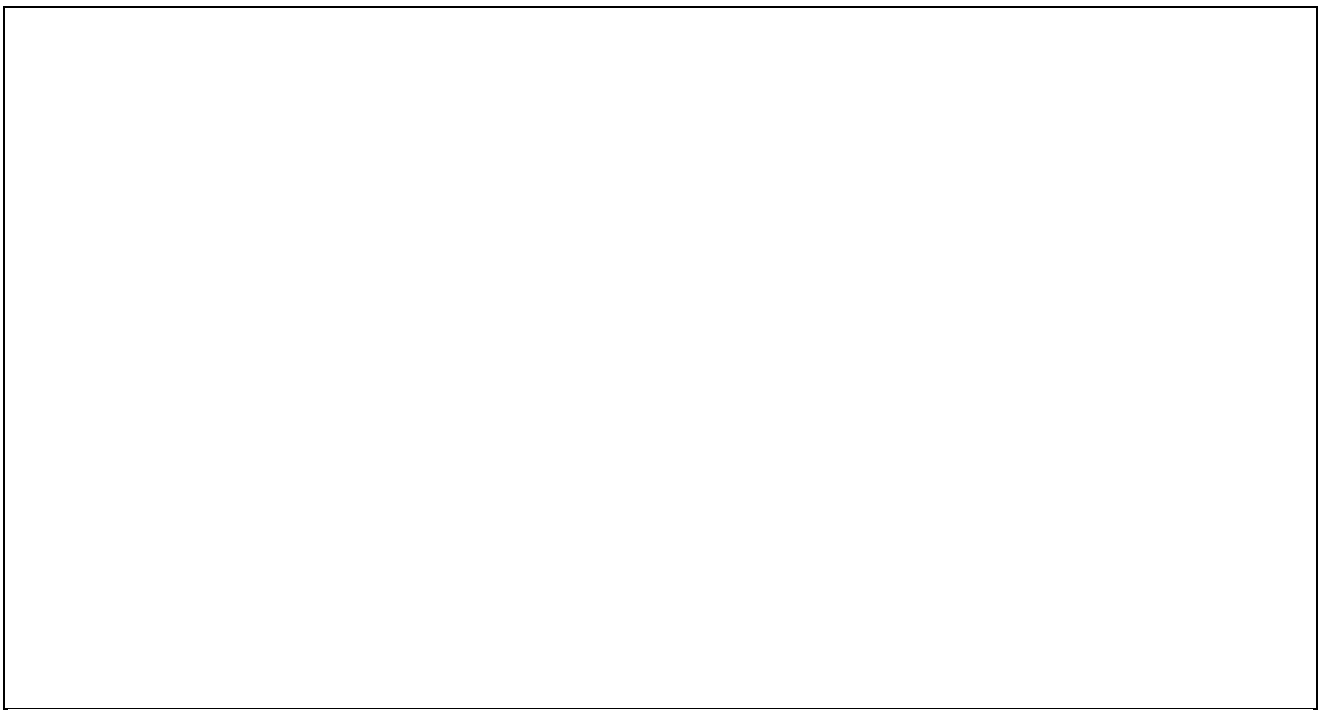

Figure 3.4 – Dynamics of the share of children born alive with a birth weight of 4000 g or more in the Russian Federation, the Northwestern Federal District and St. Petersburg in 2015-2022 (% of the number of live births).

Analysis of the dynamics of the specific weight of children born alive with a birth weight of 4000 g or more for the period 2015-2022 showed that from 2015 to 2019 in the NWFD this indicator had a clearly pronounced downward trend (Figure 4), but in 2020 there was a rise from 9.4% to 10.14%, and after that the indicator began to decline again. The share of large newborns in the NWFD exceeded the national average throughout the analyzed period. In St. Petersburg, the proportion of children born alive with high birth weight exceeded not only the mean values in the Northwestern Federal District, but also in the Russian Federation as a whole. The indicator level in 2022 amounted to 11.66%, which was 6.3% and 16.2% higher than the district and national averages, respectively.

In 2022, only 83.10% of children born alive in the Federal district had an average birth weight (Figure 3.5), which is 1.22% less than the average for the Russian Federation (84.32%).

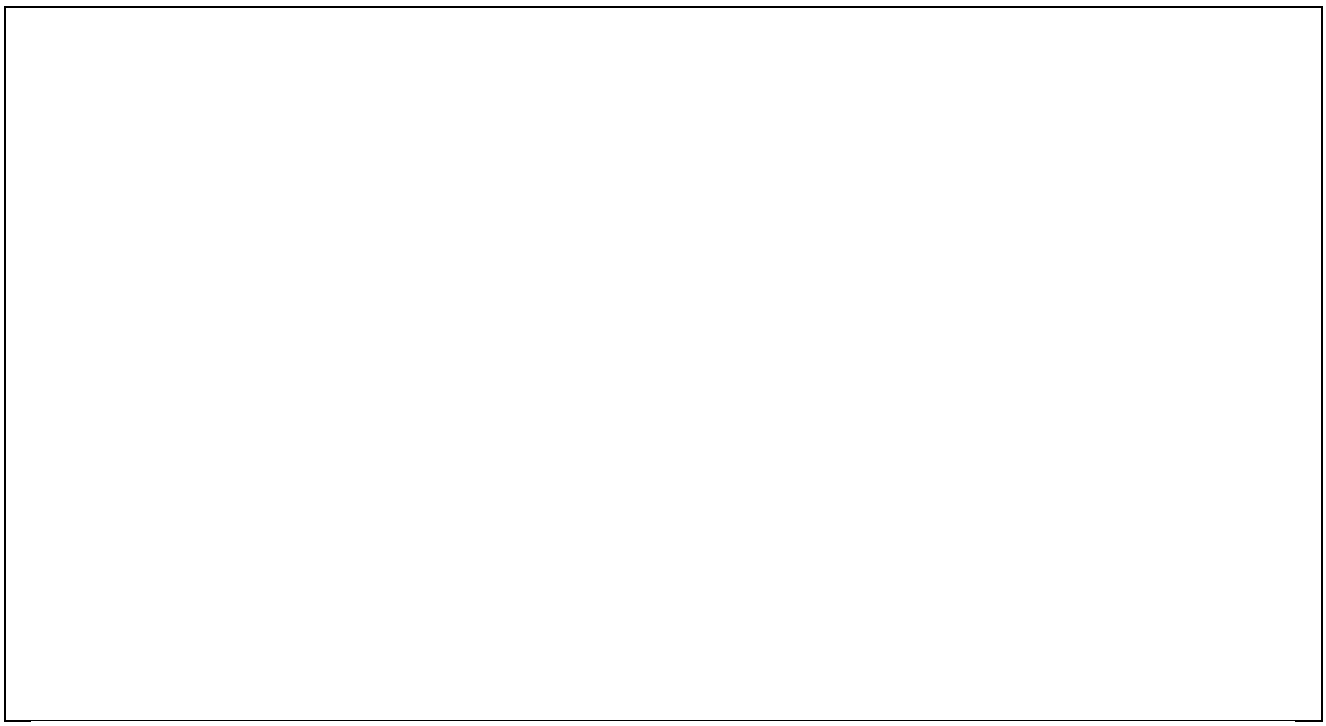

Figure 3.5 – Dynamics of the share of children born alive with average body weight in the Russian Federation, the Northwestern Federal District and St. Petersburg in 2015-2022 (% of the number of live births).

During 2015-2018, the proportion of children born with average weight did not change significantly both in the country as a whole, in the NWFD, and in the megalopolis, being in the range of 84.06-84.15% in the Russian Federation, 82.72-83.33% in the NWFD, and 82.34-83.81% in St. Petersburg. The proportion of newborns with birth weight relative to the average weight in the county and in the city showed an increase in 2017 (83.33% and 83.81%, respectively). In 2019, the proportion of children born with average weight in the Russian Federation as a whole and in St. Petersburg increased by 1.20 and 3.05%, respectively, while in the NWFD, on the contrary, it decreased by 2.12%. This caused the difference in performance between the Russian Federation as a whole and the NWFD to increase to 4.74%, and the difference with the megalopolis to 4.79%. Nevertheless, in 2020, the value of the federal district and city values are almost back to their previous values, and in 2021-2022, the proportion of such children has increased.

Compared to the average values for the Russian Federation, the lowest specific weight of those born with an average weight during the entire observation period was in the NWFD in 2019 (80.60%). It is also worth noting that, in general, the indicators of

the specific weight of children born alive with an average birth weight in St. Petersburg practically corresponded to the trend observed in the NWFD, except for the value in 2019, when an increase in the indicator was noted due to a decrease in the proportion of large-bodied children. In addition, in 2020-2022, the indicators of the specific weight of children born alive with an average weight became lower than the national and district average values [119].

In the course of this study, an assessment of the physical development of newborns was carried out based on the results of a survey of their mothers. Among both sick and healthy newborns, the majority were boys (59.6 and 56.4%, respectively). There was no significant difference when comparing the two groups by gender ($t$ = 0.77; p >0.1) [5].

An important aspect of a baby's future health is timely breastfeeding after birth. For the purpose of prolonged and full lactation, it is recommended to breastfeed the newborn in the delivery room immediately after birth. The study showed that, on average, mothers of sick infants started breastfeeding significantly later in the obstetric hospital than mothers of healthy infants: 1.74±4.84 days vs. 1.10±4.88 days ($t$ = 115.87; p <0.01). Assessing the distribution of mothers by the timing of breastfeeding, it was found that 82.8% of mothers of healthy children fed them immediately after birth (Table 3.3) [3, 34, 38].

Table 3.3 – Distribution of live-born children by timing of breastfeeding in obstetric hospital in the main and control groups (% of the total)

| Timing | Main group % | Control group % | $t$ (p) |
|---|---|---|---|
| Breastfed mmediately | 40.9 | 82.8 | 10.22 (<0.01) |
| During the first day | 8.7 | 9.2 | 0.16 (>0.1) |
| On the second day | 38.7 | 2.9 | 3.57 (<0.01) |
| Were not breastfed | 11.6 | 5.1 | 1.23 (>0.1) |
| Total | 100.0 | 100.0 | – |

Mothers of infants born sick and with congenital disorders were 2 times less likely to initiate breastfeeding immediately after birth ($t$ = 10.22; p <0.01) and 13.3 times more likely to first breastfeed their infant on the second day of life ($t$ = 3.57; p <0.01).

It was found that the average birth weight of children in the main group was 2543.14±11.06 g, in the control group – 3485.26±30.59 g had reliable differences ($t$ = 85.79; p <0.01). Assessment of the weight distribution of children revealed that 42.6% of newborns in the main group belonged to the low weight segment (up to 2500 g). In the control group, which consisted of healthy children, there were only 2.0% of newborns of this weight category, and these were children with a body weight of 2000-2499 g. In addition, there was a statistically significant difference between the proportion of children weighing 3000-3499 and 3500-3999 g in the main and control groups. The distribution of sick and healthy live-born children by birth weight is presented in Table 3.4.

Table 3.4 – Distribution of live-born children by birth weight in the main and control groups (% of the total)

| Body weight, g | Main group % | Control group % | $t$ (p) |
|---|---|---|---|
| 500–1000 | 11.4 | – | – |
| 1000–1499 | 8.1 | – | – |
| 1500–1999 | 9.4 | – | – |
| 2000–2499 | 13.7 | 2.0 | 1.85 (>0.05) |
| 2500–2999 | 15.8 | 6.1 | 1.59 (>0.1) |
| 3000–3499 | 25.8 | 45.5 | 3.81 (<0.01) |
| 3500–3999 | 12.1 | 34.2 | 2.52 (<0.01) |
| 4000 and more | 3.7 | 12.2 | 1.80 (>0.05) |
| Total | 100.0 | 100.0 | – |

Analysis of birth weights of sick and healthy children with regard to their gestational age showed statistically significant differences in each age group (significance level of differences p = 0.0001). Among sick children born before 28 weeks of gestation, the average body weight was 873.67±81.50 g (confidence interval 694.29-1053.04 g). Among healthy children, those born before 28 weeks were absent (Table 3.5, Figure 3.6).

Table 3.5 – Comparative characteristics of birth weight depending on the gestational age of newborns in the main and control groups

| Group | Gestational age, weeks | N | Mean value | Standard error | Confidence interval (-95.00%; +95.00%) | |
|---|---|---|---|---|---|---|
| Main | up to 28 | 37 | 873.67 | 81.50 | 694.29 | 1053.04 |
| | 28–31 | 112 | 1550.24 | 91.55 | 1365.35 | 1735.13 |
| | 32–36 | 83 | 2528.79 | 128.14 | 2268.09 | 2789.50 |
| | 36–40 | 245 | 3182.19 | 61.22 | 3060.61 | 3303.77 |
| | more than 40 | 4 | 3235.00 | 25.00 | 2917.34 | 3552.66 |
| Control | 28–31 | 6 | 4000.00 | no data available | no data available | no data available |
| | 32–36 | 77 | 3166.07 | 72.15 | 3017.78 | 3314.37 |
| | 36–40 | 391 | 3452.58 | 35.11 | 3383.24 | 3521.93 |
| | more than 40 | 17 | 3795.56 | 166.40 | 3411.83 | 4179.28 |

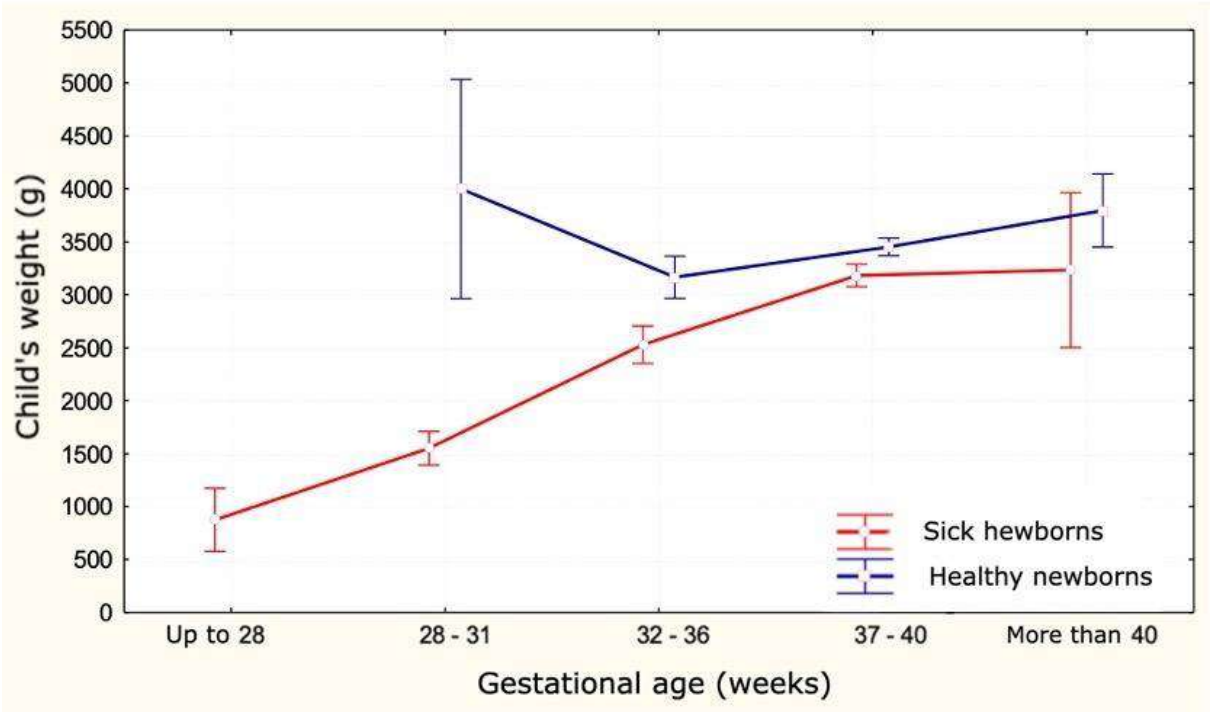


Figure 3.6 – Dependence of birth weight on gestational age of newborns in the main and control groups

In the group of children born at 32-36 weeks of gestation, the average birth weight of healthy children exceeded the average birth weight of sick and diseased children of the same gestational age by 25.2% (healthy children mean±m, 3166.07±72.15 g; sick and diseased children, 2528.79±128.14 g).

The analysis of children's weight by gender revealed no statistically significant difference in weight in both the group of healthy, sick and born with congenital disorders children. The mean weight in the group of sick children was significantly

lower than the mean weight in the group of healthy children in both boys and girls (p = 0.07). The mean weight in the group of sick children was 2492.12±94.45 g in boys and 2593.80±115.18 g in girls (Table 3.6, Figure 3.7).

Table 3.6 – Comparative characteristics of birth weight depending on gender in the main and control groups

| Group | Child's gender | N | Mean value | Standard error | Confidence interval (-95.00%; +95.00%) | |
|---|---|---|---|---|---|---|
| Main | boys | 287 | 2492.11 | 95.43 | 2302.87 | 2681.34 |
| | girls | 194 | 2593.80 | 115.18 | 2364.44 | 2823.15 |
| Control | boys | 277 | 3499.56 | 41.95 | 3416.49 | 3582.63 |
| | girls | 215 | 3315.44 | 48.55 | 3218.71 | 3412.17 |

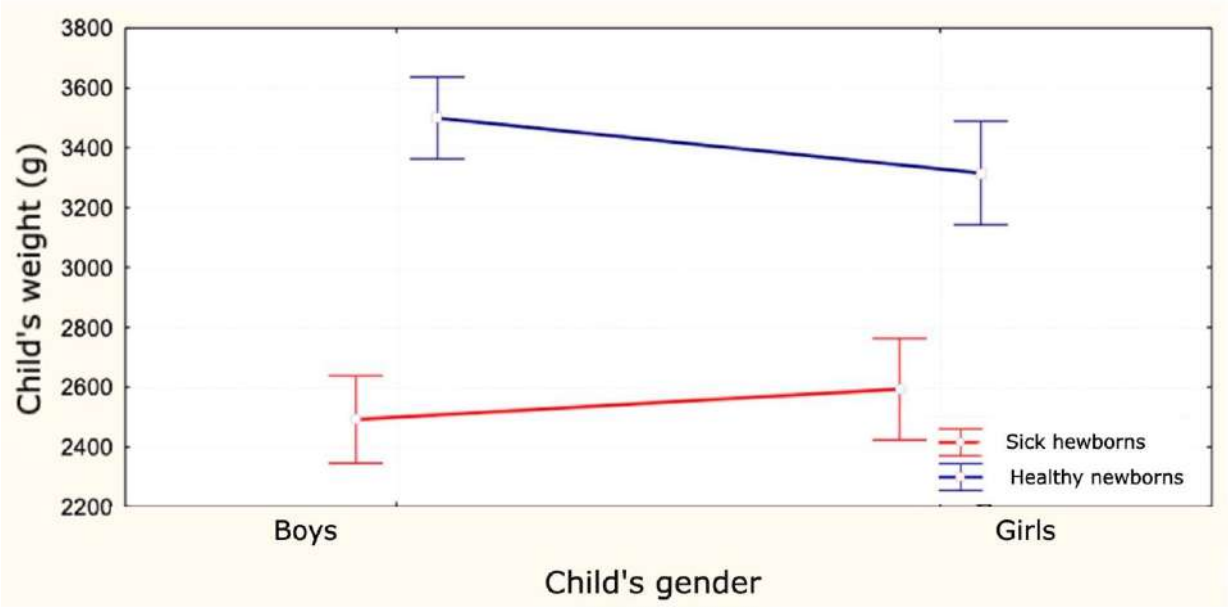


Figure 3.7 – Dependence of birth weight on gender of the child in the main and control groups

It is reasonable to assess the physical development of children not only by birth weight, but also by height. The optimal value is considered the birth height in a range of 46-56 cm. Evaluation of growth parameters in newborns revealed that the mean birth height in the main group was 45.97±28.35 cm and in the control group was 51.45±73.60 cm, which shows that there were significant differences between the groups ($t$ = 61.13; p <0.01). Analysis of the height distribution of children revealed (Table 3.7) that 33.0% of newborns in the main group belonged to the low height category (up to 46 cm).

Table 3.7 – Distribution of live-born children by birth height in the main and control groups (% of the total)

| Body length, cm | Main group % | Control group % | *t* (p) |
|---|---|---|---|
| 26–30 | 1.3 | – | – |
| 31–35 | 7.6 | – | – |
| 36–40 | 8.7 | 0.5 | 1.24 (>0.1) |
| 41–45 | 15.4 | 1.0 | 2.21(<0.05) |
| 46–50 | 26.7 | 7.2 | 3.92 (<0.01) |
| 51 and more | 40.3 | 91.3 | 13.51 (<0.01) |
| Total | 100.0 | 100.0 | – |

Only 1.5% of newborns in the control group were with low birth height, unlike children born sick and with congenital disorders, the height of these children was at least 36 cm. There was a statistically significant difference between the proportion of children in the low height range in the main and control groups ($t$ = 5.32; p <0.01).

Analysis of birth height of sick and healthy children, taking into account their gestational age, showed statistically significant differences in each age group (p = 0.0007). Among sick children born before 28 weeks of gestation, the average birth height was 34.50±1.31 cm (confidence interval 31.61-37.39 cm) (Table 3.8).

Table 3.8 – Comparative characteristics of birth height depending on the gestational age of newborns in the main and control groups

| Group | Gestational age, weeks | N | Mean value | Standard error | Confidence interval (-95.00%; +95.00%) | |
|---|---|---|---|---|---|---|
| Main | up to 28 | 37 | 34.50 | 1.31 | 31.61 | 37.39 |
| | 28–31 | 112 | 40.00 | 0.87 | 38.23 | 41.77 |
| | 32–36 | 83 | 46.68 | 0.80 | 45.05 | 48.31 |
| | 36–40 | 245 | 50.31 | 0.34 | 49.63 | 50.99 |
| | more than 40 | 4 | 50.50 | 0.50 | 44.15 | 56.85 |
| Control | 28–31 | 6 | 55.00 | no data available | no data available | no data available |
| | 32–36 | 77 | 50.22 | 0.49 | 49.21 | 51.23 |
| | 36–40 | 391 | 51.91 | 0.19 | 51.53 | 52.29 |
| | more than 40 | 17 | 53.56 | 1.04 | 51.15 | 55.96 |

In the group of children born at the age of 32-36 weeks of gestation (Figure 3.8), the average birth height of healthy children significantly exceeded the average of sick and born with congenital disorders children of the same gestational age by 7.6%

(healthy children mean±m: 50.22±0.49 cm; sick and with gestational disorders 46.68±0.08 g).

