



# SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

Proceedings of the  
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这些会议文结合了会议的材料 – 研究论文和科学工作者的论文报告。它考察了职业化人格的技术和社会学问题。一些文章涉及人格职业化研究问题的理论和方法论方法和原则。

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# CONTENTS

## ECONOMIC SCIENCES

区域中小企业数字化分指数

Sub-indices of digitalization of small and medium-sized businesses at the regional level

*Loshinskaya Elena Nikolaevna, Zubrykina Marina Vladimirovna*..... 8

创新对经济发展的重要性

The importance of innovation for economic development

*Meshkova Viktoriia Sergeevna*..... 14

金砖国家数字经济发展与信息安全：机制与挑战

Development of the digital economy and information security in BRICS countries: mechanisms and challenges

*Vardanyan Areg Gevorgovich, Vardanyan Narek Gevorgovich*..... 18

俄罗斯联邦申请人高等教育培训的重点领域：社会和管理方面

Priority areas of higher education training among applicants of the Russian Federation: social and managerial aspect

*Kazaryan Irina Rafaelevna, Ermolyeva Tamara Viktorovna*..... 23

## JURIDICAL SCIENCES

加强国际合作，打击侵害儿童利益、违反社会公德的犯罪行为

International cooperation in the fight against crimes against public morality that infringe on the interests of children

*Yaroshenko Olga Nikolaevna*..... 27

商业实体在没有必要许可的情况下进行交易的法律后果

Legal consequences of transactions carried out by a business entity without the necessary license

*Tikhomirov Konstantin Vyacheslavovich*..... 35

## PEDAGOGICAL SCIENCES

未来数学教师专业数字能力的形成途径

The ways of forming professional digital competence of a future mathematics teachers

*Skafa Elena Ivanovna, Evseeva Elena Gennadiyevna, Skvortsova Darya Alexandrovna*..... 42

学龄前儿童在空间中占据有条件动态位置的能力的形成 Formation of the ability of older preschool children to occupy a conditionally dynamic position in space <i>Shmatchenko Anna Alekseevna</i> .....	48
--	----

青春期女孩破坏性攻击行为转化的性别与跨文化特征 Gender and cross-cultural characteristics of the transformation of destructive aggressiveness of adolescent girls <i>Grinkova Marianna Yurievna, Sannikova Anna Illarionovna, Kosolapova Larisa Alexandrovna</i> .....	54
--	----

## PSYCHOLOGICAL SCIENCES

教育空间对学龄前儿童心理健康的影响 Impact of educational space on psychological well-being of preschool children <i>Davydova Anastasia Viktorovna</i> .....	59
--	----

## ART HISTORY

绘画中的贝加尔湖传说（绘画的诠释） Legends of Baikal in painting (interpretations of paintings) <i>Gorbonos Olga Konstantinovna</i> .....	64
--	----

## CULTURAL STUDIES

关于“物质生产与精神生产”与“物质文化与精神文化”概念的区别 About the difference between concepts “material and spiritual production” and “material and spiritual culture” <i>Chernyakova Natalia Stepanovna</i> .....	71
---	----

## BIOLOGICAL SCIENCES

科佩特达格野生药用植物生物资源 Biological resources of wild medicinal plants of Kopetdag <i>Akmuradov Allamurad, Nurgeldiev Maksat Yazmuradovich</i> .....	76
---	----

## MEDICAL SCIENCES

人工通气对3岁以下急性脑供血不足患儿收缩压昼夜节律的影响 Effect of artificial ventilation on the circadian rhythm of systolic blood pressure in acute cerebral insufficiency in children under 3 years of age <i>Muhitdinova Hura Nuritdinovna, Krasnenkova Maryanna Borisovna, Mirzayeva Adiba Damirovna</i> .....	83
---	----

机械呼吸支持对幼儿急性脑供血不足舒张压昼夜节律的影响 Effect of mechanical respiratory support on the circadian rhythm of diastolic blood pressure in acute cerebral insufficiency in young children <i>Muhitdinova Hura Nuritdinovna, Hamrayeva Gulchehra Shahobovna, Alauatdinova Gulhan Inyatdinovna, Sabirova Feruza Baltabayevna</i> .....	93
--	----

哈萨克斯坦现阶段艾滋病毒感染情况 HIV infection in Kazakhstan at the present stage <i>Turdaliev Botagoz, Ramazanov Manshuk, Baysugurova Venera, Aimbetova Gulshara</i> .....	103
---	-----

俄罗斯专业大学男生太阳活动期间个体时间生物学指标  
 Chronobiological individual minute indicators of young boys from specialized universities of Russia during the period of solar activity  
*Prokopyev Nikolai Yakovlevich, Kolunin Evgeniy Timofeevich, Ananiev Vladimir Nikolaevich, Bykov Evgeniy Vitalievich, Zebzeev Vladimir Viktorovich, Rubanovich Viktor Borisovich, Ananieva Olga Vasilievna, Vetoshkina Elena Alexandrovna, Limarenko Olga Vladimirovna, Romanova Svetlana Vladimirovna, Gurtovoy Elisey Sergeevich* ..... 110

俄罗斯联邦人口对矫形牙科护理的需求  
 The need of the population of the Russian Federation for orthopedic dental care  
*Suslin Sergey Aleksandrovich, Koryakin Sergey Alexandrovich, Alyokhin Ilya Andreevich, Virgiliyev Pavel Sergeyeovich*..... 118

糖尿病患者骨科治疗适应期出现的并发症  
 Complications arising during the adaptation period in patients with diabetes mellitus during orthopedic treatment  
*Chirkova Natalia Vladimirovna, Derevnina Natalia Gennadievna, Vecherkina Zhanna Vladimirovna, Kuznetsov Valery Valentinovich, Saprykin Egor Alekseevich*..... 124

术后早期阿片类药物引起的呼吸抑制  
 Opioid-induced respiratory depression in the early postoperative period  
*Gheorghiu Maria* ..... 130

坎地沙坦对老年慢性缺血性心力衰竭患者心率变异性的影响  
 The effect of candesartan on heart rate variability in elderly patients with chronic ischemic heart failure  
*Zhemchuzhnikov Sergey Vasilevich*..... 134

纤维增生性阴茎硬结症治疗的新进展  
 New aspects of the treatment of fibroplastic penile induration  
*Kurashov Dmitry Viktorovich, Zurnadzh'yantc Viktor Ardovazdovich, Kchibekov Eldar Abduragimovich, Proskurin Alexey Alexandrovich* ..... 138

## TECHNICAL SCIENCES

人工智能在预测风对高层建筑影响中的应用：传统模型与神经网络模型的分析  
 Application of artificial intelligence for predicting wind effects on high-rise buildings: a comparative analysis of traditional and neural network models  
*Zakharov Fedor, Qian Jie, Xu Yi*..... 144

区域中小企业数字化分指数

**SUB-INDICES OF DIGITALIZATION OF SMALL AND MEDIUM-SIZED BUSINESSES AT THE REGIONAL LEVEL**

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摘要。本研究并验证了工业区中小企业数字化的子指数，以确定其竞争力和可持续发展水平。

关键词：数字化、子指数、竞争力、俄罗斯联邦西南主体、区域、数字经济、企业数字化。

**Abstract.** *The article examines and substantiates the sub-indices of digitalization of small and medium-sized businesses in an industrial region in order to determine their level of competitiveness and sustainable development.*

**Keywords:** *digitalization, sub-indices, competitiveness, South-West subjects of the Russian Federation, region, digital economy, business digitalization.*

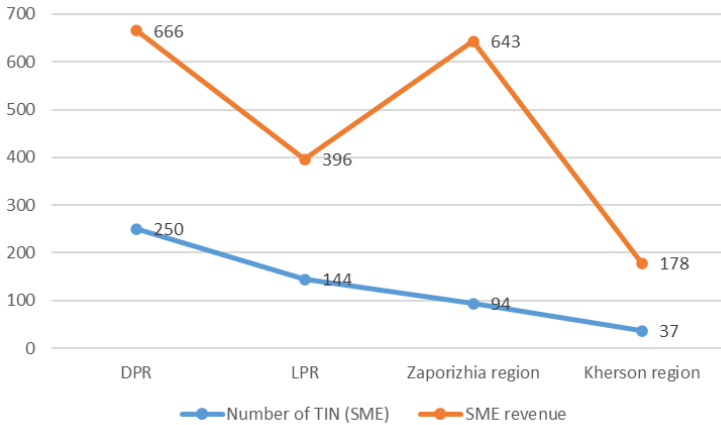
In Russia, digital transformation is formulated within the framework of national goals and strategies [1] aimed at the accelerated development of digital technologies and their integration into various spheres of the economy and society. The main goals and areas of digital transformation are:

- development of digital infrastructure;
- education and skills development;
- innovation and research;
- e-government and online services;
- digitalization of the economy and industry;
- security and data protection.

The issue of business digitalization is especially important in the regions that have recently joined the Russian Federation (RF) and formed a new district “South-West subjects of the Russian Federation” [2,3] (Fig. 1).



The leader in terms of the number of operating small and medium-sized businesses (SMEs) and revenue from their activities is the Donetsk People’s Republic (DPR), on whose territory conditions for effective business activity have been and are being created.



**Figure 1.** Analysis of the activities of SMEs in the South-West regions of the Russian Federation

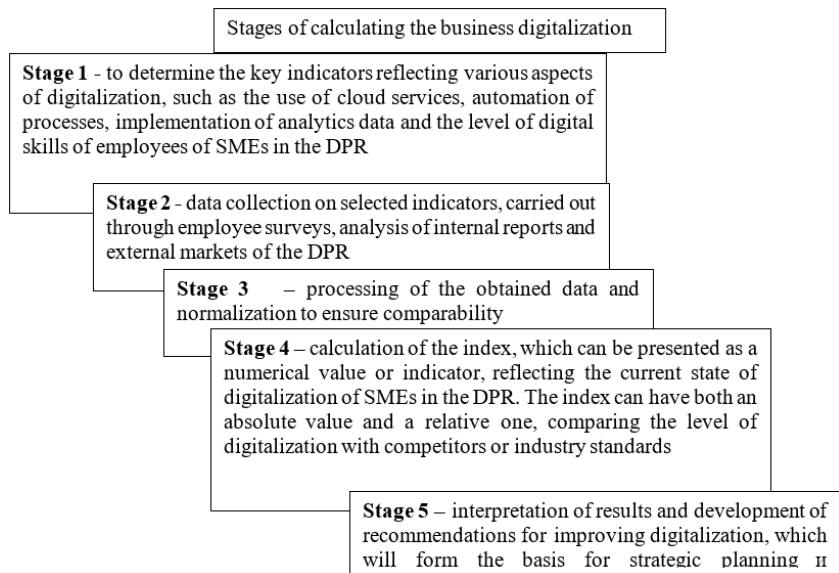
The SME digitalization index is an integrated indicator reflecting the level of implementation and use of digital technologies at industrial enterprises in the region.

The methodological basis of the scientific research is the theoretical and applied developments of domestic and foreign scientists who considered the subindex as a component of the digitalization index. The information base of the study is statistical data from the Unified Register of Small and Medium-Sized Enterprises of the Russian Federation (SMEs, SMEs) [4], Business Statistics of the Russian Federation [5], the Federal State Statistics Service [6] and other materials.

Based on the developments of the Institute for Statistical Research and Economics of Knowledge of the National Research University Higher School of Economics, a calculation of the business digitalization index was proposed, which can characterize the speed of adaptation to digital transformation of industrial enterprises in Russia, Europe, the Republic of Korea and Japan. The calculation of the index is based on five indicators, namely: the level of use of broadband Internet, cloud services, RFID technologies, ERP systems and inclusion in e-commerce [7].

The authors Bondarev N., Bondareva G., Serova E.E. showed the significance of the business digitalization index, disclosed its components from the position of

a systems approach [8]. The author Shirinkina E.V. formed a multi-factor model for the development of digitalization of business processes of enterprises and established the significance of the factors included in this model [9]. The methodology for calculating the SME digitalization index includes several key stages that allow an objective assessment of the level of implementation of digital technologies in the company (Fig. 2).



*Figure 2. Stages of calculating the business digitalization index*

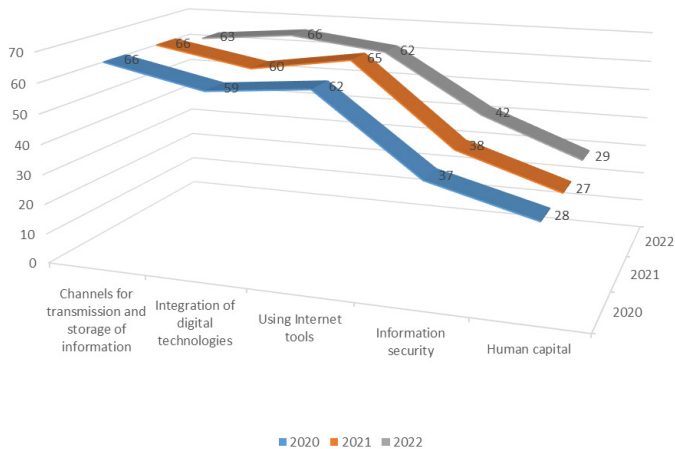
Today, there are many indicators that can be used to assess the level of development of the digital regional economy. The most interesting of them are presented in the form of cognitive factor models, which make it possible to assess the quantitative influence of factors on the integral indicator. However, in the statistical information environment, in digital economy development programs, in research reports, a different set of primary indicators and integral indices is provided.

The main objective of the Digital Economy Index of Society (DEIS) is to monitor the process that can be achieved in five areas: research and development in the field of ICT; human capital; communications; integration of digital technologies; digital public services. The Business Digitalization Index is a comprehensive indicator composed of the following key sub-indices (Table 1). Each of the sub-indices reflects various aspects of digital transformation in the business environment, which together allows you to assess the level of digitalization of enterprises [10].

**Table 1**  
*Indicators included in the Business Digitalization Index - BDI*

Subindex	Characteristic
Digital infrastructure	assesses the availability and quality of the Internet connection, the presence of digital platforms, cloud services and data centers.
Digital technologies and innovations	includes an assessment of the implementation and use of modern digital tools and solutions, such as artificial intelligence, blockchain, the Internet of Things, Big Data, etc.
Regulatory environment and security	measures the degree of development of the regulatory environment to support the digitalization of business; takes into account legislative initiatives, the level of data security, the presence of cybersecurity and the level of trust in digital services
Level of digital skills and competencies	measures the level of employee training in the use of digital technologies, analyzes the availability of educational programs on digitalization
Digital marketing and clients	considers the use of digital channels for marketing and customer interaction.
Digitalization of business processes	assesses the use of digital technologies in order to optimize internal business processes.

Thus, Otkritie Bank, together with the analytical center of the National Agency for Financial Research (NAFR), analyzed the level of digitalization of SMEs and calculated the digitalization index using 5 sub-indices (Fig. 2) [10].



**Figure 2.** Business digitalization sub-indices

The business digitalization index of the Russian Federation in 2020 was 50%, in 2021 - 51%, in 2022 - 52%. This indicator has a positive value due to the fact that SMEs pay the necessary attention to information security, cyber literacy of employees, updating and improving software.

The author Shcherbina A.Yu. [11] developed a scientific and methodological approach to assessing the innovative and digital development of entrepreneurial structures based on the definition of the index of Digital and Innovative Maturity of the entrepreneurial structure (Ic), which allows assessing innovative activity, as well as the level of implementation of digital technologies at a particular enterprise, which is formed by four sub-indices:

- the use of ICT and digital tools in business;
- human capital development;
- innovative activities of entrepreneurial structures;
- information security; the level of cooperation and cooperation.

The final value of the “digital development index” of SMEs in an industrial region can be calculated by standardizing indicators and individual indicators relative to the values for all entities and consistently aggregating the obtained values at all assessment levels, bringing them to a 100-point scale using weighting factors.

Analysis of the “digitalization index” of SMEs at the regional level is an important tool used to monitor and stimulate the development of the economy of an industrial region. Elimination of the digital divide between large and small (medium) businesses, the introduction of digital technologies and government support are becoming key factors contributing to sustainable economic growth and innovative development.

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创新对经济发展的重要性

## THE IMPORTANCE OF INNOVATION FOR ECONOMIC DEVELOPMENT

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The importance of innovations increases every year. Innovations contribute to the improvement of the standard of living of the population. Innovations often help to solve employment problems by creating new high-paying jobs. The level of health care and education also increases.

In the conditions of continuous economic growth, one of the main ways to increase the competitiveness of products and maintain high rates of development and profitability of enterprises is the introduction of innovations.

In order to adapt to changes in the market, scientific and technological progress, as well as the growing needs of customers, force companies to develop and implement innovations in all spheres of life. Thus, the most important factor in the effective functioning of the market economy is innovation, which stimulates increased competitiveness, the development of new markets, the capture of market niches and the creation of attractive conditions for investors [1, p. 25].

In this regard, the innovative development of enterprises is of particular importance, as it concentrates production activities on the needs of consumers, allows for a more flexible response and timely introduction of changes, and the formation of long-term competitive advantages.

The main points of successful innovative development of enterprises are clear setting of strategic goals and objectives, assessment of the effectiveness of their implementation, as well as forecasting possible risks that may lead to a change in the course of the innovation strategy [2, p. 31].

The effectiveness of innovative development of an enterprise largely depends on the ability of the enterprise to carry out a continuous and comprehensive process of implementing innovations.

Innovations are one of the main factors of economic development in the global space. Currently, the world is experiencing a complex process of technological innovations. The potential for further progress and improvement of old technol-

ogies, which are approaching the stage of exhaustion, has been exhausted, and a phase of active growth of new technologies is developing that can revolutionize the economy and society as a whole.

The essence of the innovation process occurring in any complex production and economic system lies in a series of gradual and qualitatively new changes that contribute to the further qualitative development of society and ensure a higher standard of living for the population [3, p. 255].

Innovations include scientific, technological, economic and organizational changes occurring in the production process. Its main characteristics are considered to be the qualitative novelty of products, production methods and technologies, the pace of implementation, the dynamics of the innovation cycle, economic efficiency and social consequences.

The development of innovations is preceded by marketing research, research and development, organizational and technical preparation of production, production processes and the registration of results. Thus, innovation can be considered as the final result of the introduction of an innovation in order to change the object of management and obtain economic, social, scientific, technical and other types of effects [4, p. 132].

Competitive enterprises are able to quickly and effectively solve innovation problems. Competition accelerates and objectively leads to the acceleration of the process of innovative development of the entire economy, including technology, technology, labor organization and management, forms and methods of market relations. The importance of innovations is increasing every year. Innovations allow to improve the standard of living of the population. Innovations contribute to solving the problem of employment by creating new highly paid jobs. However, innovations should be considered not only as the end result of the introduction of new equipment, technology or method, but also as a complex process of their production, a new method or approach to solving a real problem, which in turn leads to an increase in the standard of living and the efficiency of processes, phenomena and production sectors. This should lead to an increase in the standard of living, processes, phenomena and the efficiency of the production sector [5, p. 45].

To optimize innovation activities, it is necessary to take into account the following:

- the need to increase financial resources for training qualified specialists;
- legislative changes aimed at using benefits and incentives in the field of innovation activities;
- cooperation and exchange of experience with foreign companies;
- activation of technology parks supported by the state;
- use of the experience of developed countries in the field of cooperation between universities and enterprises.

In addition, to improve innovation, it is necessary to strengthen information, financial, intellectual, material and technological resources in order to develop scientific and technical potential and create new jobs.

The need for innovative development is due to the general pattern of development and progress in the field of individual and social reproduction; without the implementation of innovative and investment-oriented activities, any production sector will emerge from the economic crisis much more slowly.

An innovation strategy should take into account trends in the development of science and technology, the expected possibilities of updating technologies and products, assess the company's ability to create and implement innovations taking into account the current and projected market situation, and determine the goals and methods of their application [6, p. 83].

The development of the innovative focus of enterprises should be considered as a natural process of changes that increases the potential efficiency of the financial, economic, intellectual, innovative and managerial elements of enterprises to ensure sufficient competitiveness of their products in the world market and allows the values of their financial and economic indicators to exceed the break-even point.

Innovative development in any industry should be a systemic process characterized by the frequency and efficiency of innovation implementation, the industry's capabilities to develop and implement innovations, and the readiness of industry workers to change. In this case, it is possible to reduce risks in innovation activities and ensure the effectiveness of investments in the implementation of innovations.

The definition of the essence of the innovatively oriented development of an enterprise should be considered as a process of natural changes due to increased efficiency of using the financial, economic, intellectual, innovative and managerial components of the enterprise's potential, which will allow the enterprise's financial and economic indicators to reach a value above the break-even point and not lower than the growth of economic indicators in order to ensure a sufficient level of competitiveness of products in world markets [7, p. 73]. The choice of an appropriate form of external financing of an enterprise's investment project depends on the financial and economic situation of the state, the legislative framework, the political situation and other external factors. The chosen form of attracting investment resources can influence the formation of cash flows, equalize their volume, reduce the cost of repaying credit obligations and increase the overall efficiency of investment projects. Innovations are of great importance for the country and determine its long-term development potential, becoming a strategic factor in economic development not only for companies in individual industries, but also for the country as a whole.



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金砖国家数字经济发展与信息安全: 机制与挑战  
**DEVELOPMENT OF THE DIGITAL ECONOMY AND  
INFORMATION SECURITY IN BRICS COUNTRIES:  
MECHANISMS AND CHALLENGES**

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**摘要:** 数字经济已成为全球发展的主要趋势之一, 为经济增长创造了新的动力。然而, 数字经济的快速扩张可能会加剧全球不平等, 尤其影响全球南方国家的经济发展。全球治理机构, 如扩大后的金砖国家集团 (现在不仅包括巴西、俄罗斯、印度、中国和南非, 还包括其他国家) 在促进数字增长方面的作用需要更深入的研究。金砖国家在多极世界中发挥着重要作用, 其数字政策对全球互联网和数字治理的未来有着重大影响。本研究旨在分析数字经济发展的机制, 并确定金砖国家在信息安全领域面临的挑战。

**关键词:** 数字经济、信息安全、金砖国家、数字化、互联网治理。

**Abstract.** *The digital economy has become one of the key trends in global development, creating new incentives for economic growth. However, its rapid expansion may exacerbate global inequality, particularly affecting the economic development of countries in the Global South. The role of global governance institutions, such as the expanded BRICS group—which now includes not only Brazil, Russia, India, China, and South Africa but also other countries—in facilitating digital growth requires deeper examination. BRICS nations play a significant role in a multipolar world, and their digital policies have a substantial impact on the future of the global internet and digital governance. The aim of this study is to analyze the mechanisms of digital economy development and identify challenges in the field of information security within BRICS countries.*

**Keywords:** *digital economy, information security, BRICS, digitalization, internet governance.*

The term “digital economy,” emerging in the mid-1990s, reflects the rapid advancement of information technologies and changes in how they are utilized

by enterprises and consumers. Early studies, such as those by Litan and Rivlin (2001), focused on the proliferation of the internet and its immediate economic impacts. However, since the mid-2000s, researchers have shifted attention to the conditions under which the digital economy arises and develops, its influence on various sectors, and the transformation of traditional business models (Tapscott, 2015). The capability to collect, analyze, and utilize big data has become a crucial factor enabling enterprises to make more informed decisions and create new value propositions (McAfee & Brynjolfsson, 2012).

Data collection and analysis rely on digital footprints left by users on various online platforms. This wealth of information allows for a deeper understanding of consumer behavior, optimization of business processes, and the development of personalized products and services (Chen et al., 2012). The surge in global internet traffic—from approximately 100 GB per day in 1992 to over 45,000 GB per second in 2017 (Cisco, 2018)—testifies to the exponential growth of digital activity. The projected IP traffic of 180,700 GB/s by 2025 indicates further acceleration of digitalization and integration of the Internet of Things (IoT) into daily life (Statista, 2021), aligning with the concept of Industry 4.0 (Schwab, 2016).

The emergence and rapid spread of the digital economy significantly impact the global economy, national economies, and social structures. For the expanded BRICS countries, the digital economy presents both opportunities and challenges. According to Rostow's stages of economic growth model (1960), digitalization can accelerate development but requires conditions such as infrastructure, human capital, and an institutional environment.

The expanded BRICS countries—including Brazil, Russia, India, China, South Africa, Egypt, Iran, the United Arab Emirates (UAE), and Ethiopia—demonstrate significant potential in developing their digital economies. However, the levels of development and readiness for digital transformation vary among these nations.

Brazil has exhibited growth in the e-commerce sector, with market volume reaching \$39 billion in 2021, a 28% increase from the previous year (E-commerce Brasil, 2021). However, a 35% rise in cyber incidents (Martins & da Silva, 2020) underscores the necessity for investments in information security infrastructure and policies.

In Russia, the digital economy accounts for approximately 7.5% of GDP (Ministry of Economic Development of the Russian Federation, 2022). Despite a high internet penetration rate facilitating digital services development, the increasing number of cyberattacks (Lebedev et al., 2021) highlights vulnerabilities in digital infrastructure, necessitating enhanced cybersecurity measures and the development of national expertise, in line with institutional economic theories emphasizing the role of institutions in economic performance (North, 1990).

India has become a leading nation in IT sector development and e-commerce, with the market expected to grow to \$200 billion by 2025 (IBEF, 2021). However,

an 86% increase in cyber threats (Sundararajan et al., 2019) indicates a pressing need for robust cybersecurity strategies and educational programs to build human capital, supporting the human capital theory's assertion that investment in education enhances economic growth (Nelson & Phelps, 1966).

China's digital economy represents over 38% of its GDP (CAICT, 2021), with substantial investments in artificial intelligence and IoT technologies. Nevertheless, the rise in cyberattacks (Chen & Yang, 2019) challenges the country to strengthen its national cybersecurity strategy, reflecting the importance of secure digital environments for sustained competitive advantage (Barney, 1991).

South Africa shows growth in its IT market (BMI Research, 2021), yet vulnerability to cyberattacks (Solms & Jacobs, 2021) emphasizes the need for national cybersecurity development. Similar challenges face the new BRICS members: Egypt and Ethiopia are actively developing digital infrastructures, but limited resources and a shortage of qualified personnel impede progress (World Bank, 2020). Iran and the UAE are investing in digital technologies, but geopolitical tensions and regulatory barriers may limit their integration into the global digital economy (UNCTAD, 2019).

Common challenges among the expanded BRICS nations include digital inequality, a shortage of qualified professionals, and information security threats. Digital inequality, manifesting in disparities in access to technologies and digital skills among different social groups and regions, confirms the necessity of government programs to expand internet access and digital literacy (Van Dijk, 2006). The shortage of IT and cybersecurity specialists can hinder digital transformation (World Bank, 2020), necessitating investments in education and professional training.

The increasing frequency of cyberattacks demands comprehensive cybersecurity strategies encompassing legislation, technology, and international collaboration (Kshetri, 2018). Differences in legal frameworks hinder cooperation and technology exchange; thus, harmonizing legislation and establishing common standards will facilitate integration and collaborative efforts (Kovacs, 2020).

To effectively develop their digital economies, the expanded BRICS countries should intensify international cooperation. Joint projects and knowledge sharing can accelerate digital transformation (Gonçalves & Robinson, 2020). Developing a unified digitalization strategy that respects national particularities can help reduce digital inequality and ensure sustainable development (Marsh & McLennan, 2018). Investments in education and research are fundamental for fostering innovation and efficient technology utilization (Nelson & Phelps, 1966). Aligning cybersecurity and data protection laws will simplify cooperation and enhance the effectiveness of security measures (Belli, 2017). Infrastructure investments, including high-speed networks and data centers, are essential to support the growth of the digital economy (UNCTAD, 2019).