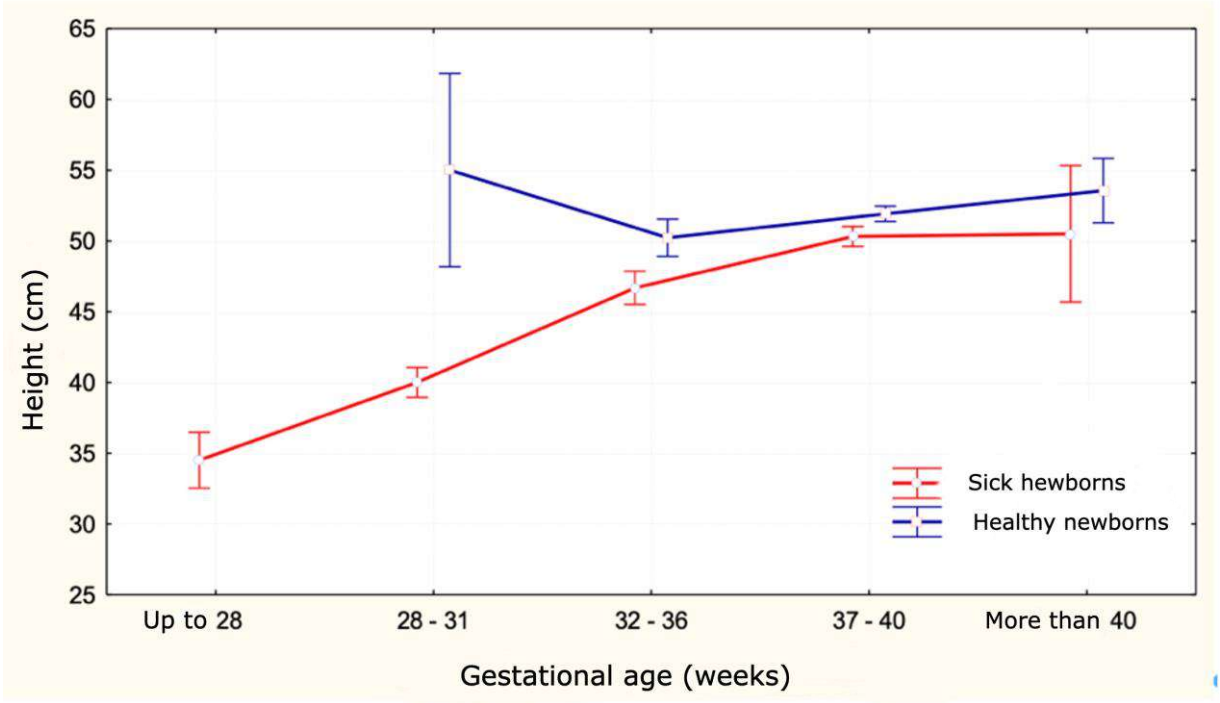


Figure 3.8 – Dependence of birth height on gestational age of newborns in the main and control groups

Analysis of children's height by gender revealed that the mean height in the group of sick children was significantly lower than the mean height in the group of healthy children (p = 0.0007) in both boys and girls (p = 0.6). The mean height in the group of sick children was 46.30±0.63 cm (confidence interval 45.05-47.56 cm) in boys and 46.14±0.79 cm (p=44.56-47.72 cm) in girls (Table 3.9, Figure 3.9).

Table 3.9 – Comparative characteristics of birth height indicators depending on gender in the main and control groups

| Group | Child's gender | N | Mean value | Standard error | Confidence interval (-95.00%; +95.00%) | |
|---|---|---|---|---|---|---|
| Main | boys | 287 | 46.30 | 0.63 | 45.05 | 47.56 |
| | girls | 194 | 46.14 | 0.79 | 44.56 | 47.72 |
| Control | boys | 277 | 52.03 | 0.27 | 51.49 | 52.57 |
| | girls | 215 | 51.35 | 0.20 | 50.95 | 51.74 |

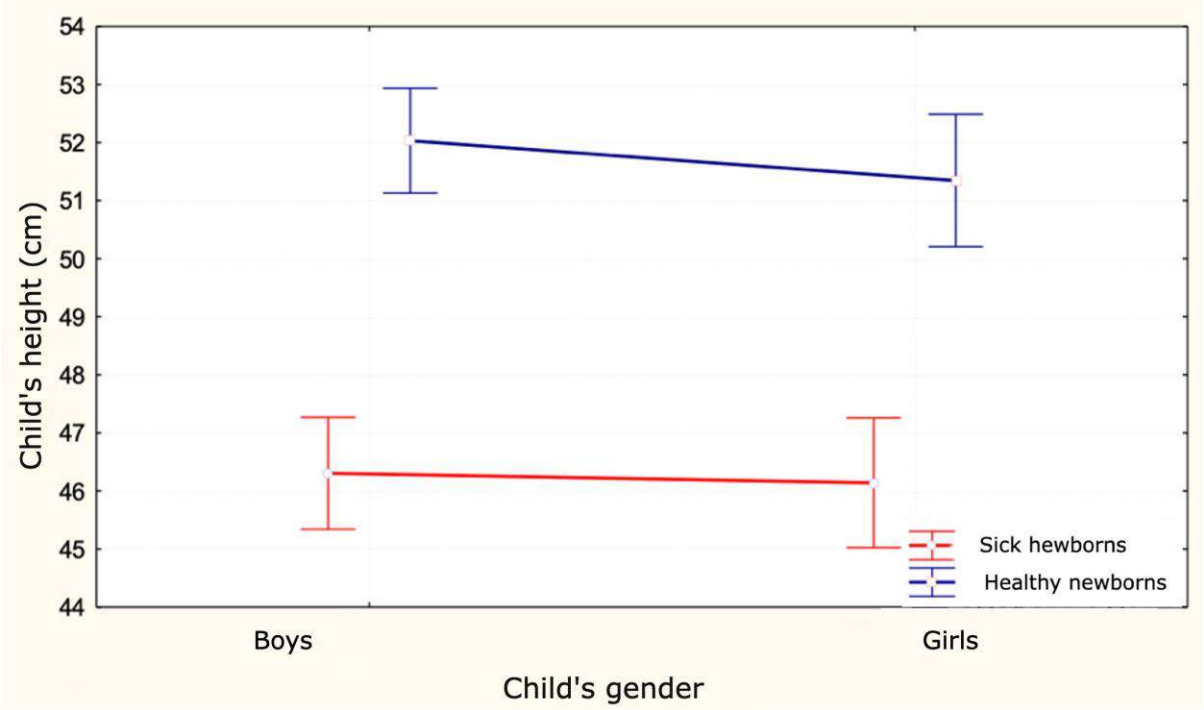


Figure 3.9 – Dependence of birth height on gender in the main and control groups

A study of the gestational age in children who died in the early neonatal period showed that children of gestational age over 28 weeks significantly prevailed in the group of deceased newborns (78.02%±4.95%) [120, 250, 251].

It was revealed that the body weight of deceased newborns of gestational age older than 28 weeks was significantly higher than that of children born before 28 weeks (p=0.001). Among the deceased newborns, whose gestational age exceeded 28 weeks, infants weighing more than 1499 g (85.51%±4.62%) were significantly predominant. The largest proportion fell on deceased newborns with a body weight of more than 2499 g – 63.8%. The mean value of body weight of children of gestational age more than 28 weeks among deceased newborns was 2659±119 g (Table 3.10).

Table 3.10 – Assessment of anthropometric data of deceased newborns

| Indicators | Deceased newborns; M±m (min–max) | |
|---|---|---|
| | <28 weeks | >28 weeks |
| Body weight, g | 794.60±49.10 (400–1200) | 2659.70±119.00* (790–6240) |
| Body length, cm | 32.20±0.90 (31–56) | 47.00±0.74* (31–56) |

Note – * Differences are significant, p = 0.04-0.000.

Analysis of the body height of deceased newborns showed that the average body height of children whose gestational age was more than 28 weeks was 47.00±0.74 cm.

Premature infants (of gestational age less than 37 weeks) prevailed in the mortality structure of children with a gestational age of more than 28 weeks – 62.3%. During the study, the sigma method was used to study the weight and height of premature infants of gestational age over 28 weeks. It was revealed that these indicators had special features. Development was consistent with gestational age when the child's parameters were assigned within 2 sigma of the term-matched physical development indicators (M±2σ), that is, from the 10th to the 90th percentile ($P_{10}$–$P_{90}$). Body weight estimates of deceased newborns are presented in Table 3.11.

Table 3.11 – Assessment of body weight of deceased newborns

| Gestational age, weeks | Normative body weight indicators, g | | | Body weight indicators of deceased newborns, g | |
|---|---|---|---|---|---|
| | M±σ | M – 2σ | M + 2σ | M±m | |
| 28 | 1124±183 | 758 | 1490 | 1038.50±42.00 | 988.17±67.00 |
| 29 | 1381±172 | 1037 | 1725 | 931.75±196.00 | 1363.33±183.00 |
| 30 | 1531±177 | 1177 | 1885 | 1311.38±213.00 | 1093.33±203.00 |
| 31 | 1696±212 | 1272 | 2120 | 1512.25±395.00 | 1500.00±100.00 |
| 32 | 1827±267 | 1293 | 2361 | 1547.00±113.00 | no data available |
| 33 | 2018±241 | 1536 | 2500 | 1420.00±210.00 | 2010.00±55.00 |
| 34 | 2235±263 | 1709 | 2761 | 2244.67±210.00 | 2229.86±39.00 |
| 35 | 2324±206 | 1912 | 2736 | 2290.75±140.00 | 2180.00±500.00 |
| 36 | 2572±235 | 2102 | 3042 | 2672.00±469.00 | 2635.00±155.00 |

Body weight estimation showed that in deceased newborns whose gestational age was more than 28 weeks, body weight in 80-90% of cases corresponded to the normative indicators.

Assessment of the body height of deceased newborns whose gestational age was more than 28 weeks revealed that it corresponded to the normal body length of children of this gestational age in 85-95% of cases (Table 3.12).

Table 3.12 – Assessment of body height of deceased newborns

| Gestational age, weeks | Normative body height indicators, cm | | | Body height according to the study, cm | |
|---|---|---|---|---|---|
| | M±σ | M – 2σ | M + 2σ | M±m | |
| 28 | 35.90±1.80 | 32.30 | 39.50 | 35.33±0.80 | 36.13±2.18 |
| 29 | 37.90±2.00 | 33.90 | 41.90 | 37.67±1.79 | 37.50±1.17 |
| 30 | 38.90±1.70 | 35.50 | 42.30 | 35.33±3.38 | 39.00±2.24 |
| 31 | 40.40±1.60 | 37.20 | 43.60 | 43.00±0.10 | 37.75±3.78 |
| 32 | 41.30±1.90 | 37.50 | 45.10 | no data available | 40.15±1.82 |
| 33 | 42.70±1.80 | 39.10 | 46.30 | 44.50±1.04 | 42.00±2.80 |
| 34 | 43.60±1.70 | 40.20 | 47.00 | 46.43±0.95 | 45.00±1.15 |
| 35 | 44.40±1.50 | 41.40 | 47.40 | 47.00±2.00 | 46.50±0.87 |
| 36 | 45.3±1.70 | 41.90 | 48.70 | 46.00±1.00 | 48.50±2.72 |

Analysis of the distribution of deceased newborns by birth weight, taking into account the term of neonatal death, showed that the proportion of children with gestational age 28-31 weeks and VLBW was 10.5% (mean 1200±95 g), with gestational age 32-36 weeks and LBW – 13.1% (mean 2257±180 g), with gestational age 37 weeks and more and weighing more than 2500 g – 27.7% (mean 3512±149 g) (Tables 3.13, 3.14).

Table 3.13 – Distribution of deceased newborns by body weight, taking into account the time of death (%)

| Time of death, day | Body weight, g | | | | |
|---|---|---|---|---|---|
| | Up to 999 | 999–1499 | 1499–2499 | More than 2499 | Total |
| First | 14.5 | 6.6 | 10.5 | 22.4 | 54.0 |
| Second | 6.6 | 2.6 | 1.3 | 4.0 | 14.5 |
| Third | 6.6 | 1.3 | 1.3 | 1.3 | 10.5 |
| Fourth – seventh | 9.2 | 2.6 | 4.0 | 5.3 | 21.0 |
| Total: | 36.8 | 13.2 | 17.1 | 32.9 | 100.00 |

Table 3.14 – Assessment of body weight indicators of newborns who died in the early neonatal period, taking into account gestational age (d)

| Gestational age, weeks | M±m | Min | Max | Median |
|---|---|---|---|---|
| 22–27 | 795.68±36.00* | 480.00 | 1466.00 | 800.00 |
| 28–31 | 1200.00±95.00* | 790.00 | 1700.00 | 1185.00 |
| 32–36 | 2256.62±180.00* | 1100.00 | 3756.00 | 2200.00 |
| 37 and more | 3512.32±149.00* | 1160.00 | 5140.00 | 3680.00 |

Note – * Differences are significant, p = 0.04-0.000.

Thus, sick children were found to have lower birth weight and height and later initiation of breastfeeding. Analysis of birth weight and height in sick and healthy

children, taking into account their gestational age, showed statistically significant differences in each age group. The analysis of children's weight by gender revealed no statistically significant difference in weight in both the group of healthy, sick and born with congenital disorders children. The mean weight in the group of sick children was significantly lower than the mean weight in the group of healthy children in both boys and girls. Analysis of children's height by gender revealed that the mean height in the group of sick children was significantly lower than the mean height in the group of healthy children in both boys and girls.

Assessment of the parameters of physical development of premature newborns who died within the first 7 days demonstrated that in 90-94% of cases it corresponds to the physical development for the given gestational age. Among newborns who died in the first 72 hours, the highest proportion (27.7% each) was in infants with gestational age 22-27 weeks and ELBW (mean 795±37 g), and those with gestational age more than 37 weeks and weight more than 2500 g (mean 3512±149 g).

## 3.2 Newborn incidence

Along with physical development indicators, incidence rates are important indicators characterizing the health status of newborns [4, 252]. In 2022, 45 656 or 40.4%, of newborns in the NWFD were born sick or with congenital disorders. Among those newborns 11.6% were infants born with a weight of 500-999 g.

Analysis of the dynamics of the specific weight of children born sick and with congenital disorders (Figure 3.10) showed that during the entire period under study (2015-2022) in the NWFD this indicator had a clearly traceable upward trend and increased 1.4 times over 8 years (from 28.8% to 40.4%), while the national average, on the contrary, insignificantly but constantly decreased. While in 2015 the specific weight of children born sick and with congenital disorders in the NWFD was below the Russian average (28.8% vs. 31.6%), starting from 2017 this indicator began to exceed the Russian average and in 2022 exceeded it 1.4 times (40.4% vs. 29.4%). An assessment of the proportion of children born sick and with congenital disorders in St.

Petersburg revealed an annual increase in indicators. At the same time, in 2015, the indicator was lower than the overall national and district levels, and in 2022 it exceeded the national and district average levels (by 1.6 and 1.2 times, respectively).

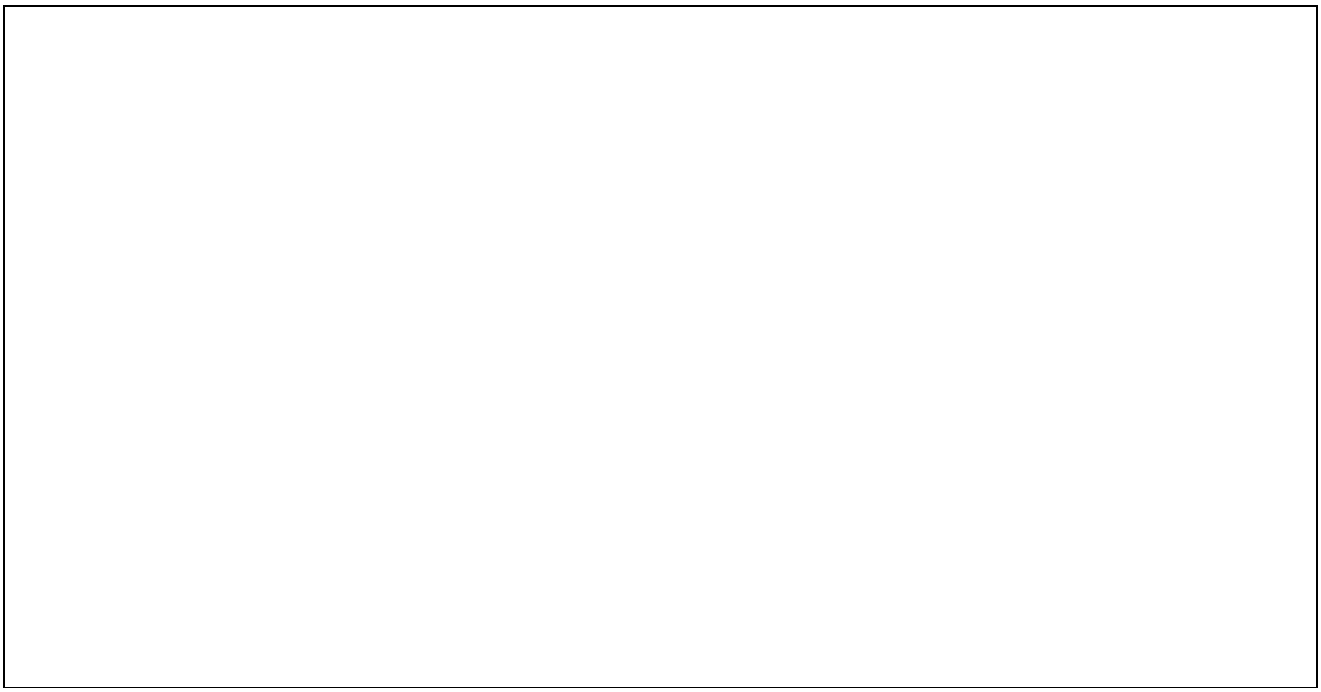

Figure 3.10 – Dynamics of the share of children born sick and with congenital disorders in the Russian Federation, the Northwestern Federal District and St. Petersburg in 2015-2022 (% of the number of live births).

It is only natural that the structure of neonatal incidence was dominated by ICD-10 class XVI "Individual conditions arising in the perinatal period", which accounted for 76.0% on average during the study period in the Northwestern Federal District, which is significantly lower than the national average (83.6%). In the megalopolis, the average proportion of diseases of the XVI class of ICD-10 over the eight studied years was significantly lower than in the whole country and the district (53.8% vs. 83.6% and 76.0%; $p < 0.05$).

Analysis of the dynamics of the indicator allowed us to establish that both in the Russian Federation as a whole and in the Northwestern Federal District during the entire period under study, the share of certain conditions occurring in the perinatal period decreased (Figure 3.11) from 89.5% to 78.8% on average in the country, and from 91.8% to 69.2% in the Northwestern Federal District.

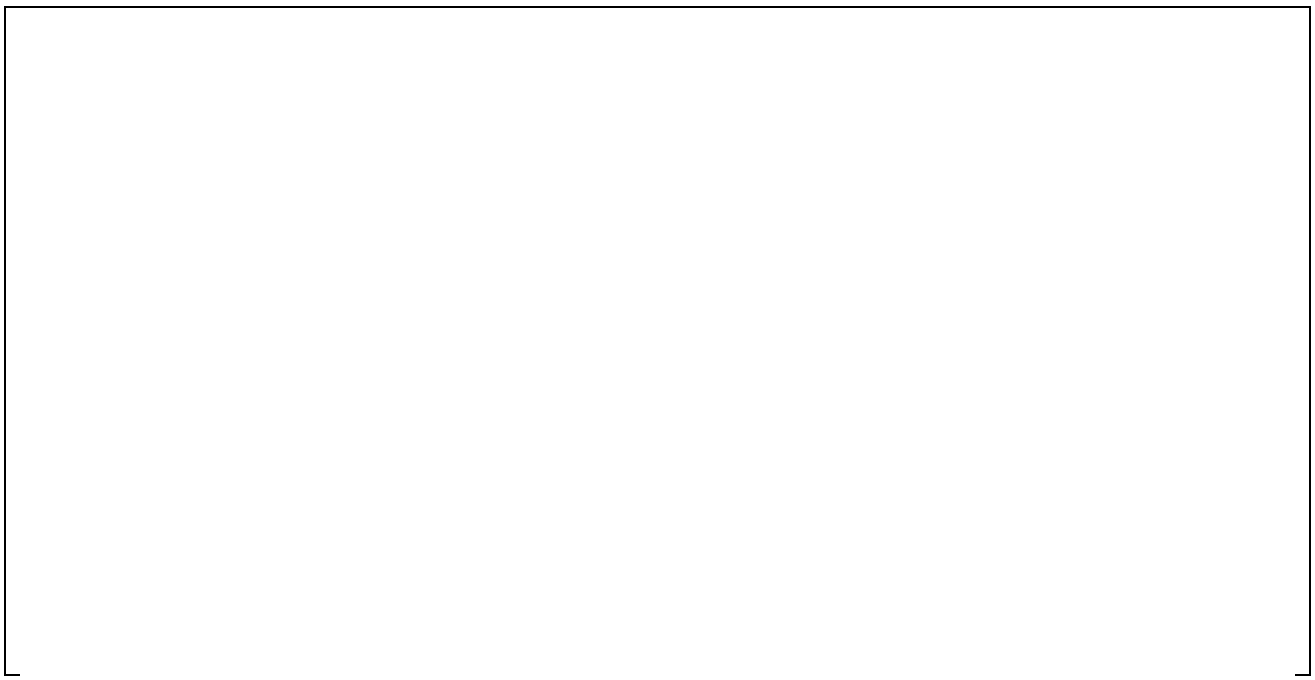

Figure 3.11 – Dynamics of the share of certain conditions occurring in the perinatal period (ICD-10 class XVI) in the structure of neonatal incidence in the Russian Federation, the Northwestern Federal District and St. Petersburg in 2015-2022 (%).

At the same time, if in 2015 the specific weight of certain conditions occurring in the perinatal period differed very slightly on average between the Russian Federation and the NWFD and was even slightly higher in the NWFD, then every year this difference increased and reached 8.9% in 2022 (78.8% vs. 69.2%). During the assessment of the level of indicators of the specific weight of certain conditions occurring in the perinatal period in the structure of neonatal incidence in St. Petersburg, it was found that the value of the indicators was lower than the average in Russia and the NWFD. The dynamics of these indicators in St. Petersburg during the study period tended to decrease, and in 2022 the specific weight of certain conditions occurring in the perinatal period decreased by 27.6% compared to the 2015 level (69.4% vs. 50.2%; $p < 0.05$).

However, a single child may have more than one XVI class of diseases, so analysis of incidence is more important.

A total of 12 754 472 children were born alive in Russia between 2015 and 2022 and 33 353 340 diseases included in class XVI of ICD-10 were registered; thus, the average incidence rate was 261.51 per 1000 live births. In the Northwestern Federal District, 1 144 060 children were born alive, and 244 175 diseases were registered for

certain conditions occurring in the perinatal period; consequently, the incidence rate in the district amounted to 262.20 per 1000 live births, which almost fully corresponds to the average indicator for the Russian Federation. In St. Petersburg between 2015 and 2022, 491 959 children were born alive and 90 209 certain conditions occurring in the perinatal period were registered; consequently, the eight-year average incidence rate for children in the megalopolis was 183.37 per 1000 live births. Thus, the average incidence rate of class XVI of ICD-10 in St. Petersburg is lower than in Russia and the Northwestern Federal District by 29.9 and 30.1%, respectively.

Analysis of the dynamics of incidence of newborns with certain conditions occurring in the perinatal period (ICD-10 class XVI) in Russia as a whole and in the NWFD showed (Figure 3.12) that in the Russian Federation the incidence rate in 2015-2018 exceeded the average rate in the NWFD.

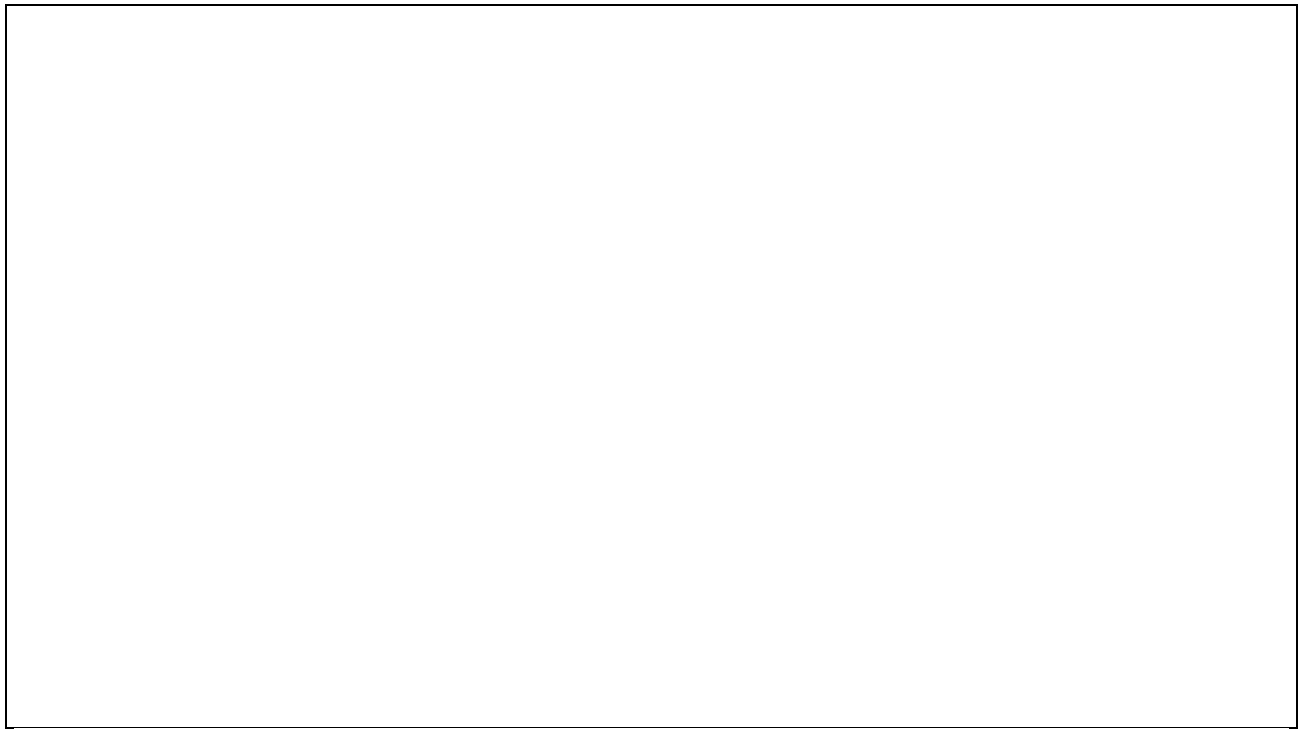

Figure 3.12 – Dynamics of incidence of newborns with certain conditions occurring in the perinatal period (ICD-10 class XVI) in the Russian Federation, the Northwestern Federal District and St. Petersburg in 2015-2022 (per 1000 live births).

In 2019, these figures were almost equal, and in 2020, the incidence of class XVI in the district exceeded the national average by 1.1 times. However, by 2022, the incidence rate in the Northwestern Federal District almost corresponded to the national average (231.10 versus 231.46 per 1000 live births). In the Russian Federation, the

decrease in the incidence of certain conditions occurring in the perinatal period in 2015-2022 amounted to 18.4%, and in the Northwestern Federal District – 12.5%. The incidence rate of newborns with certain conditions occurring in the perinatal period in St. Petersburg during the entire studied period was significantly lower than the average in Russia and the Northwestern Federal District. Up to and including 2020, the incidence of this class of diseases in the megalopolis increased annually, reaching 216.16%. After that, in 2021 it decreased to 183.97% and in 2022, the indicator increased again and amounted to 197.30%, which was lower than the national and regional averages by 14.8 and 14.6%, respectively. The dynamics of incidence of certain conditions occurring in the perinatal period in St. Petersburg for the period 2015-2022 amounted to +8.3%.

### 3.3 Newborns' need for inpatient medical care

The treatment of sick and born with congenital disorders newborns depends on the diagnosis, the condition of the newborn, and the capabilities of the medical organization. Children with life-threatening conditions are admitted to the NICU. If there is no such department in a medical organization of maternity care, then children are transferred to a medical organization of neonatology or pediatric profile. A significant part of those in need of treatment of sick and born with congenital diseases newborns are treated in the NPD, which provides round-the-clock specialized examination and treatment of newborns with various diseases of the perinatal period, nursing premature babies [119, 121].

In 2022, at the age of 0-6 days, 6 148 sick and born with congenital diseases newborns were admitted to the NPD of the Federal District, which amounted to 5.44% of the total number of children born alive. Analysis of the dynamics of the proportion of children admitted to the NPD among those born alive in the Northwestern Federal District showed that, starting in 2016, this indicator had a pronounced downward trend, but in 2022 it increased to the level of 2021. Nevertheless, compared to 2016, the indicator decreased by 1.5 times. At the same time, during all eight years of follow-up,

the proportion of those admitted to NPDs among those born alive in the Northwestern Federal District was lower than the national average (Figure 3.13).

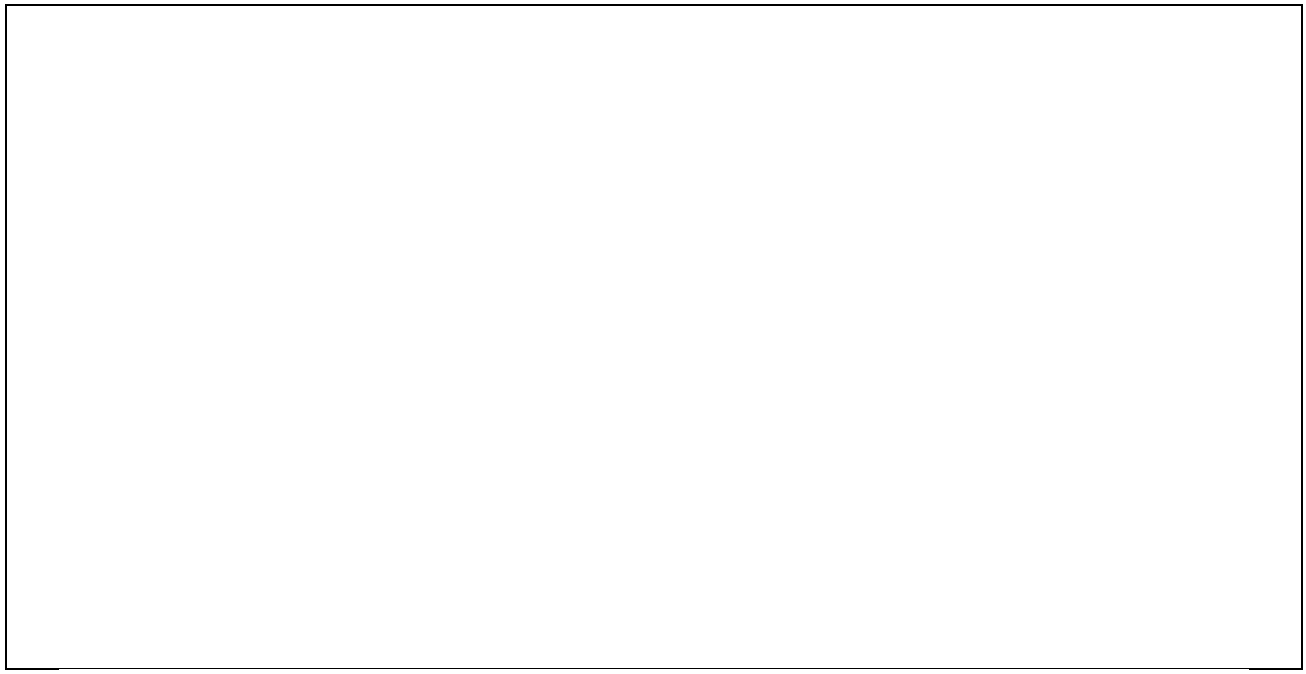

Figure 3.13 – Dynamics of the proportion of newborns and premature infants admitted to the pathology department of the number of live births in the Russian Federation, the Northwestern Federal District and St. Petersburg (%)

The share of those admitted to NPDs in St. Petersburg in 2022 was 6.91%, which is 1.1 and 1.3 times higher than the national and federal district averages, respectively. Analysis of the dynamics of indicators revealed that until 2018 in St. Petersburg the specific weight of those admitted to NPDs was lower than the average in the Russian Federation and the NWFD, and since 2019 – higher.

A total of 72 726 newborns, or 6.20% of the number of live births, were treated in NPDs in the NWFD between 2015 and 2022, and 32 660 infants, or 6.75%, were treated in St. Petersburg. Accordingly, the proportion of children in St. Petersburg who were treated in the NPD out of the total number of newborns admitted to those in the federal district amounted to 44.9%.

Thus, in St. Petersburg, in the conditions of declining birth rate and increasing incidence of newborns, there is a growing need for children to be admitted to NPDs of medical organizations.

# CHAPTER 4. FEATURES OF MEDICAL AND SOCIAL CHARACTERISTICS OF FAMILIES OF NEWBORNS BORN SICK AND WITH CONGENITAL DISORDERS, AND THEIR QUALITY OF LIFE

## 4.1 Comparative assessment of the medical and social characteristics of families and the course of pregnancy in mothers with children born sick and with congenital disorders, and healthy newborns

To study the peculiarities of the medical and social characteristics of families with children born sick and with congenital disorders, this group (main group) was compared with families of healthy newborns (control group) (Appendix 1). The findings revealed that the mean age of mothers in the main group was 30.55±0.46 years and in the control group 27.12±0.32 years ($t$ = 34.29; p <0.01). The average age of fathers in the main group was 33.14±0.54 years, while in the control group it was 29.76±0.45 years ($t$ = 25.44; p <0.01) [82]. The distribution of parents by age in the main and control groups is shown in Table 4.1.

Table 4.1 – Distribution of parents by age in the main and control groups (% of the total)

| Age, years | Mothers | | | Fathers | | |
|---|---|---|---|---|---|---|
| | Main group | Control group | $t$ (p) | Main group | Control group | $t$ (p) |
| Up to 20 | 0.5 | 2.6 | 0.31 (>0.1) | 0.6 | 2.1 | 0.21 (>0.1) |
| 20–24 | 12.1 | 31.1 | 3.32 (<0.01) | 6.6 | 19.0 | 2.05(<0.05) |
| 25–29 | 28.1 | 40.8 | 2.43 (<0.05) | 20.4 | 35.4 | 2.74(<0.01) |
| 30–34 | 26.9 | 18.9 | 3.80 (<0.01) | 32.0 | 28.7 | 0.61 (>0.1) |
| 35–39 | 21.4 | 5.1 | 2.69 (<0.01) | 18.2 | 8.2 | 1.66 (>0.1) |
| 40–44 | 8.8 | 1.0 | 1.17 (>0.1) | 11.3 | 3.5 | 1.32 (>0.1) |
| 45 and older | 2.2 | 0.5 | 0.25 (>0.1) | 10.9 | 3.1 | 1.25 (>0.1) |
| Total | 100.0 | 100.0 | – | 100.0 | 100.0 | – |

The study showed that in families with a sick child, there are statistically fewer mothers under 30 years old (p <0.05) and more mothers of age groups 30-34 years (p <0.01) and 35-39 years (p <0.01). Fathers were significantly less at age 20-29 years (p <0.05) in both age groups: 20-24 years (p <0.05) and 25-29 years (p <0.01). Thus, there is a significant difference between the age of mothers and fathers in healthy newborns and children born sick and with congenital disorders.

Assessment of the distribution of mothers by marital status showed no statistically significant difference between the main and control groups (Table 4.2). However, the proportion of unmarried mothers among women with healthy children is lower than among mothers of sick children (32.3% vs. 38.5%). When comparing the indicators obtained and information on the marital status of mothers in St. Petersburg in 2019-2020 (18.0 and 18.7%, respectively), it was revealed that the share of mothers without marriage was 2 times higher than the official statistics.

Table 4.2 -– Distribution of mothers by marital status in the main and control groups (% of the total)

| Marital status | Main group | Control group | *t* (p) |
|---|---|---|---|
| In a registered marriage | 61.5 | 67.7 | 1.62 (>0.1) |
| In a civil marriage | 19.3 | 16.9 | 0.41 (>0.1) |
| Divorced | 4.4 | 8.5 | 0.64 (>0.1) |
| Widow | 6.9 | 0.4 | 0.77 (>0.1) |
| I am not married, I have not been | 7.9 | 6.5 | 0.64 (>0.1) |
| Total | 100.0 | 100.0 | – |

The study of the influence of the education level revealed that in the studied families of the main group there were more parents with secondary and secondary specialized education than in the control group. The opposite trend was observed among parents with incomplete higher and tertiary education. In the group of mothers and fathers of healthy children, there were more parents with higher and incomplete higher education (Table 4.3) than in the group of mothers and fathers who had children born sick and with congenital disorders (62.0% vs. 74.8% for mothers and 60.5% vs. 73.3% for fathers). The significance level in the groups was determined by *t* (p) indicators equal to 3.54 and 3.46, respectively (p <0.01).

Table 4.3 – Distribution of parents by education level in the main and control groups (% of the total)

| Education | Mothers | | | Fathers | | |
|---|---|---|---|---|---|---|
| | Main group | Control group | *t* (p) | Main group | Control group | *t* (p) |
| Primary | 2.9 | 1.6 | 0.19 (>0.1) | 1.7 | 2.0 | 0.04 (>0.1) |
| Secondary | 9.4 | 6.1 | 0.52 (>0.1) | 13.1 | 5.2 | 1.29 (>0.1) |
| Specialized secondary | 25.7 | 17.5 | 1.45 (>0.1) | 24.7 | 19.5 | 0.92 (>0.1) |

Continuation of Table 4.3

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Incomplete higher | 7.7 | 21.5 | 2.31 (<0.05) | 10.6 | 15.0 | 0.73 (>0.1) |
| Higher | 54.3 | 53.3 | 0.22 (>0.1) | 49.9 | 58.3 | 2.59 (<0.05) |
| Total | 100.0 | 100.0 | – | 100.0 | 100.0 | – |

Analysis of the distribution by social status of parents in the main and control groups revealed that both mothers and fathers had a higher proportion of employees and non-working persons (housewives) and a lower proportion of workers, entrepreneurs and students (Table 4.4). However, a statistically significant difference between the main and control groups was determined only when comparing mothers with the social status of employees ($t$ = 2.12; p <0.05).

Table 4.4 – Distribution of parents by social status in the main and control groups (% of the total)

| Social status | Mothers | | | Fathers | | |
|---|---|---|---|---|---|---|
| | Main group | Control group | $t$ (p) | Main group | Control group | $t$ (p) |
| Working | 43.2 | 50.5 | 1.54 (>0.1) | 48.9 | 53.6 | 1.05 (>0.1) |
| Employee | 26.0 | 13.8 | 2.12 (<0.05) | 24.1 | 16.7 | 1.63 (>0.1) |
| Entrepreneur | 5.0 | 7.9 | 0.46 (>0.1) | 12.5 | 20.8 | 1.41 (>0.1) |
| Does not work (housewife) | 25.2 | 15.2 | 1.74 (>0.1) | 8.9 | 2.6 | 0.84 (>0.1) |
| Students | 0.6 | 12.6 | 1.73 (>0.1) | 5.0 | 6.3 | 0.20 (>0.1) |
| Retired | 0.0 | 0.0 | – | 0.6 | 0.0 | 0.11 (>0.1) |
| Total | 100.0 | 100.0 | – | 100.0 | 100.0 | – |

A significant number of authors believe [15, 31, 81, 71, 90, 97, 165, 168, 182] that there is a relationship between the health of children and the number of children in the family. In order to confirm or refute this statement, an assessment of this relationship was carried out. It was found that the average number of children in families with sick and born with congenital disorders was 1.87±0.12 and in families with healthy newborns was 1.51±0.07 ($t$ = 32.08; p <0.05). The distribution of families by the number of children in the family is shown in Table 4.5.

Table 4.5 – Distribution of families by the number of children in the family in the main and control groups (% of the total)

| Number of children | Main group | Control group | *t* (p) |
|---|---|---|---|
| 1 | 43.6 | 59.4 | 3.50 (<0.01) |
| 2 | 33.9 | 30.1 | 0.72 (>0.1) |
| 3 | 15.0 | 9.1 | 0.91 (>0.1) |
| 4 | 6.0 | 1.0 | 0.75 (>0.1) |
| 5 | 1.5 | 0.4 | 0.21 (>0.1) |
| Total | 100.0 | 100.0 | – |

Thus, large families were significantly more likely to have children born sick and with congenital disorders ($t = 2.01$; $p < 0.05$).

Early registration of pregnancy according to the legal framework is carried out up to 12 weeks. The average number of weeks of pregnancy registration in the main group was 9.94±0.04 weeks and in the control group was 8.62±0.04 weeks. Thus, mothers of sick newborns were significantly later to register for pregnancy than mothers of healthy children ($t = 23.40$; $p > 0.01$). Despite the fact that 95.0% of mothers in the main group and 96.5% in the control group registered at the antenatal clinic on time, mothers of healthy newborns were more likely to be registered before 6 weeks ($t = 3.44$; $p > 0.01$) [87]. The distribution of mothers by time of pregnancy registration in the main and control groups is shown in Table 4.6.

Table 4.6 – Distribution of mothers by time of pregnancy registration in the main and control groups (% of the total)

| Number of weeks | Main group | Control group | *t* (p) |
|---|---|---|---|
| Up to 6 | 3.7 | 24.5 | 3.44 (<0.01) |
| From 6 to 10 | 51.4 | 49.5 | 0.42 (>0.1) |
| From 10 to 14 | 39.9 | 22.5 | 3.26 (<0.01) |
| From 14 to 18 | 3.1 | 2.0 | 0.17 (>0.1) |
| From 18 to 22 | 1.5 | 1.0 | 0.07 (>0.1) |
| From 22 and later | 0.4 | 0.5 | 0.01 (>0.1) |
| Total | 100.0 | 100.0 | – |

The average period of gestation in the main group was 34.48±1.21 weeks, while in the control group it was significantly higher – 37.34±0.94 weeks ($t = 65.57$; $p < 0.05$). The study showed that healthy newborns were significantly more likely to be born later than 28 weeks of gestation ($t = 4.69$; $p < 0.01$). In addition, 79.5% of mothers in the

control group had an on-time delivery vs. 50.9% of mothers in the main group ($t$ = 7.53; p >0.01), which is a significant factor in the birth of a healthy child. The distribution of mothers by duration of pregnancy in the main and control groups is presented in Table 4.7.

Table 4.7 – Distribution of mothers by duration of pregnancy in the main and control groups (% of the total)

| Duration of pregnancy, weeks | Main group | Control group | $t$ (p) |
|---|---|---|---|
| Up to 28 | 7.7 | 0 | 1.73 (>0.1) |
| 28–31 | 23.3 | 1.2 | 3.40 (<0.01) |
| 32–36 | 17.3 | 15.8 | 0.10 (>0.1) |
| 37–40 | 50.9 | 79.5 | 7.53 (<0.01) |
| From 41 or more | 0.8 | 3.5 | 0.39 (>0.1) |
| Total | 100.0 (481) | 100.0 | – |

Assessment of the presence of chronic diseases (pathologic conditions) in mothers, diseases that occurred during pregnancy, and complications in labor showed (Figure 4.1) that mothers who had children who were born sick and with congenital disorders were statistically more likely to have them than mothers of healthy newborns ($t$ = 4.56; $t$ = 4.92 and $t$ = 3.04, respectively, at p <0.01).

Figure 4.1 – Presence of chronic diseases, diseases (pathological conditions) that occurred during pregnancy and complications in labor in the main and control groups (%)

A study of the frequency of chronic pathology in mothers of children born sick and with congenital disorders showed that respiratory diseases, genitourinary and endocrine system diseases, nutritional and metabolic disorders were most common in these women (10.7; 8.2 and 7.7 cases per 100 women who ended the pregnancy, respectively). Mothers of healthy newborns had the highest incidence of respiratory diseases, digestive and circulatory diseases (8.6; 5.4 and 4.9 cases per 100 women who completed the pregnancy, respectively). A comparative assessment of chronic pathology in mothers of newborn children showed that the mothers of the main group more often than in the control group had respiratory diseases (1.2 times), skin and subcutaneous tissue diseases (1, 4 times), genitourinary system diseases (2.3 times), diseases of the eye and its appendages (3.4 times), circulatory system (1.5 times) and endocrine system diseases, nutritional and metabolic disorders (3.1 times). The frequency of the most common forms of chronic diseases among mothers in the main and control groups is shown in Table 4.8.

Table 4.8 – Frequency of the most common forms of chronic diseases in mothers in the main and control groups (% of the number of women who ended pregnancy)

| ICD-10 disease class | Main group | Control group | *t* (p) |
|---|---|---|---|
| Endocrine system diseases, nutritional and metabolic disorders | 7.7 | 2.5 | 0.80 (>0.1) |
| Diseases of the eye and its appendages | 6.2 | 1.8 | 0.68 (>0.1) |
| Circulatory system diseases | 7.5 | 4.9 | 0.41 (>0.1) |
| Respiratory diseases | 10.7 | 8.6 | 0.34 (>0.1) |
| Digestive system diseases | 1.6 | 5.4 | 0.59 (>0.1) |
| Diseases of the skin and subcutaneous tissue | 3.1 | 2.2 | 0.14 (>0.1) |
| Genitourinary system diseases | 8.2 | 3.6 | 0.73 (>0.1) |

In mothers of the control group, only digestive diseases were more frequent than in the main group (3.4 times). However, no statistically significant difference was revealed when comparing the incidence of chronic diseases in mothers of sick and healthy newborns.

Evaluation of the frequency of diseases (pathological conditions) occurring in mothers during pregnancy in the main and control groups revealed that in mothers of children born sick and with congenital disorders, the most common forms were anemia, hypertension, and threat of pregnancy termination (35.0; 15.3 and 13.6 cases per 100

women who ended the pregnancy, respectively). Mothers of healthy newborns were more likely to have anemia, gestational diabetes mellitus, and circulatory diseases (21.3; 7.9 and 7.7 cases per 100 women who ended pregnancy, respectively) [85, 118, 224, 227]. The frequency of diseases (pathological conditions) that occurred in mothers during pregnancy in the main and control groups is shown in Table 4.9.

Table 4.9 – Frequency of diseases (pathological conditions) that occurred in mothers during pregnancy in the main and control groups (% of the number of women who ended pregnancy)

| Disease (pathological condition) | Main group | Control group | *t* (p) |
|---|---|---|---|
| Anemia | 35.0 | 21.3 | 2.51 (<0.05) |
| Hypertension | 15.3 | 2.2 | 2.09 (<0.05) |
| Endocrine system diseases | 9.8 | 4.1 | 0.90 (>0.1) |
| Gestational diabetes mellitus | 10.8 | 7.9 | 2.08 (<0.05) |
| Genitourinary system diseases | 6.2 | 6.5 | 0.05 (>0.1) |
| Circulatory system diseases | 7.1 | 7.7 | 0.10 (>0.1) |
| Venous event | 6.7 | 7.1 | 0.06 (>0.1) |
| Threatened miscarriage | 13.6 | 2.8 | 1.72 (>0.1) |
| Premature delivery | 5.4 | 1.8 | 0.55 (>0.1) |
| Rhesus incompatibility | 2.5 | 0.6 | 0.26 (>0.1) |
| Fetal pathology | 5.0 | 0.8 | 0.61 (>0.1) |
| Respiratory diseases (including acute respiratory infections, ARVI) | 8.1 | 4.0 | 0.65 (>0.1) |
| Other | 4.4 | 5.7 | 0.20 (>0.1) |

Comparative assessment of the frequency of diseases (pathological conditions) that occurred in mothers during pregnancy in the main and control groups showed statistically significant differences in the frequency of anemia (35.0% vs. 21.3% ($t$ = 2.51; p <0.05)), hypertension (15.3% vs. 2.2% ($t$ = 2.09; p <0.05)), and gestational diabetes mellitus (10.8% vs. 7.9% ($t$ = 2.08; p <0.05)).