Furthermore, developing human capital and creating conditions to retain talent domestically are crucial. This involves not only educational initiatives but also establishing attractive employment conditions for IT and cybersecurity professionals (World Bank, 2020). Such efforts align with the resource-based view, which posits that human resources are a key source of competitive advantage (Barney, 1991).

Collective efforts by the expanded BRICS countries to develop coordinated policies, share knowledge, and harmonize legislation can significantly expedite digital transformation and strengthen their positions in the global economy. Integrating scientific approaches and theories—such as the resource-based view, institutional economics, and the diffusion of innovations theory (Rogers, 2003)—allows for a deeper understanding of processes within the digital economy and the development of effective strategies.

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俄罗斯联邦申请人高等教育培训的重点领域：社会和管理方面  
**PRIORITY AREAS OF HIGHER EDUCATION TRAINING AMONG  
APPLICANTS OF THE RUSSIAN FEDERATION: SOCIAL AND  
MANAGERIAL ASPECT**

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摘要。分析了俄罗斯联邦高等教育申请人最热门的培训领域的统计数据。找出了未被录取的方向。找出了人才短缺的原因。

关键词：高等教育、申请人、培训领域、人才短缺、合格人才。

**Abstract.** *The statistical data of the most popular areas of training among applicants entering higher educational institutions of the Russian Federation are analyzed. Unclaimed directions have been identified. The reasons for the shortage of personnel have been identified.*

**Keywords:** *higher education, applicant, training areas, personnel shortage, qualified personnel.*

Qualified personnel is the key to the success of any organization. Employees who have professional skills, abilities, knowledge, and certain work experience in specialized areas most quickly and confidently solve the goals and objectives of the organization. Consequently, the training of qualified personnel is a fundamental factor in the selection of personnel for organizations. However, at present, the problem of a shortage of qualified personnel is acute due to various reasons.

Based on the analysis of Internet resources over the past three years, at the level of the Russian Federation, the most popular training areas among applicants are “Informatics and Computer Engineering”, “Education and Pedagogical Sciences”, “Economics and Management”, “Clinical Medicine” and “Mechanical Engineering”.

The direction “Informatics and Computer Engineering” is one of the most popular, the reason for this is the rapid development of information technology, high level of wages. On average, the salary of IT specialists in Russia is – 80,000 – 150,000 rubles. The salary of an IT specialist in the Zabaikalsky Krai is within 60,000 – 120,000 rubles. Innovations in the field of computer science and computing technology affect virtually all other industries, such as economics, design, logistics, marketing, personnel management, etc. Another important factor for applicants is the low passing score of the Unified State Exam for admission to the budget form of education, on average in Russian universities in 2023 it was – 63.73 points.

The demand for the direction of “Education and Pedagogical Sciences” can be explained by the fact that active work is currently underway to develop and support programs for teachers. For example, the national project “Education”, which has been in effect since 2018. Galikhanov R.R. [3], notes that the project has worked out multiple problems of education and selected ways to solve them; a system of personnel incentives has been formulated, including for the contribution to the education system of new technologies, methods of education, training. The author also notes that this project will improve the quality of education and the prestige of the teaching profession as a whole. Note that in general, the average USE score for admission to this area is lower than in other areas and some applicants for this reason ultimately make their choice in favor of educational areas.

“Economics and Management” – this area includes two aspects: the first is related to economics, accounting, audit, and the second - with competent management of possible types of resources (management). One of the main tasks of any enterprise is to make a profit, as a result of which it is necessary to organize and ensure appropriate personnel management to achieve goals and develop the enterprise, which is why the training area “Economics and Management” is popular, this is also due to the high demand for qualified specialists in economics and management in all types of activities. One of the popular areas for applicants is “Clinical Medicine”, this is due to the shortage of such qualified personnel in our country and the high demand for them, which was shown by the “Covid” pandemic and the SVO.

Baranova M.S., Ermolaeva E.V. note that in order to support healthcare, the state increases the amount of funding, this allows providing medical universities with modern equipment, which is important in the educational process, new training programs are being developed and implemented, the number of clinical bases for undergoing educational practices is increasing, and the working conditions of specialists in this area are improving [1].

“Mechanical Engineering” is another relevant area of training applicants over the past 3 years, it is the basis for the development of the economy, agriculture,



technology, especially necessary during a special military operation. The relevance of the chosen direction is determined by high wages and high demand due to the shortage of personnel in this area.

Thus, we have identified the most popular areas for admission to universities in the Russian Federation, the demand for other specialties is less in demand. According to Professor A. Ivanov, when analyzing the statistics of the 2023 admission campaign, a shortage of about 20 thousand applicants for engineering specialties was revealed [2]. This is due to the following reasons: applicants choose the most popular areas; insufficient Unified State Exam scores, high competition and other reasons. Accordingly, having studied the statistics and Internet resources, we can conclude that there is currently a shortage of technical personnel.

Coleman Services customer service specialist Bondarenko A.V. believes that the problem of personnel shortage began back in the 90s of the twentieth century, when the prestige of engineering specialties declined against the backdrop of the popularity of the professions of lawyer and economist [6]. The era of the collapse of the Soviet Union marked the beginning of the shortage of qualified technical personnel, as certified specialists were forced to leave production for entrepreneurship, and most of them migrated abroad. Currently, most organizations are experiencing a shortage of personnel, the main and related problems of this are the demographic hole (over the past ten years, the number of people aged 20-24 has decreased almost by half), aging staff, discrepancy between the level of wages and expected reality, etc. Graduates of educational institutions after receiving a diploma refuse to work in their specialized field, but show interest in “easier work”, choose freelancing, as well as activities that are not labor-intensive, do not take much human energy, resources and responsibility, and they are attracted to highly paid areas of activity, even in the absence of career growth [4, 5].

Thus, the presented reasons and statistical analysis of Internet sources confirm the relevance of the problem of shortage of qualified personnel, they are the ones that hinder the development of enterprises and the economy of our country.

To solve this problem, a systematic approach and cooperation of all participants in the process is required, that is, federal and regional authorities, representatives of educational institutions, employers of enterprises. Already now, as reported by the Ministry of Economic Development of the Russian Federation, the state is developing national projects aimed at reducing the personnel shortage, one of such projects is the “National Project “Labor Productivity”, which will allow reducing the personnel shortage by 130 thousand people by the end of 2024.

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加强国际合作，打击侵害儿童利益、违反社会公德的犯罪行为  
**INTERNATIONAL COOPERATION IN THE FIGHT AGAINST  
CRIMES AGAINST PUBLIC MORALITY THAT INFRINGE ON  
THE INTERESTS OF CHILDREN**

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摘要本文探讨了违反公共道德犯罪领域的国际合作问题。作者考察了打击侵犯儿童利益犯罪的关键法律立场和国际法律框架。比较了不同国家的刑事立法规范，以解决犯罪资格问题。

关键词：国际合作、国际犯罪、道德、违反公共道德犯罪、外国法律经验、儿童利益。

**Abstract.** *the article discusses the issues of international cooperation in the field of crimes against public morality. The author examines the key legal positions and the international legal framework for combating crimes that infringe on the interests of children. The norms of the criminal legislation of different countries are compared in order to solve the problems of crime qualification.*

**Keywords:** *international cooperation, international crimes, morality, crimes against public morality, legal experience of foreign countries, interests of children.*

In the modern world, it is becoming increasingly important international fight against crime, as one of many areas of cooperation between states. Cooperation between states develops on a single basis of fundamental or general principles of their communication that have historically developed in international law. These principles are formulated in international pacts, agreements and conventions that form the general principles and vectors of international cooperation in the fight against crime. Such documents also include treaties that form the policy and practice of states in their joint fight against crime.

Most multilateral crime conventions provide that the offences they contain are subject to the jurisdiction of the State in whose territory they are committed, or if they are committed on board a vessel or aircraft registered in that State, or if the alleged offender is a national of that State. Many conventions also provide for the jurisdiction of the State in whose territory the alleged offender is found.

Indeed, at present, the practice of combating international crime is developing under the influence of a wide range of economic, social and political trends.

International cooperation in the fight against crime is the unification of efforts of states and other participants in international relations with the aim of increasing the effectiveness of crime prevention, combating them and correcting offenders.

In accordance with the provisions of Article 1 of the UN Charter, it follows that among the key tasks of this organization is ensuring international cooperation of states in specific areas of legal regulation.<sup>1</sup> Among the subjects of cooperation in the fight against crime are also non-governmental organizations with consultative status with the UN, as well as Interpol, which provides practical assistance in identifying and detaining criminals around the world.

Thus, many international intergovernmental and non-governmental organizations make great efforts to organize and implement effective international cooperation in preventing and combating crime. They possess colossal data banks, normative materials, data from criminological and criminal-legal, criminal-political research, which can be used by each country for the purpose of more effective combating national and transnational crime.

Of great importance is also international legal cooperation, as the totality of relations between states and the integration and intergovernmental associations created by them, based on generally recognized principles and norms of international law, international treaties and other legal acts aimed at: international unification of efforts to prevent and prevent crimes against public morality, as well as their disclosure and investigation, including activities to create joint investigative bodies and conduct joint operations; to ensure international legal order, the activities of international justice bodies; protection of the individual, society and the state through the implementation of international legal proceedings.<sup>2</sup>

International cooperation in the field of combating crime and maintaining law and order, ensuring the protection of human rights and freedoms is: - cooperation at the bilateral level. This allows for a more complete consideration of the nature of relations between two states, their interests on each issue. At this level, the most widespread is the provision of legal assistance in criminal cases, the extradition of criminals, the transfer of convicted persons to serve their sentences in the state of which they are citizens;

- cooperation of states at the regional level, which is determined by the interests and nature of relations of these countries, namely among the member countries of the Council of Europe, APEC, CIS, BRICS and others:

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<sup>1</sup> Charter of the United Nations Adopted in San Francisco on June 26, 1945 // Collection of current treaties, agreements and conventions concluded by the USSR with foreign states. Issue XII. Moscow, 1956. Pp. 14-47.

<sup>2</sup> Borodin S.V. International cooperation in combating criminal offenses. Moscow: Legal Literature, 2003. P. 201.

- cooperation of states within the framework of multilateral agreements (treaties). The main content of multilateral agreements (treaties) on the joint fight against individual crimes is the recognition by the parties of these acts on their territory as criminal and ensuring the inevitability of their punishment.

It should be noted that The Russian Federation builds relations with its BRICS partners on the basis of the UN Charter, generally recognized principles and norms of international law, as well as principles agreed upon between the members of the association, such as openness, pragmatism, solidarity, non-bloc character and non-direction against third parties.

International cooperation of the BRICS states consists of a coordinated position on issues of strategic stability, international and regional security, non-proliferation of weapons of mass destruction, settlement of regional conflicts and maintenance of regional stability. And also, the main thing is to carry out measures in the sphere of combating international crimes: international terrorism, in contacts with the League of Arab States, the Organization of Islamic Cooperation, the African Union and other regional organizations. This organization develops coordination of approaches in the sphere of combating illegal trafficking of narcotic drugs, psychotropic substances and their precursors, including joint steps within the UN and regional organizations, crimes against public morality and cooperation in the interests of ensuring international information security.

The concept of international crimes, which is the core of crime affecting international relations, is of primary importance. International crime is expressed in the commission of all international crimes recognized by general international law, as well as conventional ones. International crimes affecting international relations are a wide range of crimes in the sphere of illegal trafficking in narcotic drugs and psychotropic substances, a wide variety of manifestations of international terrorism, illegal trafficking in firearms, trafficking in women and children primarily for the purpose of sexual exploitation, as well as the abduction of children and trafficking in them for the purpose of using their organs for subsequent transplantation by interested persons.

The main principle of international cooperation in the field of crimes against public morality is the observance of human rights, the protection of individual freedoms, and the protection of the interests of minors and young children.

The study of foreign legislation regulating crimes against public morality provides us with positive guidelines for improving the criminal legislation of the Russian Federation. This situation is due to the fact that the modern world is characterized by the interrelations of peoples, their culture and traditions, where the concept of morality is common to all.

We believe that the concept of morality can be formulated, as a rule, for the will, conscience of a person, it is a special form of social consciousness and a type

of social relations, spiritual and mental qualities of a person, based on the ideals of goodness, justice, duty, honor, religion and another huge complex of concepts that manifest themselves in relation to other people and nature.<sup>3</sup>

Crimes against public morality are currently one of the most serious problems for many countries in the world. Every year, a huge number of people, mainly women and children, become victims of these crimes for the purpose of sexual exploitation or other purposes, both in our country and abroad. The fight against crimes against public morality attracts the attention of the entire world, since they pose a threat to human rights and the fundamental values of a democratic society. The danger of crimes against public morality lies in the high probability of causing harm to the moral and physical health of an immature personality, introducing destructive attitudes into the psyche of a person and ultimately leading to the commission of sexual acts prohibited in society in real life.

As a result, it seems necessary and appropriate to consider the design features of the norms regulating crimes against public morality in accordance with the criminal legislation of a number of countries.

In accordance with the criminal law of Switzerland, criminal liability is provided for: actions that endanger the development of minors. Article 187 of the Criminal Code provides for liability for “Sexual acts with children”, which is the commission of sexual acts with a child under sixteen years of age, which includes inciting or involving him in such an act and this crime is punishable by imprisonment for up to five years or by imprisonment. The statute of limitations for criminal prosecution for this crime is ten years.<sup>4</sup> Criminal liability for sexual acts with dependent persons (Article 188) establishes that whoever commits a sexual act with a minor under the age of sixteen, who is dependent on him as an educator, on a person who cares for him, or is dependent on him at work or in some other way, using this dependence, and also induces such a person to sexual act using such dependence, shall be punished by imprisonment. The criminal code formulates the concept of sexual coercion: whoever forces a person to undergo actions similar to cohabitation, or to undergo other sexual acts in which he threatens the person with violence, applies mental violence against him or makes the person incapable of resistance, shall be punished by hard labor for a term of up to ten years or imprisonment. If a person acts cruelly, namely, uses a dangerous weapon or other dangerous object, then he shall be punished by hard labor for a term of not less than three years. Article 196 of the Criminal Code provides for liability for human trafficking. Thus, anyone who carries out human trafficking in order to assist in the depraved actions of another person is punished with hard labor or

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<sup>3</sup> Yaroshenko O.N. “Protection of morality in modern society and its criminal law characteristics” // Sovereign state and its law: current problems of legal science and law enforcement practice in modern Russia, 2020, v.1 p.218.

<sup>4</sup> Criminal Code of Switzerland. St. Petersburg: Legal Center - Press, 2002. P. 350.

imprisonment for a term of not less than six months. Anyone who creates an institution for human trafficking is punished with hard labor for a term of up to five years or imprisonment.<sup>5</sup>

The Turkish Penal Code provides for liability for crimes against public morality in the chapter “Crimes against public morality and family structure”.

Thus, the object of the crime is precisely public morality and family relations, which are subject to special legal protection.

According to the provisions of Article 419 of the Turkish Penal Law, persons who commit indecent acts in public are punished with imprisonment for a term of fifteen days to two months, and persons who engage in sexual intercourse under such circumstances are punished with imprisonment for a term of six months to one year and a heavy fine of 100 to 500 liras.<sup>6</sup>

The criminal law of Thailand provides for criminal liability for crimes against public morality in the chapter “Crimes of a sexual nature”.

The criminal law of this country stipulates that anyone who has sexual intercourse with a woman who is not his wife against her will, by threatening her in any way, by committing an act of violence, by taking advantage of the woman’s helplessness, or by making the woman mistake him for another person, shall be sentenced to imprisonment for a term of four to twenty years and a fine of eight thousand to forty thousand baht. If the crime is committed with the carrying or use of firearms or explosives, or is intended to deprive the victim of her virginity, the offender shall be sentenced to imprisonment for a term of fifteen to twenty years and a fine of thirty thousand to forty thousand baht, or to life imprisonment (Article 276).

Anyone who commits an indecent act on a child under fifteen years of age, whether consenting or not, shall be sentenced to imprisonment for a term not exceeding ten years and a fine not exceeding twenty thousand baht, or both.

If the crime is committed against a person over fifteen but under eighteen years of age, the offender shall be sentenced to imprisonment for a term of three to fifteen years and a fine of six thousand to thirty thousand baht.<sup>7</sup>

Unlike the criminal laws of many countries, the Criminal Code of the Republic of San Marino provides for “Violation of sexual freedom” (Article 171), which establishes that any person who, by violence, threat, hypnotic suggestion or suggestion during insomnia or by other suitable means, forces another person or entices him by deception to perform sexual acts, shall be punished by imprisonment of the third degree. If the act is committed by a relative in the ascending line, or

<sup>5</sup> Criminal Code of Switzerland. St. Petersburg: Legal Center - Press, 2002. P. 350.

<sup>6</sup> Criminal Code of Turkey / Preface by N. Safarov and H. Adjara; scientific editors and translation from Turkish by N. Safarov and H. Babaev. St. Petersburg: Publishing House “Legal Center Press”, 2003. - 374 p.

<sup>7</sup> Criminal Code of Thailand / Scientific ed. and foreword by A.I. Korobeyeva, Y.V. Golik. Moscow: Publishing House “Legal Center Press”, 2005. P.206.

by an adoptive parent, guardian, educator, teacher, physician, or a person who enjoyed the confidence of a minor on the basis of supervision, upbringing, education or treatment, then deprivation of rights of the fourth degree concerning parental authority, rights of guardianship and rights to a profession shall be applied jointly.

Article 173 “Sexual acts with a minor or incapacitated person” states that any person who commits the said acts without violence, threat or deception to the detriment of minors under fourteen years of age or persons who are physically or mentally incapable of preventing this is subject to punishment. In this case, the perpetrator cannot put forward as his own justification ignorance of the fact that the victim was a minor.

Criminal liability is provided for “Corruption of minors” (Article 177), which establishes that any person who forces a minor under the age of eighteen to commit sexual intercourse under the influence of alcohol or a narcotic substance or as a result of gambling, is subject to punishment, unless this act is provided for by other provisions of the law, in the form of imprisonment of the second degree.

Article 268 of the Criminal Code establishes liability for “Trafficking in human beings for the purpose of prostitution,” which states that any person who traffics in human beings for the purpose of using persons for prostitution abroad shall be subject to punishment in the form of imprisonment and deprivation of voting rights, political rights, and a fourth-degree ban on a profession.<sup>8</sup>

The Brazilian criminal law provides for liability for “Obtaining sexual services from a minor” (Article 240.1), which states that receipt of sexual services from a minor between the ages of sixteen and eighteen by a person who has reached the age of eighteen shall be punishable by compulsory labor for a term of up to two hundred and forty hours, or by restriction of freedom for a term of up to two years, or by forced labor for a term of up to four years, or by imprisonment for the same term. Sexual services are understood to mean sexual intercourse, sodomy, lesbianism or other acts of a sexual nature, the condition for the commission of which is monetary or any other reward for a minor or a third party, or the promise of a reward for a minor or a third party.

Also, Article 242.2 “Use of a minor for the purpose of producing pornographic materials or objects” establishes that photographing, filming or video recording of a minor for the purpose of producing and/or distributing pornographic materials or objects, or engaging a minor as a performer to participate in a pornographic entertainment event, committed by a person who has reached the age of eighteen, shall be punishable by imprisonment for a term of three to ten years with or without deprivation of the right to hold certain positions or engage in certain activities for up to fifteen years.<sup>9</sup>

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<sup>8</sup> Criminal Code of the Republic of San Marino. St. Petersburg, 2002.

<sup>9</sup> Volevodz A.G. On the issue of the essence and content of international cooperation in the fight against crime // International criminal law and international justice. 2007. N 1. P. 12 - 13.



The above provisions of the law are also interesting for practical application, given Russian criminal legislation, which is aimed at protecting the interests of children.

Family code The Russian Federation secures the priority in the upbringing of children for their parents, establishing that parental rights cannot be exercised in conflict with the interests of the child; when exercising parental rights, parents do not have the right to harm the physical and mental health of children, their moral development, and methods of raising children must exclude neglectful, cruel, rude, degrading treatment, insult or exploitation of children.<sup>10</sup>

An important legal act ensuring international cooperation in the field of child protection is Convention on the civil aspects of international child abduction of 25 October 1980 (the Hague Convention). It is in force in 101 countries of the world and the Russian Federation ratified the Hague Convention in May 2011.<sup>11</sup> During this time, it is obvious that the mechanism provided by this agreement is in demand in our country as well. The number of cases on the return of a kidnapped child to his/her permanent place of residence, considered in Russia, is growing. According to review According to the judicial practice on these cases, prepared by the Supreme Court of the Russian Federation at the end of 2019, 13 such cases were considered in 2016, 26 cases in 2017, and 32 cases in 2018.<sup>12</sup> It should be noted that the purpose of the Hague conventions is to ensure the prompt return of children wrongfully removed to or retained in any of the Contracting States and the observance of rights of custody of and access to the child provided for by the law of one Contracting State in the other Contracting States.

The Hague Convention is based on the need for the fastest possible return of an unlawfully removed or retained child to the country of his permanent (habitual) residence, since the unexpected and often violent removal of the child from the place where he is accustomed to be, separation from the parent and often from other close relatives violates his interests.

In such circumstances, the interests of children are a matter of paramount importance and international cooperation in this area is aimed at planning and expansion of joint research, creation of a system of control over its implementation, which is a very promising direction in this area.

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<sup>10</sup> Chesnokova Yu.V. Legal regulation of parental rights in the Russian Federation // *Baltic Humanitarian Journal*. 2017. Vol. 6. N 3(20). P. 377.

<sup>11</sup> *Federal law of May 31, 2011 N 102-FZ "On the accession of the Russian Federation to the Convention on the Civil Aspects of International Child Abduction"* // *Collected Legislation of the Russian Federation*. 2011. N 23. Art. 3242.

<sup>12</sup> *Review practices of courts considering cases on the return of a child based on the Convention on the Civil Aspects of International Child Abduction of October 25, 1980 (approved by the Presidium of the Supreme Court of the Russian Federation on December 18, 2019)* // SPS "Garant".

In Russia, the key principle is the protection of the moral, spiritual development and health of a person under sixteen years of age by the state, since this is the security of the future generation. Research of criminal legislation regulating crimes against public morality and international cooperation in the field the fight against crimes against children's interests will continue to contribute to increasing the effectiveness of its application in practice.

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未经必要许可的商业实体进行交易的法律后果  
**LEGAL CONSEQUENCES OF TRANSACTIONS CARRIED OUT BY  
A BUSINESS ENTITY WITHOUT THE NECESSARY LICENSE**

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注释。本文探讨了现行《民法典》中关于无效合同的规定，以及在无证经营的情况下宣布合同无效的程序问题。在此基础上，本文对《民法典》中关于无效合同的规定需要解决的问题提出了意见。

关键词：经营许可、无效交易、无证经营的法律后果、民法交易。

**Annotation.** *This article examines the provisions of the current Civil Code on invalid contracts, as well as to address issues related to the procedure for declaring a contract invalid in the case of entrepreneurial activity without a license. On this basis, the article provides opinions on issues that need to be addressed regarding the provisions of the Civil Code on invalid contracts.*

**Keywords:** *licensing of entrepreneurial activity, invalid transactions, legal consequences of including transactions without the necessary license, civil law transaction.*

Commercial contracts are an important tool for businesses to increase their competitiveness in business activities. A commercial contract involves a negotiation process that includes many conditions that the parties must take into account. Based on the agreements reached, the business will specifically determine what products it supplies (sells), which ensures true equality of the parties, the expression of their will, and also helps to limit risks in business activities.

Let's consider the main characteristics of the contract. Based on the rights and obligations of the parties. According to this criterion, contracts are divided into the following types:

Firstly, bilateral contracts. This is a type of contract in which each party has obligations to the other, the rights of one party will correspond to the obligations of the other party and vice versa.

Secondly, on the basis of interdependence between contracts.

Disputes caused by objective reasons: in addition to reasons arising from one or more parties to the contract, there are many objective reasons for disputes, including: due to fluctuations in price factors, exchange rates or supply and demand in different countries; or due to force majeure circumstances such as natural disasters, hurricanes, floods, droughts, fires, explosions, epidemics, as well as many other objective reasons arising in the process of implementation of the parties to the contract of sale.[4].

“Objective obstacles” are obstacles caused by objective circumstances that prevent persons with civil rights and obligations from knowing that their legal rights and interests are being violated or from being able to exercise their civil rights and obligations.

From the above rules we can determine that an event is considered a force majeure if it meets the following conditions: these are events that occur objectively, or are called objective events, that is, events that occur objectively and are beyond the control of the party that violated the contract (for example: flood, earthquake, tsunami).

The consequences of the event could not be foreseen either at the time of the conclusion of the contract or during the execution of the contract until the moment of the breach; the consequences of this event cannot be overcome, despite the application of all necessary and permissible measures. Consequently, only if all the above conditions are met can the event be considered a force majeure circumstance and a basis for releasing the violating party from liability [2].

Currently, legal provisions on force majeure are only general and not specifically listed, so in practice, disputes can easily arise. Therefore, when drafting a contract, the parties must provide for provisions on the occurrence of force majeure and the obligation of the violating party to notify of the occurrence of force majeure in order to limit the risks for the parties.

Article 385 of the Civil Code of the Russian Federation states: “A contract is an agreement between the parties to establish, change or terminate civil rights and obligations. Regarding the offer to conclude a contract: according to the provisions of paragraph 1 of Article 386 of the Civil Code of the Russian Federation, an offer to conclude a contract is a clear expression of the offeror’s intention to conclude a contract and to be bound by this offer to the applicant with the specified party or the public (hereinafter referred to as the proposed party).

In addition, in paragraph 1 of Article 388 of the Civil Code of the Russian Federation, the period of validity of the offer to conclude an agreement is determined as follows: it is established by the offeror; if the offeror does not, then the offer to conclude an agreement comes into force from the date of receipt of the offer by the addressee, unless otherwise established by the relevant law [1].

A response to an offer acceptance is an expression of the will of the offeree to agree to enter into an agreement with the terms and conditions set out by the offeror in oral, written or behavioral form.

The Civil Code asserts itself as common law in paragraph 1 of Article 4 of the Civil Code of the Russian Federation - “This Code is a common law governing civil relations.” Therefore, when establishing contractual relations in the field of tourism, it is mandatory to apply special law, that is, a tourist trip agreement must be concluded in writing, regardless of whether an organization or an individual purchases the goods. In fact, main contracts and subcontracts can be concluded between the same organizations; the parties to the main contract are also the parties to the subcontract.

There are cases when an agreement is concluded for the purpose of evading obligations to a third party. For example, when concluding an agreement on the transfer of land use rights, the parties declare the value of the land plot in the agreement significantly lower than the actual value in order to avoid tax obligations to government agencies. Depending on the level of violation, if it is discovered by authorities, penalties may be applied for tax evasion, administrative sanctions or even criminal punishment.

A voidable contract is considered invalid regardless of a court decision. Or, in other words, it is invalid even without a court decision. Therefore, a court decision (if any) on an invalid contract is simply one of the forms of recognizing the contract as invalid on the following grounds: in addition, a court decision has additional content that clearly defines the consequences and compels violators to comply with the consequences of an invalid contract. In addition to the Court, other competent state bodies also have the right to recognize the nullity of a contract [3].

From the main theoretical differences between voidable contracts and voidable contracts, a number of questions arise related to the correct understanding of voidable contracts and the relative invalidity of contracts (voidability), as well as the remaining questions that need to be resolved. We are talking about cases of invalidity of civil law transactions due to a violation of the formal terms of civil law transactions.