Despite the fact that mothers of children born sick and with congenital disorders were more likely to have endocrine diseases (2.4 times), threatened miscarriage (4.9 times) and premature delivery (3.0 times), rhesus incompatibility (4.2 times), fetal pathology (6.3 times), and respiratory diseases (2.0 times), there was no statistically significant difference between the frequency in the main and control groups (p >0.1).

## 4.2 Comparative assessment of the quality of life of sick and healthy newborns

Determination of the level of quality of life of newborns can be considered as an additional criterion to judge their health status. Its assessment helps to distinguish newborns with low, medium and high levels of quality of life, which, in turn, allows for measures aimed at preventing the health of expectant mothers and newborns.

The study of life quality indicators of newborns was conducted in two stages. At the first stage, quality of life indicators were studied in the group with pathologies in general and newborns without pathologies, followed by comparative analysis. At the second stage, life indicators were compared in newborns with different pathologies. The study demonstrated that life quality indicators on all scales of the PedQL questionnaire were lower in children who were born sick and with congenital disorders compared with healthy children in the comparison group [89]. Significant differences were found on the following scales: physical activity, physical symptoms, emotional state, social activity, cognitive activity, total physical functioning score, total psychosocial health score, and total score (Table 4.10).

Table 4.10 – Average indicators of the quality of life of children of the main and control groups

| PedQL Scales | Main group (n = 183), M±σ | Control group (n = 196), M±σ | p |
|---|---|---|---|
| Physical activity | 60.9±23.1 | 81.3±15.4 | <0.05 |
| Physical symptoms | 74.2±13.5 | 82.1±12.4 | <0.05 |
| Emotional state | 72.5±15.6 | 75.0±14.3 | >0.05 |
| Social activity | 75.2±24.1 | 82.9±16.8 | <0.05 |
| Cognitive activity | 80.2±24.5 | 84.2±17.2 | >0.05 |
| Physical functioning, total score | 69.3±14.5 | 81.8±11.4 | <0.05 |
| Psychosocial health, total score | 74.6±14.5 | 78.4±12.4 | <0.05 |
| Total score | 72.3±11.6 | 79.9±10.6 | <0.05 |

Statistically significant differences were obtained for the following scales: physical activity, physical symptoms, and social activity between groups (paired Student's t-test); $p < 0.05$ (Figure 4.2).

Figure 4.2 – Profiles of the quality of life of newborns in the main and control groups

There were also significant differences in total physical functioning and psychosocial health scores and total life quality score between groups (paired Student's t-test); $p < 0.05$. Thus, to a greater extent, newborns born sick and with congenital disorders were characterized by impaired physical activity, physical symptoms, and social activity. These differences are clearly seen in the quality of life profiles of newborns born sick and with congenital disorders and healthy children.

Tables 24-26 present indicators of the life quality in children with various pathologies: anemia, congenital heart defects (CHD), hydrocephalus. A comparative analysis of life quality indicators in the main group of newborns with the following types of pathology was carried out: 1) children with CHD and anemia; 2) children with CHD and hydrocephalus; 3) children with hydrocephalus and anemia.

As shown in Table 4.11, all life quality indicators are higher in children with anemia than in newborns with CHD. However, the revealed differences in indicators are statistically significant only on the scales of physical activity, physical health and total score.

Table 4.11 – Comparison of quality of life indicators of newborns in the main group in children with congenital heart disease (malformations) and anemia

| PedQL Scales | Children with congenital heart defects (n = 38), M±σ | Children with anemia (n = 34), M±σ | p |
|---|---|---|---|
| Physical activity | 50.5±27.0 | 66.2±19.4 | <0.05 |
| Physical symptoms | 68.5±17.7 | 72.8±14.4 | >0.05 |
| Emotional state | 68.0±17.6 | 74.7±17.9 | >0.05 |
| Social activity | 76.0±18.9 | 80.3±17.9 | >0.05 |
| Cognitive activity | 82.3±20.5 | 88.4±13.3 | >0.05 |
| Physical functioning, total score | 61.7±18.3 | 70.3±13.9 | <0.05 |
| Psychosocial health, total score | 72.5±15.2 | 78.6±10.5 | >0.05 |
| Total score | 67.7±11.9 | 74.9±9.8 | <0.05 |

Comparison of quality of life indicators in newborns with CHD and hydrocephalus showed that almost all quality of life indicators, except for emotional state, social activity, and psychosocial health, are higher in newborns with CHD than in children with hydrocephalus. Comparison of life quality indicators in the main group in newborns with CHD and hydrocephalus is presented in Table 4.12.

Table 4.12 – Comparison of quality of life indicators in the main group in newborns with congenital heart defects and hydrocephalus

| PedQL Scales | Children with congenital heart defects (n = 38), M±σ | Children with hydrocephalus (n = 24), M±σ | p |
|---|---|---|---|
| Physical activity | 50.5±27.0 | 46.7±28.3 | >0.05 |
| Physical symptoms | 68.5±17.7 | 66.8±21.1 | >0.05 |
| Emotional state | 68.0±17.6 | 69.0±17.4 | >0.05 |
| Social activity | 76.0±18.9 | 76.3±21.5 | >0.05 |
| Cognitive activity | 82.3±20.4 | 80.0±20.8 | >0.05 |
| Physical functioning, total score | 61.7±18.2 | 59.2±21.0 | <0.05 |
| Psychosocial health, total score | 72.5±15.2 | 72.7±15.7 | >0.05 |
| Total score | 67.7±11.9 | 66.7±11.8 | <0.05 |

Identified differences in life quality indicators in newborns born sick and with congenital disorders are statistically significant on the scales of total physical functioning score and total score.

Comparison of life quality indicators in the main group in children with anemia and hydrocephalus revealed that all quality of life indicators of children with anemia are higher than those of newborns with hydrocephalus. The identified differences in life quality indicators are statistically significant on the physical activity, physical functioning, and total score scales. These differences are shown in Table 4.13.

Table 4.13 – Comparison of quality of life indicators of newborns in the main group in children with anemia and hydrocephalus

| PedQL Scales | Children with hydrocephalus (n = 24), M±σ | Children with anemia (n = 34), M±σ | p |
|---|---|---|---|
| Physical activity | 46.7±28.3 | 66.2±19.4 | <0.05 |
| Physical symptoms | 66.8±21.1 | 72.8±14.4 | >0.05 |
| Emotional state | 69.0±17.5 | 74.7±17.9 | >0.05 |
| Social activity | 76.3±21.5 | 80.3±17.9 | >0.05 |
| Cognitive activity | 80.0±20.8 | 88.4±13.3 | >0.05 |
| Physical functioning, total score | 59.2±21.0 | 70.3±13.9 | <0.05 |
| Psychosocial health, total score | 72.7±15.7 | 78.6±10.5 | >0.05 |
| Total score | 66.7±11.8 | 74. ±9.8 | <0.05 |

Additionally, the quality of life indicators of newborns born sick and with congenital disorders and healthy children were analyzed depending on the health group. Indicators of newborns born sick and those with congenital disorders differ in children with different health groups. Significant differences were found on the scales of physical activity, social activity, cognitive activity, psychosocial health, and total quality of life score. A comparison of indicators for newborns born sick and with congenital disorders by health group is shown in Table 4.14.

Table 4.14 – Comparison of indicators of the quality of life of newborns born sick and with congenital disorders by health groups

| PedQL Scales | Health group II (n = 52), M±σ | Health group III (n = 87), M±σ | p |
|---|---|---|---|
| Physical activity | 67.3±20.8 | 58.0±24.6 | <0.05 |
| Physical symptoms | 74.0±13.2 | 73.4±14.3 | >0.05 |
| Emotional state | 75.0±14.4 | 70.4±16.2 | >0.05 |
| Social activity | 80.6±18.6 | 69.5±28.6 | <0.05 |
| Cognitive activity | 89.4±14.2 | 71.2±29.6 | <0.05 |
| Physical functioning, total score | 71.5±13.5 | 67.7±15.8 | >0.05 |
| Psychosocial health, total score | 79.0±10.7 | 70.4±16.6 | <0.05 |
| Total score | 75.7±9.5 | 69.2±12.5 | <0.05 |

Comparison of indicators in healthy newborns between children with health groups I and II showed no significant differences. The results of comparative analysis are presented in Table 4.15.

Table 4.15 – Comparison of quality of life indicators in healthy newborns by health groups

| PedQL Scales | Health group I (n = 138), M±σ | Health group II (n = 58), M±σ | p |
|---|---|---|---|
| Physical activity | 81.6±13.6 | 80.5±19.2 | >0.05 |
| Physical symptoms | 82.7±12.3 | 80.5±12.7 | >0.05 |
| Emotional state | 75.4±14.7 | 74.0±13.5 | >0.05 |
| Social activity | 82.8±17.3 | 83.0±15.6 | >0.05 |
| Cognitive activity | 83.7±17.6 | 85.2±16.2 | >0.05 |
| Physical functioning, total score | 82.3±10.8 | 80.6±12.9 | >0.05 |
| Psychosocial health, total score | 78.6±12.6 | 78.0±11.9 | >0.05 |
| Total score | 80.2±10.5 | 79.1±11.0 | >0.05 |

Thus, the quality of life of healthy newborns is significantly better than that of children born sick and with congenital disorders. The indicators of sick newborns are significantly lower than the corresponding indicators in healthy children. Sick newborns have decreased physical activity, physical symptoms, and social activity. When comparing the quality of life in children with different pathologies, it was found that the life quality indicators of newborns with anemia are higher than those of children with CHD and hydrocephalus. The quality of life of newborns with hydrocephalus is lower than that of children with CHD. Significant differences in the quality of life of newborn children have been established between health groups I and III. The indicators of newborns with health groups I and II are similar. Thus, the quality of life of a newborn child can be considered as an integral characteristic of the health status of children of this age group.

# CHAPTER 5. BASIC INDICATORS OF ACCESSIBILITY AND QUALITY OF MEDICAL CARE FOR NEWBORNS BORN SICK AND WITH CONGENITAL DISORDERS, AND SUBSTANTIATION OF ORGANIZATIONAL MEASURES TO IMPROVE IT

## 5.1 Objective assessment of the organization of medical care for newborns born sick and with congenital disorders

According to the routing, in case of medical grounds, the newborn, if there is no need for resuscitation measures, is transferred from the 2nd level obstetric organization to the pediatric medical organization NPD or to the child outpatient department according to the profile of the disease. If it is a level 3 obstetric organization, the newborn is transferred to the NPD available within it, based on internal routing. It was found that the provision of beds for the NWFD in 2022 was 3.1% lower than the national average and amounted to 77.2 beds per 10 thousand children under 1 year old. Assessment of the dynamics of indicators in 2015-2022 revealed that the average district indicator was mostly below the national average. The positive dynamics of provision, which was observed during this period, in the Russian Federation amounted to +17.7%, and in the district +8.7%. The analysis of the availability of the NPD beds for children under 1 year old in St. Petersburg showed that in 2022 it amounted to 64.7 beds per 10 000 children, which is 18.8 and 16.2% below the national and district averages, respectively. The provision of beds in the city's emergency medical center had a negative trend from 2015 to 2017 inclusive, and since 2018 it increased almost annually [86, 124]. In general, the growth during the study period was 18.5%. The dynamics of the provision of beds for the NPD in the Russian Federation, the Northwestern Federal District and St. Petersburg is shown in Figure 5.1.

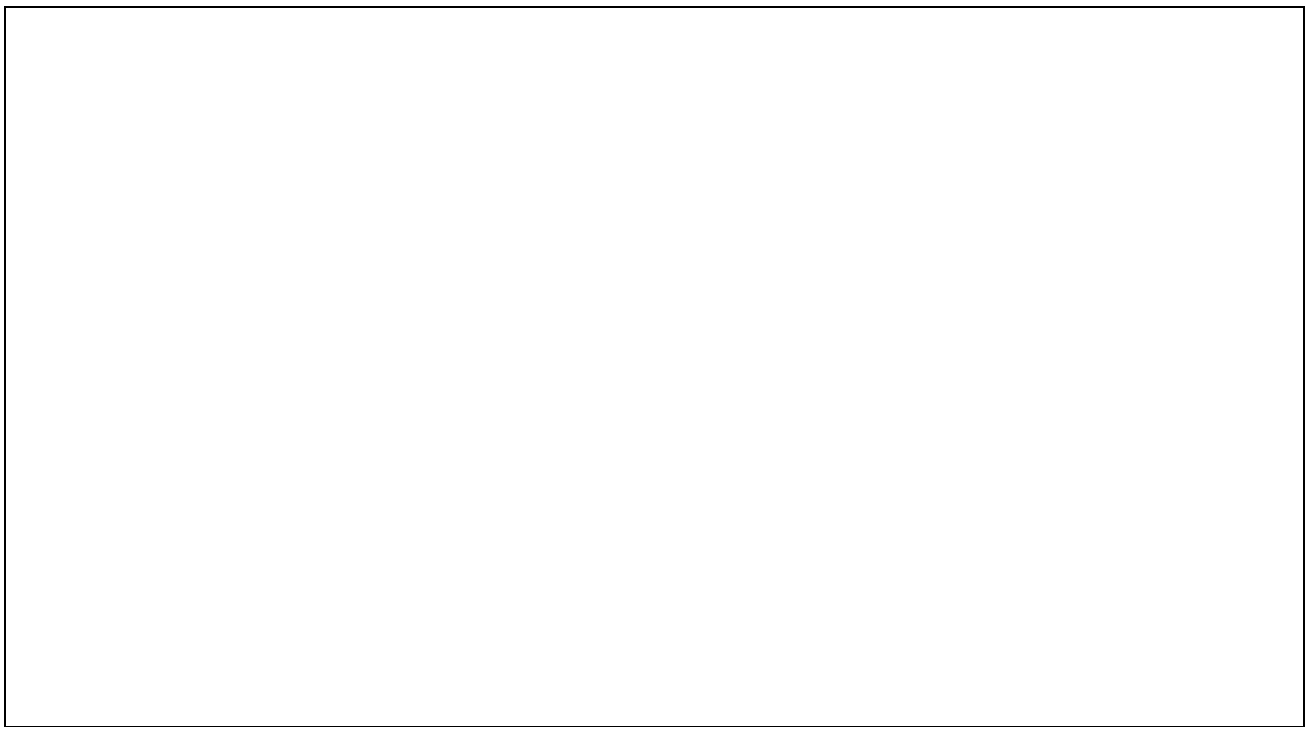

Figure 5.1 – Dynamics of neonatal and premature infant pathology beds in the Russian Federation, the Northwestern Federal District and St. Petersburg (per 10 000 children under 1 year old)

The most significant objective indicators of the quality of medical care are hospital mortality rates. When assessing the quality of medical care for newborns born sick and with congenital disorders, such indicators will be hospital mortality of children with ELBW and with birth weight of 1000 g and above at the age of 0-6 days. The study showed that, as in the Russian Federation and the NWFD as a whole, as well as in St. Petersburg, there was a decrease in hospital mortality of newborns with ELBW between 2015 and 2022 (Table 5.1). The exception was in 2021, when the hospital mortality rate for children up to 1000 g increased sharply in the federal district to 24.57%, and in the megalopolis to 24.68%. In the Russian Federation, an annual decrease in mortality of newborns with ELBW was observed in the eight-year time interval under study until 2021-2022. The Federal District had an increase in this rate in 2016-2017 and 2020-2022, and St. Petersburg had an increase in 2016 and 2020-2022. In St. Petersburg in 2022, the hospital mortality rate of children with ELBW was higher than the national and district averages by 20.5 and 11.6%, respectively [88, 225].

Table 5.1 – Dynamics of hospital mortality of newborns with a body weight of 500-999 g at the age of 0-6 days in the Russian Federation, the Northwestern Federal District and St. Petersburg (% of live births )

| Region | Years | | | | | | | | Growth/ decline rate, times (%) |
|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | |
| Russian Federation | 21.00 | 20.37 | 18.98 | 18.98 | 17.50 | 13.20 | 13.48 | 13.93 | <1.5 (–33.7%) |
| NWFD | 20.91 | 24.81 | 25.00 | 20.06 | 12.55 | 14.6 | 24.57 | 17.26 | <1.2 (–17.5%) |
| St. Petersburg | 21.16 | 24.82 | 24.65 | 20.42 | 8.30 | 13.79 | 24.68 | 19.53 | <1.1 (–7.7%) |

The assessment of hospital mortality of children born with a body weight of 1000 g or more revealed (Table 5.2) that while in Russia and in the megalopolis the rates have decreased over eight years (by a factor of 1.5 and 1.1, respectively), in the NWFD they have increased (by a factor of 1.2).

Table 5.2 – Dynamics of hospital mortality of newborns with body weight of 1000 g and more at the age of 0-6 days in the Russian Federation, the Northwestern Federal District and St. Petersburg (% of live births)

| Region | Years | | | | | | | | Growth/ decline rate, times (%) |
|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | |
| Russian Federation | 1.10 | 0.96 | 0.84 | 0.92 | 0.79 | 0.78 | 0.75 | 0.63 | <1.7 (–42.7%) |
| NWFD | 1.19 | 1.06 | 0.96 | 0.99 | 1.33 | 1.05 | 1.10 | 1.29 | >1.1 (–7.7%) |
| St. Petersburg | 2.36 | 2.21 | 1.45 | 1.54 | 1.90 | 1.55 | 1.50 | 1.59 | <1.5 (–32.6%) |

As in the case of mortality rates of children with ELBW, there was an annual decrease in the rates for the country as a whole. Assessment of the dynamics of indicators revealed that hospital mortality had a common rise in 2018 for the Russian Federation, the Northwestern Federal District and St. Petersburg. In the NWFD, an increase in pediatric NPDs mortality was observed in 2021-2022, and in St. Petersburg in 2019 and 2022. As shown in Table 28, the hospital mortality rate for newborns with a body weight of 1000 g or more was 2.5 and 1.2 times higher than the national and district averages, respectively.

Thus, the analysis of provsion of the NPD with beds showed that both the NWFD as a whole and St. Petersburg had a lower provision than the Russian Federation in

2015-2022 in average. The assessment of the indicators revealed that hospital mortality of newborns in St. Petersburg was higher than the national and district averages, which is associated with the routing of pregnant women, women in labor and delivery and newborns of high obstetric and perinatal risk to the city's medical organizations from the NWFD regions. Thus, the city's emergency medical center beds bear the main burden of providing medical care to children born sick and with congenital disorders in the federal district.

If it is impossible to provide the necessary medical care in the conditions of the obstetrics organization, the newborn should be transported to a specialized hospital. Currently, several models of emergency care for newborns with critical conditions are used in Russia. The first option is when transfer of a newborn from the maternity hospital to a specialized medical organization is carried out by a visiting resuscitation team, which is, as a rule, a structural unit of the resuscitation department of regional or republican children's hospitals. The second option is when the newborn is transported by an intensive care unit (ICU), whose task, in addition to accompanying the child, is advisory assistance in the diagnosis and treatment of emergencies in maternity hospitals. A special feature of the ICU is the ability to coordinate and integrate the activities of children's hospitals of different levels in the region. Transportation of children in critical conditions is a high-risk procedure and should be performed in their stable clinical condition. Both the personnel of the resuscitation team transporting the newborn and the personnel of the receiving medical organization must be fully informed about the newborn's condition and the therapeutic and diagnostic measures being taken to ensure continuity of treatment and plan its further management. Transportation should be carried out by medical personnel with specialized training and the necessary logistical support.

The third option is the provision of specialized medical care for the newborn in the conditions of a perinatal center, the main advantage of which is the possibility of carrying out delivery in pregnant women with various types of fetal pathology, which allows the immediate provision of medical care to the child. The obvious advantage of this model is that there is no need to transport a newborn child to a specialized hospital.

As is known, the first 72 hours are the most critical period, when any transportation create the possibility of additional risks of complications in a newborn. The key difference between a perinatal center and a maternity hospital is the presence of the NICU and NPDs, which allows full care immediately after birth.

Based on the regulatory framework for the routing of children in St. Petersburg, if a child cannot be discharged home from the maternity hospital, then he is routinely transferred to other specialized departments of hospitals in the city. Information about children requiring urgent transfer is transmitted by phone to the St. Petersburg ICU, which is located in the St. Petersburg State Budgetary Institution "Children's City Multidisciplinary Clinical Specialized Center of High Medical Technologies", and subsequently by a specialized ambulance brigade children are transferred to the departments of the appropriate profile (intensive care) hospitals of the city. This occurs if the child was not born in a federal perinatal center, where there are opportunities to provide the child with specialized care, including HTMC, according to the profile of the disease. There are two federal perinatal centers in St. Petersburg – Federal State Budgetary Educational Institution of Higher Education "Saint Petersburg State Pediatric Medical University" of the Ministry of Health of the Russian Federation and Federal State Budgetary Educational Institution "V.A. Almazov National Medical Research Center" of the Ministry of Health of Russia and one regional center – St. Petersburg State Budgetary Healthcare Institution "City Perinatal Center No. 1".

Perinatal center of Saint Petersburg State Pediatric Medical University (level 3B), in accordance with the tasks it performs, contains a 50-bed emergency room. By profile, beds are divided into neonatal – 37, surgical – 5, cardiac – 5 and neurosurgical – 3. The department has two intensive care units for 26 beds (one for 16 beds, the second for 10 beds) and mother-child joint wards for 24 beds.

The perinatal center NPD of V.A. Almazov National Medical Research Center, as well as the perinatal center of Saint Petersburg State Pediatric Medical University, belongs to level 3B. The department contains 30 neonatology beds for mother and child. The perinatal center has a department of pediatric surgery of malformations and acquired pathology for newborns and infants, 3 anesthesiology-intensive care units with

NICU wards (including one for children of cardio-surgical profile and one for children of surgical profile).

St. Petersburg City Perinatal Center No. 1 belongs to the 3A level. In its structure, it contains NPD – 10 beds of the neonatology profile. The perinatal center has a 12-bed NICU. However, due to its level, this perinatal center does not provide neonatal care to newborns and therefore children of this category, according to the routing, are transferred to federal perinatal centers or to Children's City Multidisciplinary Clinical Specialized Center of High Medical Technologies.

The third level is also represented by the multidisciplinary pediatric hospital of Children's City Multidisciplinary Clinical Specialized Center of High Medical Technologies, which contains two NPDs. No. 1 NPD is designed for 60 beds, of which 38 are intended for the treatment of premature babies, 15 beds are of a surgical profile. No. 2 NPD is designed also for 60 beds. The departments treat newborns with a weight from 500 g and children with various types of somatic, surgical, neurological pathology, as well as with CMs of the central nervous system, genitourinary system, digestive organs, CHD and newborns with asphyxia. Neurosurgical surgical interventions in children with severe neurological pathology are performed in the NPD of Children's City Multidisciplinary Clinical Specialized Center of High Medical Technologies. There are 26 wards for joint stay (round-the-clock), the rest of the wards operate on the principle of day admission or it is possible to stay in maternity wards to provide constant care for the child.

In order to provide specialized medical care, newborns according to the profile of the disease, if there is no need for surgical care, are transferred from obstetrics organizations of St. Petersburg to the NPDs of children's multidisciplinary hospitals (city children's hospitals). St. Petersburg State Medical Institution "St. Olga Children's City Hospital" is equipped with a 30-bed emergency room. The department has all the facilities for nursing and treatment of deep premature babies.