If the parties have entered into a contract which, by law, must comply with the form, but the parties do not comply with it, then the contract is naturally void. If one or more parties request a declaration from the Court, the Court will declare the contract invalid and consider the legal consequences of the invalid contract, taking into account the fault of the parties to the contract, as well as taking into account the protection of the rights of bona fide third parties related to invalid contracts due to non-compliance with the provisions of the law. This emphasizes the importance of compliance with the legal rules on form in the process of concluding contracts and helps to protect the rights of the parties concerned.

An invalid contract is a contract that exists but does not meet one or more conditions of validity as required by civil law or in cases where the law provides otherwise. A transaction may be declared invalid for subjective and objective reasons. Objective reasons are events that occur outside the will, and not the subjective wishes of the subject, such as a mistake by one of the two parties when concluding the contract; the subject concluding the contract is not aware of and does not control his behavior; because the contract contains an object that cannot be performed; because the main contract is invalid. In addition to the cases of invalidity of a contract in accordance with the general provisions of the Civil Code, specialized laws regulating individual contracts in each area also provide for separate provisions on cases of invalidity of a contract.[2].

The “dispersion” of legal provisions from many different legal documents makes it difficult for entrepreneurs and judges to understand specific legal consequences. Such fragmentation not only creates difficulties for counterparties, but also affects their rights and obligations in the process of concluding civil law transactions. In reality, today there are entrepreneurs who take advantage of certain loopholes in the legal system, taking advantage of the lack of knowledge, information, as well as the inequality of access to information of some people when participating in legal proceedings, participating in transactions. These actions are carried out mainly for the purpose of evading government control and obtaining personal benefit. The consequence of this is that disputes are becoming more common and complex, and their complexity is increasing [2].

It can be argued that transactions made without a license infringe on public interests, and therefore they should be attributed to the scope of paragraph 2 of Article 168 of the Civil Code of the Russian Federation. Since the licensing institution is designed to protect public interests, life and health of citizens, making a transaction in the absence of the required license is an action that violates the requirements of a regulatory legal act and infringes on public interests or the rights and legitimate interests of third parties. Therefore, such a transaction is null and void unless other consequences are provided for by law.

Upon systematic assessment of all grounds for invalidity, it can be concluded that this transaction, in our opinion, may return to the category of illegal transactions as violating the requirements of the Federal Law of May 4, 2011 No. 99-FZ “On Licensing of Certain Types of Activities” ... and, accordingly, public interests. The legislation on licensing does not establish the civil-legal consequences of such transactions, only the administrative-legal consequences are indicated [4].

The above allows us to say that in the event that business entities carry out transactions without the required license or in violation of its terms, these transactions should be considered null and void, regardless of whether the court recognizes them as such.

This content still has many different points of view in the process of being resolved, in particular:

The first point of view: if transactions must be made in writing, but have the signature of only one party, then the contract does not exist, since the moment of conclusion of a written contract is the moment of signing the document by the last party. Therefore, when resolving a dispute in this case, the provisions on invalid contracts do not apply, but other provisions on civil obligations must be applied.

The second point of view is that the signature is only a way of expressing consent to the content of the contract, but not the only way of expressing the consent of one party. We agree with the second point of view, since this point of view corresponds to the modern legislative trend of facilitating the consent of the parties when concluding contracts.[1].

Clause 89 of the Resolution of the Plenum of the Supreme Court of the Russian Federation dated June 23, 2015 No. 25 “On the Application by Courts of Certain Provisions of Section I of Part One of the Civil Code of the Russian Federation” states: “Unless otherwise expressly provided by law, the conclusion of a transaction by a person who does not have a license to engage in the relevant activity does not entail its invalidity. In such a case, the other party to the transaction has the right to withdraw from the agreement and demand compensation for damages (Article 15, paragraph 3 of Article 4501 of the Civil Code of the Russian Federation).” However, if a business entity carries out transactions that are not contracts, then the provisions of paragraph 2 of Article 168 of the Civil Code of the Russian Federation should be followed and such transactions should be recognized as null and void.

Judicial practice resolves the issue under consideration in different ways, focusing mainly on the contestability of transactions concluded without a license, and the need to establish the right of the subject to appeal to the court to recognize such transactions as invalid. Perhaps, Article 168 of the Civil Code of the Russian Federation should establish a general rule for all transactions, directly indicating that transactions concluded without the necessary license are null and void, regardless of which person makes a claim for recognition of such a transaction as null and void or what decision the court makes.

Resolving the legal consequences when the parties must restore to the original state and return to each other what they received after the contract was declared invalid has many complex and unclear points. In the practice of applying the law, the concepts of “restore to the original state” and “return to each other what they received” are often understood as synonyms. However, these are two completely different issues, and such a misunderstanding stems from the nature of the main object of the contract, usually property. In judicial practice, the Court requires the parties to an invalid contract to restore the original state. However, the return

of assets does not always correspond to the state at the time of the conclusion of the transaction. There may be cases where the property has been damaged, its value has decreased, or the property has been repaired, built or modernized to increase its value. This leads to the fact that the law does not specifically provide for the return of assets, but leaves it to the discretion of the judge to decide on an appropriate solution for each specific case. This situation leads to inconsistency and inconsistency in how to resolve and handle the consequences of invalid contracts.[5].

The Civil Code provision that “the guilty party must compensate for the damage” does not clearly define who or what is a “party.” Does “the guilty party” mean the party to the contract, the party invalidating the contract, or another person involved in the transaction? This becomes very problematic, especially when considering cases where the contract was notarized but subsequently declared invalid by the court.

At present, the issue of determining damages under invalid civil contracts is not specifically regulated in general. To study this issue, one can rely only on some of the Supreme Court’s guidelines.

In order to ensure the appropriateness and effectiveness of regulation of business licensing, as well as a transparent and fair resolution of the legal consequences of contracts that do not comply with the provisions on form, the author proposes to offer the following recommendations:

First, it is necessary to amend and supplement the Civil Code of the Russian Federation as follows: “Licensing of business activities is a valid condition of the transaction in cases where this is provided for by law or there is an agreement of the parties.” This adjustment will help to clarify and supplement the rights of the parties when agreeing on the form of the contract that they want to use.

Secondly, study and supplement the Civil Code of the Russian Federation to specifically indicate which types of contracts must comply with formal rules in order to increase the clarity and efficiency of the system for regulating the form of a contract. In particular, it is necessary to focus on contracts that require registration and notarization. If these contracts do not comply with formal conditions, they will always be considered invalid. At the same time, it is necessary to strengthen the legal system, create a systematization and unification of this regulation in legal documents, avoid duplication and illogicality, and help minimize difficulties in the review process. Eliminate and prevent legal loopholes.

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未来数学教师专业数字能力的形成途径

## THE WAYS OF FORMING PROFESSIONAL DIGITAL COMPETENCE OF A FUTURE MATHEMATICS TEACHERS

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**摘要。**本文致力于在数学教育数字化背景下培养数学教师的专业数字能力问题。作者将教师的专业数字能力现象解释为教师人格的综合素质，其特点是知识、理解、准备和使用数字工具的能力；数学活动；组织学生的数学教育活动；数学教学的设计，包括开发自己的数字教具。本文提出了培养未来数学教师专业数字能力的方法。

**关键词：**数字能力、数学教师、数学教师的专业能力。

**Abstract.** *The article is devoted to the problem of developing professional digital competence of a mathematics teacher in the context of digitalization of mathematical education. The phenomenon of professional digital competence of a teacher is interpreted by the authors as an integrative quality of a teacher's personality, characterized by knowledge, understanding, readiness and ability to perform using digital tools: mathematical activity; organization of educational activities of students in mathematics; design of teaching mathematics, including the development of their own digital teaching aids. The article suggests ways of developing professional digital competence of a future mathematics teacher.*

**Keywords:** *digital competence, mathematics teacher, professional competence of a mathematics teacher.*

Digital transformation of education involves the introduction of information and communication technologies and intelligent learning systems into the educational process. The essence of the modernization of the educational environment lies in the transition to a new system of assigning IP addresses, mass user access to wireless access systems, practical use of cloud computing, development of technology, production and use of wireless sensor networks, etc. [7]. In order to successfully solve all the problems of digital transformation of education, it is necessary that all employees involved in the educational process and its provision have developed the appropriate competencies [6].

At the moment, researchers believe that digital competence should begin to form at school age [13]. A mathematics teacher can make a significant contribution to this process, since mathematical methods underlie almost all information processes, so much attention of the scientific community is focused on the study of the formation of information and digital competence in pedagogical education.

In connection with the rapid development and implementation of digital technologies in all aspects of human life, including those related to the process of digitalization of the educational sphere, there is a need to correct the competencies formed in the training of future mathematics teachers. Mathematics teachers should not only be able to apply digital technologies in their professional activities, but also promote the students to use digital technologies productively and develop their own educational projects based on them [4].

The results of a survey of employers on the needs for teachers with professional competencies based on the use of digital technologies made it possible to identify the necessary digital competencies and determine a list of disciplines and technologies for their implementation (the use of mathematical modeling, programming in mathematics, information technology in the practice of the psychological, pedagogical and methodological block of training courses, etc.) [11].

Donetsk National University has developed and is implementing in professional training a scientifically based system for training future mathematics teachers, created on the basis of a comprehensive program for managing the project-heuristic activities of students for their productive work in a modern school [8].

Within the framework of this program, issues of organizing the project-heuristic activities of future mathematics teachers to create multimedia teaching aids have been developed [9], however, the issue of forming the digital competence of a future mathematics teacher in a bachelor's degree remains undeveloped, requiring theoretical justification, structuring the phenomenon under study and determining the paths for the development of all its components. The problem of professional training in the context of digitalization of education was studied by such scientists as A.V. Babayan, T.G. Vezirov, M.V. Kuzmina, N.G. Lebedeva and others. P. Gilster and A. Martin considered the concept of digital literacy as

a system of cognitive, social and technical skills in the information society. K.T. Vezirov and M.A. Sukharev define the goal of digitalization of education as providing students with the opportunity to master the skills to use and create various tools using modern digital technologies [2].

A number of Russian scientists (Yu.V. Voronina, E.I. Rasskazova, G.U. Soldatova, etc.) and foreign (A. Martin, D. Madigani, M. Reznik, etc.) define digital competence as readiness (knowledge, skills, motivation and responsibility) to effectively use information and communication technologies not only in everyday life but also in professional activities [1; 3]. Scientists S. Carretero, R. Vuorikari and Y. Punie presented a model that displays a list of digital competencies with 8 levels of qualification and examples of use [12]. The authors formulated technical skills for working with digital devices; for the professional competence of a teacher, we will highlight the following groups:

1) competencies related to information literacy: the ability to search for and analyze, interpret and critically evaluate materials in the digital environment;

2) skills and abilities of communication in the digital environment: the ability to interact and know the rules of conduct when using digital technologies, the ability to apply various strategies depending on the contingent;

3) the ability to change and improve existing and create your own digital content;

4) skills and abilities to ensure digital, as well as psychological, security;

5) the ability to identify and eliminate technical difficulties when working with digital devices [5].

In the studies of E.I. Rasskazova and G.U. Soldatova, the integrative nature of digital competence is highlighted [10]. The components and the level of its formation are usually considered as a combination of three components: motivational, cognitive and operational.

One of the components of the professional competence of a mathematics teacher is professional digital competence. The phenomenon of “professional digital competence (PDC) of a mathematics teacher” is interpreted by us as an integrative quality of the teacher’s personality, characterized by knowledge, understanding, readiness and ability to perform using digital tools: mathematical activity; organization of educational activities of students in mathematics; design of teaching mathematics, including the development of their own digital teaching aids [7]. Scientists distinguish two types of models of the phenomenon of digital competence of a teacher: taxonomic and hierarchical types. Taxonomic models determine the components of the structure of the modeled phenomenon, while hierarchical models establish the level differentiation of its development. Taxonomic models of digital competence of a teacher were proposed by such scientists as N.V. Maksimenko, T.A. Chekalina, E.V. Yakovleva, L. Ilomaki, S. Paavola, M.

Lakkala, A. Kantosalo [13], O. McGarr and A. McDonagh [14], and hierarchical models - R. J. Krumsvik [15].

Thus, based on the analysis of psychological and pedagogical literature, research in the field of formation of digital competence of a teacher, we came to the conclusion about the diversity of models of digital competence of a teacher, as well as the lack of structuring of the digital competence of a mathematics teacher as part of the professional competence of a mathematics teacher.

We propose to use a taxonomic model of professional digital competence of a mathematics teacher, which consists of the following components: 1) mathematical-digital; 2) methodological-digital; 3) project-digital.

The formation of each component is characterized by certain indicators. For the mathematical-digital component, the indicator is the formation of methods of mathematical activity using digital tools; for the methodological-digital - the formation of skills to organize the mathematical activity of students; for project-digital – the ability to design mathematical activities using digital tools. We propose to form each component of the professional digital competence of a mathematics teacher by developing appropriate educational projects:

- a project on a mathematical discipline using various digital tools,
- a project on organizing the teaching of mathematics using digital tools,
- a project on developing electronic educational tools/

To form the mathematical-digital and methodological-digital components of the digital competence of a future mathematics teacher, we identified learning outcomes, which include the ability to use various digital tools and means, for example, the use of MS Word, MS Excel, MS PowerPoint, MS Publisher, Visme, Canva, Prezi, interactive whiteboards, social networks, e-mail, electronic educational resources, DreamWeaver, AuthorWare, website builders, MathCad, GeoGebra, AdvancedGrapher, Trigonometry, EasyQuizzzy; Crossword Creator, Online-TestPad, iSpring, e.Учебно, ЯКласс, Google and Yandex forms, quizzzz, Desmos, matrixcalc, math-solution, mathway, MathHelpPlanet, wolframalpha, mathforyou, symbolab, MathDF and much more.

As for the project-digital component, in addition to the skills of using the above tools, there are also skills of developing their own tools on their basis, such as computer-oriented lessons, electronic textbooks, teacher or discipline websites, tests and crosswords, computer simulators, interactive lessons on the Online Test Pad platform and much more.

Disciplines are studied in a certain sequence, provided by the curriculum. During the entire period of a student's education in the bachelor's degree, there is a gradual development of the competencies of a future teacher, which involves a gradual, systematic "build-up" of professionally significant competencies, mastering the methods of activity using digital tools, as a result of which the professional digital competence of a mathematics teacher is formed and improved.

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学龄前儿童在空间中占据有条件动态位置的能力的形成  
**FORMATION OF THE ABILITY OF OLDER PRESCHOOL  
CHILDREN TO OCCUPY A CONDITIONALLY DYNAMIC  
POSITION IN SPACE**

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**摘要。**本文作者研究了学龄前儿童在空间中占据条件动态位置的能力形成的特征。本文写作的基础是 V.A. Nedopasova 的研究,旨在克服学龄前儿童在环境中的自我中心态度。在这项工作的框架内,试图利用这个实验来解释学龄前儿童教学支持的特点,提供适应现代现实的改进的角色扮演游戏形式。本文还专门分析了教师在教育过程中的个性,以及它对教学活动条件和结果的影响。

**关键词:** 学龄前儿童; 教学实验; 顺序中心化; 角色扮演游戏; 事实位置; 条件动态位置。

**Abstract.** *In this article, the author examines the features of the formation of senior preschool children's ability to occupy a conditionally dynamic position in space. The basis for writing the work was the study of V.A. Nedopasova, aimed at overcoming the egocentric attitude in the environment in preschoolers. Within the framework of this work, an attempt was made to use this experiment to explain the features of pedagogical support for preschoolers, to offer improved formats of role-playing games adapted to modern reality. A separate place in the article is occupied by the analysis of the personality of the teacher in the educational process, its influence on the conditions and results of pedagogical activity.*

**Keywords:** *preschoolers; pedagogical experiment; sequential centering; role-playing game; factual position; conditionally dynamic position.*

The conditionally dynamic position is an intermediate link between the role and symbolic perception of the world by the child. By occupying it, children move away from the egocentric idea of what is happening and learn to evaluate the situation from the point of view of other people. Unlike the play position, where the child tries on the role of a character regardless of the real context, here he is able to associate the features of his behavior with the nature of the problem being solved.

According to L.S. Vygotsky, the conditionally dynamic position is a means of the process of internalization, during which higher mental functions are formed,



including logical thinking [2]. During the process of internalization, understanding the motive for another person to commit a particular action, the child subconsciously becomes his “accomplice”.

As a rule, the conditionally dynamic position is characteristic of children experiencing the “crisis of 7 years”, a period when they develop a generalized self-esteem, which is actualized mainly when communicating with adults. The conditionally dynamic position can develop both spontaneously and through special training, which in the future can contribute to the rapid transition of the child to a new level of mental development and readiness to be included not only in play, but also in educational activities. It is noteworthy that some researchers associate the formation of children’s ability to take a conditionally dynamic position in space with the personality traits of the teacher conducting classes with them. Thus, they distinguish two positions that he can take in relation to preschoolers: factual and conditionally dynamic. In the first case, the strategy of the educational process will be aimed at introducing the child to the rules of behavior in society in an imperative way. A teacher who takes a factual position is distinguished by: inability to perceive a children’s group from the standpoint of values typical of preschool age; lack of unconditional love for children, as such, which is manifested in the selection of “favorites” in a group of people and imposing on the majority the idea that attention and love from an adult must be “earned”; maintaining a distance between the student and oneself, which manifests itself in a rather cold, “formal” form of communication, interest exclusively in the development of the child’s intellectual abilities without addressing his inner world. An alternative version of the educational process is represented by the conditionally dynamic position of the teacher, the main characteristics of which are: the ability to correlate elements of classes with the personality traits of each child (comfort, children’s readiness to complete individual tasks); flexibility in communication, an individual approach to the development of intellectual abilities and the spiritual world of students; a tendency to present certain moral standards to a children’s audience through the analysis of problem situations (most often played out in a game format, where, as the plot develops, the child needs to make moral choices). Thus, the child’s attitude to society directly depends on the personality of the teacher, when, while learning the same moral and ethical standards, children can perceive them both detachedly as certain rules of the game, the violation of which entails negative consequences primarily for themselves, and as a basis for the formation of a sense of empathy for other people, in which a correlation between their own and someone else’s value systems occurs.

The ability to occupy a conditionally dynamic position in space at a high level provokes in preschoolers the ability to combine external manifestations of another person’s distress with manifestations of an internal nature. In most cases, children

reach this level by analyzing their own emotions and projecting them onto their peers; here, the role of the teacher is to expand the boundaries of the manifestation of empathy beyond the preschool group, which can be achieved through role-playing games.

G. G. Kravtsov describes the transition from an egocentric perception of the surrounding world to occupying a conditionally dynamic position using a sequence of stages such as:

1. The child's being "inside" the task - a stage when children are able to complete tasks only if it is consistent with their internal motives for cognitive activity. At this stage, preschoolers are most often inclined to neglect the rules established by teachers, change them at will, and in some cases even transform the task in such a way that their way of solving the problem will seem the only correct one; 2. The child's search for reasons for subsequent actions - in this case, children are able to look at the task from the teacher's point of view, that is, their activity becomes dual-subject, that is, generated by both internal motives and the attitude of another person. At this stage, children do not treat the adult as critically as at the previous stage, are able to respond sensibly to his comments, and recognize the existence of different ways to achieve the desired result;

3. Theoretical approach to the task - the stage when children are able to work in "one team with adults", listen to their advice, and in some cases divide the task into several actions, each of which is assigned to an individual child and a teacher;

4. Independent completion of the task - the stage at which the child is able to cope with the task without tangible help from an adult, taking into account his requirements and having the ability to correlate the result he obtained with the teacher's expectations [4].

To form a conditionally dynamic position in space in preschoolers, it is recommended to refer to the method proposed by psychologist V.A. Nedopasova, who suggested the following exercise: introduce children to a doll family of five (two adults and children) and, playing the role of any of the characters, ask the children to analyze the family ties between him and the rest of the family from his position, then the children can independently play the role of one of the dolls and analyze the situation from the point of view of another character [3]. When performing this exercise, according to V.A. Nedopasova, it is useful to select a group of children-observers who, by using logical thinking skills, will evaluate how correctly (from their point of view) the other participants perform the exercises. It is necessary to emphasize that the positions of children "actors" and children "observers" should alternate with the goal that the child learns to see both the situation as a whole and to pay attention to its individual details. The second stage of this exercise included replacing real objects with graphic images, that is, instead of dolls, children were offered colored circles with which the child had to identify both himself and others

(characters already familiar to him) and mark the family ties between them with a colored pencil. At the final stage of the exercise, the student had to move on to purely verbal establishment of connections between characters without relying on visual material. However, practicing teachers, including V.A. Nedopasova herself, noticed during a pedagogical experiment that preschoolers only half-completed this task, easily drawing parallels between themselves and other characters, but with difficulty establishing a relationship between those heroes whose role they are not currently playing. This phenomenon was called “sequential centering” in the pedagogical environment, which to some extent can explain the importance of teaching educational material in elementary grades with an emphasis on its visualization.

Special attention should be paid to the experiment conducted by the candidate of psychological sciences E.A. Bugrimenko, during which she offered preschoolers a role-playing game, in which, in addition to the direct participants, the role of an observer was introduced [5]. The child performing it had to monitor the execution of the rules of the game by other children. Thus, E.A. Bugrimenko wanted to test the hypothesis that in order to perform any action, a child must be aware of its meaning. For this purpose, he must first observe the execution of a particular operation by others and only then perform the action himself.

The result of the described experiment was the observation that the children who played the role of an observer at the beginning of the game were subsequently more disciplined in the role of players: they followed the rules more willingly, more clearly fulfilled the teacher’s requirements. Thus, another hypothesis was proven that the formation of the control function in preschoolers precedes the self-control function. In applying this experiment to the pedagogical practice of a primary school teacher, one can explain the following pattern: it is easier for primary school students to complete tasks based on an example than to approach an exercise independently, thus, they have the opportunity to visually trace the course of any action from the theoretical formulation of the problem to the result of its implementation.

The exercises described above can be called an experimental model of a role-playing game aimed at developing a specific skill in a child, while a modern teacher has a wider arsenal of tools for creating role-playing games to overcome centralization in preschool children.

In addition to traditional games that include children transforming into representatives of various professions, a teacher can offer them games of a more complex format, prepared based on those that preschoolers are used to playing using mobile devices. Most of these games are conducted according to the following scheme:

1. watching a video fragment on the topic of the game;

2. a conversation about the personal experience of the child or his parents; making attributes for the game process;
3. the direct process of the game;
4. reading fiction, verbally reinforcing the results of the game;

As a result, one game becomes a set of successive stages, during which the child is first psychologically prepared to play a particular role, then immersed in a game situation and, upon its completion, offered to look at what happened from the outside. Thus, in the child's mind there is a constant change in the center of attention, due to which he becomes able to evaluate not only his own actions, but also the actions of other children, which seems important to us for the formation of psychological defense mechanisms.

Improved forms of familiar role-playing games allow the teacher to overcome the consequences of excessive immersion of the child in virtual reality, where the game is presented to him in a ready-made version, excluding the stages of psychological preparation and self-reflection.

The advantage of using role-playing games to develop the ability to take a conditionally dynamic position in older preschool children is that the game as a pedagogical technology is one of the most psychologically comfortable forms of conducting a lesson. This happens because everything that happens in the game is conditional, that is, the child is required to perform this or that action not because he is obliged to do it, but because such is the content of the role of this or that character [1]. As a result, the child feels inner freedom and begins to navigate in relationships between people, thanks to identifying himself with those characters whose behavior he wants to associate himself with at the moment. This is why the choice of the direction of the plot-role-playing game should come first of all from the children's group itself, while the teacher should have several games of similar themes for working with children of different interests and inclinations.

Thus, having analyzed the conditions and methods of developing the ability of senior preschool children to occupy a conditionally dynamic position in space, we noted that the most psychologically comfortable pedagogical form for this process is a plot-based role-playing game of an expanded format, during which the child acquires both knowledge about the peculiarities of social communication and about himself. However, in order to consolidate the skills acquired during classes in kindergarten, senior preschool children need pedagogical support from adults at home, who can perform the same exercises with them, modified for the context of everyday life and aimed to a greater extent at developing family ties and self-service skills.

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青春期女孩破坏性攻击行为转化的性别与跨文化特征

**GENDER AND CROSS-CULTURAL CHARACTERISTICS OF THE  
TRANSFORMATION OF DESTRUCTIVE AGGRESSIVENESS OF  
ADOLESCENT GIRLS**

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摘要. 本文探讨青春期女孩破坏性攻击行为的性别跨文化特征转化

关键词: 青少年攻击行为, 性别差异, 跨文化特征, 破坏性攻击行为, 积极攻击行为, 成就动机。

**Abstract.** *This article explores the gender cross-cultural characteristics of the transformation of destructive aggressiveness of adolescent girls*

**Keywords:** *Adolescent aggression, gender differences, cross-cultural characteristics, destructive aggression, positive aggression, achievement motivation.*

In contemporary theory, the problem of adolescent aggression is highly relevant, as reflected in the research of Russian and foreign scholars. The rise in adolescent aggression, particularly the specific manifestations among girls, necessitates the search for new solutions and the modernization of existing approaches to its prevention.

It is important to note the global significance of the problem, as research in the field of adolescent aggression is actively developing in the works of scholars from various countries. Among Chinese scholars making significant contributions to this area are Es Ha Chen, Li Feng Hai, Huang Ti, and others. Furthermore, the cross-cultural context of the problem can be significantly enriched through the analysis of classical ideas from Chinese philosophers such as Confucius and Mencius.

In the research of Russian scholars, substantial gender differences in the manifestation of destructive aggressiveness among adolescents have been identified [2]. The authors statistically demonstrated on a representative sample of Russian schoolchildren that boys more often exhibit direct aggression (physical violence, verbal insults, property destruction), while girls more often resort to indirect, relational forms of aggression (ignoring, spreading rumors, manipulation). According to scholars, this is due to biological factors, social expectations, and gender cultural stereotypes that influence the formation of identity and the expression of emotions. Direct manifestations of aggression by adolescent girls can have negative consequences for maintaining positive social relationships, which, according to research, is a more important factor for girls. Therefore, they more often resort to more covert forms of aggression. This tendency is intensified precisely in adolescence, as evidenced by data on the more frequent use of social ostracism and manipulation in interactions with peers. The acceptance of gender roles by adolescent girls involves a process of self-regulation, the formation of motivation, and certain psychological traits that reflect the differentiation of cultural stereotypes of femininity and masculinity. If established gender role expectations do not correspond to the individual experience of the adolescent, this can lead to internal conflicts and destructive aggressiveness.

Researchers also note that cross-cultural characteristics significantly influence the manifestation and transformation of destructive aggressiveness in adolescent girls in social perception. Cultural norms and values largely determine which forms of aggression are considered acceptable or unacceptable and how society reacts to aggressive behavior in adolescent girls. For example, in the cultures of East Asia, where harmony and social adaptation are valued, indirect aggression may be more prevalent than in the individualistic cultures of the West, where open competition and direct forms of aggression are more acceptable for adolescent girls [3].

Given the above features, while studying the theoretical aspects, we note that the phenomenon of aggressiveness in adolescent girls is generally viewed by scholars as ambiguous. For instance, in the research of E.P. Ilyin and P.A. Kovalev, this phenomenon is not only seen as destructive but can also be considered an advantage, a strength of the individual with a positive orientation [1].

Based on this thesis, in our research aimed at transforming the destructive aggressiveness of adolescent girls, we consider two types of aggressiveness.

The first type is negative aggressiveness, which represents a stable set of personal qualities that contribute to the coincidence of the need and goal of violent behavior in adolescents.

The second type is positive aggressiveness, which can be considered as morally motivated behavior of the adolescent, contributing to the achievement of a goal

in a situation of confrontation. This type of aggressiveness includes qualities such as assertiveness, aggressiveness, and stubbornness. It should be noted that these qualities are characteristic of individuals with a pronounced desire for success.

Believing that the lack of positive interaction experience leads adolescent girls to consider indirect aggression as an acceptable form of relationships, we chose a mechanism for transforming destructive aggressiveness to effectively address this problem. Our approach, aimed at transforming destructive aggressiveness, is intended to facilitate the adaptation of adolescent girls to the social environment by teaching them self-control skills and constructive conflict resolution. The development of these skills, as our experimental experience showed, allowed adolescent girls to become more successful in the community of peers, achieve personal goals through socially approved methods, and form a motivation for success.

Experimental work conducted at MAEL “SES 132 with advanced study of subjects of the natural-ecological profile” in Perm confirmed the effectiveness of this approach. Our study involved 44 adolescent girls from 7th grades in April 2022. At the time of the study’s completion in October 2023, they were already 9th-grade students.

In the first stage, we conducted a constituting experiment, the results of which confirmed the relevance of the research problem related to the need to transform the destructive aggressiveness of adolescent girls.

In the formative stage of the experimental work, we implemented a psychological-pedagogical program “Energy of Success” aimed at transforming the destructive aggressiveness of adolescent girls. The uniqueness of the program lay in its impact on the motivational sphere of schoolgirls to form a motivation for success through stimulating the desire for self-improvement and achieving personally significant goals through socially acceptable methods. The program was also aimed at increasing self-confidence and forming skills of cooperation and effective interpersonal interaction in students.

Characterizing the program, we note that it included several blocks: diagnostic, organizational, practical, and control.

The diagnostic block implemented the constituting stage of the experiment. The organizational block included a pedagogical council aimed at educating teachers about the problem of destructive aggressiveness in adolescent girls; as well as a presentation at a parent meeting, which involved informing parents about the problem of high aggressiveness in adolescent girls and its social significance. The practical block combined the content of 10 sessions with adolescent girls.

A key aspect of our experimental program was the study of the gender aspect of the phenomenon of adolescent aggression and the identification of mechanisms for managing negative aggressive emotional states. During the sessions, adolescents acquired skills in applying constructive aggression to achieve personally



significant successes and socially approved results. Additionally, participants in the experimental group gained an understanding of methods for constructive conflict resolution, which contributed to improving the emotional atmosphere in the educational community. The sessions within the program also included tasks to stimulate processes of self-development and self-determination. Participants were involved in various activities, including a tourist rally “Unity in Action: Journey to Success,” where they had the opportunity to strengthen team bonds and demonstrate leadership qualities such as assertiveness, aggressiveness, and stubbornness, reflecting the motivation for success.

The final stage of the experiment confirmed the effectiveness of the “Energy of Success” program, aimed at transforming the destructive aggressiveness of adolescent girls. As the analysis of the obtained results showed, by the end of the study, the majority of the subjects showed a pronounced dynamic increase in positive aggressiveness, manifested in active goal-orientation. A pronounced dynamic decrease in destructive aggressive reactions among schoolgirls and an overall decrease in the level of conflict were also recorded compared to the data from the constituting stage.

Overall, the positive changes that occurred in the experimental group indicated the demonstration of emotional maturity and constructive aggressiveness in the interactions of adolescent girls.

Below, Table 1 presents the experimental data indicating the changes that occurred, recorded using the methodology of E.P. Ilyin and P.A. Kovalev “Personal Aggressiveness and Conflict” (Table 1). Comparison of the results of measuring the conflict index in the form of positive and negative aggressiveness at the constituting and final stages indicates a positive dynamic.

**Table 1**  
*Comparison of Index Results (Methodology by E.P. Ilyin and P.A. Kovalev «Personal Aggressiveness and Conflict»)*

	Low Level		Medium Level		High Level	
	Primary diagnosis	Final diagnosis	Primary diagnosis	Final diagnosis	Primary diagnosis	Final diagnosis
Positive Aggressiveness	22 people (50%)	12 people (27%)	17 people (39%)	24 people (55%)	5 people (11%)	8 people (18%)
Negative Aggressiveness	7 people (16%)	13 people (30%)	24 people (55%)	21 people (48%)	13 people (29%)	10 people (22%)
Conflict	21 people (49%)	31 people (70%)	17 people (40%)	10 people (23%)	5 people (11%)	3 people (7%)

Additionally, significant positive changes in the logic of our research were recorded using the questionnaire “Motivation for Success and Fear of Failure” by

A.A. Rean (Table 2). The results of the motivation diagnosis show a significant decrease in the proportion of adolescent girls with avoidance motivation, indicating a reduction in emotional tension. At the same time, the decrease in the number of schoolgirls with an undetermined motivational pole indicates an understanding and awareness of their own goals.

The proportion of participants in the experimental group demonstrating motivation for success significantly increased, indicating confidence in themselves and a desire to achieve set goals through socially acceptable means.

**Table 2**  
*Comparison of Results of the Questionnaire “Motivation for Success and Fear of Failure” by A.A. Rean*

	<b>Motivation for Avoidance of Failure</b>	<b>Motivational Pole Not Expressed</b>	<b>Motivation for Achievement of Success</b>
Primary diagnosis	8 people (18%)	17 people (39%)	19 people (43%)
Final diagnosis	3 people (7%)	9 people (20%)	32 people (73%)

Thus, based on the analysis of theoretical research and the testing of the experimental program, we have identified a conditional dependence between the aggressiveness of the individual and the motivation for success in adolescent girls. This indicates the possibility of transforming the destructive aggressiveness of adolescent girls into constructive forms of its manifestation. This research does not exhaust all aspects of solving the problem of adolescent aggression, but the accumulated experience can be useful in the context of considering gender and cross-cultural characteristics of transforming the destructive aggressiveness of adolescents.

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教育空间对学龄前儿童心理健康的影响  
**THE IMPACT OF EDUCATIONAL SPACE ON THE  
PSYCHOLOGICAL WELL-BEING OF PRESCHOOL CHILDREN**

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注释。本文对心理健康的概念进行了理论分析。确定了参数，定义了教育环境的心理和教学条件，并证实了教师的个人能力对学龄前儿童心理健康的贡献。教师的解释性同理心被视为一种个人能力，是儿童成功发展的教育空间资源。

关键词：教育环境、心理健康、学龄前儿童、教师、解释性同理心。

**Annotation.** *The article presents a theoretical analysis of the concept of psychological well-being. The parameters are identified, the psychological and pedagogical conditions of the educational environment are defined, and the role of the personal competencies of the teacher contributing to the psychological well-being of preschool children is substantiated. The hermeneutic empathy of the teacher is considered as a personal competence that is a resource of the educational space for the successful development of children.*

**Keywords:** *educational environment, psychological well-being, preschool children, teacher, hermeneutic empathy.*

### **Introduction**

In domestic and foreign studies, psychological well-being is distinguished by structural diversity and polysemantic definition of the concept itself. Research by such scientists as I. A. Berdnikova, A. N. Veraksa, I. V. Dubrovina, E. A. Kozlova, M. V. Safronova, A. Ben-Arieh, T. Fattore, B. K. Nastasi, E. L. Pollard reveal the structural and substantive side and mechanisms that contribute to the formation of psychological well-being.

The formation of this psychological manifestation, in the range of senior preschool age, is presented more widely in the works of Russian scientists L. I. Bozhovich, A. N. Leontiev, D. B. Elkonin. The scientists' studies reveal the features and present the fundamental significance of the child's psychological well-being in

the further development of the personality during the transition to primary school age, in relation to the child's realization of his potential and the development of communicative interaction and socialization in society [4; 5; 6].

The theoretical analysis of the content of the concept of psychological well-being allowed us to state the fact of the presence of similarities in the intersection with such related concepts as "subjective well-being", "emotional well-being", "psychological health". Psychological well-being is defined by many scientists as a set of mental phenomena (states and properties) that allow an optimal response to circumstances by correlating positive experiences with subjective experience and in the unfolding fullness of the realization of one's own capabilities [1].

V. A. Yasvin considered the educational environment as a process specially organized for the purposeful development of the individual and his/her capabilities contained in the social and spatial-subject environment. According to V. A. Yasvin, in creating an educational environment it is necessary to take into account the possibility of realizing individual development trajectories of children. He paid special attention to the personality of the teacher, emphasizing that a person acts as an element of the environment for a person [7, p.11].

### **Results and discussion**

A comprehensive analysis of studies of the educational space and its types of environments allowed us to identify the following parameters, which together serve as psychological and pedagogical conditions for the formation of psychological well-being in preschool children:

- breadth of the educational environment (determines the structural and substantive characteristics);
- intensity of the educational environment (determines the activity of using the educational environment);
- the degree of awareness of the educational environment (determines the conscious involvement of all subjects of the educational process);
- generality of the educational environment (determines the degree of coordination of the activities of all subjects of a given educational environment);
- emotionality of the educational environment (determines the ratio of emotional and rational components in it);
- dominance of the educational environment (determines the significance of a given local environment in the value system of subjects of the educational process);
- coherence of the educational environment (determines the degree of consistency of the influence of a given local environment on the individual with the influence of other factors);
- social activity of the educational environment (determines socially oriented creative potential);

- mobility of the educational environment (determines the mobility capabilities of the educational environment and teachers);

- stability of the educational environment (determines stability over time).

Thus, the psychological well-being of children in the educational space of a preschool institution is characterized by a variable set of psychological and pedagogical conditions expressed in the following criteria:

- the emotional state of the child with a predominance of positive and neutral emotional states;

- the child's subjective position in play activities;

- the formation of age-related psychological neoplasms;

- the presence of positive relationships determined by the social situation of development [2;3].

To date, methodological analysis of research has shown the absence of a unified structure of the educational environment that promotes the well-being of subjects of the educational space. Selective studies of correlations of its individual components raise new questions about the content of psychological and pedagogical conditions and resources of the educational environment in the formation of the well-being of preschool children (N. E. Veraksa, A. K. Nisskaya, E. O. Smirnova, O. V. Soldatova, O. A. Shiyan, etc.).

In our study on the influence of the educational environment of a preschool institution on the formation of a child's well-being, we define the hermeneutic empathy of a teacher as an important personal competence. For the first time, the need to perform the hermeneutic function of empathy was presented in the works of V. Kail, in client-centered therapy. Theoretical and methodological analysis allowed us to identify the main criteria expressing hermeneutic empathy, to which we include intrapersonal and interpersonal emotional intelligence, the level of expression of empathic competencies.

**Research hypothesis:** The expressed hermeneutic empathy of the teacher is a resource of the educational space for the successful development of preschool children.

We used a battery of diagnostic tools to determine significant scales that allow us to measure the level of expression of hermeneutic empathy ("General Empathic Tendencies Questionnaire" by A. Mehrabian, N. Epstein; "Multifactor Empathy Questionnaire" by M. Davis (adapted by T.D. Koryagina, N.A. Budagovskaya, S.V. Dubrovsky); questionnaire of cognitive and affective empathy by R. Renier (adapted by M.A. Okatova); questionnaire EmIn D.V. Lyusin; questionnaire "Empathic competencies" T.E. Yatsenko, N.I. Olifirovich, Z.V. Rzaeva). The study involved 160 teachers from different preschool educational institutions of Khabarovsk. Factor analysis of 5 components allowed us to identify 8 indicators allowing to measure the level of manifestation of the components of hermeneutic

empathy: indicators of empathic competence (ability to decenter, empathic care, empathic understanding, ability to emotional response); indicators of intrapersonal emotional intelligence (emotional awareness, control of one’s behavior by managing one’s emotions, control of expression); indicator of interpersonal emotional intelligence (ability to influence the emotional state of others) (Table 1)

**Table 1**

*Results of factor analysis for determining indicators of hermeneutic empathy*

	Factor	Factor		Factor	Factor	Factor		Factor		Factor	Factor
Per1	0,174390	0,000117	Per1	0,057501	-0,015099	0,248792	Per1	0,021863	-0,026787	0,224947	0,183143
Per2	0,243422	0,049616	Per2	0,185960	0,043728	0,165595	Per2	-0,000979	-0,015380	0,045154	0,841787
Per3	0,608136	0,196740	Per3	0,584925	0,199529	0,207165	Per3	0,508866	0,188354	0,159735	0,399949
Per4	0,598967	0,284094	Per4	0,530462	0,280363	0,284672	Per4	0,401741	0,250440	0,204750	0,623209
Per5	0,005636	0,710168	Per5	-0,005095	0,709630	0,033892	Per5	-0,019530	0,709932	0,037071	0,018323
Per6	0,056406	0,868506	Per6	0,050522	0,869373	0,042227	Per6	0,001629	0,860518	0,025866	0,164045
Per7	0,305575	0,808417	Per7	0,283968	0,809339	0,135102	Per7	0,264507	0,815144	0,135833	0,074805
Per8	0,137887	0,752458	Per8	0,131726	0,753917	0,062315	Per8	0,142735	0,766281	0,082241	-0,076905
Per9	0,750894	-0,037775	Per9	0,798930	-0,023620	0,117797	Per9	0,793153	-0,007382	0,111287	0,126676
First 10	0,739313	0,074581	First 10	0,786178	0,088606	0,118900	First 10	0,828763	0,121757	0,145551	-0,091441
Per11	0,737222	0,096214	Per11	0,765646	0,107582	0,150627	Per11	0,742179	0,117941	0,135067	0,193744
Per12	0,798898	0,023585	Per12	0,806394	0,032424	0,201927	Per12	0,829864	0,058865	0,215063	0,004420
Per13	0,529656	0,146370	Per13	0,169826	0,099657	0,766796	Per13	0,160324	0,098516	0,760526	0,119557
Per14	0,501647	0,192539	Per14	0,108672	0,140824	0,817453	Per14	0,151713	0,156157	0,845818	-0,113204
Per15	0,665336	0,103262	Per15	0,356095	0,065118	0,714956	Per15	0,332050	0,063355	0,698307	0,201331
General diss.	4,200875	2,686212	General diss.	3,422287	2,658397	2,097185	General diss.	3,225963	2,665652	2,026841	1,458861
Share of total	0,280058	0,179081	Share of total	0,228152	0,177226	0,139812	Share of total	0,215064	0,177710	0,135123	0,097257

Correlation analysis confirmed the research hypothesis. The expressed hermeneutic empathy of the teacher is a resource of the educational space for the successful development of preschool children. The students of teachers with a higher level of hermeneutic empathy are psychologically more prosperous.

**Conclusion**

We agree with the opinions of scientists who attribute the personality of the teacher and his/her personally oriented interaction with children to more significant determinants of psychological well-being in the educational space. And we admit that the personal qualities of the teacher can act as a resource of the educational space in the formation of the well-being of preschool children. It should be noted that professional qualities consist of knowledge, skills and abilities, while personal qualities are determined by the motivational side, awareness of pedagogical knowledge, reflexivity, the use of emotional and spiritual experience in accepting and understanding the child. Such personal qualities, in our opinion,

can act as a resource in the pedagogical activity of the educator in the formation of the psychological well-being of the child in the educational environment of the preschool educational institution.

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绘画中的贝加尔湖传说 (绘画的诠释)

## LEGENDS OF BAIKAL IN PAINTING (INTERPRETATIONS OF PAINTINGS)

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**摘要。**本文致力于描述描绘贝加尔湖著名自然景点的风景画，例如萨满石、霍博伊角和贝加尔湖本身，这些风景画与1988年在《贝加尔湖传说》系列中正式出版的关于湖泊起源的传说和故事有关。传说的文本以特定的绘画为导向。因此，本文介绍了艺术家的风景画供研究：V. S. 罗加尔的《贝加尔湖的太阳》，1980-1981年，位于伊尔库茨克市文化局“伊尔库茨克市历史博物馆，以A. M. 西比里亚科夫命名”；G. P. 马克萨科夫的《萨满石》，2003年，位于市文化局“图片画廊”；V. A. 伊万诺夫的《霍博伊角》。2006年建成的“奥尔洪岛”位于楚瓦什共和国新切博克萨尔斯克市市级预算机构“历史艺术博物馆综合体”。

**关键词：**自然景观、贝加尔湖、萨满石、霍博伊角、传说和传统、贝加尔湖童话、风景画家。

**Abstract.** *The article is devoted to the description of landscape works depicting famous natural places of Lake Baikal, such as the Shaman-stone rock, Cape Khoboy and Baikal itself, in the context of legends and tales about the origin of the lake, officially published in the collection “Baikal-lake tales” in 1988. The texts of the legends are given with an orientation to a specific painting. Thus, landscape works of the artists are presented for study: V. S. Rogal “The Sun of Baikal”, 1980-1981, is located in the municipal budgetary institution of culture of the city of Irkutsk “Museum of the History of the City of Irkutsk named after A. M. Sibiryakov”; G. P. Maksakov “Shaman-stone”, 2003, is located in the municipal budgetary institution of culture “Picture Gallery”; V. A. Ivanov “Cape Khoboy. Olkhon Island”, 2006, is located in the municipal budgetary institution “Historical and Art Museum Complex” of the city of Novocheboksarsk, Chuvash Republic.*



**Keywords:** *natural landscape, Lake Baikal, Shaman-stone rock, Cape Khoboy, legends and traditions, Baikal-lakes-fairy tales, landscape artists.*

Fine art of individual regions arouses genuine interest among all lovers of painting. Such a landmark as Baikal cannot leave anyone indifferent. Therefore, the study of paintings of local artists, in particular, landscape, is relevant. Nevertheless, the fine art of a particular region reflects the development trends of all art in general. The genre of landscape is closest to the origins, since the depiction of nature- this is the key motif in painting, it is where everything began, starting with the first people.

The purpose of this article is to examine the landscape works of artists V. S. Rogal, G. P. Maksakov, V. A. Ivanov, dedicated to the depiction of famous natural places of Lake Baikal in the context of the presented texts of fairy tales, officially published in 1988.

To achieve the set goal, The following tasks need to be solved:

- indicate a list of scientific and other sources on the topic under study;
- determine the research methodology;
- present brief definitions of famous natural places of Lake Baikal;
- in the context of the presented texts of fairy tales, examine the landscape works of artists V. S. Rogal “The Sun of Baikal”, 1980-1981; G. P. Maksakova “Shaman-stone”, 2003; V. A. Ivanova “Cape Khoboy. Olkhon Island”, 2006.

The image of Baikal is a visiting card of the region in question. Its sights attract not only local artists, but also those from other regions.

This study, all its materials and the conclusions obtained have scientific and practical value, since, in this case, works of fine art are considered in the context of works of literature (fairy tales).

During the preparation of this material, the following literature was studied and used:

- scientific article Baidzhumanova H. “Landscape as a type of painting”, which defines landscape, examines its origin, formation, development, characteristic features and differences from other types of fine art in general;
- publication Head of the Drawing Department M. S. Bostanov “Questions of Determining Tone and Color Relationships in Landscape Drawing and Painting” is devoted to color and tone solutions in landscape work. The color palette and color scheme of the entire work are decisive in landscape painting;
- article Gurlenova L. V. “Realistic image of nature in modern regional painting” talks about the development of landscape painting in the regions, about the role of nature in the fine arts;
- scientific work senior lecturer Bekisheva A.V. “Landscape in the painting of Transbaikalian artists of the second half of the 20th century”, which examines the

landscape works of specific artists, their features and artistic techniques formed in a certain place under the influence of the environment and local color; images of specific recognizable places in a given region;

– the article continues the theme of fine art in Transbaikalia Lyashenko E. S. “Transbaikal painting of the 18th - early 21st centuries: problems of periodization”, which presents the stages of formation and development of painting in this region.

The Baikalscapes presented in the study have a direct meaning and find their response in the above-mentioned literature.

The collection of “Baikal-Lake Fairy Tales” in this work is the object of research in the context of the presented landscape works of artists.

The literature indicated fully helps to explore and reveal the subject of this work. Legends of Baikal in painting (interpretations of paintings”).

In addition, when examining artistic and fine art works, general scientific methods were also used - descriptions, generalizations; comparative analysis was applied.

The following natural objects are considered in this paper:

1. Lake Baikal– one of the largest fresh water bodies on earth. The name of the lake has Buryat roots, translated as “rich”. The lake has the shape of a moon, is located in Eastern Siberia. In addition, Baikal is also the deepest lake in the world (more than 1000 meters). Many medium and large rivers (Selenga, Barguzin, etc.) and streams (more than three hundred) flow into Baikal, but only one flows out–Angara. It has the largest reserve of fresh water. In winter, Baikal freezes almost completely, except for a small source of the Angara. The ice of Baikal is considered a unique phenomenon, very transparent and porous. And also very beautiful, attracts many tourists, specialists in various fields of knowledge, creative people. Researchers distinguish several types of ice. There are more than 25 islands on Baikal, one of the main and largest is Olkhon Island. The Baikal region is a seismically active territory, where earthquakes occur regularly. Winds with individual names blow on Baikal, for example, Sarma or Barguzin. The age of Baikal is determined to be more than 25 million years. In Baikal itself and on its coast, there is a very diverse flora and fauna. Baikal in Buryat is Baigal, a very ancient name.

2. Shaman Stone- is a rock, figuratively protruding into the sea (Baikal). According to ancient beliefs, the Shaman Stone was the dwelling place of the master spirit and possessed enormous mystical power. It was here that shamanic rituals with sacrifices to the spirits of all the elements were previously held. There is also a legend that the gray and wise Baikal decided to give his beloved daughter Angara in marriage to the glorious hero Irkut. But Angara resisted, violated her father’s command and secretly ran away from home to the handsome Yenisei, whom she had fallen in love with. Baikal got angry and threw a huge stone with all his might after his disobedient daughter. Since then, it has been called the Shaman Stone.

3. Cape Khoboy– is the final geographical point of Olkhon Island on Lake Baikal, located in the north of the lake. Khoboy is translated from Buryat as a fang. The abrupt cliffs of the cape resemble fangs. Although from the sea, the outlines of the cape look like a lying girl. There is a Buryat legend about this, according to which she was evilly envious of her husband, to whom the spirits granted a beautiful palace. As punishment, they turned her into stone (Cape Khoboy).

These are the natural attractions on Lake Baikal that artists have depicted in their paintings.

Let us consider the landscape by V. S. Rogal “The Sun of Baikal”, 1980-1981.

The composition of the painting is horizontal. At the bottom of the work is the steep bank of Lake Baikal, executed in a dark color scheme and conventionally divided by the artist into two equal parts. From the line of the bank above and to the very top, the surface of the lake is symbolically shown, stretching to the very sky, illuminated by the rays of the sun. Here the artist wanted to show an analogy: as the sun gives life on earth, so Baikal gives life to all living things living on its shores and in it. Baikal is a symbolic sun. The dark bottom of the painting is contrasted with its top - very light and life-affirming. This work has features of the symbolism style.

There are many legends and stories about the origin of the lake. Here is one of them.

*Fairy tale “About Baikal”: “In ancient times, in the place where Baikal is now, there grew a dense forest. There were so many birds and animals in this forest that it was difficult for a person to pass. Among the birds, one stood out, it was the size of a large sturgeon. Its wings were huge, strong, if it touched a tree, it would fall to the ground with its roots, touch a rock- the rock flies apart.*

*People were afraid of that bird and could not kill it because when she flew, such hot rays came from her that the hunters fell dead.*

*But then one man was born among people. He grew by leaps and bounds. Soon he grew up to be a strong man and was not afraid of any force. The people went to him to ask him to save them all from trouble and kill that fiery bird. The strong man obeyed. He made himself a bow from a hundred trees, hewed an arrow from two hundred logs and went hunting. Soon the whole earth shook. That bird fell from a well-aimed shot, such a fire began that the sky was hot. The people dispersed from that taiga to the mountains and saw how columns of water were breaking through the flames. So the sea appeared in that place.*

*When the land and taiga were burning, people kept shouting: “Baikal, Baikal!” When the sea stopped, the name Baikal remained for that place from century to century. Either the fire was called Baikal by the large people, or that bird was called that, or maybe this word meant “a lot of water”... People only remembered that this place was called Baikal”[2, 235].*

The next recognizable popular place on Baikal is the rock “Shaman-stone”, considering the work of G.P. Maksakov “Shaman-stone”, 2003 with this symbol.

The landscape composition tends to an equal rectangle. The whole work is done very realistically. The angle of the image can be called unusual. The artist seems to be observing the rock from above, having risen to a height. The landscape is dominated by realistic colors and shades: the rock is made in light gray-beige colors. The artist has painted the rocks and dark places of the rock caves in great detail. The surface of the land and water near the rock have a natural shade. The rock is depicted on a bright sunny day, probably a summer day. This work has signs of the realism style. The origin of this place is also reflected by ancient people in legends and traditions.

*The Tale of the “Bull Mountains”*: “Below the village of Guzhiry there is a place called Dalhai. In this place there is a mountain called Bychya. It happened like this.

*Two huge bulls came out of Mongolia. In Mongolia they drank up all the rivers and lakes. They were overcome with thirst. They went in search of water. They walked for a long time, but could not find water. The bulls walked along the Zun-Murino River. They crushed everything in their path, crushed it so much that the trees sank into the ground with their tops. One bull, dying of thirst, ran into a cliff- and turned to stone. The appearance of Mount Dalhai now resembles a bull. The horns are especially prominent.*

*Another bull reached the Angara. He drank half of the Angara, fell asleep. But at night Baikal filled the river with water again. The sleeping bull drowned in this water. This bull is now visible from the Angara, only one horn is visible, resembling a pointed rock. This rock is called the Shaman Stone”[2, 239].*

Another iconic place on Baikal-This is Cape Khoboy. Take a look landscape by V. A. Ivanov with the same name-“Cape Khoboy. Olkhon Island”, 2006

The composition of the work, like the previous works, has a horizontal position. The artist is “laconic” in his work, as it depicts: a rock, the surface of Lake Baikal and the sky. The bright color of the water and the sky is opposed by the cape block, made in dark brown colors. The rock looks very massive and heavy, justifying its name “Cape Khoboy”, in comparison with Baikal and the sky. In this, a certain symbolism is read, intentionally created by the artist: by removing everything unnecessary, focusing the viewer’s attention only on the rock and water, placed in the space of air, the artist highlights and emphasizes the main thing in his work. The presented painting has signs of symbolism. The plot of the origin of this place is also reflected in oral traditions.

*The Tale of “The Trunk Rock”*: “In the distant, distant times on the shores of the Glorious Sea- Baikal - it was very warm. Large, unseen trees grew here and huge animals lived: giant rhinoceroses, saber-toothed tigers, cave bears and shaggy giants - mammoths.

*The long trumpet sounds of the mammoths shook the mountains.*

*Mammoths were considered the largest and most powerful of all animals on earth, but by nature they were modest and peace-loving.*

*And only one of the Baikal mammoths was distinguished by a tough character, excessive bragging and arrogance. He always walked alone, important and proud, and woe to anyone who met him on his way. He grabbed smaller animals with his long trunk and threw them into the bushes, and those who were larger he forged with thick tusks and threw to the ground. For fun, the boastful mammoth tore out giant trees by the roots, turned over huge boulders and blocked the rivers flowing into Baikal.*

*More than once the leader of mammon Tov tried to reason with the braggart:*

*“Come to your senses, you obstinate one, don’t hurt the weak animals, don’t destroy the trees in vain, don’t muddy the rivers, otherwise you’ll get into trouble.” The arrogant old mammoth listened to him, but continued to do things his own way. And one day he got really mad. “Why do you keep telling me? - he roared at the leader, - why are you scaring me! Yes, I am the strongest here, yes, if you want, I will not only throw stones at the rivers, but at the whole of Baikal, like a puddle!”*

*The leader was horrified, the other mammoths waved their trunks at the braggart. Baikal stirred, splashing the shore with a wave and hiding an unkind smile in his gray moustache.*

*But the mammoth saw nothing. He ran, stuck his tusks into the rock, lifted it up to throw it far into the sea, but suddenly the rock became so heavy. The tusks broke from the excessive weight and fell into the water together with the rock. The mammoth roared with grief, stretched his long trunk into the water to get his tusks, and froze, petrified forever.*

*Since then, there has been a huge rock on the shore of Lake Baikal, hanging over the water like a trunk. And now people call it that- Trunk Rock” [2, 239].*

Having examined all the presented works by the artists V. S. Rogal, G. P. Maksakov and V. A. Ivanov, the following conclusions can be drawn:

- all the artists’ works are done in the landscape genre;
- all the artists’ works depict popular and well-known natural places of Lake Baikal;
- works of artists V. S. Rogal and V. A. Ivanov have features of the symbolist style;
- the artist’s work G. P. Maksakova has features of the realism style;
- all the presented works of artists are related to the literary texts of the fairy tales cited in the study;
- all the presented works of the artists have a horizontal composition, which emphasizes their plot direction;

– all the presented works of artists together create a single, unique image of Baikal and its attractions.