St. Petersburg Children's City Hospital No. 22 (Kolpino, St. Petersburg) includes 6 intensive care beds and 34 beds of the second stage of neonatal care. The department provides care for premature newborns with birth weight over 1500 g, treatment of

newborns with diseases and CMs. Maternity wards are available in addition to co-parenting rooms.

In the structure of "St. Nicholas the Wonderworker Hospital No. 17" there are two pediatric departments for newborn children No. 1 and No. 2. Pediatric department No. 1 is equipped with 60 beds. The department receives two rounds of children: by referral of maternity hospitals; by referral of children's polyclinics, emergency and ambulance stations with diseases of the newborn period. The pediatric neonatal unit No. 2 currently has 5 posts with 50 beds. Children are transferred to the department from NICU, from maternity hospitals and, during the summer, by referral from outpatient clinics. About 70% of incoming babies are premature. The priority of the department's doctors is nursing babies born with VLBW and ELBW.

The assessment of the performance of the Perinatal Center NPD showed (Table 5.3) that the number of both admissions and discharges from the department increased in 2022. In the Pediatric Inpatient NPD in 2022 to 2019 levels, admissions and discharges decreased while transfers to other hospitals and children's homes increased (42.9% and 37.1%, respectively).

Table 5.3 – Performance indicators of departments of pathology of newborns and premature infants of the perinatal center and children's hospital 2019-2022 (abs. units)

| Indicator | Perinatal center | | | | | Children's inpatient department | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | 2021 | 2022 | Dynamics, % | 2019 | 2020 | 2021 | 2022 | Dynamics, % |
| Admitted | 420 | 515 | 741 | 682 | +38.4 | 744 | 955 | 651 | 687 | –7.7 |
| Dropped out | 550 | 633 | 747 | 689 | +20.2 | 960 | 859 | 850 | 756 | –21.3 |
| Discharged | 540 | 617 | 727 | 674 | +19.9 | 930 | 808 | 804 | 707 | –24.0 |
| Transferred to other hospitals | 10 | 16 | 20 | 15 | +33.3 | 8 | 25 | 19 | 14 | +42.9 |
| Children's homes | – | – | – | – | – | 22 | 26 | 27 | 35 | +37.1 |
| Died | – | – | – | – | – | – | – | – | – | – |

Evaluation of the structure of hospital admission of neonatal patients in the NPD showed (Table 5.4) that the largest proportion of those admitted to the NPD of the perinatal center in 2019-2022 was from other medical organizations (31.4-38.5%).

However, the proportion of such patients decreased by 5.5% due to an increase in planned admissions from home and new episodes [121].

Table 5.4 – Distribution of children depending on the place of admission to the department of pathology of newborns and premature infants of the Perinatal Center of the "St. Petersburg State Pediatric Medical University" of the Ministry of Health of the Russian Federation in 2019-2022 (%).

| Place of admission | 2019 | 2020 | 2021 | 2022 | Dynamics, % |
|---|---|---|---|---|---|
| Maternity room, neonatal physiology department | 24.0 | 17.0 | 13.9 | 15.1 | –29.2 |
| NICU and cardiac intensive care unit | 31.0 | 25.0 | 21.2 | 17.6 | –21.4 |
| Other medical organizations | 36.0 | 38.5 | 31.4 | 31.4 | –5.5 |
| Planned hospital admission from home | 9.1 | 11.5 | 17.0 | 22.6 | +20.9 |
| NPD (new episodes) and other clinic departments | – | 7.4 | 16.1 | 13.3 | – |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | – |

Through 2019-2022, the majority of newborns were admitted to the pediatric inpatient NPD from maternity city hospitals (46.1-63.3%). In addition, children were admitted to the pediatric inpatient NPD from COD and other medical organizations. Distribution of children by place of admission to the NPD of "St. Nicholas the Wonderworker Children's Hospital No. 17" is presented in Table 5.5.

Table 5.5 – Distribution of children by place of admission to the department of pathology of newborns and premature infants of "St. Nicholas the Wonderworker Children's Hospital No. 17" in 2019-2022 (%) -

| Place of admission | 2019 | 2020 | 2021 | 2022 | Dynamics, % |
|---|---|---|---|---|---|
| Maternity hospitals | 46.2 | 46.1 | 47.9 | 63.4 | +27.1 |
| NICU | 21.3 | 22.5 | 26.3 | 17.9 | –16.0 |
| Other medical organizations | 32.5 | 31.4 | 25.8 | 18.7 | –42.5 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | – |

Thus, while in 2019, among children admitted to the NPD of the perinatal center, there was a predominance of children admitted according to internal routing and in the NPD of the children's hospital – with external routing, in 2022 the situation has changed. Both in the perinatal center and in the children's hospital, external routing became predominant.

An assessment of the distribution of those who left the perinatal center in 2022 showed (Table 5.6) that there were slightly fewer premature newborns than in the

pediatric hospital (46.5% vs. 59.3%; p <0.05) and the proportion of children with LBW was significantly lower (36.8% vs. 41.5%; p <0.05).

Table 5.6 – Distribution of discharges from the department of pathology of newborns and premature infants by birth weight in perinatal center and children's hospital in 2019-2022 (% and abs.)

| Indicator | Perinatal center | | | | | Children's inpatient department | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | 2021 | 2022 | Dynamics, % | 2019 | 2020 | 2021 | 2022 | Dynamics, % |
| Full-term babies | 54.2 | 58.8 | 51.3 | 53.5 | –1.3 | 58.4 | 54.0 | 52.1 | 40.7 | –30.3 |
| Premature babies | 45.8 | 41.2 | 48.7 | 46.5 | +1.5 | 41.6 | 46.0 | 47.9 | 59.3 | +29.8 |
| LBW, including | 46.0 | 40.1 | 47.1 | 36.8 | –20.0 | 55.5 | 58.7 | 60.4 | 41.5 | –25.2 |
| VLBW | 11.5 | 7.9 | 13.5 | 12.3 | +6.5 | 7.2 | 7.3 | 7.4 | 4.0 | –44.4 |
| ELBW | 11.8 | 11.2 | 10.2 | 5.3 | –55.1 | 0.3 | 0.3 | 0.0 | 0.0 | – |
| Average body weight | 48.5 | 55.0 | 50.5 | 60.0 | +19.2 | 39.3 | 34.8 | 34.3 | 47.1 | +16.7 |
| High body weight | 5.5 | 4.9 | 2.4 | 3.2 | –41.8 | 5.2 | 6.5 | 5.3 | 7.4 | +29.7 |
| Dropped out | 100.0 | 100.0 | 100.0 | 100.0 | – | 100.0 | 100, 0 | 100.0 | 100.0 | – |

There was a higher proportion of children with ELBW (5.3% vs. 0.0%) and average birth weight (60.0% vs. 47.1%; p <0.05). Evaluation of the dynamics of indicators revealed that in the NPD of the perinatal center the specific weight of premature babies (-1.3%), newborns with low birth weight and ELBW (-20.0 and -55.1%, respectively) and babies born with high birth weight (-41.8%) decreased.

The frequency of hospital admissions to the children's hospital NPD of premature infants (+29.8%) with a decrease in premature infants (-30.3%) increased significantly. In addition, the proportion of all children born with the low birth weight decreased: LWB by 25.2%, VLBW by 44.4%, and the proportion of babies with ELBW decreased to 0%. Thus, the proportion of children with medium and high body weight increased in pediatric inpatient NPDs (+16.7 and 29.7%, respectively).

In 2019-2022, the pediatric inpatient NPD (including the COVID-19 pandemic period) strengthened nursing activities for premature infants as part of its work. The perinatal center NPD, given the structure of newborns according to the place of admission to the department during the pandemic, during 2019-2022 increased its work within the function of providing medical care as a federal facility, increasing the proportion of admissions by external routing.

Analysis of the structure of patients discharged from the perinatal center and children's hospital NPDs revealed statistically significant differences. Differences were also found between the proportion of disorders associated with shortened maternal gestation and low birth weight ($p < 0.05$), the proportion of growth retardation and malnutrition ($p < 0.05$), the proportion of respiratory disorders characteristic of the perinatal period ($p < 0.05$), and the proportion of congenital malformations ($p < 0.01$). The structure of patients discharged from the department of pathology of newborns and premature infants of the perinatal center and children's hospital is presented in Figure 5.2.

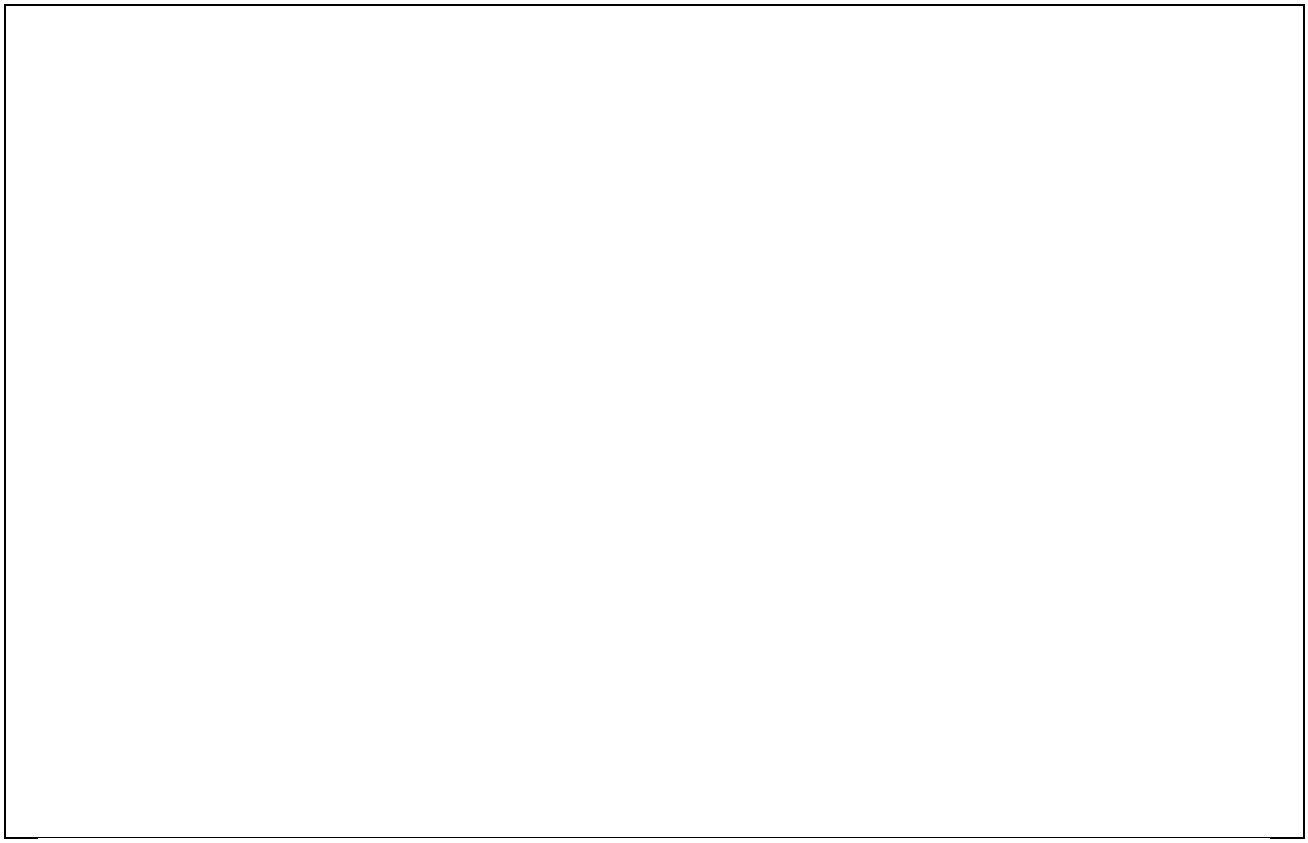

Figure 5.2 – Structure of patients discharged from the department of pathology of newborns and premature infants of the perinatal center and children's hospital (%)

Thus, there is significantly more somatic pathology in the children's hospital, which is due to the focus of the work of the children's hospitals on the care of premature and sick newborns. The perinatal center has a 7.0-fold higher proportion of CM, which is due to the presence of a surgical service for the treatment of these patients.

An analysis of the use of the NPD bed fund revealed (Table 5.7) that in 2022, the average bed occupancy per year increased in the perinatal center (+2.1%) and decreased

in the children's hospital (-1.8%). This was due to a 4.0% increase in bed turnover in the perinatal center and a 13.1% decrease in inpatient beds. It was found that the implementation of the work plan for the NPD beds in the perinatal center in 2022 increased by 1.2% compared to 2019, and in the children's hospital – by 0.8%. Thus, we can talk about a higher load on the beds of the perinatal center with a more rational use of it in 2019-2022.

Table 5.7 – Indicators of the bed stock use of the department of pathology of newborns and premature infants of the perinatal center and children's hospital in 2019-2022.

| Indicator | Perinatal center | | | | | Children's inpatient department | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | 2021 | 2022 | Dynamics, % | 2019 | 2020 | 2021 | 2022 | Dynamics, % |
| Bed operation, days | 298.5 | 304.9 | 305.4 | 304.9 | +2.1 | 295.7 | 282.3 | 294.0 | 290.4 | –1.8 |
| Average length of stay in bed, days | 15.7 | 16.0 | 14.8 | 15.4 | –1.9 | 17.6 | 17.4 | 15.0 | 19.8 | +11.1 |
| Bed turnover | 19.0 | 19.1 | 20.6 | 19.8 | +4.0 | 16.8 | 16.2 | 19.6 | 14.6 | –13.1 |
| % of plan completion | 91.3 | 93.3 | 93.6 | 92.4 | +1.2 | 90.4 | 86.3 | 93.0 | 91.1 | +0.8 |
| Mortality | 0.0 | 0.0 | 0.0 | 0.0 | – | 0.0 | 0.0 | 0.0 | 0.0 | – |

Full breastfeeding plays a significant role in preserving and maintaining the health of children, especially those born sick and with congenital disorders [160, 166]. This allows for optimal conditions to support natural feeding, which is critical for children with ELBW (Table 5.8).

Table 5.8 – Distribution of newborns treated in the department of pathology of newborns and premature infants of the perinatal center and children's hospital by type of feeding in 2019-2022 (%)

| Indicator | Perinatal center | | | | | Children's inpatient department | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | 2020 | 2021 | 2022 | Dynamics, % | 2019 | 2020 | 2021 | 2022 | Dynamics, % |
| Breast milk | 35.5 | 36.5 | 37.2 | 38.3 | +7.3 | 24.0 | 25.3 | 27.1 | 23.7 | –1.3 |
| Mixed | 25.8 | 31.3 | 32.4 | 32.6 | +20.9 | 46.2 | 38.7 | 38.7 | 30.8 | –33.3 |
| Bottle feeding | 38.7 | 32.2 | 30.4 | 29.1 | –24.8 | 29.8 | 36.0 | 34.2 | 45.5 | +34.5 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | – | 100.0 | 100.0 | 100.0 | 109.0 | – |

Breastfeeding was found to be significantly higher in perinatal center than in pediatric inpatient NPDs (38.3% vs. 23.7%; $p < 0.05$), which was associated with a

higher proportion of mother-child co-presence in the perinatal center. At the same time, an increase in the proportion of breast- and mixed-fed children (by 7.3 and 20.9%, respectively) and a decrease in the proportion of bottle-fed children (by 24.8%) was observed in the perinatal center. In the pediatric inpatient NPD, there was an increase in the proportion of children on bottle feeding (+34.5%) and a decrease in the proportion of children on breast and mixed feeding (by 1.3 and 33.3%, respectively) [264, 278].

Thus, the evaluation the perinatal center and children's hospital NPDs showed a significant difference in the structure of patients both by disease (pathological condition), weight and prematurity of children, and by place of admission to the departments. The NPD bed stock of the perinatal center operates with a higher load and more rationally than in the pediatric hospital. In the perinatal center, due to the peculiarities of its activity and the work of the surgical service, significantly more children admitted by external routing and newborns with CM, as well as a significantly higher proportion of newborns are breastfed in the NPD of the perinatal center than in the children's hospital. In the children's hospital NPD, the main function of which is nursing newborns and premature infants, somatic pathology and those admitted by internal routing prevail.

## 5.2 Subjective assessment by mothers of the organization of medical care for newborns born sick and with congenital disorders

According to Federal Law No. 323-FZ "On the fundamentals of health protection of citizen in the Russian Federation", the very concept of the quality of medical care is aimed at the consumer of medical services – the patient. In modern conditions, the quality of medical care is based on the assessment of satisfaction of the population with the provision of medical care, and in this case mothers of newborns born sick and with congenital disorders, with the very process of providing medical services in the NPD.

The assessment of the survey results revealed that 83.0% out of 100 mothers who participated in the questionnaire were fully satisfied with the technical condition, repair and space of the NPD premises (Table 5.9). Moreover, the proportion of completely satisfied was higher in the perinatal center NPD than in the pediatric hospital

(86.10%±2.48% vs. 82.10%±2.67%). The level of satisfaction of mothers with the technical condition, repair and area of the NPD premises, according to the methodological recommendations of the Federal FFCHI, can be assessed as high, since the proportion of fully satisfied respondents corresponds to 75-100% both in general and in the perinatal center and children's hospital [123].

Table 5.9 – Criterion 1. Assessment of mothers' satisfaction with the technical condition, repair and space of the premises of the department of pathology of newborns and premature infants p±m (%)

| Characteristic | Perinatal center | Children's inpatient department | *t* (p) | Overall |
|---|---|---|---|---|
| Satisfied | 86.10±2.48 | 82.10±2.67 | 1.10 (>0.05) | 84.00±1.83 |
| More satisfied than not satisfied | 8.10±6.62 | 7.90±6.19 | 0.02 (>0.1) | 8.00±4.46 |
| More dissatisfied than satisfied | 2.60±7.12 | 3.20±6.65 | 0.06 (>0.1) | 2.90±4.65 |
| Not satisfied | 0.30±8.50 | 0.80±8.90 | 0.05 (>0.1) | 0.60±5.47 |
| I find it difficult to answer | 2.90±6.85 | 3.60±6.59 | 0.07 (>0.1) | 3.30±4.61 |
| Total | 100.00 | 100.00 | – | 100.00 |

Satisfaction with the comfort of the hospital room and the newborn's places of stay showed lower results than satisfaction with the technical condition, repair and space of the rooms. 72.8% of mothers out of 100 were fully satisfied (Table 5.10). The comparative assessment of comfort satisfaction was also slightly higher in the perinatal center (75.80%±3.33% vs. 71.00%±3.39%). There were more partially and completely dissatisfied mothers among mothers whose children were treated in the pediatric hospital NPD. Both among those who are satisfied rather than dissatisfied (15.30%±6.17% vs. 17.10%±5.81%), and among those who are dissatisfied rather than satisfied (5.10%±6.63% vs. 6.20%±6.23%), and dissatisfied (2.50%±6.98% vs. 3.90%±6.45%). The level of satisfaction of mothers according to criterion 2 and the methodological recommendations of the FFCHI, can be assessed as high only in the perinatal center, and in general and separately in the children's hospital – average level (50-75%).

Table 5.10 – Criterion 2. Assessment of mothers' satisfaction with the comfort of the hospital room and places of stay of the newborn in the department of pathology of newborns and premature infants (%).

| Characteristic | Perinatal center | Children's inpatient department | *t* (p) | Overall |
|---|---|---|---|---|
| Satisfied | 75.80±3.33 | 71.00±3.39 | 0.92 (>0.05) | 72.80±2.32 |
| More satisfied than not satisfied | 14.30±6.17 | 17.10±5.81 | 0.21 (>0.05) | 16.20±4.20 |
| More dissatisfied than satisfied | 5.10±6.63 | 6.20±6.23 | 0.12 (>0.1) | 5.70±4.55 |
| Not satisfied | 2.50±6.98 | 3.90±6.45 | 0.14 (>0.1) | 3.20±7.87 |
| I find it difficult to answer | 2.30±7.50 | 1.80±6.64 | 0.05 (>0.1) | 2.00±4.67 |
| Total | 100.00 | 100.00 | – | 100.00 |

The analysis of mothers' distribution according to the degree of satisfaction with the work of auxiliary services (laboratory, X-ray room, physiotherapy room, etc.) showed that this indicator was rated the worst of all the assessed indicators of maternal satisfaction. Only 69.4% of 100 women were fully satisfied with auxiliary services (Table 5.11). At the same time, the satisfaction score was lower in the children's hospital emergency department – the proportion of those who were fully satisfied was below the target [144]. However, during the evaluation of indicators according to the methodological recommendations of the FFCHI, both in general and in the perinatal center and children's hospital, it was found that the level of satisfaction of mothers with the work of auxiliary services corresponds to the average.

Table 5.11 – Criterion 3. Assessment of mothers' satisfaction with the work of auxiliary services (laboratory, X-ray room, physiotherapy room, etc.) (%)

| Characteristic | Perinatal center | Children's inpatient department | *t* (p) | Overall |
|---|---|---|---|---|
| Satisfied | 70.30±3.62 | 68.50±3.65 | 0.35 (>0.05) | 69.40±2.52 |
| More satisfied than not satisfied | 22.70±5.86 | 22.20±5.60 | 0.06 (>0.1) | 22.40±4.03 |
| More dissatisfied than satisfied | 2.60±7.12 | 3.80±6.37 | 0.15 (>0.1) | 3.20±4.54 |
| Not satisfied | 1.10±7.37 | 1.30±8.01 | 0.02 (>0.1) | 1.20±4.87 |
| I find it difficult to answer | 3.30±6.75 | 4.20±6.32 | 0.10 (>0.1) | 3.80±4.87 |
| Total | 100.00 | 100.00 | – | 100.00 |

The provision of medicines and supplies to mothers admitted to the emergency room was rated very high. Overall, the satisfaction rate was 92.1% (Table 5.12).

Table 5.12 – Criterion 4. Assessment of mothers' satisfaction with the provision of the department of pathology of newborns and premature infants with medicines and consumables (%)

| Characteristic | Perinatal center | Children's inpatient department | *t* (p) | Overall |
|---|---|---|---|---|
| Satisfied | 92.70±1.75 | 91.60±1.83 | 0.43 (>0.05) | 92.10±1.28 |
| More satisfied than not satisfied | 4.50±6.91 | 4.90±6.50 | 0.04 (>0.1) | 4.70±4.51 |
| More dissatisfied than satisfied | 0.70±8.34 | 0.90±9.44 | 0.02 (>0.1) | 0.80±5.14 |
| Not satisfied | 0.00 | 0.00 | – | 0.00 |
| I find it difficult to answer | 2.10±7.17 | 2.60±6.50 | 0.05 | 2.40±4.84 |
| Total | 100.00 | 100.00 | – | 100.00 |

The rate was slightly higher in the perinatal center. However, there were no mothers completely dissatisfied with the availability of medicines and consumables in either the perinatal center or the pediatric inpatient NPD assessment. The level of satisfaction of mothers with the provision of the department with consumables, according to the methodological recommendations of the FFCHI, is high in general and separately in the perinatal center and children's hospital.

The analysis of mothers' distribution according to the degree of satisfaction with the quality of medical care received in the NPD revealed that 86.1% of respondents out of 100 rated it highly and were completely satisfied. There were 3.5% more fully satisfied mothers among women whose children were treated at the perinatal center NPD (85.30%±2.55% vs. 82.00%±2.68%). Assessment of mothers' satisfaction with the quality of medical care in the department of pathology of newborns and premature infants is presented in Table 5.13.