Thus, in the course of the conducted research:

- a list of scientific and other sources on the topic under study was designated;
- the research methodology was determined;
- brief definitions of famous natural sites of Lake Baikal were presented;
- in the context of the presented texts of fairy tales, landscape works of artists were examined V. S. Rogal “The Sun of Baikal”, 1980-1981; G. P. Maksakova “Shaman-stone”, 2003; V. A. Ivanova “Cape Khoboy. Olkhon Island”, 2006.

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关于“物质生产与精神生产”与“物质文化与精神文化”概念的区别  
**ABOUT THE DIFFERENCE BETWEEN CONCEPTS “MATERIAL  
AND SPIRITUAL PRODUCTION” AND “MATERIAL AND  
SPIRITUAL CULTURE”**

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**摘要。**本文分析了“物质生产和精神生产”与“物质文化和精神文化”概念的区别。认为“物质生产”和“精神生产”概念是社会经济学和社会学分析的范畴，“物质文化”和“精神文化”概念是文化分析的范畴。重要的是要理解这两对范畴反映了公众生活的不同方面。

**关键词：**文化，文化学，物质生产，精神生产，物质文化，精神文化。

**Abstract.** *The difference between concepts “material and spiritual production” and “material and spiritual culture” is analyzed in the article. It is asserted that the concepts of “material production” and “spiritual production” are categories of economic and sociological analysis of society, and the concepts of “material culture” and “spiritual culture” are categories of cultural analysis. And it is important to understand that these pairs of categories reflect different aspects of public life.*

**Keywords:** *culture, culturology, material production, spiritual production, material culture, spiritual culture.*

Activities to satisfy people’s material needs have always been different and will always be different from activities to satisfy their spiritual needs. It is precisely the variety of material and spiritual needs of a person as a social being that leads to the formation of two inextricably linked, but at the same time relatively autonomous from each other types of social production: material and spiritual, between which various types of activities of cultural subjects are distributed.

The sphere of material production includes those types of practical activities, the purpose of which is to create material conditions and means of human existence, starting from material goods and ending with a system of material relations that develop in the process of production and reproduction of material goods.



The sphere of spiritual production includes those types of activities that aimed at creating spiritual goods: scientific theories, philosophical teachings, religious doctrines, moral codes, works of art, etc. Spiritual products give people knowledge of the laws of the World, understanding the meaning of their own lives, the ability to distinguish good from evil, beautiful from ugly, true from false, experiencing aesthetic enjoyment and sublime feelings.

The creation of material and spiritual goods is an attribute of social existence. In their socio-cultural essence, material production as the production of things and relationships and spiritual production as the production of consciousness in a social form are united and inextricably linked with each other. The creation of spiritual products differs from the creation of material products only within the boundaries of the relative independence of one of the branches of the unified process of social production of human life.

However, the concepts of “material production” and “spiritual production” are categories of economic and sociological analysis of society, and the concepts of “material culture” and “spiritual culture” are categories of cultural analysis. And it is important to understand that these pairs of categories reflect different aspects of public life [1].

Material and spiritual production are two sides of the production of a social form of existence.

Material and spiritual culture are two sides of the way of life of specific cultural subjects involved in the holistic process of production and reproduction of a social form of existence.

The concepts of “material culture” and “spiritual culture” do not reflect the economic laws of material production or professionally made types of spiritual production: science, philosophy, morality, art, religion, etc., but only the specific features of the way of satisfying material and spiritual needs that is inherent in a particular subject of culture.

A social being, a subject of culture, has norms for obtaining and consuming food, creating and decorating homes, utensils, tools, clothing, etc.; there are worldviews and value orientations that justify and support these norms; there are specific means and methods of activity for the production of material goods and there are ideals of satisfying material needs, to which should be sought, etc.

Thus, it is not the material need itself, but how this need is satisfied, that characterizes the material culture of a particular subject: a primitive man, a medieval knight or a modern Russian student. Ultimately, material culture as one of the sides of a specific way of life of a particular subject expresses the degree of socialization, “domestication” of his animal instincts in the process of satisfying biological needs.

The culturologist does not describe the features of material and spiritual production inherent, for example, in feudalism, but those features of the material and



spiritual development of the world that characterize cultural subjects who lived under feudalism. From a culturological point of view, it is important that different cultures existed on the basis of the same form of material and spiritual production: noble, peasant, monastic, knightly, burgher, etc. But the concept of “material culture” characterizes the way of satisfying material needs (in food, clothing, housing, means of labor and much more what he calls material goods) inherent in a particular subject of culture, without which the subject of culture simply cannot survive.

In accordance with this understanding of material culture, the concept of “spiritual culture” characterizes the way of satisfying spiritual needs inherent in a particular cultural subject.

But what is a “spiritual” need? Or to put it another way: the need for what can be called a “spiritual” need? Is, for example, the need to listen to music or read books “spiritual”?

It would not be an exaggeration to say that there is only one need that can be called strictly spiritual, and that is the need for meaningfulness of existence, for the validity of the goals of activity. It is this need that is satisfied in the process of making sense, establishing a value attitude to the world, reflecting on the ultimate goals of human existence and the meaning of life of a particular cultural subject.

When we speak in the plural about spiritual needs, we actually mean those universal ways of creating the value-meaning content of culture that are associated with knowledge of the world, its aesthetic and artistic development, religious and philosophical comprehension, deep emotional experience. These universal ways of developing spiritual culture are concretized in the life of various subjects in many different ways and forms of activity, among which we find reading books, visiting theaters and museums, communicating with other cultural subjects, contemplating nature and much more.

It would be wrong to identify the social production of material and ideal products carried out by individual professional groups with the material and spiritual culture of various cultural subjects, including the professional groups themselves.

Spiritual culture is not just a collection of ideas, knowledge or works of art, and not even the production of ideal (spiritual) goods in itself, but a way inherent in some subject of culture to create value-meaning content (resource, component) or value foundations of culture. Spiritual culture satisfies the need of a cultural subject for a meaningful existence [2].

Let us pay special attention to the correlation of the results of professional activity in the field of spiritual production and the subject’s own reflections in the process of creating the value foundations of culture.

Undoubtedly, the substrate from which one creates one’s own meaning is never the product of one’s own creativity alone. That is why there is a spiritual her-

itage, professional spiritual production, teachers, preachers, mentors, etc., to help specific subjects build their own spiritual world. But if the products of material culture can be inherited or obtained in their original form from those who know how to create them, then the products of spiritual production are always recreated in the process of perception and inheritance, because it is possible to borrow or inherit ideal products only in the process of thinking, understanding, experiencing them. That is why knowledge, experiences, and meaningfulness can be only one's own. No one can create the spiritual culture of a subject for him, instead of him, without him. Each cultural subject creates the meaning space of his own life by himself, in the process of spiritual development of the world. The specific way of mastering this is the spiritual culture of this subject, which only he can create.

In other words, speaking about spiritual culture, we single out from the holistic way of life of a cultural subject only that which characterizes him as the creator of the value-meaning resource of his own life activity. Spiritual culture, in contrast to the technology of production of spiritual goods, is expressed in the originality of the spiritual motivation inherent in this subject of culture, in the degree of meaningfulness of his life and the development of value orientation.

Those who think that only products of professional spiritual production, such as art, religion, science, philosophy, can be the means of gaining meaningfulness of being and replenishing the value-meaning resource of the vital activity of a cultural subject, do not take into account that any cultural products and natural phenomena can become means, intermediaries or motivating factors for gaining meaning and choosing a value orientation.

The function of various types of spiritual production: science, philosophy, religion, art, etc. – is not to create the spiritual culture of various subjects, but only such ideal products: scientific knowledge, philosophical systems, theological teachings, works of art, etc., which are able to provide objective conditions and means for the formation of the spiritual culture of specific subjects forming this society.

How specific individuals and social groups will use the products of spiritual production will characterize the spiritual culture of these subjects. But in any case, spiritual culture will remain a way to satisfy the need for meaningfulness of being, and the spiritual world will remain a world of meanings, ideas with which a person justifies his goals, reaches an understanding of the World and himself [3].

Concluding the consideration of the content of the concepts of “material culture” and “spiritual culture”, we emphasize once again that the satisfaction of material needs is a necessary aspect of human life, and the way to meet material needs is the most important characteristic of culture. However, satisfying material needs does not make a person's life meaningful, although it makes it more convenient. Achieving meaningful existence is the result of activities other than material production.

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科佩特达格野生药用植物生物资源

## BIOLOGICAL RESOURCES OF WILD MEDICINAL PLANTS OF KOPETDAG

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**摘要。**所研究的野生药用植物有望获得植物来源的药用产品。科佩特达格药用植物群中一些具有生态意义的关键物种的生物资源和植物化学特性揭示了它们在土库曼斯坦制药工业中使用的资源可能性。

**关键词:** 药用植物、生物资源、生物储备、植物量、精油、科佩特达格。

**Abstract.** *The studied wild medicinal plants are promising for obtaining medicinal products of plant origin. Biological resources and phytochemical characteristics of some ecologically significant key species from the medicinal flora of Kopetdag have revealed the resource possibilities of their use in the pharmaceutical industry of Turkmenistan.*

**Keywords:** *Medicinal plants, biological resources, biological reserve, phytomass, essential oil, Kopetdag.*

**Introduction.** An important task of modern pharmacy and biochemistry is to expand the range of medicinal plant raw materials, with sources being common medicinal plants from the local flora. Despite significant advances in the synthesis and use of chemical pharmaceuticals, plants remain one of the most promising sources for obtaining medicinal products.

In recent years, the medicinal and other useful plants of mountainous Turkmenistan have been actively studied as sources of biologically active compounds and as objects for economic use. Although the mountain ecosystems of Turkmen-

istan occupy relatively small areas, the plant communities of this natural region are distinguished by their rich diversity of medicinal and other useful plants [1].

**Research methods.** The determination of natural reserves of medicinal raw materials was carried out according to standard methods. During expeditions from 2020 to 2024, ethnomedical aspects of the studied medicinal plants of the Kopetdag were explored, with factual material collected and oral surveys conducted among the local population regarding the use of endemic medicinal plants in Turkmen folk medicine (“Ethnobotanical” and “Ethnomedical Questionnaire”) [2-5; 7; 8].

**Bioecological and morphological characteristics and distribution.** Kopetdag Dorema (*Dorema kopetdaghense* M. Pimen.) – is a perennial herbaceous plant from the Apiaceae family, reaching a height of 150–200 cm. It is a taproot monocarpic plant. The stem is cylindrical, tapering, round, and branches in the middle into a pyramidal panicle, slightly pubescent. The leaves are grayish-pubescent, tripinnately dissected, with segments further divided into bipinnate oblong-lanceolate sections. The umbels contain 5–12 flowers and are almost sessile. The plant blooms in May–June and bears fruit in June–July.

It grows in the foothills and lower mountain belts, inhabiting rocky and gravelly slopes, terraces, and dry riverbeds.

In the Central Kopetdag, it has been recorded in locations such as Germab, Gokdere, Archabil Gorge, Vannovsky, Neftyanovsky, Yablonovsky, Kurtsuv, Babazav, Dushakerekdag, Heyrabad, Karaagach, Mergenolen, Kurkulab Arvaz, Gaudan, and others.

**Biological Resources.** In the Central Kopetdag, dense thickets of Kopetdag Dorema are rare despite its wide distribution. One such area was identified by us in the Sunchi tract, where the plant occupies approximately 30 hectares. The plant density ranges from 5–6 to 30–35 individuals per 100 m<sup>2</sup>.

The average weight of a raw root is 2080.3 g, and the above-ground biomass weighs 929.6g. The yield of air-dried raw materials is 30% for roots and 28% for aerial parts. Assuming an average of 12 plants per 100 m<sup>2</sup> and a total plant population of 36,000,000, the total biological reserve of air-dried material for this area is estimated at 22.5 tons of underground biomass and 9.4 tons of above-ground biomass.

**Biochemistry.** The aerial parts of Kopetdag Dorema contain 0.09–0.12% essential oil, along with coumarins and flavonoids. The roots contain 19% resin, terpenoids, and coumarins (umbelliferone).

**Pharmacology and Ethnomedicine.** An extract from the roots of Dorema exhibits mild antitumor properties. The resin can also be used in the paint and varnish industry. However, the medicinal and other beneficial properties of Dorema species in Turkmenistan have not been sufficiently studied [1]. The wide distribu-

tion of certain species within the genus, along with relatively high raw material reserves, makes *Dorema* a promising subject for further research and practical application.

**Technology of Raw Material Harvesting and Storage.** The roots of *Dorema* are harvested from well-developed perennial vegetative plants, while the aerial parts are collected from generative shoots.

It is preferable to dig the roots after the plant has completed its vegetative cycle.

Grass (leaves and stems) should be harvested at the peak of leaf development, before they start to wither. The collected leaves and shoots are pre-chopped and dried in small stacks in the shade.

After digging, roots are cleaned from soil residues and cut into pieces no larger than 5–10 cm. They are dried either in the shade or in direct sunlight using active drying methods, spreading them in thin layers and frequently turning them. Dried raw materials are stored in bales or bags in dry, well-ventilated rooms, kept separate from other medicinal plant materials.

Based on accumulated experience, it is recommended to harvest no more than 15–20% of the plant population annually in industrial collection areas. This practice ensures sustainable regeneration of *Dorema* thickets and maintains their stability within the plant community.

**Bioecological and morphological characteristics and distribution.** *Ungernia trisphaera* (*Ungernia trisphaera* Bunge) – is a perennial bulbous herb from the Amaryllidaceae family, growing to a height of 30–50 cm. Its bulb is very large, ovoid-conical, 15–20 cm long, and covered with multiple black membranous layers. The leaves are strap-shaped, 15–20 mm wide, and arranged in a rosette, with a bluish-gray color. The stem is stocky, and the spathe is membranous with a light brown tip, longer than the pedicels. It flowers in August and bears fruit in September [6].

*Ungernia trisphaera* grows from foothill plains to mid-mountain belts, often found on loess slopes of the foothills. The plant typically forms sparse clumps but grows abundantly within these clumps. It has been recorded in the Central and Eastern Kopetdagh regions.

**Biological resources.** In its natural habitat, *Ungernia* usually grows in scattered clumps without forming dense thickets. These clumps extend in narrow strips across the foothills from Eastern Kopetdagh to the Archabil area (Firyuza) in Central Kopetdagh, covering an area of approximately 160 hectares. The largest population was documented near the villages of Pervomayskoye, Kalininsk, and Kurykhovdan, covering about 50 hectares. The average plant density is 10,450 individuals per hectare, with a biological reserve of air-dried leaves amounting to 8.4 quintals (840 kg) per hectare. The total biological reserve across the entire

area is 420 quintals (42 tons). To maintain the population's vitality, one-tenth of the plants are reserved for natural regeneration, and harvesting is planned on a three-year rotation. Under this sustainable harvesting regime, the projected annual harvest volume is 126 quintals (12.6 tons).

**Biochemistry.** The leaves and bulbs of *Ungernia trisphaera* contain the primary alkaloid galantamine, along with lycorine, hordenine, tazettine, and pancratine. The total alkaloid content reaches its peak during the early leaf development stage and gradually decreases toward the end of the vegetation period.

**Pharmacology and ethnomedicine.** In medical practice, galantamine is used to alleviate the residual effects of poliomyelitis, polyneuritis, and radiculitis, as well as in the treatment of sensory and motor nerve injuries. Additionally, it is prescribed for the treatment of intestinal and bladder atony and is used in functional X-ray diagnostics of stomach and intestinal diseases.

**Harvesting and storage technology.** The leaves of *Ungernia* are harvested when they reach their maximum length of 30–35 cm, typically from mid-April until the onset of yellowing. Leaves are cut with knives or sickles to avoid damaging the bulb's growth point. After collection, the leaves are stacked in small piles (2–3 cm thick) and spread in a thin layer on tarps or open platforms. They are turned 2–3 times a day with rakes or pitchforks to prevent moisture buildup. Rapid drying is essential to maintain the green color of the leaves. If drying takes 4–5 days, the leaves may yellow and turn black. The final moisture content of the dried material should not exceed 12%, and the galantamine content should be at least 0.03%. The shelf life of the raw material is 2 years.

**Bioecological and morphological characteristics and distribution.** *Verbascum songaricum* Schrenk, known as Dzungarian mullein, is a perennial herbaceous plant from the family Scrophulariaceae. It grows to a height of 60–150 cm and is densely covered with ash-gray hairs, with heavily branched upper parts. The basal leaves are nearly sessile or have short petioles. The flowers grow in clusters, with a yellow corolla densely covered with hairs on the outside. It blooms and bears fruit from May to August.

This species inhabits rocky slopes in grass-forb mountain steppes and, less frequently, on fallow lands. It has been recorded in various areas, including Khojakala, Germab, Gaudan, Nokhur, Gökdere (Chuli), Gendivar, Yablonovsky, and Kurkusuv [6].

**Biological resources.** Anthropogenic degradation of vegetation in the Kopetdag region has reduced the ecological significance of mullein in plant communities from foothills to the juniper belt. However, the plant remains abundant and often forms independent communities or acts as a subdominant species in various formations. For instance, near Dushakerekdag, *Verbascum songaricum* is often a subdominant or associate in feather-grass-wormwood-fescue and grass-wormwood-juniper associations.

On the Saiwan massif, it appears in hawthorn-grass-spikelet associations and in maple formations as part of crimson-wormwood-maple communities. On the Saiwan massif, *Verbascum* occupies about 50 hectares, with dense thickets covering 30 hectares. The average density is 25 plants per 100 m<sup>2</sup>. A model plant (based on 100 samples) weighs 750 g, with a dry yield of 35%. Our data show that the biological reserve of above-ground biomass on 30 hectares is approximately 197 quintals (19.7 tons). The exploitable reserve, at 90% of the biological reserve, is 177 quintals (17.7 tons), and the annual harvesting potential is 88.6 quintals (8.86 tons). Harvesting should be conducted no more than once every three years at each site to ensure sustainable regeneration. Dense stands of *Verbascum songaricum* have also been recorded in other areas, including: Yablonovka-Kurkusuv massif – 25 ha Sunchi tract – 15 ha Germab-Heyrabad area – 500 ha Dushakerekdag region – 200 ha. The estimated raw material reserves of Dzungarian mullein across 1,000 hectares of industrial harvesting areas in Central Kopetdag range between 300 and 350 tons.

**Biochemistry.** The roots of the Dzungarian mullein (*Verbascum songaricum*) contain triterpenoid saponins and alkaloids (0.07%). The aerial parts hold essential oils, iridoids, triterpenoid saponins, alkaloids, coumarins, and flavonoids. Alkaloid content in stems ranges from 0.07% to 0.09%, while leaves contain 0.09%–0.18% alkaloids along with other nitrogen-containing compounds, such as anabasine, plantagonin, acetamide, vitamin C, coumarins (2.15%), and flavonoids (0.5%). Buds, flowers, fruits, and seeds also contain triterpenoid saponins, alkaloids, coumarins, and flavonoids.

**Pharmacology and ethnomedicine.** The decoction and infusion of *Verbascum* flowers exhibit pressor effects and stimulate cardiac activity. Dried leaves, their decoction, and fresh leaf juice have analgesic and wound-healing properties, particularly for burns, tumors, and ulcers. The essential oil extract demonstrates antifungal activity. Additionally, the plant shows insecticidal and ichthyocidal properties.

**Harvesting and storage technology.** The medicinal raw materials of *Verbascum* include the entire above-ground biomass (herb) and flowers. Both are best harvested during peak flowering, from late May to the first ten days of June. For whole-plant harvesting, the plants are cut entirely, while for flower harvesting, only the inflorescences are collected. The plants are spread on tarps in layers of 25–30 cm and dried in the shade. Drying is complete when the stems break easily with slight pressure. Once dry, the stems are crushed and packed into bags weighing 10–15 kg. Flowering stalks are threshed with sticks, and the separated flowers are bagged and stored in dry rooms on shelves.

**Bioecological and morphological characteristics and distribution.** *Ziziphora clinopodioides* Lam., known as wedge-leaved ziziphora, is a small shrub from



the Lamiaceae family, reaching 20–50 cm in height. The perennial parts of the shoots are woody and branched, while the annual twigs are numerous, thin, and herbaceous. The entire plant is covered with short hairs. The leaves range from ovate-elongate to lanceolate, with short pointed tips. The inflorescences are terminal, capitate, and multi-flowered, with light lilac corollas. It blooms from May to July and bears fruit from July to August [6].

**Biological resources.** We have conducted a detailed survey of two areas with ziziphora thickets, which are of interest for raw material procurement. These areas are located in the western part of the Central Kopetdagh.

The first area is situated on the southeastern gentle slope near the locality of Gosharcha, adjacent to the buffer zone of the Syunt-Hasardag State Nature Reserve. The site and its surrounding area have served as pasturelands for many years, which directly impacts the vegetation cover.

We studied the structural composition of the ziziphora-thyme association over a transect area of 100 m<sup>2</sup> (25 × 4 m). The plants were categorized by size into the following classes: Class I: Shrubs with a diameter greater than 50 cm, Class II: Diameter from 50 to 30 cm, Class III: Diameter from 30 to 10 cm. In the Gosharcha locality, the ziziphora thickets cover an area of 10–12 hectares, including 5–6 hectares of potentially high-yield zones, which were used to calculate the exploitable stock of raw materials. We estimate that 4/5 of the exploitable stock can be harvested annually, with 1/5 of mature plants left for natural regeneration through seeds.

The exploitable stock of ziziphora across 6 hectares amounts to 12.48 quintals, with an estimated annual harvestable volume of 9.98 quintals.

The second harvestable area of ziziphora thickets is located 3–4 km south of the village of Saiwan. This area covers degraded pastures at elevations of 1300–1400 m above sea level. Ziziphora communities here are part of a mixed herb-grass formation that dominates the Saiwan-Sumbar Plateau. The total area of thickets in this region is about 50 hectares, half of which is suitable for raw material harvesting.

We determined that the harvestable area of ziziphora covers 25 hectares. The exploitable stock in this area is 95.3 quintals, with a potential annual harvest of 76.2 quintals.

**Biochemistry.** In the Central Kopetdag region, the content of essential oil in the above-ground parts of ziziphora remains relatively stable, ranging from 0.50% to 0.56%. Other biologically active compounds found in ziziphora include alkaloids, flavonoids, coumarins, lactones, and saponins. The seeds contain up to 10% fatty oil.

**Pharmacology and ethnomedicine.** Ziziphora raw materials have traditionally been used in perfumery and medicine, particularly for the production of men-

thol. As a medicinal plant, it is employed to treat sore throats in children, stomach pain, nausea, and as a diuretic. A floral extract is recommended for the treatment of gastric catarrh. The diverse applications of ziziphora have led to its introduction into cultivation.

**Technology of raw material harvesting and storage.** It has been established that ziziphora thickets regenerate within 1–2 years after industrial harvesting. The collection of raw material is carried out during the plant's peak flowering period. Aerial shoots are cut at a height of 2–3 cm above the soil surface, and uprooting the plants is strictly prohibited. The collected raw material is dried outdoors but always in the shade, spread in layers of 5–7 cm on tarps, with frequent stirring. During the drying process, the plants lose up to 43% of their essential oil, so for optimal oil extraction, it is preferable to process the plants fresh. The shelf life of dried raw material is 3 years.

Thus, the medicinal plants of the Kopetdagh region that were studied show promise for the production of plant-based pharmaceuticals. The biological resources and phytochemical characteristics of several ecologically significant medicinal species from the Kopetdagh flora reveal their potential for use in the pharmaceutical industry of Turkmenistan.

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人工通气对3岁以下急性脑供血不足患儿收缩压昼夜节律的影响  
**EFFECT OF ARTIFICIAL VENTILATION ON THE CIRCADIAN  
RHYTHM OF SYSTOLIC BLOOD PRESSURE IN ACUTE  
CEREBRAL INSUFFICIENCY IN CHILDREN UNDER 3 YEARS OF  
AGE**

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摘要。在动态方面，在整个观察过程中，机械通气对最初中度升高的SBP昼夜节律中值没有显著影响。应激保护疗法的有效性表现为两组SBP昼夜节律幅度相对于指标在第一天降低，组1降低7mm Hg，组2降低19mm Hg，随后几天波动在5mm Hg以内。组1中SBP昼夜节律适应性重组的应激反应趋势更为明显，也表现为倒置持续时间增加2.5%的趋势。在长期机械通气的儿童中，SBP昼夜节律中值的变化直接取决于每日平均体温的动态。

关键词：人工通气，昼夜节律，收缩压，急性脑供血不足，儿童。

**Abstract.** *In dynamics, throughout the observation, mechanical ventilation did not have a significant effect on the initially moderately elevated mesor of the circadian rhythm of SBP. The effectiveness of stress-protective therapy was manifested in a decrease in the amplitude of the circadian rhythm of SBP in both groups relative to the indicator on the first day in group 1 by 7 mm Hg and by 19 mm Hg in patients of group 2, with fluctuations in the following days within 5 mm Hg. The tendency to a more pronounced stress reaction of the adaptive restructuring of the circadian rhythm of SBP in group 1 was also expressed in a tendency to increase the duration of inversion by 2.5%. In children with prolonged mechanical ventilation, changes in the mesor of the circadian rhythm of SBP were directly dependent on the dynamics of the average daily body temperature.*

**Keywords:** *artificial ventilation, circadian rhythm, systolic blood pressure, acute cerebral insufficiency, children.*

**Relevance.** In early age periods (in newborns, infants and young children), the systemic inflammatory response is characterized by two main features: when an inflammatory focus occurs, a tendency to generalization is clearly defined due to the inability of the macroorganism to limit the local process, which depends on the age, anatomical and functional immaturity of the organs of immunogenesis and barrier tissues, which facilitates the penetration of pathogens and their toxins into the bloodstream and lymph; in newborns and infants, some special types of alternative and productive inflammation are observed, which are close to the inflammatory reaction of the intrauterine period and reflect the formation of this reaction in phylo and ontogenesis. At the same time, the authors of numerous studies take into account that the presence of special forms of inflammation does not exclude the development of exudative, even purulent inflammation in the fetus, newborn and infant. The listed features are characteristic of a young child, when his reactions are close to reactions during the period of intrauterine development. Later, these features lose their significance, but the tendency to generalization of the local process during inflammation accompanies almost the entire period of childhood, so in young children, a primitive form of infectious disease, sepsis, easily occurs. The systemic inflammatory response (SIR) is considered the main pathogenetic link in sepsis. The leading place in the development of SIR is given to inflammatory mediators. More than 300 inflammatory mediators are known, but only dozens of them are used in clinical practice as markers, while the rest need to be discussed from the standpoint of reliability, sensitivity and specificity. None of the markers can be considered universal, which is why there are difficulties in identifying the key moments of the pathogenesis of SIR. The most severe complication of SIR is progressive multiple organ failure (POF), including acute cerebral failure (ACF). Mortality from PON remains extremely high, reaching 80% of the total mortality in intensive care units. The peculiarities of the course of pneumonia in children with childhood cerebral insufficiency are caused by: decreased vital capacity of the lungs due to muscle weakness or spastic scoliosis; weakening of the cough reflex; frequent dysphagia and vomiting with the development of aspiration; gastroesophageal reflux disease; severe protein-energy malnutrition with manifestations of cachexia; frequent antibiotic resistance of pathogens; rapid development of metabolic acidosis and hypercapnia; development of seizures - both true and febrile. Due to the lack of information on the peculiarities of managing children with early cerebral insufficiency, an attempt was made to assess the effect of mechanical respiratory support on the circadian rhythm of systolic blood pressure (SBP) in the inflammatory response to complicated infectious diseases in young

children based on the study of hourly prolonged monitoring of hemodynamic parameters [1-5].

**Objective of the work.** To study and evaluate the effect of mechanical respiratory support on the circadian rhythm of systolic blood pressure in acute cerebrovascular insufficiency caused by complicated infectious diseases in young children.

**Material and methods of the study.** The results of continuous prolonged monitoring with hourly recording of hemodynamic and respiratory parameters were studied in children admitted to the ICU of the RRCEM in a critical condition due to infection complicated by acute cerebral and respiratory failure at the age of 5.5 months to 2.5 years. Intensive care was carried out according to the recommendations in the relevant clinical protocols. Group 1 included 8 children with impaired consciousness aged  $12.6 \pm 5.5$  months who had no indications for mechanical respiratory support upon admission to the clinic and throughout intensive care. Almost all patients of group 2 (11 children) aged  $17.4 \pm 6.1$  months were transferred to mechanical ventilation according to indications from the moment of admission to the clinic. Impairment of cerebral function was assessed according to the Glasgow scale in group 1  $9.1 \pm 0.4$ , in the second  $6.5 \pm 1.0$  points, which corresponded to a reliably significant suppression of brain function by 29%, which determined the duration of MCI, the duration of intensive care in the ICU and in the hospital as a whole (Table 1).

**Table 1.**  
*Characteristics of the clinical material*

Groups	gender, m/f	Age, months	G S, points	Duration of artificial ventilation, days	In intensive care unit, 24 hours	In hospital, 24 hours
1	2/6,	12,2±5,5	9,1±0,4	0	12,3±5,2	16,3±4,1
2	8/3,	17,4±6,1	6,5±1,0	40,4±15,0	74,3±14,7	79,3±9,5

Severe pneumonia was detected in 11 children (100%) of group 2 (Table 2). The peculiarity of patients of group 2 was concomitant chronic neurological diseases, such as Aicardi syndrome, floppy child syndrome (27%), acute severe hypoxic brain injury caused by complications of oropharyngeal burn (9%), foreign body in the respiratory tract (9%), acute severe pneumonia complicated by grade 3 acute respiratory failure (82%).

**Table 2.**

Diagnosis	1 group	2 group
Bilateral pneumonia	87% (7)	100% (11)

Sepsis	37% (3)	12% (1)
Acute renal failure	37% (3)	18% (2)
Acute respiratory failure	25% (2 patients 1-2 degree)	82% (9 patients 3 degree)
DIC	0	9% (1)
Congenital anomaly of the central nervous system	12% (1)	27% (3)
Thermal burn of the oropharynx, post-hypoxic encephalopathy	0	9% (1)
Post-resuscitation disease, CPR, foreign body in the respiratory tract.	0	9% (1)
total	100% (8)	100% (11)

As the condition improved, the impaired organ functions were effectively corrected, reflexes and consciousness were restored, the patients were transferred to a specialized department. Thus, in group 1, by the 14th day, 4 children (50%) needed intensive care, in group 2, 8 patients (72%). In the average values of the parameters of the phase structure of the circadian rhythm of SBP, a predominance of the tendency to an increase in the meso of the circadian rhythm of SBP was noted in group 1 by 19%, in group 2 - by 15%, the difference in indicators in both groups (Table 3) between patients of groups 1 and 2 was 4%, which turned out to be insignificant. With a generally accepted norm of SBP = 80-85 mm Hg in the age group.

**Table 3.**

*Effect of artificial ventilation on the average values of the phase structure of the circadian rhythm of SBP*

Groups	Mesor	Acrophase	Batiphase	Amplitude	Range of daily fluctuations
1	102±3	110±4	93±3	8±2	17±4
2	99±3	106±3	94±4	7±2	12±3

**Table 4.**

*Dynamics of the mesoscopic circadian rhythm of systolic blood pressure*

Days	1 group	2 group
1	99±5	100±9
2	98±3	100±2
3	97±3	98±2
4	100±3	97±4
5	100±3	97±2
6	98±2	94±2

7	98±4	101±2
8	100±2	101±2
9	97±3	100±2
10	107±5	102±2
11	105±4	104±2
12	103±3	102±2
13	103±4	100±2
14	101±3	102±2
15	105±5	101±2
16	108±3	101±2
17	99±2	104±2
18	108±3	101±2
19	98±3	99±4
20	111±4	100±3
21		106±2
22		103±2
23		97±2
24		97±3
25		98±2
26		98±3
27		105±2
28		103±3
29		104±2
30		104±2
31		99±5
32		95±2
33		96±3
34		94±2
35		99±4
36		93±2
37		91±3
38		89±3
39		100±4
40		93±2

**Table 5**  
*The effect of artificial ventilation on the average circadian rhythm of SBP up to 3 years*

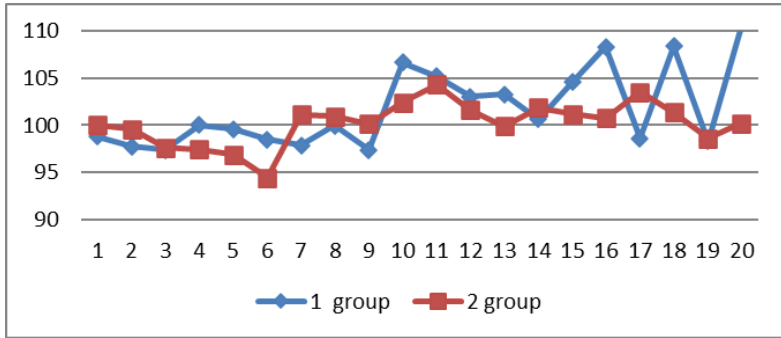
Hours	1 group	2 group
8	104±5	100±4

9	102±5	100±4
10	102±4	99±4
11	101±4	98±4
12	102±4	99±4
13	102±5	100±4
14	102±4	101±4
15	100±5	101±4
16	102±5	100±4
17	102±4	100±3
18	103±4	100±4
19	103±5	100±4
20	103±4	100±4
21	102±4	99±4
22	102±5	99±4
23	102±5	99±4
24	100±5	98±5
1	99±5	98±4
2	100±6	98±5
3	100±5	98±5
4	103±5	98±3
5	102±5	98±5
6	101±5	99±4
7	102±5	99±4

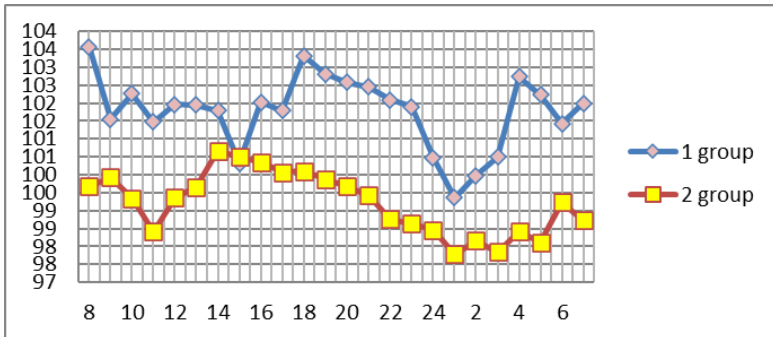
In dynamics, throughout the observation period (Table 4), the applied method of artificial ventilation did not have a significant effect on the mesomorph of the circadian rhythm of SBP. Although Fig. 1 shows an increase in fluctuations of the indicator on days 10, 16-20 in Group 1. While with prolonged artificial ventilation, a tendency to decrease was noted on day 6 (Fig. 1) with stabilization of the mesomorph of the circadian rhythm of SBP at the level of 100-104 mm Hg, maintaining a tendency to increase on days 11-40 (Table 4). In the average circadian rhythm of SBP, no significant effects of artificial ventilation on cardiac output were revealed (Table 5). The peak of the acrophase of the average circadian rhythm of SBP in Group 2 was at 14:00 (the shift was 3 hours), while in Group 1 it was at 8 and 18:00. That is, it can be assumed that under the influence of a more pronounced stress reaction of hemodynamics, two waves were formed - 8-hour and 10-hour (Fig. 2), which can be represented as an adaptive compensatory restructuring of the circadian rhythm of the SBP to a more pronounced stress reaction of the cardiovascular system in conditions of limited, less significant drug stress-protective therapy in children in order to preserve the adaptive capabilities of the respiratory



system in conditions of comparatively less damage to the central nervous system and acute cerebral insufficiency in group 1.

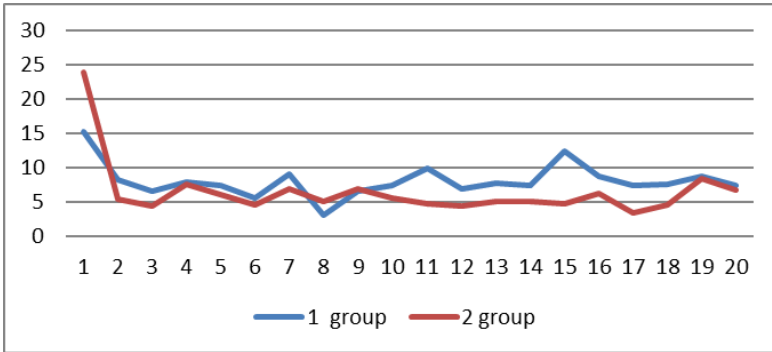


**Figure 1.** Mesozoic circadian rhythm of SBP in children with cerebral insufficiency up to 3 years, mmHg.

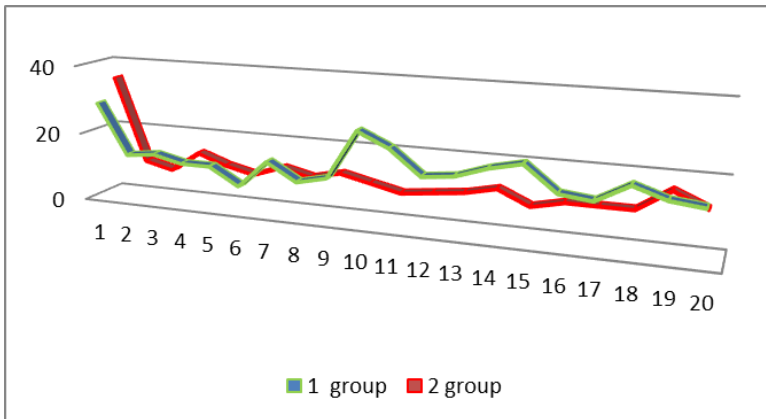


**Figure 2.** Effect of artificial ventilation on the average circadian rhythm of SBP up to 3 years

The effectiveness of stress-protective therapy is also demonstrated by a decrease in the amplitude of the circadian rhythm of SBP in both groups (Fig. 3) relative to the indicator on the first day in group 1 by 7 mm Hg in group 1 and by 19 mm Hg in patients of group 2, with fluctuations in the following days within 5 mm Hg. Synchronous dynamics of changes in the range of daily SBP fluctuations confirmed the effectiveness of stress-limiting therapy for ACI in both groups (Fig. 4).



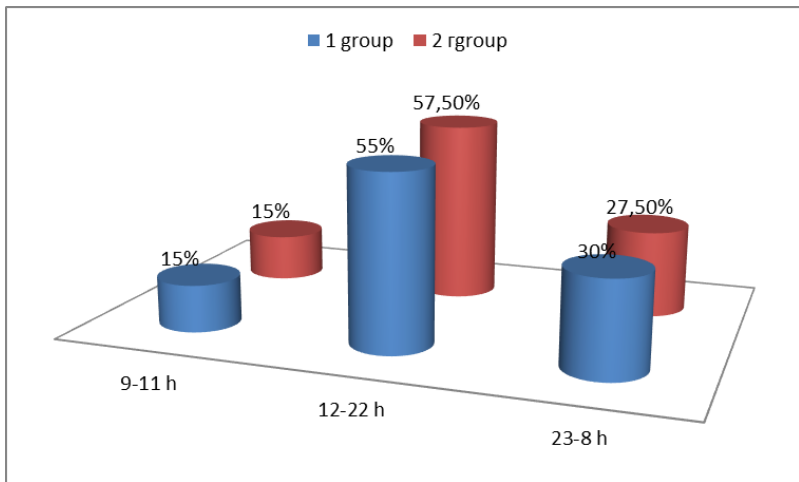
**Figure 3.** Effect of artificial ventilation on the amplitude of the circadian rhythm of SBP, mm Hg.



**Figure 4.** Effect of mechanical ventilation on daily fluctuations of SBP, mmHg.

Unlike Group 1, where the correlation between the temperature response and the SBP indicator was (0.12), a direct strong correlation was found between changes in the circadian rhythm of the average hourly body temperature in children of Group 2 (0.73). That is, in children with prolonged mechanical ventilation, changes in the mesoscopic circadian rhythm of SBP were directly dependent on the dynamics of the average daily body temperature. The latter is one of the leading causes of increased stress on the heart due to the hyperdynamic type of hemodynamics with insufficiently suppressed systemic inflammatory response, which, in the absence of the necessary supportive therapy for increased cardiac output, leads to cardiac failure and cardiac decompensation. The identified factor is an indication for the development of methods of nutritional support in the fight against

the energy-deficient state of the myocardium, preventive administration against the background of more effective anti-inflammatory therapy of cardiogenic, stimulators of the synthesis of energy-intensive substrates that increase not only functional activity, but also ensure improved metabolism of the muscular structures of the cardiovascular system, regulating the properties of CNS cells, increasing the adaptive capabilities of vital homeostasis systems, and the survival of the body. One of the key factors in the management of patients with prolonged mechanical ventilation is, along with maintaining cardiac output, improving the rheological properties of the blood, since an increase in blood viscosity at an early age with preserved physiological hypertrophy of the smooth muscles of the vascular walls is a factor involved in increasing pressure in the pulmonary artery system, has a significant aggravating effect on the work of the myocardium.



**Figure 5.** Shift of the peak of the acrophase of the circadian rhythm of SBP

The tendency to a more pronounced stress reaction of the adaptive restructuring of the circadian rhythm of SBP was also expressed in the tendency to increase the duration of inversion in group 1 by 2.5% (Fig. 5).

**Conclusion.** In dynamics throughout the observation, the method of artificial ventilation did not have a significant effect on the moderately increased mesoral index of the circadian rhythm of SBP. The effectiveness of stress-protective therapy was also demonstrated in a decrease in the amplitude of the circadian rhythm of SBP in both groups relative to the indicator on the first day in group 1 by 7 mm Hg and in group 2 by 19 mm Hg in patients of group 2, with fluctuations in the following days within 5 mm Hg. The tendency to a more pronounced stress

reaction of the adaptive restructuring of the circadian rhythm of SBP in group 1 was also expressed in the tendency to increase the duration of inversion by 2.5%. In children with prolonged mechanical ventilation, changes in the mesocircadian rhythm of SBP were directly dependent on the dynamics of average daily body temperature.

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机械呼吸支持对幼儿急性脑供血不足舒张压昼夜节律的影响

**EFFECT OF MECHANICAL RESPIRATORY SUPPORT ON THE  
CIRCADIAN RHYTHM OF DIASTOLIC BLOOD PRESSURE IN  
ACUTE CEREBRAL INSUFFICIENCY IN YOUNG CHILDREN**

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摘要。在两组中，DBP昼夜节律中值的平均值与标准值没有偏差，在DBP昼夜节律幅度和指标每日波动方面存在差异，在第7天后，DBP昼夜节律中值有增加的趋势，在第2组中更为明显。第2组在重症监护10天后DBP每日波动增加对应于严重的炎症反应，并发急性脑功能不全，直至不同严重程度的昏迷，这无助于全身血流动力学的稳定。揭示的相关性对应于在机械呼吸支持下，3岁以下儿童在严重炎症反应中血流动力学适应能力的保留。

关键词：机械呼吸支持，舒张压昼夜节律，急性脑功能不全，幼儿。

**Abstract.** In the absence of deviations of the average values of the meso of the circadian rhythm of DBP from the normatives in both groups of differences in the amplitude of the circadian rhythm of DBP and the daily fluctuation of the indicator, a tendency to an increase in the meso of the circadian rhythm of DBP after the 7th day was noted, somewhat more pronounced in group 2. An increase in

*daily fluctuations in DBP after 10 days of intensive care in group 2 corresponded to a severe course of a pronounced inflammatory reaction complicated by acute cerebral insufficiency up to coma of varying severity, which did not contribute to the stabilization of systemic hemodynamics. The revealed correlations corresponded to the preservation of the adaptive capabilities of hemodynamics in severe inflammatory reaction in children under 3 years of age under mechanical respiratory support.*

**Keywords:** *mechanical respiratory support, circadian rhythm of diastolic blood pressure, acute cerebral insufficiency, young children.*

**Relevance.** Acute cerebral failure (ACF) is a critical condition caused by the loss of higher and basic nervous activity by the body, as well as neuronal regulation of the activity of vital organs and systems. Along with clinical and laboratory manifestations of brain damage, acute cerebral failure is accompanied by manifestations from the vital organs and systems of the body, which can significantly complicate the course of the critical condition. Acute cerebral failure is a life-threatening condition accompanied by “neurogenic” multiple organ failure, the development of which aggravates the course of the disease and increases the risk of an unfavorable outcome. “Neurogenic” organ dysfunction requires clinicians to conduct basic monitoring of vital parameters, a set of measures for the prevention and treatment of neurogenic complications. The presence of special forms of inflammation does not exclude the development of exudative, even purulent inflammation in the fetus, newborn and infant. The listed features are typical of a young child, when his reactions are close to reactions during the period of intrauterine development. Later, these features lose their significance, but the tendency to generalization of the local process during inflammation accompanies almost the entire period of childhood, so in young children, a primitive form of infectious disease - sepsis - easily develops. Systemic inflammatory response (SIR) is considered as the main pathogenetic link in sepsis. The leading place in the development of SIR is given to inflammatory mediators. The most severe complication of SIR is progressive multiple organ failure (POF), including acute cerebral failure (ACF). Mortality from PON remains extremely high, reaching 80% of the total mortality in intensive care units. Features of the course of pneumonia in children with childhood cerebral failure are due to: a decrease in the vital capacity of the lungs due to muscle weakness or spastic scoliosis; weakening of the cough reflex; frequent dysphagia and vomiting with the development of aspiration; gastroesophageal reflux disease; severe protein-energy malnutrition with manifestations of cachexia; frequent antibiotic resistance of pathogens; rapid development of metabolic acidosis and hypercapnia; development of seizures - both true and febrile. Due to the lack of information on the specifics of managing children with

early cerebral insufficiency, an attempt was made to assess the effect of mechanical respiratory support on the circadian rhythm of systolic blood pressure (SBP) in the inflammatory response to complicated infectious diseases in young children based on the study of hourly prolonged monitoring of hemodynamic parameters [1-6].

**Objective.** To study and assess the effect of mechanical respiratory support on the circadian rhythm of DBP in early cerebral insufficiency caused by complicated infectious diseases in young children.

**Material and methods of the study.** The results of continuous prolonged monitoring with hourly recording of hemodynamic and respiratory parameters were studied in children admitted to the ICU of the RRCEM in a critical condition due to infection complicated by acute cerebral and respiratory failure at the age of 5.5 months to 2.5 years. Intensive care was carried out according to the recommendations in the relevant clinical protocols. Group 1 included 8 children with impaired consciousness aged  $12.6 \pm 5.5$  months who had no indications for mechanical respiratory support upon admission to the clinic and throughout intensive care. Almost all patients of group 2 (11 children) aged  $17.4 \pm 6.1$  months were transferred to mechanical ventilation according to indications from the moment of admission to the clinic. Impairment of cerebral function was assessed according to the Glasgow scale in group 1  $9.1 \pm 0.4$ , in the second  $6.5 \pm 1.0$  points, which corresponded to a reliably significant suppression of brain function by 29%, which determined the duration of MCI, the duration of intensive care in the ICU and in the hospital as a whole. As the condition improved, the impaired organ functions were effectively corrected, reflexes and consciousness were restored, the patients were transferred to a specialized department.

The research data were processed by the method of variation statistics using the Excel program by calculating the arithmetic mean values (M) and errors of the mean (m). To assess the reliability of differences in two values, the parametric Student's criterion (t) was used. The relationship between the dynamics of the studied parameters was determined by the method of paired correlations. The critical level of significance was taken to be 0.05.

**Results and their discussion.** The average meso of the circadian rhythm of DBP for the entire observation period was within the permissible normatives in both groups (Table 1). No significant differences in the amplitude of the circadian rhythm of DBP and the daily fluctuation of the indicator were noted.

**Table 1**

*Average values of the phase structure of the circadian rhythm of DBP in children under 3 years of age, mm Hg.*

Groups	Mesor	Acrophase	Batiphase	Amplitude	Fluctuation per day
1	58±2	67±4	52±2	9±2	16±4
2	60±2	66±3	52±4	7±2	14±5

**Table 2**

*Dynamics of the meso circadian rhythm of DBP, mm Hg*

Days	1 group	2 group
1	57±4	57±5
2	55±2	58±3
3	57±3	57±2
4	57±2	57±3
5	57±2	57±2
6	54±3	57±2
7	57±4	60±2
8	57±2	60±2
9	56±2	60±2
10	59±4	59±2
11	59±3	63±2
12	55±3	58±2
13	58±3	58±2
14	60±4	61±3
15	61±4	59±3
16	60±2	60±2
17	61±4	62±3
18	60±3	60±2
19	61±4	58±2
20	62±4	60±2
21		61±2
22		64±3
23		61±2
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25		59±4
26		57±2
27		63±2
28		62±3
29		63±2
30		62±2

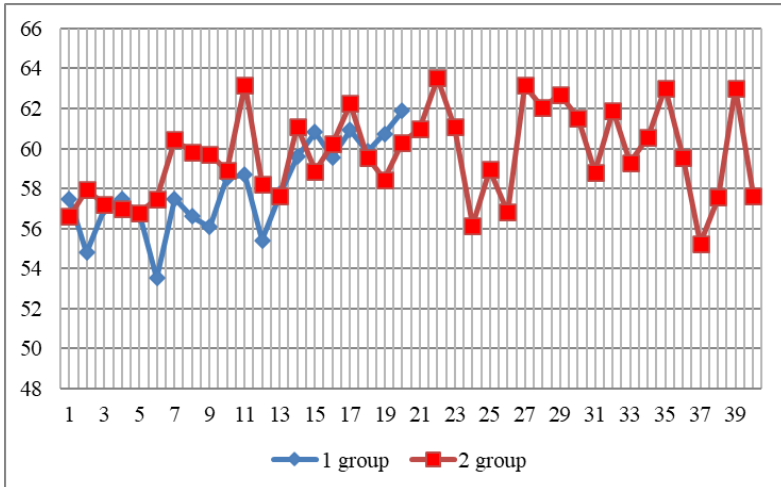


31		59±5
32		62±2
33		59±3
34		61±2
35		63±3
36		60±2
37		55±3
38		58±4
39		63±4
40		58±4

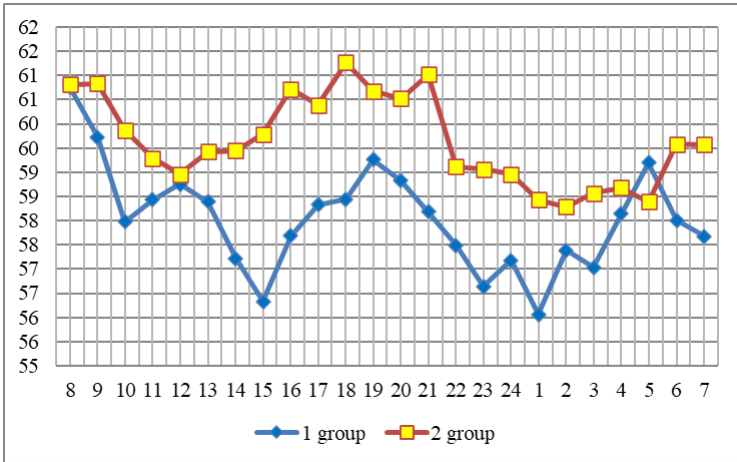
**Table 3**  
*Average circadian rhythm of DBP, mm Hg*

<b>Hours</b>	<b>1 group</b>	<b>2 group</b>
8	61±4	61±3
9	60±4	61±3
10	58±4	60±3
11	58±4	59±2
12	59±3	59±2
13	58±3	59±3
14	57±3	59±2
15	56±2	60±2
16	58±3	61±2
17	58±4	60±3
18	58±3	61±3
19	59±3	61±3
20	59±3	61±4
21	58±2	61±3
22	57±3	59±4
23	57±3	59±4
24	57±4	59±4
1	56±4	58±3
2	57±4	58±3
3	57±4	59±3
4	58±4	59±3
5	59±3	58±3
6	58±3	60±4
7	58±3	60±4

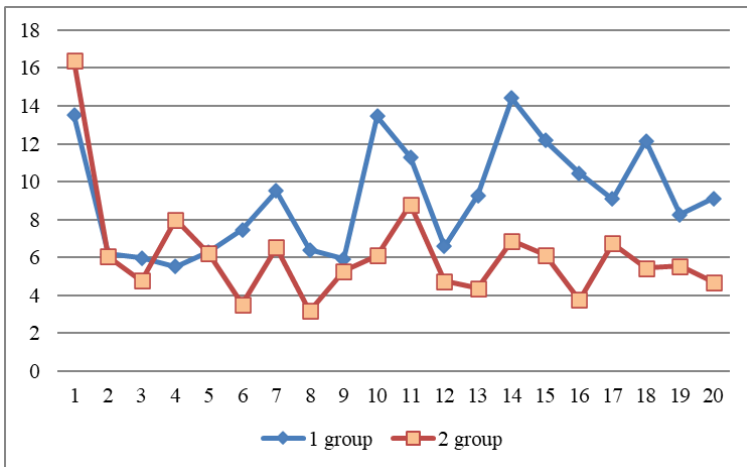
During 20 days of intensive care in the ICU in group 1 and 40 days in group 2, no significant deviations from the norm were detected (Table 2). A tendency to increase in the mesoscopic circadian rhythm of DBP after the 7th day was noted, somewhat more pronounced in group 2 (Fig. 1). In the average circadian rhythm of DBP in group 1, formation of 3-phase waves from one circadian sinusoid with a length of 7, 10, 7 hours and an oscillation amplitude of 5 mm Hg, 3 mm Hg, 3 mm Hg was noted, which can be understood as a stress reaction of the circadian wave of DBP in the absence of mechanical respiratory support, under conditions of a lower degree of sedation in SIRS caused by pneumonia and less pronounced cerebral insufficiency of children in group 1. The projection of the acrophase of the circadian rhythm of DBP in group 2 was shifted by 18 hours (the norm is 9-11 hours) (Fig. 2).