Table 5.13 – Criterion 5. Assessment of mothers' satisfaction with the quality of medical care in the department of pathology of newborns and premature infants (%)

| Characteristic | Perinatal center | Children's inpatient department | *t* (p) | Overall |
|---|---|---|---|---|
| Satisfied | 85.30±2.55 | 82.00±2.68 | 0.16 (>0.1) | 86.10±1.74 |
| More satisfied than not satisfied | 13.90±6.21 | 16.70±5.82 | 0.33 (>0.05) | 12.40±3.86 |
| More dissatisfied than satisfied | 0.30±14.02 | 0.50±13.58 | 0.28 (>0.05) | 0.40±11.75 |
| Not satisfied | 0.00 | 0.00 | – | 0.00 |
| I find it difficult to answer | 0.50±10.56 | 0.90±9.45 | 0.36 (>0.05) | 0.20±3.16 |
| Total | 100.00 | 100.00 | – | 100.00 |

As in the assessment of satisfaction with the provision of the NPD with medicines and consumables, there were no patients of the perinatal center and children's hospital who were completely dissatisfied with the quality of free medical care received. Assessment of the level of satisfaction of mothers with the quality of medical care received in the NPD showed that the indicator corresponds to a high level both in general and individually in the organizations under study.

Evaluation of the work of physicians and secondary medical personnel consists of several components. First, female respondents were asked to assess personal qualities of neonatologists (Table 5.14). The study revealed that this indicator was rated highest by mothers and 95.9% of 100 women felt that neonatologists were always attentive and involved. Moreover, the pediatric hospital NPD physicians were rated slightly higher than perinatal center neonatologists (96.10%±1.24% vs. 95.60%±1.39%) [29, 30, 31, 32]. The level of satisfaction of mothers with attentiveness and politeness of a neonatologist with regard to the patients of the department can be assessed as high in general and individually in medical organizations.

Table 5.14 – Criterion 6. Assessment of mothers' satisfaction with the attentiveness and courtesy of neonatologists with patients of the department of pathology of newborns and premature infants (%)

| Characteristic | Perinatal center | Children's inpatient department | *t* (p) | Overall |
|---|---|---|---|---|
| With attention and participation | 95.60±1.39 | 96.10±1.24 | 0.27 (>0.05) | 95.90±9.24 |
| Not very attentive | 3.80±7.23 | 3.60±6.59 | 0.02 (>0.1) | 3.70±4.72 |
| Indifferent | 0.30±7.85 | 0.20±6.58 | 0.02 (>0.1) | 0.20±4.47 |
| I find it difficult to answer | 0.0 | 0.00 | – | 0.00 |
| With annoyance and rudeness | 0.30±5.47 | 0.10±3.16 | 0.03 (>0.1) | 0.20±6.35 |
| Total | 100.00 | 100.00 | – | 100.00 |

Mothers rated the personal qualities of the secondary medical personnel significantly worse (Table 5.15) than the work of doctors (71.10%±2.45% vs. 95.90%±9.24%; p >0.05). 25.9% fewer respondents felt that the NPD secondary medical personnel always behaved attentively and with participation. Meanwhile, personal qualities of nurses were rated higher in perinatal center compared to pediatric hospital (72.30%±3.51% vs. 70.10%±3.45%). In addition, unlike the pediatric inpatient NPD, there were no mothers at the perinatal center who indicated that the nurses were irritable and rude.

Table 5.15 – Criterion 7. Assessment of mothers' satisfaction with the attentiveness and courtesy of secondary medical personnel with patients of the neonatal and premature babies pathology department (%)

| Characteristic | Perinatal center | Children's inpatient department | *t* (p) | Overall |
|---|---|---|---|---|
| With attention and participation | 72.30±3.51 | 70.10±3.45 | 0.45 (>0.05) | 71.10±2.45 |
| Not very attentive | 23.50±5.82 | 25.10±5.96 | 0.19 (>0.1) | 24.30±3.98 |
| Indifferent | 0.30±5.96 | 0.50±4.58 | 0.32 (>0.05) | 0.40±6.31 |
| I find it difficult to answer | 3.90±6.76 | 4.10±6.61 | 0.03 (>0.1) | 4.00±4.61 |
| With annoyance and rudeness | 0.00 | 0.20±2.32 | 0.01 (>0.1) | 0.20±1.23 |
| Total | 100.00 | 100.00 | – | 100.00 |

A study of the distribution of mothers' assessment of the amount of time and attention given by neonatologists to patients revealed that 85.8% of respondents out of 100 believed that neonatologists always gave their child enough time and attention (Table 5.16). Although a greater proportion of mothers rated this criterion higher in the pediatric inpatient NPD than in the perinatal center (86.50%±2.31% vs. 85.10%±2.56%), there were no respondents among whose children were treated in the perinatal center NPD who indicated that the doctor did not pay attention to the child at all. The conducted assessment demonstrated that the level of satisfaction of mothers, according to the methodological recommendations of the FFCHI, can be assessed as high both in general and individually in medical organizations.

Table 5.16 – Criterion 8. Assessment of mothers' satisfaction with the amount of time and attention given by neonatologists to patients in the department of pathology of newborns and premature infants (%)

| Characteristic | Perinatal center | Children's inpatient department | *t* (p) | Overall |
|---|---|---|---|---|
| It's always enough | 85.10±2.56 | 86.50±2.31 | 0.40 (>0.05) | 85.80±1.72 |
| Sometimes it's not enough, I would like more | 13.20±3.29 | 11.70±5.97 | 0.14 (>0.05) | 12.40±4.29 |
| Often in a hurry, pays not enough attention | 0.40±5.65 | 0.30±7.32 | 0.52 (>0.05) | 0.40±6.31 |
| I find it difficult to answer | 1.10±7.38 | 1.20±8.70 | 0.01 (>0.05) | 1.20±4.87 |
| Doesn't pay attention at all | 0.00 | 0.30±5.85 | 0.03 (>0.05) | 0.20±4.47 |
| Total | 100.00 | 100.00 | – | 100.00 |

When assessing criterion 9, only 68.8% of respondents out of 100 believed that the nurses always gave the child enough time and attention (Table 5.17). As with the assessment of personal qualities of medical personnel, mothers were statistically

significantly more likely to believe that the neonatologist always gave enough time and attention than when assessing secondary medical personnel (p >0.05). At the same time, this indicator both in the perinatal center and in the children's hospital was below the target set by St. Petersburg TSGP.

Table 5.17 – Criterion 9. Assessment of mothers' satisfaction with the amount of time and attention given by secondary medical personnel to patients in the department of pathology of newborns and premature infants (%).

| Characteristic | Perinatal center | Children's inpatient department | *t* (p) | Overall |
|---|---|---|---|---|
| It's always enough | 67.70±3.78 | 69.80±3.46 | 0.41 (>0.05) | 68.80±2.55 |
| Sometimes it's not enough, I would like more | 22.30±5.88 | 21.00±5.65 | 0.16 (>0.05) | 21.60±4.05 |
| Often in a hurry, pays not enough attention | 5.60±6.64 | 4.80±5.45 | 0.09 (>0.05) | 5.50±0.61 |
| I find it difficult to answer | 3.10±7.07 | 3.30±6.75 | 0.02 (>0.05) | 3.20±4.70 |
| Doesn't pay attention at all | 1.30±8.01 | 1.10±7.38 | 0.02 (>0.05) | 1.20±4.87 |
| Total | 100.00 | 100.00 | – | 100.00 |

Assessment of the satisfaction level of mothers with the amount of time and attention given by neonatologists to patients showed that the level, according to the methodological recommendations of the FFCHI, was assessed by the respondents as average both in general and individually in medical organizations.

The level of satisfaction of mothers with the attentiveness and politeness of secondary medical personnel with patients of the department, according to the methodological recommendations of the FFCHI, is rated as average in general and separately in the perinatal center and children's hospital.

The activity of medical personnel was assessed by mothers in relation to the work of doctors and secondary medical personnel in general in the emergency medical center on a five-point system. It was found that 84.9% of respondents out of 100 rated the work of neonatologists as excellent (Table 5.18). Neonatologists of children's hospitals received a greater number of excellent points in comparison with doctors of perinatal centers (86.50%±2.31% vs. 83.10%±2.72%). The respondents did not give unsatisfactory evaluations to the work of neonatologists in general [33, 35, 36, 37].

Table 5.18 – Mothers' assessment of the work of neonatologists in general in the department of pathology of newborns and premature infants according to the five-point system (%)

| Characteristic | Perinatal center | Children's inpatient department | *t* (p) | Overall |
|---|---|---|---|---|
| Excellent | 83.10±2.72 | 86.50±2.31 | 0.95 (>0.05) | 84.90±1.77 |
| Good | 16.60±6.12 | 13.30±5.91 | 0.39 (>0.05) | 14.90±4.26 |
| Satisfactory | 0.30±4.25 | 0.20±5.26 | 0.25 (>0.05) | 0.20±4.47 |
| Unsatisfactory | 0.00 | 0.00 | – | 0.00 |
| Average score (M±m) | 4.82±0.23 | 4.88±0.22 | 0.16 (>0.1) | 4.84±0.16 |

On average, the work of neonatologists in the maternal NPD was rated 4.84±0.16 points, in the perinatal center NPD 4.82±0.23 points, and in the pediatric inpatient NPD 4.88±0.22 points ($t$ = 0.16; p >0.1). The average scores given by mothers to the work of neonatologists and nursing personnel in general in the department of pathology of newborns and premature infants according to the five-point system are shown in Figure 5.3.

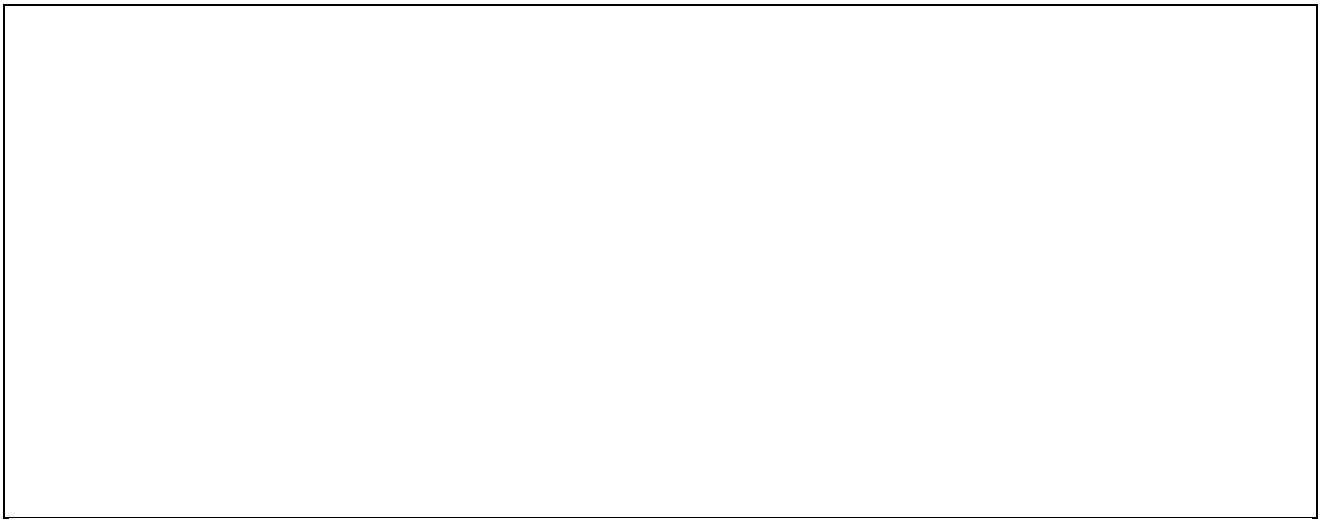

Figure 5.3 – Average ratings given by mothers to the work of neonatologists and nursing personnel in general in the department of pathology of newborns and premature infants according to the five-point system (points).

Similar to interpersonal relationships, mothers rated the work of nursing personnel with newborns in general in the NPD lower than that of physicians on a five-point system. 20.3% fewer respondents gave excellent marks to the work of nurses than doctors. There is a significant difference between the excellent scores when evaluating the performance of doctors and secondary medical personnel in the NPD (p<0.05). Mothers rated the work of secondary medical personnel with newborns in the children's hospital NPD lower than in the perinatal center, giving 7.1% fewer excellent ratings, but

with 6.5% more satisfactory. On average, the work of secondary medical personnel in the maternal NPD was rated 4.62±0.14 points (Table 5.19), in the perinatal center NPD 4.64±0.21 points, and in the pediatric inpatient NPD 4.59±0.20 points ($t$ = 0.17; p >0.1).

Table 5.19 – Mothers' assessment of the work of secondary medical personnel in general in the department of pathology of newborns and premature infants according to the five-point system (% and abs.)

| Characteristic | Perinatal center | Children's inpatient department | $t$ (p) | Overall |
|---|---|---|---|---|
| Excellent | 70.30±3.62 | 65.30±3.72 | 0.96 (>0.05) | 67.70±2.60 |
| Good | 23.50±2.82 | 28.90±5.34 | 0.68 (>0.05) | 26.30±3.92 |
| Satisfactory | 6.20±6.69 | 5.80±6.25 | 0.04 (>0.1) | 6.00±4.56 |
| Unsatisfactory | 0.00 | 0.00 | – | 0.00 |
| Average score (M±m) | 4.64±0.21 | 4.59±0.20 | 0.17 (>0.1) | 4.62±0.14 |

To the question "What disadvatages do you see in the work of the medical organization NPD where your child was staying?" 14.9% of mothers out of 100 respondents indicated that the main one was the lack of joint stay with the child. Moreover, such a high value of this indicator was ensured by a significant proportion of mothers who indicated it as the main reason for dissatisfaction with their stay in a pediatric inpatient hospital (25.1% out of 100). In the perinatal center, only 3.5% of 100 respondents expressed this deficiency among the reasons for dissatisfaction (p <0.05). In the perinatal center, 9.2% of the respondents out of 100 mothers of newborns undergoing treatment at the NPD were dissatisfied with nutrition. The second main reason for mothers' dissatisfaction with the NPD of both perinatal center and children's hospital was the attitude of secondary medical personnel to patients (8.3 and 9.9% of mothers out of 100 interviewed, respectively) [108, 122, 125, 265]. The main reasons for mothers' dissatisfaction with their stay in the NPD are shown in Table 5.20.

Table 5.20 – Main reasons for mothers' dissatisfaction with their stay in the department of pathology of newborns and premature infants (%)

| Reason | Perinatal center | Children's hospital | $t$ (p) | Overall |
|---|---|---|---|---|
| Unaccompanied stay of mother and child | 3.5 | 25.1 | 2.44 (<0.05) | 14.9 |
| Nutrition | 9.2 | 6.2 | 0.23 (>0.05) | 7.7 |
| Irregular communication with a neonatologist | 5.7 | 7.1 | 0.16 (<0.1) | 6.4 |
| Secondary medical personnel attitude | 8.3 | 9.9 | 0.34 (>0.05) | 9.1 |

Thus, in general, mothers rated most highly the provision of NPDs with medicines and consumables, as well as politeness and attentiveness of neonatologists. The assessment of auxiliary services and the amount of time and attention given by secondary medical personnel to patients was below the target set by St. Petersburg TSGP (below 70%). Despite the fact that the quality of health care delivery on all characteristics was most highly rated by mothers in the perinatal center NPD, when assessing the amount of time and attention given by both neonatologists and secondary medical personnel, higher scores were given to the medical personnel of the children's hospital. However, these differences were not statistically significant for any of the studied indicators. Among the reasons for dissatisfaction, the most significant was the "unaccompanied stay of mother and child", which was indicated by 25.1% of mothers who were treated in a children's hospital.

## 5.3 Financial support for the activities of neonatal and premature infant pathology departments

Financial provision of medical care for newborns born sick and with congenital disorders in the NPD is carried out mainly without charge in accordance with the Program of state guarantees. There are differences in the formation of tariffs for medical care in medical organizations of the regional and the federal levels. From January 1, 2021 for medical organizations subordinate to the Government of the Russian Federation or federal executive authorities, the procedure for payment for specialized care, including HTMC, is determined by a special provision, which is contained in Appendix 3 to the Decree of the Government of the Russian Federation No. 2505 dated 28.12.2021 (as amended of 14.04.2022) "On the program of state guarantees of free medical assistance to citizens for 2022 and for the period of 2023 and 2024" [135].

At the regional level, a tariff policy is formed for medical organizations that meets the requirements set out in the Methodological recommendations on the methods of payment for medical care at the expense of MHI funds [138, 139, 140, 141, 144], which is reflected in the Territorial Programs of state guarantees of free medical care for citizens for the relevant year. A comparative analysis of the formation of the tariff for

payment for medical care in a 24-hour hospital for federal and regional medical organizations of St. Petersburg in 2021 is shown in Table 5.21.

Table 5.21 – Comparative analysis of tariff formation for payment for medical care in a 24-hour hospital for federal and regional medical organizations of St. Petersburg in 2021

| Indicator name | Indicator designator | Calculation of the cost of a completed case (DRG) for federal medical organizations | Calculation of the cost of a completed case (DRG) under the Territorial Program |
|---|---|---|---|
| Tariff calculation formula: diagnosis-related group average cost | DRGAC | DRGAC = FCS × PRF × DR × (DRGCR × DRGSC+ PTCR) | DRGAC = BR × DR × (DRGCR × DRGSC × MOLC + PTCR) |
| Average standard of financial costs, rub. | FCS | 70 119 | not defined |
| Prime rate conversion factor | PRF | 0.35 | not defined |
| Base rate, rub. | BR | not defined | 29 757.2 |
| Differentiation ratio | DR | 1.24 | 1.236 |
| DRG relative cost intensity ratio | DRGCR | from 0.15 to 56.65 | from 0.27 to 29.91 |
| Medical organization level coefficient | MOLC | absent | 1 |
| Diagnosis-related group specificity coefficient | DRGSC | from 1.4 to 1 | 1 |
| Patient treatment complexity ratio | PTCR | from 0 to 3.49 | from 0 to 3.49 |

The cost analysis of payment for medical care in the "neonatology" profile for federal and regional medical organizations of St. Petersburg showed deviations in the range of 15.8-17.3% for the main DRG profiles. For the purpose of cost estimation of sufficiency of financial provision of medical care in the "neonatology" profile, a sample calculation of the actual cost of nursing children with ELBW at birth, including those with body weight up to 1000 g was carried out. This method of treatment is included in the list of types of HTMC included in the basic CHI program. The results obtained indicate an underfunding of 118% for the treatment methods included in the 19th HTMC group. The main NPD disease profiles and a comparative analysis of their tariff costs are shown in Table 5.22.

Table 5.22 – Comparative analysis of the cost of tariff for payment for medical care by clinical and statistical groups for the "neonatology" profile for federal and regional medical organizations of St. Petersburg in 2021

| Code | Profile (KPG) and DRG | Tariff for a regional medical organization, rub. | Tariff for a federal medical organization, rub. | Deviation, % |
|---|---|---|---|---|
| st17.001 | Low birth weight, prematurity | 154 843.38 | 179 364.12 | +15.8 |
| st17.002 | Extremely low birth weight, extreme immaturity | 574 869.82 | 665 905.28 | +15.8 |
| st17.003 | Treatment of newborns with severe pathology using hardware methods to support or replace vital functions | 272 171.25 | 315 271.85 | +15.8 |
| st17.004 | Hemorrhagic and hemolytic disorders in newborns | 70 617.41 | 58 428.76 | –17.3 |
| st17.005 | Other disorders that occurred during the perinatal period (level 1) | 51 124.06 | 42 299.99 | –17.3 |
| st17.006 | Other disorders that occurred during the perinatal period (level 2) | 69 514.01 | 57 515.81 | –17.3 |
| st17.007 | Other disorders that occurred during the perinatal period (level 3) | 94 156.54 | 109 067.02 | +15.8 |

Medical organizations providing medical care to children requiring intensive care, diagnosis and treatment of neonatal period pathology are forced to optimize business processes as much as possible, reduce costs and use sources of additional profit to maintain the quality of medical care.

The analysis of financial security of the perinatal center NPD of "Saint Petersburg State Pediatric Medical University" of the Ministry of Health of the Russian Federation for the period 2019-2020 shows that the department within the medical organization was in subsidized conditions. Until 2021, when paying for the provision of medical care to patients in federal institutions, regions transferred financial resources from their territorial funds and therefore were not interested in hospital admissions of patients at the federal level. To increase the availability of medical care from 2021, the financing of medical care in federal medical organizations was entrusted to the FFCHI, which had a positive impact on the indicators of the bed stock and financial provision of the NPD. The indicators of bed use of the neonatal and premature infant pathology departments of the perinatal center in 2020-2021 are shown in Table 5.23.

Table 5.23 – Bed use indicators of the neonatal and premature infant pathology departments of the perinatal center in 2020-2021.

| Indicator | 2020 | 2021 | Dynamics, % |
|---|---|---|---|
| Non-resident patients | 236 | 274 | +13.9 |
| Treated patients | 633 | 747 | +15.3 |
| Used patients | 956 | 1030.5 | +7.2 |
| Bed-days spent | 15 295 | 15 270 | –0.2 |
| Average length of stay in bed, days | 16.0 | 14.8 | –7.5 |
| Bed turnover | 19.1 | 20.6 | +7.3 |
| Bed operation, days | 304.9 | 305.4 | +0.2 |
| % of plan completion | 93.3 | 93.6 | +0.3 |

This made it possible to withdraw the work of the department from subsidized conditions and ensured that the medical organization made a profit.

The assessment of the NPD economic activity revealed that there was a difference in tariffs for the provision of medical care by individual profiles, that ensured almost equal conditions of financial provision of medical organizations. The analysis of tariffs for the provision of inpatient medical care in the "neonatology" profile in the NPD revealed an increase in the performance of this department after the transition of federal medical organizations to a new type of financing.

## 5.4 Evaluation of the efficiency of medical care for newborns in the newborns and premature infant pathology department

Healthcare efficiency is a measure of the extent to which the industry's performance has been achieved. When assessing the efficiency of individual medical organizations or their structural subdivisions, it is advisable to calculate an integral indicator of medical, social and economic efficiency. The evaluation of the medical efficiency of the NPD as a whole showed that the index was high, and in the perinatal center NPD it was higher than in the children's hospital (0.97 and 0.94, respectively). The results of calculations based on individual criteria of social efficiency are shown in Table 5.24.

Table 5.24 – Satisfaction coefficients by criteria

| No | Criteria | Perinatal center | Children's hospital | Overall |
|---|---|---|---|---|
| 1 | Satisfaction with the technical condition, repair and floor space | 0.94 | 0.91 | 0.92 |
| 2 | Satisfaction with the comfort of the hospital room and the places of stay of the newborn | 0.90 | 0.87 | 0.88 |
| 3 | Satisfaction with the work of auxiliary services | 0.89 | 0.88 | 0.89 |
| 4 | Satisfaction with the availability of medicines and supplies | 1.01 | 0.96 | 0.97 |
| 5 | Satisfaction with the quality of medical care | 0.96 | 0.95 | 0.95 |
| 6 | Satisfaction with the attentiveness and politeness of the neonatologist with patients | 0.98 | 0.99 | 0.99 |
| 7 | Satisfaction with the attentiveness and courtesy of the secondary medical personnel with patients | 0.91 | 0.90 | 0.91 |
| 8 | Satisfaction with the amount of time and attention given by neonatologists to patients | 0.96 | 0.96 | 0.96 |
| 9 | Satisfaction with the amount of time and attention given by secondary medical personnel to patients | 0.88 | 0.89 | 0.88 |
| | Integral satisfaction coefficient | 0.94 | 0.92 | 0.93 |

Calculation of satisfaction coefficients allowed us to determine the coefficient of integral efficiency of the NPD activity, which in our case is the social efficiency of the NPD work.

For all the studied criteria the satisfaction coefficients had a high level (0.75-1.0), in the perinatal center NPD the provision of medicines and consumables was very high (more than 1.0). Calculation of the coefficient of social efficiency also showed a high level regardless of the medical organization.

The assessment of economic efficiency showed that the $K_e$ of the children's hospital NPD is 0.60, and the $K_e$ of the perinatal center is 0.71. Only 60% of capacity is used in the pediatric inpatient NPD and 71% of capacity is used in the perinatal center. The coefficient level can be estimated as average in children's hospitals and perinatal centers.

Based on the function of NPD bed fund to provide admissions for children born sick and with congenital disorders from maternity hospitals and NICU, especially given

the functions of the federal perinatal center and the high proportion of patients admitted by internal routing, we can say that in the children's hospital NPD not all the capacities of the department beds are implemented, and in the perinatal center beds are used more rationally and operate more efficiently.

The conducted study, as a result of which the efficiency coefficient of NPD was calculated, showed that in the children's hospital its value corresponded to a high level and was equal to 0.82. The efficiency coefficient of the perinatal center NPD was higher than in the children's hospital and amounted to 0.87. Thus, for all types of efficiency, the NPD of the perinatal center was slightly higher than in the children's hospital, which affected the final evaluation result.

## 5.5 Scientific substantiation of organizational measures to improve medical care for newborns born sick and with congenital disorders

An important sign of health is a normal birth weight. Children born with low birth weight are more likely to have functional impairment, higher incidence, often unfavorable prognosis in terms of neurological outcomes, and higher risk of neonatal mortality. Perinatal disorders in such children are more severe. The proportion of children born alive with ELBW in St. Petersburg tended to increase, which, on the one hand, is an indicator of the availability and quality of medical care due to the implementation of measures to route pregnant women, women in labor and delivery, and newborns under the three-level system of obstetric and perinatal care. On the other hand, it refers to insufficient identification of risk factors for adverse pregnancy outcomes at the stage of women's consultation, which does not allow prolongation of pregnancy in inpatient settings. The data obtained from the official sources were confirmed by a questionnaire survey of mothers of newborns born sick and with congenital disorders who were treated in NPDs. Mothers of sick children, compared to mothers of healthy children, on average had a later gestational age at the antenatal clinic, were less likely to be registered before 6 weeks of gestation, had a significantly shorter mean gestational length, and sick children were significantly more likely to be

born with gestation before 28 weeks. Thus, not fully implemented antenatal fetal protection is a reliable factor in the birth of a sick child.

However, the birth of children with LBW (more than 4000 g) can also be seen as a negative phenomenon. This can lead to complications during childbirth, such as untimely discharge of amniotic fluid, labor abnormality, birth trauma, acute fetal hypoxia and others, to an increase in the frequency of surgical delivery – fetal extraction using obstetric forceps, vacuum extractor, by cesarean section, frequency of amniotomy, childbirth, using medical methods. Giving birth to a large fetus can lead to postpartum problems for both the mother and the newborn. Children born with high body weight have an increased risk of diabetes mellitus, obesity, primary immunodeficiency, increased allergic background, abnormalities in neuropsychiatric status and others. Studies have shown that the proportion of children born with high body weight in St. Petersburg was higher than the district average and the national average. The questionnaire survey showed that mothers of sick newborns were 2 times more likely than healthy mothers to have endocrine system diseases and statistically significantly more likely to have gestational diabetes mellitus during pregnancy, which is a prerequisite for the development of overweight children. This category of pregnant women requires special supervision by an obstetrician-gynecologist for timely hospital admission of women for delivery. In addition, the high frequency of chronic pathology in the mothers of sick children indicates insufficient preparation for pregnancy, which points to the unsatisfactory work of the women's counseling center on family planning.

The study showed that sick children had lower birth weight and height than healthy newborns. Analysis of birth weight and height in sick and healthy children, taking into account their gestational age, showed statistically significant differences in each age group. Assessment of the physical development of deceased newborns of gestational age after 28 weeks showed that the highest proportion of children was in deceased newborns with birth weight of 2500 g or more – 63.8%. Their body weight in 80-90% of cases corresponded to the normative indicators of children of this gestational age, and height in 85-95% of cases. Evaluation of the parameters of physical development of premature newborns who died during the first 7 days in 90-94% of

cases revealed compliance with the standards of physical development for this gestational age. Thus, a reserve has been found to reduce the loss of viable children.

The established features of medical and social characteristics of families (age of parents, their level of education, family status, number of children in the family, etc.) of newborns born sick and with congenital disorders, and features of obstetric and gynecological history of the mother (presence of chronic diseases (pathological conditions) of diseases that occurred during pregnancy, complications in childbirth, etc.) allowed to identify risk factors for the birth of a sick child, which should be taken into account in the management of pregnancy in order to to form groups of obstetric and perinatal risk. In addition, the results of assessing the quality of life of a newborn can be considered as an integral characteristic of the health status of children in this age group.

Accordingly, it is possible to identify the first direction in improving medical care for newborns born sick and with congenital disorders, which consists in improving the quality of antenatal fetal protection, timely identification of risk factors for the health of mother and child at the stage of antenatal counseling.

The assessment of the dynamics of neonatal incidence indicators in St. Petersburg revealed that the specific weight of children born sick and with congenital disorders increased annually and in 2022 exceeded the national and district average levels. The share of certain conditions arising in the perinatal period accounted for 53.8% of diseases on average during the study period, which is significantly lower than the average for the Russian Federation and the NWFD. In 2022, 6.91% of the number of live births in a given year were admitted to St. Petersburg NPD, which is 1.1 times higher than the national average and 1.3 times higher than the federal average. At the same time, until 2018, the specific weight of those admitted to NPDs in was lower than the average in the Russian Federation and the NWFD, and since 2019 – higher. The proportion of children in St. Petersburg who were treated in the NPD out of the total number of newborns admitted to those in the federal district amounted to 44.9%. The routing of pregnant women to obstetric hospitals at the appropriate level, based on risk groups, has also improved. This fact confirms the expediency of introducing a three-

level system of obstetric and perinatal care and the competent work of the unified system of medical care for sick children in St. Petersburg.

The assessment of resource provision of medical care for neonatal patients demonstrated sufficient provision of medical organizations and NPD beds, which allows children in the city to receive specialized care, including HTMC, in full. As the main link in providing medical care to newborns in the federal district under the three-level health care system, federal perinatal centers and Children's City Multidisciplinary Clinical Specialized Center of High Medical Technologies, according to routing, concentrate cases of high obstetric and perinatal risk, which makes it possible to provide nursing care for newborns and premature infants.

Thus, it is possible to identify the second direction in improving medical care for newborns born sick and with congenital disorders, which is to improve routing in order to increase the quality and availability of specialized care, including HTMC.

Summing up the above, it should be stated that the leading role of acute respiratory infections in the organization of treatment of children born sick and ill was established. The evaluation of the perinatal center and children's hospital NPDs showed a significant difference in the structure of patients both by disease (pathological condition), weight and prematurity of children, and by place of admission to the departments. The NPD beds of the perinatal center work with a higher load and more rationally than in the pediatric hospital, which does not use the full possible capacity of NPD beds. In the perinatal center, due to the peculiarities of its activity and the work of the surgical service, there are significantly more children admitted to the NPD beds by external routing, and newborns with congenital malformations. In the children's hospital NPD, the main function of which is nursing of newborns and premature babies, somatic pathology (individual conditions arising in the perinatal period) and those admitted according to external routing from maternity hospitals of the city prevail.

Based on the assessment, a third direction was identified to improve medical care for newborns born sick and with congenital disorders, which consists in increasing the capacity of the children's hospital at the expense of rational use of the department's beds

or re-designing the bed stock, taking into account the structure of incidence and/or the age of patients.

Meeting patient expectations is an important characteristic of the quality of medical care, an indicator of which is patient satisfaction. The assessment of the quality of medical care in the NPD showed that, in general, mothers rated most highly the provision of NPDs with medicines and consumables, as well as the politeness and attentiveness of doctors. The assessment of auxiliary services and the amount of time and attention given by secondary medical personnel to patients was below the target set by St. Petersburg TSGP. Despite the fact that the quality of health care delivery on all characteristics was most highly rated by mothers in the perinatal center NPD, when assessing the amount of time and attention given by both doctors and secondary medical personnel, higher scores were given to the medical personnel of the children's hospital. However, these differences were not statistically significant for any of the studied indicators. Among the reasons for dissatisfaction, the most significant were the "unaccompanied stay of mother and child" (14.9%), the attitude of secondaru medical personnel (9.1%) and nutrition (7.7%). At the same time, dissatisfaction due to unaccompanied stay of mother and child was indicated by 25.1% of mothers who were treated in a children's hospital, which has a negative impact on the optimal conditions for prolonged natural feeding. Breastfeeding coverage was found to be significantly higher in the perinatal center NPD, which was associated with a higher proportion of mother-newborn co-parenting. In addition, a questionnaire survey of mothers revealed that mothers of sick children significantly later started breastfeeding in obstetric hospital than mothers of healthy newborns, were 2 times less likely to start breastfeeding immediately after birth and 13.3 times more likely to breastfeed for the first time on the second day of life. This circumstance shows that there is a risk for incomplete breastfeeding of a child, which is extremely important for children with ELBW.

Interpersonal relationships between medical personnel and patients are also one of the main characteristics of the quality of medical care. Both in assessing the personal qualities of medical workers and in assessing satisfaction with the amount of time and attention given to patients, mothers rated the work of doctors significantly higher. The

attitude of secondary medical personnel was indicated by 8.3% of mothers in the perinatal center NPD and 9.9% in the children's hospital NPD, which determines the need to take measures to address this problem.

Dissatisfaction with nutrition was in the first place due to the reasons of dissatisfaction of mothers in the work of the perinatal center. Taking into account the peculiarities of nutrition of breastfeeding mothers, it is necessary to conduct explanatory conversations with mothers about the expediency of the appropriate diet.

Thus, the fourth direction of improving medical care for newborns born sick and with congenital disorders is to improve the quality of medical services by improving the service component: providing additional opportunities for joint stay of mother and child, compliance of medical personnel with the principles of ethics and deontology, strengthening the control of doctors over the work of secondary medical personnel, increasing the level of hygienic education, etc.

An assessment of the financial support and efficiency of the NPD showed differences in performance between obstetric and perinatal NPDs. The analysis of the financial support of the NPD activities did not reveal a significant difference in the tariffs of federal and city medical organizations. Under almost equal financial conditions, the medical, social and economic efficiency of the perinatal center NPD is higher than of the children's hospital. All the efficiency coefficients studied had a high level, except for the coefficient of economic efficiency of the NPD, the level of which is estimated as average both in the children's hospital and in the perinatal center. The efficiency coefficient of the perinatal center NPD was higher than in the children's hospital (0.87 vs. 0.82 – a high level). The cost-efficiency ratio is directly related to bed turnover, but the perinatal center has more severe newborns, so the recommended duration of 12.1 days for these patients will not coincide with clinical guidelines in most cases. However, even under the given conditions, the economic efficiency of using NPD bed fund of the perinatal center is higher.

Thus, it is possible to identify the fifth direction in improving medical care for newborns born sick and with congenital disorders, which is to increase the economic

efficiency of the children's hospitals NPD in particular and to optimize the financial support of the activities of departments of this profile as a whole.

# CONCLUSION

To preserve and strengthen children's health, the Russian Federation has introduced a three-level system of obstetric and perinatal care, which has made it possible to significantly reduce maternal and infant mortality rates in our country. In Russia, about a third of children with various health conditions are born every year. Given the unfavorable demographic conditions of recent years, it should be stated that one of the main areas of activity of the modern system of maternal and child health care should be to improve the availability and quality of medical care for newborns born sick and with congenital disorders. As a stage of nursing of newborns and premature babies, the NPD is available in two types of medical organizations: in perinatal centers and pediatric multidisciplinary hospitals. Thus, improving the organization of medical care for newborns born sick and with congenital disorders through high efficiency of medical organizations is a relevant topic for research.

Due to the contribution of St. Petersburg to the birth rate in the NWFD (44.6%) and taking into account the importance of health care in the system of medical care for children in the federal district and in the country, the present study was conducted in this particular subject of the Russian Federation. The bases of the study were 4 medical organizations of the city, and it included 4 stages.

Physical development and incidence, along with demographic indicators, are the main indicators of children's health. The assessment of official statistics data showed that in 2015-2022 in St. Petersburg the specific weight of children born alive with low body weight was lower than the national and district averages. However, the proportion of children born with high birth weight in 2022 was higher at 11.66% respectively.

A comparative assessment of the physical development of newborns based on the results of mothers' questionnaires showed that among both sick and healthy newborns the majority were boys (59.6 and 56.4%, respectively). On average, mothers of sick infants significantly later started breastfeeding in the obstetric hospital than mothers of healthy infants – 1.74±4.84 days vs. 1.10±4.88 days ($t$ = 115.87; $p < 0.01$), 2.0 times less

likely to start breastfeeding immediately after birth ($t$ = 10.22; p <0.01) and 13.3 times more likely to first breastfeed on the second day ($t$ = 3.57; p <0.01).

The average birth weight of sick and born with congenital disorders infants had significant differences with healthy newborns (2543.14±11.06 g vs. 3485.26±30.59 g ($t$ = 85.79; p<0.01). At the same time, among sick children, 42.6% of newborns belonged to the low weight segment, and among healthy children in this weight category there were only 2.0%. In addition, there were statistically significantly fewer children born with an average body weight among the patients. A comparative assessment of growth indicators in newborns allowed us to establish the presence of significant differences between the groups (45.97±28.35 cm vs. 51.45±73.60 cm ($t$ = 61.13; p <0.01). Analysis of birth weight and height in sick and healthy children, taking into account their gestational age, showed statistically significant differences in each age group. The analysis of the children's weight, taking into account gender, did not reveal a statistically significant difference in both the group of healthy and sick children. Analysis of children's height by gender showed: the average height in the group of sick children was significantly lower than in the group of healthy children (p = 0.0007).

A study of the gestational age in children who died in the early neonatal period showed that children of gestational age over 28 weeks significantly prevailed in the group of deceased newborns (78.02%±4.95%). An assessment of anthropometric data showed that among deceased newborns of gestational age before 28 weeks, the average body weight and height were 794.60±49.10 g and 32.20±0.90 cm, respectively, after 28 weeks - 2659.7±119.0 g and 47.00±0.74 cm, respectively.

The assessment of the dynamics of newborn incidence indicators in St. Petersburg according to official statistics showed that the proportion of children born sick and with congenital disorders increased annually. At the same time, in 2015, the indicator was lower than the overall national and district levels, and by 2022 it exceeded the national and district average levels. The share of certain conditions occurring in the perinatal period accounted for 53.8% of diseases on average during the study period, which is 1.6 times lower than the average in the Russian Federation, and 1.4 times lower in the Northwestern Federal District. The incidence rate of certain conditions

occurring in the perinatal period in 2022 in the megalopolis amounted to 197.30% (+8.4% for the period under study), which was lower than the national average and the average regional indicators by 14.8 and 14.6%, respectively.

The organization of treatment of patients born sick and with congenital disorders, if there is no need for resuscitation measures, is carried out by the emergency medical services of medical organizations. An analysis of the need of newborns in inpatient medical care showed that the proportion of children treated in St. Petersburg of the total number of newborns admitted to NPDs in the federal district was 44.9%. The proportion of those admitted to NPDs in St. Petersburg in 2022 was 6.91%, which is 1.1 times higher than the national average and 1.3 times higher than the federal district average. Analysis of the dynamics of indicators revealed that since 2019 the proportion of admitted to NPDs exceeded the national average. This is evidence of the city's increasing importance in the federal district's health care system by improving the routing of newborns born sick and with congenital disorders.

To study the peculiarities of the medical and social characteristics of families with children born sick and with congenital disorders, this group was compared with families of healthy newborns.

The data obtained revealed a significant difference between the age of the parents of newborns born sick and with congenital disorders and the parents of healthy children: in mothers (average age 30.55±0.46 vs. 27.12±0.32 years ($t$ = 34.29; p <0.01), in fathers (average age 33.14±0.54 vs. 29.76±0.45 years ($t$ = 25.44; p <0.01).

The assessment of the distribution of mothers by marital status showed no statistically significant difference between the indicators in the main and control groups, but the proportion of mothers who were not married was higher among women with a sick child than among mothers of healthy children (38.5% vs. 32.3%). The study of the level of parents' education revealed that families with a sick child had more mothers and fathers with secondary and specialized secondary education and significantly fewer parents with incomplete higher and higher education ($t$ = 3.54 and $t$ = 3.46, respectively (p<0.01)). The survey showed that among both parents, the share of employees and non-working persons (housewives) is higher and the share of workers, entrepreneurs

and students is lower. The survey also showed that large families were significantly more likely to have children born sick and with congenital disorders ($t$ = 2.01; p <0.05).

Mothers of sick newborns had on average a later gestational age at the antenatal clinic than mothers of healthy infants (9.94±0.04 weeks vs. 8.62±0.04 weeks ($t$ = 23.40; p >0.01), and they were significantly less likely to register before 6 weeks of gestation ($t$ = 3.44; p >0.01). Mothers of sick children had significantly lower average gestational length (34.48±1.21 weeks vs. 37.34±0.94 weeks ($t$ = 65.57; p <0.05).

Assessment of the presence of chronic diseases (pathologic conditions) in mothers, diseases that occurred during pregnancy, and complications in labor showed that mothers who had children who were born sick and with congenital disorders were statistically more likely to have them than mothers of healthy newborns ($t$ = 4.56; $t$ = 4.92 and $t$ = 3.04, respectively, at p <0.01). In addition, in mothers of sick newborns, diseases of the eye and its appendage (3.4 times), endocrine system diseases, nutritional and metabolic disorders (3.1 times), genitourinary system diseases (2.3 times) were more frequent. Comparative assessment of the frequency of diseases (pathological conditions) that occurred in mothers during pregnancy in the main and control groups showed statistically significant differences in the frequency of anemia (35.0% vs. 21.3% ($t$ = 2.51; p <0.05)), hypertension (15.3% vs. 2.2% ($t$ = 2.09; p <0.05)), and gestational diabetes mellitus (10.8% vs. 7.9% ($t$ = 2.08; p <0.05)). There were no statistically significant differences between the frequency of complications in childbirth in mothers of sick and healthy children, but in the main group, mothers were more likely to have fetal pathology (6.3 times), threatened miscarriage (4.9 times), rhesus incompatibility (4.2 times) and premature delivery (3.0 times).

The study demonstrated that quality of life scores on all scales of the PedQL questionnaire were lower in children who were born sick and with congenital disorders compared with healthy children. Significant differences were found on the following scales: physical activity, physical symptoms, emotional state, social activity, cognitive activity, total physical functioning score, total psychosocial health score, and total score. When comparing the quality of life in children with different pathologies, it was found that the quality of life indicators of newborns with anemia are higher than those of

children with CHD and hydrocephalus. The quality of life of newborns with hydrocephalus is lower than that of children with CHD. Significant differences in the quality of life of newborn children have been established between health groups I and III. The indicators of the quality of life of newborns with health groups I and II are similar.

The objectives of this study were to assess the accessibility, quality and financial provision of health care for children born sick and with congenital disorders. One of the leading indicators of accessibility of inpatient care is the availability of hospital beds. The analysis of the availability of the NPD beds for the pediatric population of St. Petersburg revealed that in 2022 it was equal to 64.7 beds per 10 000 children under one year of age, which is 17.7% below the national average and 8.7% below the district average. The provision of beds in the city's emergency medical center had a negative trend from 2015 to 2017 inclusive, but since 2018 it increased annually.

The most significant objective indicators of the quality of medical care are hospital mortality rates. In St. Petersburg, the hospital mortality rate for children with ELBW aged 0-6 days in 2022 was 19.53%, which was higher than the national and district averages by 20.5 and 11.6%, respectively. The hospital mortality rate of newborns with a body weight of 1000 g or more (1.59%) was 2.5 and 1.2 times higher than the national and district averages, respectively.

The assessment of the information obtained from the health care organizations' activity reports showed that in 2022, the number of both admissions and discharges from the unit increased in the perinatal center NPD in 2022 compared to the 2019 level, while in the pediatric inpatient NPD, the number of children transferred to other hospitals and children's homes increased significantly over four years, with a significant decrease in discharges. Evaluation of the structure of hoapital admissions to NPDs revealed that both in the perinatal center and in the children's hospital the proportion of children admitted by external routing was the highest.

An assessment of the distribution of those who left the perinatal center in 2022 showed that there were slightly fewer premature newborns than in the pediatric hospital

(46.5% vs. 59.3%; p <0.05) and the proportion of children with LBW was significantly lower (36.8% vs. 41.5%; p <0.05).

Analysis of the structure of patients discharged from the perinatal center and children's hospital NPDs showed statistically significant differences between the specific weight of disorders associated with shortening of the mother's gestational age and low birth weight ($t$ = 2.45; p <0.05), the proportion of growth retardation and malnutrition ($t$ = 3.02; p <0.05), the proportion of respiratory disorders characteristic of the perinatal period (t = 2.12; p <0.05), and the proportion congenital malformations ($t$ = 10.02; p <0.01).

The assessment of the NPD bed utilization showed that in 2020, the average annual bed occupancy in the perinatal center increased from 298.5 to 304.9 days (+2.1%) and in the pediatric inpatient unit decreased from 295.7 to 290.4 days (-1.8%). This was due to a 4.0% increase in bed turnover in the perinatal center and a 13.1% decrease in inpatient beds. It was found that the implementation of the NPD bed plan increased in the perinatal center from 91.3 to 92.4% and in the pediatric hospital from 90.4 to 91.1%.

Proper breastfeeding has a special role in maintaining and strengthening the health of children. Evaluation of information from the NPD work reports showed that breastfeeding coverage was significantly higher in the perinatal center than in the pediatric inpatient NPD (38.3% vs. 23.7%; p <0.05).

The assessment of the organization of medical care for newborns born sick and with congenital disorders showed that in the perinatal center NPD, compared to the children's hospital, there was a higher proportion of mothers fully satisfied with the technical condition, repair and area of the premises (86.1%±2.48% vs. 82.1%±2.67%); comfort of the hospital ward and places of stay of the newborn (75.8%±3.33% vs. 71.0%±3.39%); work of auxiliary services (70.3%±3.62% vs. 68.5%±3.65%); provision with medicines and consumables (92.7%±1.75% vs. 91.6%±1.83%); quality of medical care (85.3%±2.55% vs. 82.0%±2.68%); attentiveness and politeness of secondary medical personnel with patients of the department (72.3%±3.51% vs. 70.1%±3.45%). In the children's hospital NPD, compared to the perinatal center, there was a higher

proportion of mothers completely satisfied with the attentiveness and courtesy of the neonatologist (96.10%±1.24% vs. 95.60%±1.39%); the amount of time and attention given to patients (86.5%±2.31% vs. 85.1%±2.56%); the amount of time and attention given by nurses to patients (69.8%±3.46% vs. 67.7%±3.78%).

The performance of NPDs was evaluated by mothers based on the performance of physicians and secondary medical personnel using a five-point system, and it was shown that mothers rated the performance of neonatologists of the children's hospital higher than in the perinatal center (4.88±0.22 points vs. 4.82±0.23 points ($t$ = 0.16; p >0.1). When evaluating the activities of secondary medical personnel, the opposite was observed: 4.64±0.21 points in the primary care unit of the perinatal center vs. 4.59±0.20 points in the primary care unit of the children's hospital ($t$ = 0.17; p >0,1) [29, 30, 31, 33, 34].