*Figure 1. Dynamics of the mesocircadian rhythm of DBP, mm Hg.*

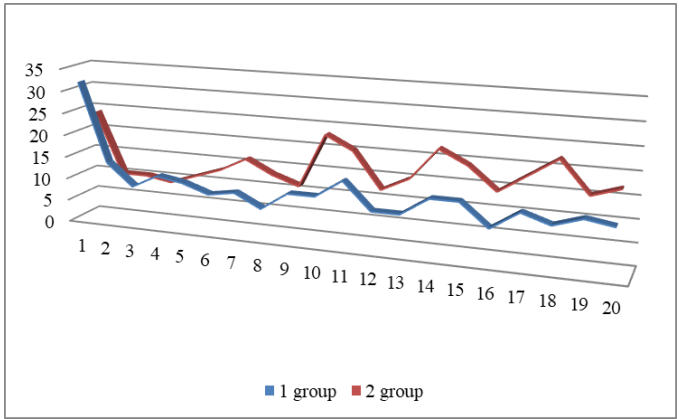


**Figure 2.** Average circadian rhythm of DBP, mm Hg.



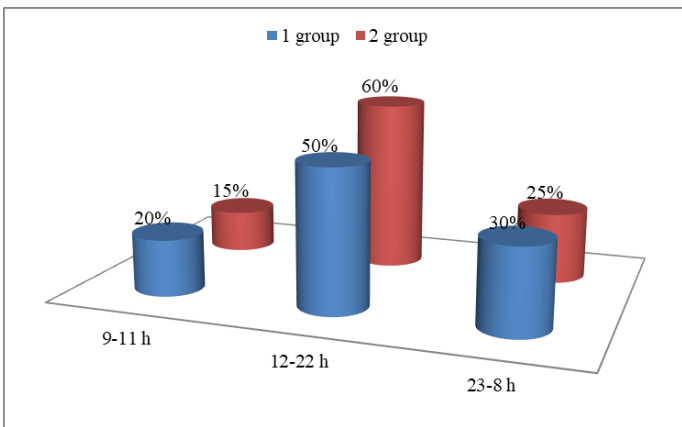
**Figure 3.** Dynamics of the amplitude of the circadian rhythm of DBP, mm Hg.

During the first 20 days of observation, a slight tendency towards an increase in the amplitude of the circadian rhythm of DBP was noted in group 1 after the 9th day by 5 mmHg on the 10th, 14th, 18th day, while this indicator in group 2 was characterized by monotony and a lower amplitude of daily fluctuations, starting from the 2nd day against the background of mechanical ventilation (Fig. 3).



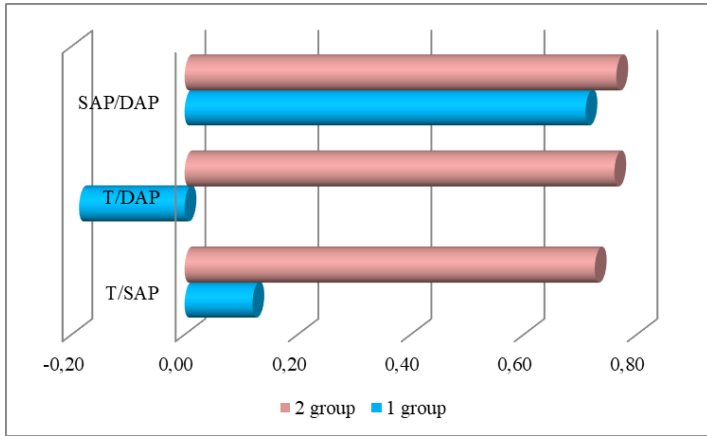
**Figure 4.** Dynamics of daily fluctuations in DBP, mmHg.

The daily fluctuations in DBP were the greatest on the 1st day (group 1 – 30 mmHg, group 2 – 23 mmHg), then the repeated increase in the daily range was more pronounced in patients of group 2 (up to 10 mmHg on the 10th day) and almost twice as small in children of group 1. The revealed difference can be explained by the positive dynamics of the condition in group 1 due to the effectiveness of the intensive care. While in group 2, more severe bilateral pneumonia combined with a more pronounced inflammatory reaction complicated by acute cerebral insufficiency up to coma of varying severity did not contribute to the stabilization of systemic hemodynamics (Fig. 4).



**Figure 5.** Effect of artificial ventilation on the duration of inversion of the circadian rhythm of DBP in ACI

Some predominance of the duration of inversion of the circadian rhythm of DBP (by 5%) in Group 1 confirmed a more active participation of the circadian rhythm of DBP in adaptive processes with preserved spontaneous breathing in severe ACI, which complicated an infectious disease in young children (Fig. 5).



*Figure 6. Correlation links of DBP dynamics*

A direct strong correlation link of DBP with the level of SBP (0.76), hyperthermic reaction (0.76), as well as a direct dependence of SBP on the temperature level (0.73) was found in children of group 2 (Fig. 6). The revealed corresponded to the preservation of the adaptive capabilities of hemodynamics on the severity of the inflammatory reaction in children of group 2.

**Conclusion.** In the absence of deviations of the average values of the meso of the circadian rhythm of DBP from the normatives in both groups, differences in the amplitude of the circadian rhythm of DBP and the daily fluctuation of the indicator, a tendency to an increase in the meso of the circadian rhythm of DBP after the 7th day was noted, somewhat more pronounced in group 2. The increase in daily fluctuations of DBP after 10 days of intensive care in Group 2 corresponded to a severe course of a pronounced inflammatory reaction complicated by ACI up to coma of varying severity, which did not contribute to the stabilization of systemic hemodynamics. The revealed correlations corresponded to the preservation of adaptive capabilities of hemodynamics in a pronounced inflammatory reaction in children under 3 years of age under mechanical respiratory support.

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哈萨克斯坦现阶段艾滋病毒感染情况  
HIV INFECTION IN KAZAKHSTAN AT THE PRESENT STAGE

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注释。本文探讨了现阶段哈萨克斯坦共和国艾滋病毒感染的流行病学特征。研究了哈萨克斯坦共和国艾滋病预防和控制服务部门 2000 年至 2023 年期间的官方统计数据。结果表明，使用新型精神活性物质可能会增加通过注射和性传播艾滋病毒的风险。

关键词：流行病学、艾滋病毒感染、新型精神活性物质、哈萨克斯坦。

**Annotation.** *This article examines the epidemiological features of HIV infection in the Republic of Kazakhstan at the present stage. The data of official statistics of the service for the prevention and control of AIDS of the Republic of Kazakhstan for the period from 2000 to 2023 were studied. It was revealed that the use of new psychoactive substances may be accompanied by an increased risk of HIV transmission both by injection and sexually.*

**Keywords:** *epidemiology, HIV infection, new psychoactive substances, Kazakhstan.*

### Introduction

According to data provided in the UNAIDS fact sheet, The total number of people worldwide living with HIV in 2023 was 39.9 million (36.1–44.6 million) [1], and the number of new HIV infections in 2023 was 1.3 million (1–1.7 million)

people. In total, 42.3 million (35.7–51.1 million) people have died from AIDS-related illnesses since the beginning of the epidemic. At the same time, the UNAIDS report notes a 60% decrease in the number of new HIV infections compared to 1995, when this indicator peaked [2]. The sharpest decline in new infections occurred among children (aged 0–14 years) and young people (aged 15–24 years), who have been targeted by effective interventions in recent years. The global 95–95–95 targets [3, 4] have become the starting point for all countries to stop the spread of the AIDS epidemic by 2030. These targets reflect a fundamental shift in the global approach to HIV testing and treatment, taking into account the number of people living with HIV (PLHIV) who know their status (the first 95), the number of people receiving antiretroviral therapy (the second 95), and the importance of maximal viral suppression in people living with HIV (the third 95). The fight against HIV infection is an important area for public health in the Republic of Kazakhstan. In order to fulfill the global commitments on AIDS adopted by the Government of the Republic of Kazakhstan, the Ministry of Health of the Republic of Kazakhstan on March 16, 2023 approved the roadmap “On the implementation of measures to prevent HIV infection in the Republic of Kazakhstan for 2023–2026” [5], which includes activities for the prevention, diagnosis and treatment of the disease, the development of specialized non-governmental organizations, increasing human resources, etc. Following the Global Health Sector Strategy for HIV, Viral Hepatitis and Sexually Transmitted Infections adopted by WHO for 2022–2030 [6], epidemiological surveillance remains a priority in each country, identifying population groups that are most at risk of contracting HIV, viral hepatitis and sexually transmitted infections.

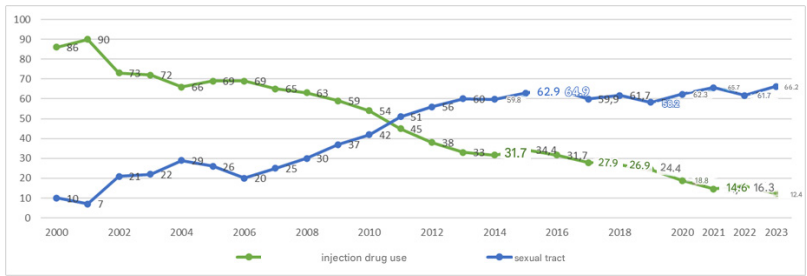
**Purpose of the study:** to identify the epidemiological features of HIV infection in the Republic of Kazakhstan at the present stage.

**Materials and methods of research:** data from official statistics of the AIDS Prevention and Control Service of the Republic of Kazakhstan for the period from 2000 to 2023 were studied.

### **Results.**

As of the beginning of 2024, 32,659 people living with HIV were registered in the Republic of Kazakhstan. Men accounted for 64.3%, women - 35.7%. In 2023, 3,862 new cases of HIV infection were identified in the country. The predominant route of HIV transmission is sexual transmission, which in 2023 accounts for 66.2% ( $n = 2,557$ ) of new HIV cases. Parenteral transmission associated with injection drug use accounted for 12.4% in 2023. Homosexual transmission of HIV accounts for 8.8% of new cases. If at the beginning of the HIV epidemic in Kazakhstan in 2000, sexual transmission accounted for 10% of new cases, then in 2023 this route of infection predominates. The proportion of sexual and parenteral (associated with injection drug use) routes of HIV transmission since 2000 is shown in Figure 1.





**Figure 1.** The proportion of sexual and parenteral routes of HIV transmission (%), 2000 – 2023

It should be noted that the country has shown positive dynamics compared to 2022, as AIDS mortality has decreased by 24%, from 0.9 to 0.7 per 100 thousand population; mother-to-child transmission of HIV has decreased from 3.6% to 1.6%. The following indicators are observed in achieving the 95-95-95 goals in Kazakhstan: 82% of PLHIV know their status, 88% of PLHIV are on ART treatment, and 92% of PLHIV have achieved viral suppression (less than 1000 cells/ml).

However, the current epidemiological situation is characterized by an increased risk of HIV transmission among young people, which is associated with the use of new psychoactive substances (PAS). Even when using non-injectable forms of narcotic substances, the risk of HIV transmission may increase as a result of unprotected sexual contact under the influence of new PAS.

The current situation in Kazakhstan is characterized by the active expansion of new psychoactive substances on the illegal market. The market for these substances is quite dynamic and is very quickly replenished with new types, including stimulants with little-studied properties that affect the risky behavior of drug users.

Currently, the following main types of drugs are used in Kazakhstan [7]:

- opiates, including those in transit from Afghanistan through the country’s territory along the so-called “Northern Route,” which runs through the territories of Kazakhstan and the Central Asian states and is actively used by organized crime in neighboring states;
- synthetic drugs, the production of which has become widespread throughout the country;
- growing and cultivated hemp and its derivatives;
- medicinal preparations containing psychoactive substances, the so-called “pharmacy” drug addiction.”

According to the Ministry of Health, as of January 1, 2024, 108,722 people are under dynamic observation in the Republic of Kazakhstan with a diagnosis of

“mental behavioral disorders due to the use of psychoactive substances”, including 18,329 people with addiction to narcotic drugs and psychotropic substances. Of the drug addicts, 91% (16,817) are men, 9% (1,512) are women, 15% (2,734) are young people aged 18 to 29, 66 people are children and adolescents. It should be noted that official statistics do not reflect the real number of drug addicts in the country, and it should also be taken into account that dynamic observation is carried out only with the informed consent of the patient. Despite the measures taken, the expansion of new psychoactive substances continues, including stimulants with poorly studied properties that affect the risky behavior of drug users. Drug use remains more prevalent among young people than among adults and is more widespread than in previous generations.

### **Discussion.**

The current youth subculture focused on the use of synthetic drugs, the most common of which is mephedrone, promotes risky behavior for HIV infection. A number of researchers note that mephedrone causes stimulating effects such as elevated mood and increased sexual desire [8, 9, 10, 11].

There is a risk that mephedrone use may be associated with a possible increase in HIV incidence as a result of risky sexual practices, particularly among men who have sex with men (MSM) [12, 13].

In a pilot study conducted in St. Petersburg, 30 interviews and data from two focus groups with consumers of psychoactive stimulants – synthetic cathinones – were analyzed [14]. A total of 40 people were examined: 23 men and 17 women; the age range was from 19 to 56 years. Inclusion criteria were: systematic use of synthetic cathinones (“salts”) for more than one month, voluntary informed consent to participate in the study.

The identified behavioral characteristics of synthetic cathinone users demonstrated that they had high risks of HIV infection, both through injection and sexual means. Thus, the participants in this study noted that “when injecting synthetic cathinones, there is no need to heat the solution in the container, as is the case with opioids, because “the powder mixed with water in the syringe is ready for use.” In addition, the study revealed that under the influence of “salts,” their users were less concerned about the sterility of the instrument. This was especially true for people who were in a state of prolonged, continuous drug use (“marathon”). At the same time, “salt” users were ready not only to take a syringe used by someone else, but also to “wash” several dozen other people’s syringes or even try to use something that outwardly resembles “salt” powder. More than two thirds of the surveyed synthetic cathinone users noted that when using “salts,” sexual liberation occurred. This condition could lead to both unplanned sex and unprotected sexual contacts.” The property of psychostimulants to enhance sexual activity may contribute to the sexual transmission of HIV infection [15, 16, 17].

With the advent of new psychoactive substances, the term “chemsex” (a relatively new term that refers to sex with the use of psychoactive (narcotic) substances) has appeared. This phenomenon is common among men who have sex with men and transsexuals. According to some estimates, at least every fifth person in this category periodically or constantly takes drugs for sex. The reasons may be different: to get rid of shyness and complexes, to gain courage and try new sexual practices, to increase sexual desire and endurance, to get more vivid sensations from intimacy and climax. Most often, psychoactive substances with a stimulating effect are used to feel euphoria, a surge of strength and sexual arousal. Chemsex uses different routes of drug administration: swallowing, inhaling, smoking, inserting into the rectum. Some people inject substances, which creates additional risks of infection with blood-borne infections.

A systematic review with meta-analysis conducted by Nevendorff L., Schroeder SE, Pedrana A., Bourne A., Stoové M. [18] was devoted to the issues of sexual relations with the use of psychoactive substances and the risk of HIV infection among sexually active men who have sex with men (MSM) in East and South Asian countries. The authors found that chemsex is a risk factor for HIV infection among men who have sex with men. The overall odds ratio was 4.73 (95% CI 2.72–8.21).

At the same time, in Kazakhstan, the issue of behavioral risks of HIV transmission among users of new psychoactive substances has not yet been sufficiently studied. This group should be considered as a vulnerable population group requiring new approaches to prevention.

**Conclusions** Thus, the epidemiological features of HIV infection in Kazakhstan at the present stage are:

1. The relationship between the use of new psychoactive substances and HIV infection: the use of new psychoactive substances is often associated with an increased risk of unprotected sexual intercourse.
2. Drug use remains more common among young people than among adults and is more widespread than in previous generations.
3. Consumers of new psychoactive substances often belong to socially vulnerable groups of the population, which complicates access to medical services and reduces motivation for HIV testing and treatment.

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俄罗斯专业大学男生太阳活动期间个体时间生物学指标  
**CHRONOBIOLOGICAL INDIVIDUAL MINUTE INDICATORS OF  
YOUNG BOYS FROM SPECIALIZED UNIVERSITIES OF RUSSIA  
DURING THE PERIOD OF SOLAR ACTIVITY**

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**摘要。**首次进行了时间生物学研究(每周 8、12、16 和 20 小时),研究了高水平太阳活动对俄罗斯各地区专业大学 235 名青少年学生的个体分钟(IM, 秒)持续时间的影 响。结果表明,在太阳活动的日子里,学生主观上认为没有任何活动的时间过得慢,在此期间,无论接受大学教育的情况和居住地区如何,年轻男性的“个体”分钟都会缩短( $p < 0.05$ )。主观上,学生注意到嗜睡、困倦、疲劳、心率加快、收缩压升高。3 名学生出现鼻出血。

**关键词:** 俄罗斯大学生、磁暴、个体分钟。

**Abstract.** For the first time, a chronobiological study (at 8, 12, 16 and 20 hours during the week) is devoted to the study of the influence of high levels of solar activity on the duration of an individual minute (IM, sec) in 235 students of adolescence studying in various territorially located specialized universities of Russia. It is shown that on days of solar activity, time not filled with any kind of activity is subjectively assessed by students as slowly flowing, during which the “individual” minute in young men, regardless of the profile of receiving university education and region of residence, is reliably ( $p < 0.05$ ) shortened. Subjectively, students note lethargy, drowsiness, fatigue, increased heart rate, increased systolic blood pressure. Nasal bleeding was observed in 3 students.

**Keywords:** students of Russian universities, magnetic storms, individual minute.

**Relevance.** According to the Hydrometeorological Center of the Russian Federation, the number of solar flares has increased sharply in the last months of 2024,

which astronomers attribute to the fact that the Sun is approaching its 11-year peak activity. It is impossible to predict with precision how long such solar activity can last, but there is an assumption that our earth will experience frequent magnetic storms for another two years, after which the intensity of explosions on the Sun will decrease. From a scientific and practical point of view, it is important to track the impact of solar magnetic storms on human health, which is the subject of extensive specialized literature [2, 3, 4, 5, 8]. There is no doubt that any scientific research aimed at developing regional standards for the functional state of modern student youth is both relevant and in demand. The authors are deeply convinced that today it should become a mandatory rule - a university teacher, especially a physical education teacher, starting classes with students, must have a clear idea of their health, functional state and adaptive capabilities. At the same time, in our opinion, the arsenal of his research should include simple and safe methods of assessment, allowing them to be used in any conditions of the educational or training process.

The problem of maintaining and strengthening the health of student youth in our country, increasing the level of their physical activity is becoming increasingly relevant [1, 6. 7].

During their studies at universities, students are exposed to a number of both specific (age, physiological and psychological effects, emotional overload, sedentary lifestyle) and non-specific (climatogeographic, environmental) factors. Modern innovative models of student training require significant mental and neuro-emotional stress from them.

We believe that the nature of professional development of the first stage of study at a university is associated, first of all, with the difficulties that arise in the adaptation processes, requiring maximum involvement of physiological reserves and capabilities of the body, which at the initial stage of education has not yet reached physical and functional maturity.

A person's internal assessment of the passage of time has great theoretical and practical significance. The work of the so-called "internal clock" reflects the activity of physiological processes, depends on the characteristics of higher nervous activity, and is related to gender and age.

Despite numerous studies in the field of studying the problem of individual assessment of time indicators, they are contradictory and do not touch upon some aspects of the course of the "internal chronometer".

Perception of time or the ability to adequately navigate in time is one of the most complex forms of subjective reflection of a person's external world. One of the tests that determine the features of time perception is the IM test. In the literature available to us, we have not found studies reflecting the IM indicators in adolescent students of specialized universities of the Russian Federation.



**Object of the study:** adolescent students of various specialized territorially located universities of the Russian Federation.

**Subject of the study** - the IM indicator in young men of universities of Russia.

**Research hypothesis.** It is suggested, firstly, that in adolescent students, IM does not reliably depend on the region of residence. Secondly, the values of IM are most significantly affected by a high level of physical activity associated with regular physical education and sports classes, both in a comprehensive school and in a youth sports school, before entering the university.

**The purpose of the study:** to characterize the features of time perception by students of the adolescent period of specialized universities in Russia.

**Material and methods.** Using the method of random sampling, a chronobiological (seven days a week at 8, 12, 16 and 20 hours) study of IM was conducted in 235 young men of nine specialized higher educational institutions of the Russian Federation of full-time education.

Among them:

1. Khabarovsk Regional Institute for Education Development named after K.D. Ushinsky (KhKIRO) – 22 (9.36%),
2. Irkutsk State University (ISU) – 24 (10.21%),
3. Siberian Federal University (SFU) – 29 (12.34%),
4. Novosibirsk State Pedagogical University (NSPU) – 31 (13.19%),
5. Tyumen State University (TSU) – 32 (13.61%),
6. Tyumen State Medical University (TSMU) – 21 (8.93%),
7. Tyumen Industrial University (TIU) – 34 (14.46%),
8. Ural State University of Physical Education – (UralSUPE) 26 (11.06%),
9. Tchaikovsky State Academy of Physical Education and Sports (TSAPhEaS) – 17 (7.23%).

The results of the study were processed on a personal computer using the Statistika program. The reliability of differences was assessed using Student's t-test, and differences were considered reliable at  $p < 0.05$ .

Ethical review. When working with students, we observed the principles of voluntariness, rights and freedoms of the individual guaranteed by Articles 21 and 22 of the Constitution of the Russian Federation, as well as the Order of the Ministry of Health and Social Development of Russia No. 774n of August 31, 2010 "On the Ethics Council". The study was conducted in compliance with the ethical standards set out in the Helsinki Declaration of the World Medical Association "Ethical Principles for Medical Research Involving Human Subjects", which was adopted at the 59th General Assembly in October 2008. The authors received oral consent from the students to conduct the study and publish the data.

Research results and their discussion. It was established from the anamnesis that out of 235 students, 67 (28.51%) had previously been involved in sports, and

they continued to train actively at the time of the examination. It should be noted that during the period of high solar activity, students subjectively noted lethargy (43 - 12.29%), drowsiness (31 - 13.19%), difficulty falling asleep (29 - 18.34%), fatigue (26 - 11.06%), irritability (17 - 17.23%), decreased mental performance (23 - 9.78%), unwillingness to communicate (15 - 6.38%), unwillingness to do morning hygienic gymnastics (27 - 11.48%), unwillingness to do sports training (9 - 3.82%). 152 (64.68%) students noticed an increase in heart rate, and 34 (14.46%) noticed an increase in systolic blood pressure. 3 (1.27%) students had nosebleeds.

To obtain reliable information about the functional state of adolescent students studying and living in various universities in the regions of Russia, we conducted a chronobiological IM test (Table 1) at the peak of strong and moderate solar activity. Note that our previous study of IM in adolescent students receiving higher education showed that it was  $59.73 \pm 0.46$  sec.

**Table 1**

*Individual minute in adolescent students of specialized universities in Russia at the peak of strong and moderate solar activity in September 2024 (M ± m)*

University	8 hours	12 hours	16 hours	20 hours
UralSUPE n=26	56,69±1,14	57,63±1,16	58,41±1,20	55,17±1,23
TSAPhEaS n=17	56,77±1,16	57,89±1,17	58,53±1,19	56,29±1,20
ISU n=24	53,24±1,24	53,72±1,21	53,99±1,22	53,11±1,23
TSU n=32	54,09±1,22	54,48±1,24	54,98±1,26	53,62±1,25
NSPU n=31	53,67±1,26	53,94±1,25	54,24±1,23	53,21±1,24
SFU n=29	53,14±1,23	53,87±1,26	54,17±1,27	53,32±1,26
KhKIRO n=22	53,28±1,25	53,92±1,23	54,09±1,25	53,40±1,27
TSMU n=21	53,86±1,29	54,13±1,28	54,55±1,26	53,61±1,27
TIU n=34	54,03±1,31	54,49±1,30	54,92±1,29	53,29±1,30
IM <sub>av</sub>	54,30	54,45	55,32	53,88

Thus, it can be concluded that during the peak of strong and moderate solar activity, no student, regardless of the profile of study and region of residence, had the classical astronomical value of IM.

On the third day of the chronobiological study of the influence of a magnetic storm on IM (Table 2), it was noted that, albeit insignificantly, it approached the classical value.

**Table 2**

*Individual minute in students of the adolescence period of specialized universities in Russia on the third day from the peak of the magnetic storm in September 2024 (M±m)*

University	8 hours	12 hours	16 hours	20 hours
UralSUPE n=26	56,69±1,13	57,88±1,15	58,33±1,18	55,03±1,17
TSAPhEaS n=17	56,93±1,19	58,06±1,19	58,49±1,21	56,52±1,22
ISU n=24	53,78±1,27	53,93±1,22	54,37±1,20	53,43±1,25
TSU n=32	54,31±1,20	54,66±1,21	55,18±1,23	53,87±1,23
NSPU n=31	53,96±1,21	54,15±1,23	54,59±1,24	53,61±1,23
SFU n=29	53,62±1,24	54,06±1,25	54,57±1,26	53,38±1,24
KhKIRO n=22	53,56±1,27	54,22±1,26	54,79±1,28	53,43±1,29
TSMU n=21	54,19±1,28	54,40±1,27	54,68±1,28	53,55±1,28
TIU n=34	54,41±1,16	54,67±1,26	54,94±1,29	53,31±1,30
IM <sub>av</sub>	54,60	55,40	55,54	54,01

Seven days after the peak of the magnetic storm, the IM values of students also increased, but also did not reach the classical astronomical value (Table 3).

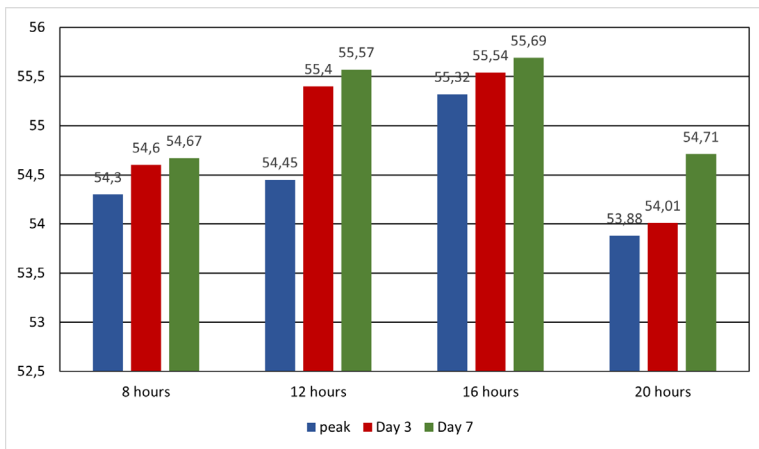
**Table 3**

*Individual minute of students of the youth period of specialized universities of Russia on the seventh day from the peak of the magnetic storm in September 2024 (M±m)*

University	8 hours	12 hours	16 hours	20 hours
UralSUPE n=26	56,94±1,14	58,29±1,15	58,84±1,17	55,03±1,16
TSAPhEaS n=17	57,21±1,20	57,85±1,23	58,57±1,22	57,02±1,21
ISU n=24	54,07±1,17	54,73±1,20	55,05±1,21	54,29±1,19
TSU n=32	54,73±1,18	55,41±1,18	55,88±1,19	54,99±1,20
NSPU n=31	54,29±1,17	54,95±1,20	55,75±1,19	54,31±1,21
SFU n=29	53,92±1,21	54,38±1,21	54,90±1,22	54,12±1,21
KhKIRO n=22	53,98±1,28	54,61±1,24	55,18±1,24	54,10±1,25

TSMU n=21	54,42±1,29	54,93±1,25	55,42±1,28	54,15±1,26
IM <sub>av</sub>	54,67	55,57	55,69	54,71

It is noteworthy that the students of UralSUPE and TSAPhEaS, in comparison with the IM indicators of students from other universities, have a significantly higher IM ( $p < 0/05$ ) on all days of the study. We attribute this difference to the fact that these educational institutions train specialists in the field of physical education and sports. As for the IM values of students from other universities, we did not receive reliable differences ( $p > 0/05$ ). As shown by the study of the average individual minute (IM<sub>av</sub>) of students of adolescence receiving higher education in various territorially located universities of Russia, during high levels of solar activity it was in the range from 54.30 to 55.69 sec, i.e. did not reach the classic value of 60 sec. (Fig. 1).