The results of the mothers' survey made it possible to identify the main causes of dissatisfaction, which had a significant difference in obstetric and pediatric medical organizations. In perinatal center mothers were more dissatisfied with nutrition (9.2%) and in the pediatric inpatient NPD they were more dissatisfied with lack of co-parenting (25.1%); $t$ (p) = 2.44 (<0.05).

There are differences in the formation of tariffs for payment for medical care in medical organizations of the regional and the federal levels, which were revealed by the comparative analysis of tariff formation and cost of tariff for payment for medical care according to DRG "neonatology" profile for federal and regional medical organizations of St. Petersburg. The difference in tariffs for the provision of medical care for individual profiles generally provided almost equal financial conditions for medical organizations. A selective calculation of the actual cost of caring for children with ELBW at birth, which is included in the list of HTMC types included in the basic CHI program, showed an underfunding of 118%. The analysis of financial security of the perinatal center NPD of the "Saint Petersburg State Pediatric Medical University" of the Ministry of Health of the Russian Federation for the period 2019-2020 proves that the department within the medical organization was in subsidized conditions. Since 2021, the financing of medical care in federal medical organizations has been entrusted to the

FFCHI, which had a positive impact on the indicators of the bed fund, financial support for the emergency medical services and, in general, on the availability of medical care to children born sick and with congenital disorders. The increase in treated patients amounted to 15.3%, bed turnover – 7.3%, bed operation – 0.2%, plan implementation – 0.3%, which ensured profit for the medical organization. The analysis of tariffs for the provision of inpatient medical care in the "neonatology" profile in the NPD revealed an increase in the performance of this department after the transition of federal medical organizations to a new type of financing.

The evaluation of the medical efficiency of NPDs as a whole showed that the level of the index was high, and in the perinatal center NPD it was higher than in the children's hospital (0.97 and 0.94, respectively). The calculation of the NPD social efficiency coefficients showed that it was also higher in the perinatal center than in the children's hospital (0.94 and 0.92, respectively) and had a high level regardless of the medical organization. The assessment of economic efficiency showed that the $K_e$ of the children's hospital NPD is 0.60, and the $K_e$ of the perinatal center is 0.71. The coefficient level can be estimated as average in children's hospitals and perinatal centers. Thus, the efficiency coefficient of the perinatal center NPD was higher than in the children's hospital (0.87 vs. 0.82 — a high level). In general, we can talk about high NPD efficiency in a megalopolis.

Based on a comprehensive assessment of the current system of organization of medical care for newborns born sick and with congenital disorders, a set of medical and organizational measures aimed at improving the organization of medical care for children of this category was developed, scientifically substantiated and implemented.

## FINDINGS

1. The proportion of children born alive with low and high birth weight in St. Petersburg was higher than the national average and tended to increase. Birth weight and height of sick and healthy children with regard to their gestational age showed statistically significant differences in each age group. The average birth weight of sick and born with congenital disorders infants had significant differences at birth with that of healthy infants (2543.14±11.06 g vs. 3485.26±30.59 g ($t$ = 85.79; p <0.01)). Comparative assessment of height indicators in newborns also revealed significant differences (45.97±28.35 cm vs. 51.45±73.60 cm ($t$ = 61.13; p <0.01)). Assessment of the parameters of physical development of deceased newborns among both premature and preterm infants has established compliance with the norms of physical development for a given gestational age in 80-95% of cases, which allowed us to identify a reserve for reducing the loss of viable children.

2. The proportion of children in St. Petersburg who were born sick and with congenital disorders increased annually and in 2022 exceeded the national and district average levels by 1.6 and 1.2 times, respectively. The incidence rate of newborns with certain conditions occurring in the perinatal period in 2015-2022 was lower than the average in the Russian Federation and the NWFD (by 14.8 and 14.6%, respectively), and the indicator level, with an almost annual increase in 2022, amounted to 197.30%. The proportion of those admitted to St. Petersburg NPDs has increased annually since 2017. In 2022, 6.91% of the number of live births were admitted, which is 1.1 times higher than the national average and 1.3 times higher than the federal average. Thus, in St. Petersburg, in the conditions of declining birth rate and increasing incidence of newborns, there was a growing need for children to be admitted to NPDs of medical organizations.

3. Families of newborns born sick and with congenital disorders have peculiarities both in the medical and social characteristics and in the obstetric and gynecological history of the mother. Parents of sick children differed in age, education level, marital status, number of children in the family, etc. Mothers of sick children on

average had a later pregnancy registration at the antenatal clinic ($t$ = 23.40; p >0.01), were less likely to be registered before 6 weeks of pregnancy ($t$ = 23.40; p >0.01), their average pregnancy duration was lower ($t$ = 65.57; p <0.05), they were more likely to have chronic diseases (pathologic conditions) ($t$ = 4.56; p <0.01), diseases that occurred during pregnancy ($t$ = 4.92; p <0.01), and complications during labor ($t$ = 3.04; p <0.01). On average, mothers of sick children started breastfeeding later in the obstetric hospital ($t$ = 115.87; p <0.01).

4. Quality of life indicators of sick newborns are significantly lower than the corresponding indicators in healthy children: physical activity (60.9±23.1 vs. 81.3±15.4; p <0.05), physical symptoms (74.2±13.5 vs. 82.1±12.4; p <0.05), social activity (75.2±24.1 vs. 82.9±16.8; p <0.05), total score of physical functioning (69.3±14.5 vs. 81.8±11.4; p <0.05), total score of psychosocial health (74.6±14.5 vs. 78.4±12.4; p <0.05), and total score (72.3±11.6 vs. 79.9±10.6; p <0.05). Significant differences were found when comparing the quality of life in children by individual pathologies (p < 0.05) and between health groups I and III (p < 0.05).

5. The assessment of resource provision of medical care for neonatal patients demonstrated sufficient provision of medical organizations and the NPD beds, which allows children in the city to receive specialized care, including HTMC, in full. In St. Petersburg in 2015-2022, there was an increase in the availability and quality of medical care for newborns born sick and with congenital disorders due to an increase in the provision of the NPD beds by 18.5% to the level of 64.7 beds per 10 000 children under one year old and a decrease in hospital mortality of newborns with ELBW (1.1 times) and with a body weight of 1000 g and more (1.5 times) to the level of 19.53% and 1.59%, respectively.

6. The evaluation of the perinatal center and children's hospital NPDs showed a significant difference in the structure of patients both by disease (pathological condition), weight and prematurity of children, and by place of admission to the departments. In the structure of discharged patients from the perinatal center NPD, there were significantly more newborns with CM ($t$ = 10.02; p <0.01) and fewer children with disorders associated with shortening of the mother's gestational age and low birth

weight ($t$ = 2.45; p <0.05), growth retardation and malnutrition ($t$ = 3.02; p <0.05), and respiratory disorders during the perinatal period ($t$ = 2.12; p <0.05). The NPD bed stock of the perinatal center undergoes a higher load and more rationally: the bed operation rate is 5.0% higher (304.9 days vs. 290.4) and the bed turnover rate is 26.3% higher (19.8 vs. 14.6) and the average length of stay of a child in a bed is 22.2% lower (15.4 days vs. 19.8). The children's hospital NPD doesn't operate in full, as the implementation of the NPD bed plan is lower than in NPD of the perinatal center.

7. Despite the high assessment of the quality of medical care in NPDs (satisfaction rate 86.1%), mothers rated the work of auxiliary services (69.4%) and the amount of time and attention given by secondary medical personnel to patients (68.8%) the lowest, which is below the target satisfaction rate set by St. Petersburg TSGP for 2020 and for the planning period of 2021 and 2022. Despite the fact that the quality of health care delivery on all characteristics was most highly rated by mothers in the perinatal center NPD, when assessing the amount of time and attention given by both neonatologists and secondary medical personnel, higher scores were given to the medical personnel of the children's hospital. Among the reasons for dissatisfaction, the most significant were the "unaccompanied stay of mother and child" (14.9%), the attitude of secondary medical personnel (9.1%) and nutrition (7.7%). At the same time, 25.1% of mothers in the emergency department of children's hospitals indicated dissatisfaction due to the separation of mother and child.

8. An assessment of the financial support and efficiency of NPDs showed differences in performance between obstetric and perinatal NPDs. The analysis of financial provision of the NPD activities revealed differences in the provision of medical care by individual profiles, which in general ensured almost equal conditions of their financial provision. The medical and social performance of the perinatal center NPD was higher than that of the pediatric inpatient and had a high level. The assessment of economic efficiency showed that the efficiency coefficient of the pediatric inpatient NPD is 0.60 and that of the perinatal center NPD is 0.71, which corresponds to the average level. Thus, the efficiency coefficient of the perinatal center NPD was higher than in the children's hospital (0.87 vs. 0.82, quite a high level). Under

almost equivalent financial conditions, the efficiency of the perinatal center NPD is higher than that of the children's hospital. In general, we can talk about high NPD efficiency in a megalopolis.

9. The conducted research allowed us to establish that despite the high assessment of the current system of organization of medical care for newborns born sick and with congenital disorders, there are some shortcomings in its work, which creates reserves for its improvement. To this end, a set of medical and organizational measures aimed at improving the organization of medical care for children born sick and with congenital disorders was developed, scientifically substantiated and implemented.

## PRACTICAL RECOMMENDATIONS

To the Ministry of Health of the Russian Federation and the Federal Compulsory Health Insurance Fund of the Russian Federation:

1. In order to improve the quality of medical care in the pathology departments of newborns and premature infants, optimize tariffs for the provision of specialized, including high-tech, medical care.

To the executive authorities in the field of healthcare of the city of St. Petersburg:

1. In order to improve the quality of antenatal fetal protection, timely identification of risk factors for the health of mother and child, provide for increased control over the activities of the antenatal clinic in the following areas:

- timeliness of women's registration for pregnancy and the implementation of a set of measures for its prolongation;
- regular monitoring of pregnant women from obstetric and perinatal risk groups in order to prevent the occurrence of diseases during pregnancy and complications during childbirth;
- family planning in order to better prepare the family for the upcoming pregnancy.

2. To strengthen the control of routing of women during pregnancy, childbirth, as well as the control of routing of newborns in accordance with the degree of obstetric and perinatal risk.

3. Regularly monitor the quality of medical care in obstetric and pediatric hospitals using sociological research methods.

4. To use methods to study the quality of life of newborns as an integral characteristic of the health status of children of this age group.

Chief physicians of obstetric and pediatric hospitals:

1. To consider the possibility of redesigning the hospital's bed stock, taking into account the structure of incidence and/or the age of patients in order to rationalize the use of the department's capacity.

2. Provide additional opportunities for mother and child to stay together.

3. More carefully monitor the compliance of medical personnel with the principles of ethics and deontology.

Neonatologists of medical organizations:

1. Strengthen doctors' control over the work of subordinate secondary medical personnel.

2. Carry out sanitary and hygienic education more actively.

3. Conduct regular events to promote and support breastfeeding among mothers.

## PROSPECTS FOR FURTHER DEVELOPMENT OF THE SUBJECT

The prospects for further development of the thesis topic are to study the organization of medical care for newborns born sick and with congenital diseases in other regions that are part of the Northwestern Federal District, to assess the organization of medical care in NICU, and to compare the results of the study with the performance of the maternal and child health care system of the city of Moscow.

## LIST OF ABBREVIATIONS AND SYMBOLS

BR – base rate

HTMC – high-tech medical care

WHO – World Health Organization

CM – congenital anomalies (malformations), deformities and chromosomal abnormalities

CHD – congenital heart defects

Children's City Multidisciplinary Clinical Specialized Center of High Medical Technologies – St. Petersburg State Budgetary Institution "Children's City Multidisciplinary Clinical Specialized Center of High Medical Technologies"

COD – child outpatient department

PRF – prime rate conversion factor

DR – differentiation ratio

CRDRG – relative cost intensity ratio clinical and statistical groups

DRG – diagnosis-related group

SCDRG – specificity coefficient

PTCR – patient treatment complexity ratio

MOLC – medical organization level coefficient

ICD-10 – International classification of diseases and health-related problems, X revision

LBW – low body weight

FCS – average standard of financial costs

CHI – compulsory health insurance

VLBW – very low birth weight

NPD – neonathal pathology department

NICU – neonatal intensive care units

ICU – intensive care and advisory unit

NWFD – Northwestern Federal District

City Perinatal Center No. 1 – St. Petersburg State Budgetary Health Care Institution "City Perinatal Center No. 1"

St. Nicholas the Wonderworker Children's City Hospital No. 17 – St. Petersburg State Budgetary Healthcare Institution "St. Nicholas the Wonderworker Children's City Hospital No. 17"

ACDRG – average cost of the diagnosis-related group used for tariff calculation

TSGP– territorial program of state guarantees

Saint Petersburg State Pediatric Medical University - Federal State Budgetary Educational Institution of Higher Education "Saint Petersburg State Pediatric Medical University" of the Ministry of Health of the Russian Federation

V.A. Almazov National Medical Research Center – Federal State Budgetary Institution "V.A. Almazov National Medical Research Center" of the Ministry of Health of the Russian Federation

FFCHI – federal compulsory health insurance fund

Central Research Institute of Health Care Organization and Informatization – Federal State Budgetary Institution "Central Research Institute of Health Care Organization and Informatization" of the Ministry of Health of the Russian Federation

ELBW – extremely low body weight

M – arithmetic mean

p – significance level

*t* – Student's t-test

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# APPENDICES

## Appendix 1

## QUESTIONNAIRE FOR MOTHER OF A NEWBORN

*Please read and fill out the questionnaire carefully. Truthful answers will help to objectively assess the organization of medical care for newborns and promptly eliminate the shortcomings of its provision.*
*You do not need to specify the last name, since the questionnaire is anonymous.*

### Part 1. Information about family and child

1. Mother's age (full years): _____
2. Father's age (full years): _____
3. Your marital status: *I live in a registered marriage – 1; I live in a civil marriage – 2; divorced – 3; widow – 4; I am not married and have not been – 5.*
3. Mother's education: *primary – 1; secondary – 2; specialized secondary – 3; incomplete higher – 4; higher – 5.*
4. Father's education: *primary – 1; secondary – 2; specialized secondary – 3; incomplete higher – 4; higher – 5.*
5. Mother's social status: *worker – 1; employee – 2; entrepreneur – 3; housewife – 4; student – 5; pensioner – 6, disabled – 7; other: _____– 8.*
6. Father's social status: *worker – 1; employee – 2; entrepreneur – 3; unemployed – 4; student – 5; pensioner – 6, disabled – 7; other: _____– 8.*
7. Number of children in the family (together with this child) _____
8. What pregnancy counts _____
9. How many months pregnant were you registered *(write in)* _____
10. Duration of pregnancy (in months) _____
11. Diseases (pathological conditions/complications) that you had during pregnancy: *yes – 1; no – 2.*

| Name of diseases | Present | Absent |
|---|---|---|
| Anemia | | |
| Hypertension | | |
| Endocrine system diseases | | |
| Gestational diabetes mellitus | | |
| Genitourinary system diseases | | |
| Circulatory system diseases | | |
| Venous event | | |
| Threatened miscarriage | | |

| | | |
|---|---|---|
| Premature delivery | | |
| Rhesus incompatibility | | |
| Fetal pathology | | |
| Others (*write in*)_____ | | |

12. Were there any complications during childbirth: *yes – 1; no – 2.*

13. 11. Chronic diseases of the mother before pregnancy: *no – 1, yes – 2;*

13.1. If there is, then specify which ones *(enter them):* _____

14. Your child's gender: *male – 1; female – 2.*

15. What was your child's birth weight (kg) _____

16. What was your child's height at birth (cm) _____

17. In the maternity hospital: *the newborn was immediately put to the breast – 1, was put to the breast for ___ days – 2, was not put to the breast – 3.*

18. Does the child have any diseases: *no – 1; yes – 2* (specify which ones) _____

_____

19. Child health group _____

**Part 2. Assessment of the quality of medical care in a hospital**

| No. | Characteristic | Answer options |
|---|---|---|
| **Assessment of the conditions of stay in a medical organization** | | |
| 20. | Satisfaction with the technical condition of places where newborns stay (availability of repairs, availability and serviceability of sanitary and technical equipment, electrical appliances, beds, changing tables, etc.). | 1 – Yes, completely<br>2 – Rather yes than no<br>3 – Rather no than yes<br>4 – I find it difficult to answer<br>5 – Not satisfied |
| 21. | Satisfaction with the comfort<br>of places where newborns stay (optimal temperature, lighting, sanitary conditions in places where children stay, sufficient room space and layout to accommodate mother and child, availability of all furniture necessary for newborns in the medical organization, etc.). | 1 – Yes, completely<br>2 – Rather yes than no<br>3 – Rather no than yes<br>4 – I find it difficult to answer<br>5 – Not satisfied |
| 22. | Satisfaction with the work of auxiliary services (laboratory, X-ray room, physiotherapy room, etc.) | 1 – Yes, completely<br>2 – Rather yes than no<br>3 – Rather no than yes<br>4 – I find it difficult to answer<br>5 – Not satisfied |

| | | |
|---|---|---|
| 23. | Satisfaction with the provision of medicines and consumables (the medical organization fully provided everything necessary and none of the medicines, medical consumables and infant formula (if necessary) was offered to the mother and she did not have to buy it for the child from her personal funds) | 1 – Yes, completely<br>2 – Rather yes than no<br>3 – Rather no than yes<br>4 – I find it difficult to answer<br>5 – Not satisfied |
| 24. | Satisfaction with the quality of medical care for the newborn as a whole | 1 – Yes, completely<br>2 – Rather yes than no<br>3 – Rather no than yes<br>4 – I find it difficult to answer<br>5 – Not satisfied |
| **Assessment of the attitude of medical personnel to newborns** | | |
| | Characteristic | Answer options |
| 25. | Assessment of personal qualities of neonatologists | 1 – With attention and participation<br>2 – Not very attentive<br>3 – Indifferent<br>4 – I find it difficult to answer<br>5 – With annoyance and rudeness |
| 26. | Assessment of the personal qualities of secondary medical personnel | 1 – With attention and participation<br>2 – Not very attentive<br>3 – Indifferent<br>4 – I find it difficult to answer<br>5 – With annoyance and rudeness |
| 27. | Assessment of the amount of time and attention given by doctors to newborns | 1 – Always gives the child enough time and attention<br>2 – Sometimes he does not pay enough time and attention, I would like more<br>3 – Often in a hurry, does not pay enough time and attention<br>4 – I find it difficult to answer<br>5 – Does not pay attention to the child at all |
| 28. | Assessment of the amount of time and attention given by the secondary medical personnel to newborns | 1 – Always gives the child enough time and attention<br>2 – Sometimes he does not pay enough time and attention, I would like more<br>3 – Often in a hurry, does not pay |

| | | |
|---|---|---|
| | | enough time and attention<br>4 – I find it difficult to answer<br>5 – Does not pay attention to the child at all |
| 29. | Evaluation of the work of doctors with newborns in points (write in) | _____ points |
| 30. | Assessment of the work of secondary medical personnel with newborns in points (write in) | _____ points |

31. What shortcomings you see in the work of the OPN of the medical organization where your child was *(you can specify several):* _____

***Thank you for your help in conducting the study***
***and wish you and your child good health!***

## Appendix 2

### QUESTIONNAIRE FOR ASSESSING THE QUALITY OF LIFE OF A NEWBORN

***Please fill out this form. Circle the corresponding number in each section.***

1. Age of the child at the time of the study _____ (days)
2. Does the child have any diseases: *no – 1; yes – 2* (specify) _____
3. Child health group _____

**PedsQL questionnaire.**

Quality of life questionnaire for children. Assessment scale for infants.

It is filled in based on the last 7 days.

During the past 7 days, your child has experienced the following difficulties.....

| Physical activity (in the last 7 days, your child has experienced the following difficulties...) | Never | Almost never | Sometimes | Often | Almost always |
|---|---|---|---|---|---|
| 1. Low energy level | 0 | 1 | 2 | 3 | 4 |
| 2. It is difficult to participate in an active game | 0 | 1 | 2 | 3 | 4 |
| 3. He/she was in pain | 0 | 1 | 2 | 3 | 4 |
| 4. Feeling tired | 0 | 1 | 2 | 3 | 4 |
| 5. Lethargy | 0 | 1 | 2 | 3 | 4 |
| 6. The child rested (slept) a lot | 0 | 1 | 2 | 3 | 4 |
| Physical symptoms (in the last 7 days, your child has experienced the following difficulties...) | Never | Almost never | Sometimes | Often | Almost always |
| 1. Gases | 0 | 1 | 2 | 3 | 4 |
| 2. Regurgitation after feeding | 0 | 1 | 2 | 3 | 4 |
| 3. Shortness of breath | 0 | 1 | 2 | 3 | 4 |
| 4. Abdominal discomfort | 0 | 1 | 2 | 3 | 4 |
| 5. Difficulty swallowing | 0 | 1 | 2 | 3 | 4 |
| 6. Constipation | 0 | 1 | 2 | 3 | 4 |
| 7. Rash | 0 | 1 | 2 | 3 | 4 |
| 8. Diarrhea | 0 | 1 | 2 | 3 | 4 |
| 9. Wheezing breath | 0 | 1 | 2 | 3 | 4 |
| 10. Vomiting | 0 | 1 | 2 | 3 | 4 |
| Emotional state (in the last 7 days, your child has experienced the following difficulties...) | Never | Almost never | Sometimes | Often | Almost always |
| 1. He/she was feared | 0 | 1 | 2 | 3 | 4 |
| 2. It happened that he/she was angry | 0 | 1 | 2 | 3 | 4 |
| 3. Cried or got cranky if left alone | 0 | 1 | 2 | 3 | 4 |

| | | | | | |
|---|---|---|---|---|---|
| 4. Had difficulty calming down if he/she was upset | 0 | 1 | 2 | 3 | 4 |
| 5. Difficulty falling asleep | 0 | 1 | 2 | 3 | 4 |
| 6. Crying or was naughty when picked up | 0 | 1 | 2 | 3 | 4 |
| 7. He/she felt a sense of sadness | 0 | 1 | 2 | 3 | 4 |
| 8. Difficulty calming down when lifted or held in arms | 0 | 1 | 2 | 3 | 4 |
| 9. Didn't sleep well most of the night | 0 | 1 | 2 | 3 | 4 |
| 10. Cried a lot | 0 | 1 | 2 | 3 | 4 |
| 11. Naughty | 0 | 1 | 2 | 3 | 4 |
| 12. Was difficult to put to sleep during the day | 0 | 1 | 2 | 3 | 4 |
| Social activity (in the last 7 days, your child has experienced the following difficulties...) | Never | Almost never | Sometimes | Often | Almost always |
| 1. Did not smile at others | 0 | 1 | 2 | 3 | 4 |
| 2. Did not laugh when tickled | 0 | 1 | 2 | 3 | 4 |
| 3. Did not make eye contact with his/her caregiver. | 0 | 1 | 2 | 3 | 4 |
| 4. Did not laugh when taken in arms | 0 | 1 | 2 | 3 | 4 |
| Cognitive activity (in the last 7 days, your child has experienced the following difficulties...) | Never | Almost never | Sometimes | Often | Almost always |
| 1. Did not imitate the actions of the caregiver(s) | 0 | 1 | 2 | 3 | 4 |
| 2. Did not mimic the facial expression of the of the caregiver(s) | 0 | 1 | 2 | 3 | 4 |
| 3. Did not imitate(a) sounds uttered by those who take care of him (her) | 0 | 1 | 2 | 3 | 4 |
| 4. Couldn't focus on objects | 0 | 1 | 2 | 3 | 4 |

Thank you!