**Figure 1.** Chronobiological values of the average individual minute in students during daylight hours.

Such a shortening of time perception, in our opinion, is an indicator of not only an increase in the tension of homeostatic adaptation mechanisms, but also a decrease in the adaptive capabilities of the adolescent organism associated with the negative impact of solar activity. We believe that an easy-to-use and valid IM test can serve as a kind of marker of the adaptive capabilities of the human body. Considering that a high level of solar activity can last for another two years, we plan to further study

Conclusions:

1. A high level of solar activity has a significant impact on human somatic health, causing lethargy, drowsiness, poor sleep, fatigue, irritability, decreased mental performance, unwillingness to communicate, unwillingness to do morning hygienic gymnastics and conduct sports training. 2. High solar activity caused an increase in heart rate in 64.68% of young men, and an increase in systolic blood pressure in 14.46%. 1.27% of students had nosebleeds.

3. During periods of high solar activity, the individual minute values of young students studying at specialized universities in the Russian Federation do not reach the astronomical minute values, indicating tension in adaptation mechanisms. As solar activity decreases, the individual minute values gradually increase, but still do not reach 60 seconds.

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俄罗斯联邦人口对矫形牙科护理的需求

**THE NEED OF THE POPULATION OF THE RUSSIAN  
FEDERATION FOR ORTHOPEDIC DENTAL CARE**

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注释。本文探讨了俄罗斯人口对矫形牙科医疗需求的现代问题。矫形牙科治疗的需求每年都在稳步增长。人口状况恶化，导致人口老龄化，诊断和治疗方法不完善，难以选择正确的矫形结构，导致使用寿命缩短，患者的生活质量下降 – 这些只是一些决定性因素。

在矫形牙科护理需求水平高且提供不完善的情况下，需要新的基于科学的方法来组织提供，能够减轻现有的负面因素和可能的未来威胁。

关键词：牙科护理，矫形护理，需求，人口。

**Annotation.** *The article examines modern problems of the Russian population's need for orthopedic dental medical care. The need for orthopedic dental treatment is steadily growing every year. The deterioration of the demographic situation, leading to the aging of the population, the imperfection of diagnostic and treatment methods, the difficulty of selecting the correct orthopedic structure, as a result of which the service life is reduced and the patient's quality of life is worsened - these are just some of the determining factors.*

*In conditions of a high level of need for orthopedic dental care and incomplete provision of it, new scientifically based approaches to the organization of its*

*provision are needed, capable of mitigating existing negative factors and possible future threats.*

**Keywords:** *dental care, orthopedic care, need, population.*

Researchers are unanimous in their opinion that over the last 5-7 years, despite significant advances in diagnostics and treatment, the prevalence of dental diseases has been steadily increasing. The incidence among children approaches 95%, while the rate among adults, according to a number of sources, reaches 100%.

Most researchers involved in public health and healthcare in relation to the dental industry believe that the need for orthopedic care is determined by a number of circumstances: geography of residence and the corresponding medical and social conditions (availability of medical personnel, availability of dental care, cost of paid medical services), quality of equipment and resources, organizational and managerial factors (patient routing, digitalization of activities, productivity of specialists).

According to statistical information presented in scientific periodicals, reports of state and commercial analytical companies, the population of the Russian Federation is currently in dire need of orthopedic care: thus, more than 65% of people over 35 years old seek orthopedic care from an orthopedic doctor with the need for prosthetics. Patients whose orthopedic structures are about to expire or whose quality leads to breakage and unsuitability are taken into account separately. It should be noted that in the current reality, removable structures serve on average about three years, bridge prostheses - 5-7 years. In scientific literature, one can increasingly come across the opinion that modern orthopedic care is not developing intensively enough, even taking into account the general progress in the industry and the development of digital diagnostic technologies.

Thus, N.M. Guseynova (2019) suggests that most of the treatments carried out are often ineffective due to a number of external circumstances: the age of patients, imperfections in the choice of treatment tactics, the departure of material suppliers from the market and the need to find a replacement, and incomplete information for making objective decisions (1).

At the same time, the field of orthopedic dentistry can be called one of the most complex areas, the tasks of which are the restoration of the lack of units in the dental row; restoration (formation) of destroyed crowns of teeth; solving aesthetic problems.

B.N. Porfiryev et al. (2023) note that orthopedic dentistry has great potential, but at the same time, its capacity does not correspond to the real need for treatment. The approximate number of patients in the country who are completely toothless is 10 million people, while 5-7 million do not have dentures, or the service life or degree of wear require the manufacture of new structures. For comparison, the number of patients in need of dentures in 2015 was about 8 million people (2).

Despite the general digitalization, there is currently no single statistical database that would allow us to estimate the exact volumes of orthopedic care both on a regional and federal scale. However, the authors provide representative data on the number of manufactured dentures in Moscow by the beginning of 2023 (57 thousand removable structures) and claim that the commercial sector performs a comparable amount of work.

Extrapolating these data to Russia as a whole, we can estimate the need for prosthetics at the federal level at 1-1.5 million prostheses per year. It is noteworthy that, given the demographic situation in the country (rapid aging of the population and an increase in the number of senior citizens), this need will only grow.

F.K. Dzalayeva et al. (2020) in their work present the results of a survey of 2.57 thousand patients conducted at Sechenov University jointly with the commercial sector in 2020, within the framework of which the need for orthopedic treatment was identified, or the type and quality of previously provided care was assessed. The results of the study showed that in the city of Moscow, the need for the installation of orthopedic structures is at the level of 70%, while in the group under 30 years old this figure is 56%, from 60 to 70 years old - 86%, in the older age group - 73%. At the same time, 62% of patients in the sample had orthopedic structures at the time of the study (14% - removable, 30% - bridge, with support on implants - 18% (3).

One of the significant problems that many researchers note in their works is the need to replace existing orthopedic structures due to either their physical wear and tear, or breakage or poor quality of materials and/or structure. In the cited study, the authors indicated that 20% of patients who took part in the survey needed such a replacement.

M.I. Sadykov et al. (2018), citing the results of their own research, say that at present we should talk about a set of problems that reduce the effectiveness of orthopedic treatment. In particular, about 25% do not use removable dentures made for them due to the following circumstances: problems with fixation of the structure (noted by 50% of patients included in the survey group); insufficient quality of the structure (47% of the surveyed patients in the group); insufficient quality of hygiene of the structure (33% of the surveyed patients); delamination of the soft lining (70% of the surveyed). Thus, it can be concluded that for patients at the present stage, such properties of structures as biocompatibility and ease of use are extremely important in orthopedic treatment (4).

Returning to the analysis of the results of the study conducted by Sechenov University, it should be noted that there is a noticeable differentiation among age groups by the type of structures used. This allows us to understand the real need, possible problems and ways to improve the effectiveness of the assistance provided.



The fact that the need for orthopedic treatment after 60 years of age generally decreases globally indicates that people of working age consciously care about their own quality of life, which is affected by the state of the dental system.

It should be noted that the group of patients from 20 to 30 years old more often choose bridge structures or removable ones, preferring them to those made with support on a distal implant (DI). In the age group of 30-40 years, the situation changes and structures on DI are chosen more often than removable ones. The trend continues for all age groups under 70 years. Researchers are inclined to believe that this is largely due to the economic component of treatment. Bridge structures are comparatively cheaper than those using DI.

For older age groups, the return of removable dentures to second place in popularity can also be explained from an economic point of view, as well as by the fact that their production is included in the Compulsory Health Insurance (CHI).

The work by L.A. Markina et al. (2024) presents the results of a survey of 1.8 thousand people who sought paid orthopedic care, which was conducted in the period from 2018 to 2022. The authors examined a larger number of types of structures and analyzed the dynamics of the volume of need for them. According to the data presented in the scientific work, the largest number of removable structures used for partial tooth loss (32%) were manufactured during the specified period, followed by single crowns (26%). Implant-supported structures and removable dentures for complete tooth loss were similar in production volumes (14% and 16%, respectively), the smallest number (5%) were pin structures. It is interesting to turn to the general dynamics, which generally shows two important aspects: conditional stability in the need for orthopedic treatment and the “coronavirus effect” (a decline in 2020 and a stable growth in 2021-2022) (5).

There are a number of studies devoted to the analysis of the degree of correlation between orthopedic morbidity and the consequences of coronavirus infection, however, no clear interdependence has been identified on a global scale.

Thus, L.A. Markina et al. (2024) believe that the decline in 2020 is primarily associated with the period of forced isolation of the population, when it was physically unable to seek orthopedic care; from this position, the stable growth of the following years can be associated with the accumulation effect (5).

At the same time, attention should be paid to the dynamics of manufacturing structures by types. In general, it repeats the general picture, demonstrating the leadership of removable structures with partial loss of teeth and single crowns throughout the entire period of research.

Addressing the main problems of orthopedic dentistry, it is necessary to pay attention to the work of V.O. Sevagina et al. (20). The authors emphasize that often after the initial request for help, patients return for follow-up treatment or redoing due to poor quality work or mistakes made. Analyzing the reasons for this, we can

highlight the imperfection of diagnostics, violation of operating rules, incompleteness of information necessary for decision-making (6).

A.K. Iordanishvili et al. (2023) are confident that the process of adaptation to orthopedic structures plays a major role. Despite the development of manufacturing technologies and materials, the psychoemotional perception of a foreign structure in the oral cavity in some cases can lead to a refusal to wear them (7).

M. Wondergem et al. (2016) emphasize that a similar problem exists in the related field of orthodontics, however, in orthopedics everything is complicated by the fact that the structure (removable or non-removable) becomes not a temporary, but a permanent additional element of life (8).

E.A. Vakushina et al. (2021) believe that some of the problems are related to the insufficient study of the biomechanics of the human masticatory system. The authors believe that improving the modeling of human biological systems and studying the nature of certain pathologies will reduce the percentage of errors in the manufacture of orthopedic structures in the future (9).

Li, G. (2007) draws attention to the fact that at present the impact of materials from which orthopedic structures are made on the human body has not been fully studied, which in some cases can affect both their service life and the overall state of comfort and safety (10).

Thus, orthopedic dentistry is one of the most complex areas of the industry, operating in the conditions of a dynamically changing external environment, sanctions and import substitution, and a changing paradigm of medical development.

The need for orthopedic dental treatment is steadily growing every year. The deterioration of the demographic situation, leading to the aging of the population, the imperfection of diagnostic and treatment methods, the difficulty of selecting the correct orthopedic structure, as a result of which the service life is reduced and the patient's quality of life is worsened - these are just some of the determining factors.

In conditions of a high level of need for orthopedic dental care and incomplete provision of it, new scientifically based approaches to the organization of its provision are needed, capable of mitigating existing negative factors and possible future threats.

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糖尿病患者骨科治疗适应期出现的并发症  
**COMPLICATIONS ARISING DURING THE ADAPTATION  
PERIOD IN PATIENTS WITH DIABETES MELLITUS DURING  
ORTHOPEDIC TREATMENT**

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**Annotation.** According to experts, in 2045, the total prevalence of diabetes mellitus may reach 700 million people (10.9% of the adult population of the globe). This pathology has an irreversible effect on the condition of the tissues of the oral cavity. Diabetes mellitus affects the prevalence and frequency of periodontal diseases. For people suffering from severe forms of periodontitis, removable prosthetics is the only option for orthopedic treatment. Their advantage is that they restore the functions of the oral cavity with complete loss of teeth and atrophy of jaw bones of any shape; ease of manufacture; financial accessibility, which is of great importance for the majority of the population. Bacteria adheres to the prosthesis on irregularities, bulges and retention points, which also causes plaque formation on its surface. The adaptation of patients to removable structures is a complex and lengthy process, which is influenced by various factors.

**Keywords:** *type 2 diabetes mellitus, removable plate prostheses, adaptation, hygiene of prostheses, oral microflora, acrylic base.*

Today, the number of people suffering from type 2 diabetes is becoming much larger. According to experts, in 2045, the overall prevalence of diabetes may reach 700 million people (10.9% of the adult population of the globe). Type 2 diabetes is more common than type 1 diabetes. It is typical for people of mature age, most often it is detected after 40 years, and about 90% of people with type 2 diabetes are overweight [3, p. 10]. Type 2 diabetes differs from type 1 in that it begins gradually and is unnoticeable for a person, and an elevated blood glucose level can be detected by chance. This pathology has an irreversible effect on the condition of the tissues of the oral cavity. The patient may not suspect his disease for a long time. He feels slight dryness in the mouth, thirst, itching, pustular inflammations on the mucous membrane of the oral cavity, gum disease, tooth loss may appear. This occurs because sugar that does not enter the cells goes into the walls of blood vessels, and bacteria and fungal infections actively produce sugar. Circulating sugar in the bloodstream gets into saliva, which leads to a violation of its quality and properties. It becomes viscous, which in turn leads to a violation of the natural self-cleaning of the oral cavity [1, p.34].

Scientists believe that periodontal diseases are complications of diabetes mellitus, which are aggravated by hyperglycemia (high blood sugar). At the same time, systemic inflammation caused by periodontitis worsens blood glucose levels in patients with diabetes mellitus, which indicates a bidirectional relationship. Diabetes mellitus affects the prevalence and incidence of periodontal diseases. As a rule, this pathology is accompanied by bone resorption, which is characterized by a decrease in its volume. In addition to diabetes mellitus, the course of the disease is negatively affected by the age of patients, as well as poor oral hygiene. All this accelerates the pathological process; therefore, bone resorption increases significantly, which leads to loosening or early loss of teeth [7, p. 78].

Orthopedic treatment of patients with complete edentia and diabetes mellitus in the anamnesis has a number of limitations. Most often, due to severe atrophy of the bone tissue of the jaw bones, the only option for orthopedic treatment is removable plate dentures made of acrylic polymer. Their advantage is that they restore the aesthetics and functioning of the oral cavity, ease of manufacture, financial availability, which is of great importance for the majority of the population. It is known that the basis of the denture made of acrylic plastic is quite rigid and requires getting used to. Orthopedic structures are perceived by the organs and tissues of the oral cavity as a foreign body, being an irritant for nerve endings. Simultaneously with the sensation of the denture as a foreign body, salivation increases. It occurs a short time after the application of the denture and indicates

the occurrence of a salivary reflex when the receptors of the oral mucosa are irritated [6, p. 20]. By its nature, this reflex is unconditional and resembles a reaction caused by the action of rejected substances. In addition, during the first period of using a denture, biting off food, the actual act of chewing and the act of swallowing occur uncoordinated; changes in speech formation are also observed, and sometimes a gag reflex occurs.

Adaptation of patients to removable structures is a complex and lengthy process, which is influenced by various factors. In the process of habituation, both general and local factors take place, which is explained by the individual characteristics of the patient's body. In the development of the adaptation process, two interrelated components can be conditionally distinguished: psychological and functional. Psychological adaptation is more labile and largely depends on the functional activity of the central nervous system and the type of higher nervous activity [4, p. 80]. Functional adaptation is more difficult when performing movements necessary for speech pronunciation, chewing food and normal facial expressions. This requires a significant restructuring of habitual motor stereotypes taking into account the new orthopedic structure. Such psychophysiological restructuring takes a long time and is determined by the speed of nervous processes. Adaptation can be considered as a complex of adaptive reactions at different levels, leading to the formation of a stable structural trace of adaptation, the content of which is complete adaptation to the factor that caused disharmony. The body's reaction in the process of interaction with orthopedic dental structures is formed depending on the strength of the influencing factor, the time of exposure and the body's capabilities, which are determined by the presence of functional and metabolic resources [5, p. 19].

V.Y. Kurlyandsky divided the adaptation period into phases. The first phase or irritation is characterized by the patient's fixed attention to the design features of the prosthesis, increased salivation, changes in diction and phonation, loss or significant decrease in chewing efficiency, hypertonicity of the masticatory muscles, possible nausea, tense state of the perioral tissues (lips, cheeks). The second phase is partial inhibition (2-5 days). Normalization of salivation and extinction of the gag reflex, restoration of diction and phonation occur, chewing efficiency gradually increases, tension of the perioral tissues disappears. The third phase is complete inhibition (from 5 to 33 days). The prosthesis is no longer a foreign body for the patient, the feeling of discomfort disappears, complete adaptation of the neuromuscular state is observed and restoration of chewing efficiency reaches its maximum. It has been proven that the quality of adaptation to the design is affected by: the condition of the oral tissues, the degree of damage to the oral mucosa, the degree of atrophy of the jaw bones, the structure of the dental apparatus, the psychological state, as well as the design features of the prosthesis, its

correct choice of fixation strength. The presence of general somatic pathology, for example, type 2 diabetes mellitus, significantly increases the time and quality of adaptation to the prosthesis. As a rule, such patients require more physical effort and emotional stability [2, p. 20].

Acrylic plastic, which consists of polymethyl methacrylate copolymers, is most often used to manufacture bases for complete removable plate dentures. It has excellent technological and aesthetic properties, but can have an adverse effect on the tissues of the denture bed. Perhaps one of the main disadvantages is the microporosity of the base structure, which appears during the polymerization process. The reason for this is the residual monomer, which is released from the base over several years after polymerization. The pores in the denture base are an ideal environment for the vital activity of pathogenic microflora, causing a violation of the microbiological balance of the tissues of the oral cavity [8, p. 212].

The bacterial environment in the oral cavity is maintained constant due to the functioning of the salivary glands and mucous membrane, as well as the relationship between opportunistic microorganisms. Patients using removable dentures are characterized by microflora with certain qualitative and quantitative composition. The structural features of the denture base, poor hygiene and a history of diabetes mellitus create ideal conditions for an increase in pathogenic microflora. Scientists have conducted examinations, which revealed that patients with removable dentures are dominated by microorganisms such as bacteria of the genus *Enterococcus* (from 24 to 26%), *Escherichia coli* (from 11 to 60%), *Staphylococcus aureus* (from 11 to 23%), fungi of the genus *Candida* (from 11 to 35%). It was noted that changes in the quantitative composition of microorganisms in the oral cavity began immediately after the completion of orthopedic treatment. During their life activity, microorganisms secrete acids and toxins that have a negative effect on the tissues of the denture bed. Bacteria adhere to the denture on uneven surfaces, bulges and retention points, which also causes plaque to form on its surface. Tartar build-up on the surface of the denture can shift the balance of the structure, which increases the risk of breakage of the denture base, and also disrupts proper functioning [9, p. 88]. Failure to comply with hygienic rules for the care of a removable denture significantly reduces the adaptation period, and also reduces its service life. Patients who neglect hygienic care of the oral cavity and denture cause a long-term imbalance of microflora, which causes inflammatory diseases of the oral tissues, unpleasant odor, and due to disruption of its proper functioning, chips and cracks may occur. Regular care of a plate denture will reduce the risk of inflammatory diseases of the mucous membrane of the denture bed and increase its service life. Proper care of dentures includes mechanical cleaning of the denture with a toothbrush and regular disinfection, as well as procedures for removing tartar and pigment spots [10, p.46].



Today, orthopedic dentists offer various methods to reduce the period of getting used to a removable structure. However, the most important thing is proper hygienic care, which patients must perform daily. Even at such a simple stage, complications may arise that lead to an unfavorable outcome. The most common mistake is using a hard toothbrush and highly abrasive toothpaste, which causes small scratches to appear on the base of the prosthesis. The base becomes rough, which creates ideal conditions for the deposition of plaque on its surface and the maintenance of pathogenic microflora. Today, there are many special effervescent tablets and acid solutions. They significantly facilitate home care for orthopedic structures and are intended for daily use (once a day). They are dissolved in a glass of water, and then the prosthesis is immersed in it for 3-10 minutes [11, p. 75]. Such tablets contain chemical components that dissolve not very pronounced pigment plaque and tartar, and are also largely capable of disinfecting it. All effervescent tablets for cleaning removable dentures have one major drawback, which is associated with their disinfecting ability. With the help of their components, they are able to affect yeast fungi of the genus *Candida*, which in most cases are the cause of denture stomatitis. All manufacturers indicate a disinfecting effect on *Candida albicans*, but nothing is written about much more dangerous representatives of the genus *Candida* - *C. glabrata*, *C. krusei*, *C. tropicalis*. and *C. albicans*, which are resistant to drugs of the triazole group (fluconazole) [7, p. 88]. Correctly applying all methods for caring for an orthopedic structure, you can improve the level of hygiene of the patient's oral cavity, as well as speed up adaptation to the prosthesis, improve its quality and avoid complications.

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术后早期阿片类药物引起的呼吸抑制

## OPIOID-INDUCED RESPIRATORY DEPRESSION IN THE EARLY POSTOPERATIVE PERIOD

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**摘要。**众所周知，急性疼痛管理是围手术期医学最重要的组成部分之一。然而，对于围手术期疼痛管理的最佳模式尚无共识，主要是由于缺乏多方面的证据。本文对预测和预防阿片类药物引起的呼吸抑制作为医疗保健系统中围手术期疼痛管理并发症的各种模型进行了描述性综述。

**关键词：**呼吸缓慢、阿片类药物、呼吸抑制、术后疼痛、手术、麻醉、镇痛药。

**Abstract.** *It is a well-known fact that acute pain management is one of the most important components of perioperative medicine. However, there is no consensus on the best model for perioperative pain management, mainly due to the lack of evidence in many aspects. This article provides a descriptive review of various models for predicting and preventing opioid-induced respiratory depression as a complication of perioperative pain management in health care systems.*

**Keywords:** *bradypnea, opioids, respiratory depression, postoperative pain, surgery, anesthesia, analgesics.*

Narcotic analgesics are basic drugs in routine anesthetic practice, as well as the entire perioperative period. It is difficult to imagine performing surgery under general anesthesia without this group of drugs. Quite often, opiates are used to relieve pain in the early postoperative period, as well as in patients with oncological pathology. Even in basic training courses, it becomes known about the side effects of narcotic drugs, and primarily about respiratory problems. Nevertheless, the need to use this group of drugs to achieve adequate pain relief in clinical practice is a necessity in the treatment of pain syndrome of varying severity. The pathways of pain afferentation transmission have been studied quite well and, based on this knowledge, methods have been developed to influence those structural formations that participate in this transmission, from the place where the pain impulse originates to the place of its final processing in the central nervous system. The place of narcotic analgesics in this chain is at the stage of modulation and perception in the

central nervous system. To achieve the most optimal pain relief effect, it is necessary, if possible, to influence the maximum number of links in the transmission of the pain impulse, which, in fact, is multimodal analgesia. In a study published in 2024, which examined postoperative pain management models in 4 European countries: France, Germany, the UK, the Netherlands, an unacceptably high number of patients reported moderate to severe pain after surgery in all countries participating in the study. It turned out that there is no consensus on the best model for postoperative pain management and that training of personnel involved in this process is needed. The lack of a unified approach to the treatment of postoperative pain syndrome suggests a liberal view on the use of narcotic analgesics, which can lead to the problem of opioid-induced respiratory depression. (1) A meta-analysis aimed to assess the risk factors associated with postoperative opioid-induced respiratory depression considered the problem described in less than 1% of cases, which amounted to slightly more than 4,194 observations, of which the vast majority of respiratory depression factors were recorded in the first 24 hours after the use of narcotic drugs. The conclusion of this study is that patients with cardiac, respiratory diseases and/or obstructive sleep apnea had a significantly increased risk of opioid-induced respiratory depression, while patients who underwent surgery received higher doses of narcotic analgesics in the postoperative period. (2)

To objectify the data related to the detection and identification of opioid-induced respiratory depression, it is necessary to conduct objective monitoring that can confirm this undesirable complication.

In the prospective study presented by the international community, 2 continuous monitoring methods were used for 24 hours: capnography and pulse oximetry. Based on the data obtained from these monitoring methods, it was concluded that continuous pulse oximetry and capnography accurately predict episodes of respiratory depression in patients receiving opioids in the general therapy department. An association of respiratory depression with age, gender, and absence of opioid use in anamnesis, as well as patients with a history of obstructive sleep apnea and heart failure, was also found. (3) Another study aimed to determine the incidence and predictors of saturation and bradypnea during general anesthesia using a continuous and centralized monitoring system in patients not in the intensive care unit, showed that respiratory depression was reliably established in patients with a history of sleep apnea and the use of opioids for postoperative analgesia. Thus, it can be concluded that respiratory distress develops in the first 8 hours after the administration of drugs that cause respiratory depression in the early postoperative period. (4)

Thus, the analysis of the above studies, which consider the development of various adverse events in the early postoperative period, including opioid-induced respiratory depression, suggests: awareness and training of health workers who

provide monitoring of patients receiving narcotic analgesics; it is very important to identify patients at risk of respiratory depression caused by the use of opioids; the use of the necessary equipment and duration of monitoring for the timely detection of respiratory disorders caused by the use of opioids; control and timely assessment of the level of sedation; the use of multimodal approach schemes in the treatment of postoperative pain with the possibility of replacing narcotic analgesics. It is known that the innovative drug Tafalgin, which is a tetrapeptide analgesic, namely a  $\mu 1$ -agonist, is used in a multimodal scheme of postoperative pain relief, which made it possible to avoid the use of central and other blockades while maintaining the quality of pain relief after gynecological and oncological operations. An important achievement was also the absence of respiratory depression with maintaining good patient and staff satisfaction with the quality of postoperative pain relief.

### Conclusions

The problem of opioid-induced respiratory depression exists and requires a precision approach to the timely detection of such an undesirable phenomenon from all participants in the treatment process, namely: training of personnel monitoring patients and having access to narcotic drugs for timely detection and response in case of respiratory depression; the use of several sources of information that help to identify respiratory depression; the use of multimodal approach schemes in the treatment of pain syndrome with minimization or refusal of narcotic analgesics and their replacement with drugs with comparable analgesic potential, allowing to exclude opioid-induced respiratory depression.

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坎地沙坦对老年慢性缺血性心力衰竭患者心率变异性的影响  
**THE EFFECT OF CANDESARTAN ON HEART RATE  
VARIABILITY IN ELDERLY PATIENTS WITH CHRONIC  
ISCHEMIC HEART FAILURE**

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注释。冠状动脉疾病 (CAD) 是俄罗斯联邦慢性心力衰竭 (CHF) 的主要原因之一。先前的研究表明,自主神经调节状态、肾素-血管紧张素-醛固酮系统 (RAAS) 活动与心血管并发症之间存在可靠的关系。本研究旨在调查坎地沙坦对缺血性 CHF 老年患者心率变异性的影响。材料和方法。研究包括 67 名年龄 60-70 岁 (平均  $64.5 \pm 2.6$  岁) 的患者,根据 NYHA 的 CHF IIFC 评分,左心室射血分数中度降低 (LVEF 40-49%),窦性心律稳定。根据 RAAS 阻滞剂的使用情况,患者被分成 2 组:第 1 组 - 34 人服用 ACE 抑制剂依那普利,剂量为每天 20 毫克,第 2 组 - 33 人,由于对 ACE 抑制剂不耐受,服用坎地沙坦,每日剂量为 16 毫克。为评估 HRV,在治疗前和治疗 3 个月后使用 Cardiotechnica 设备 - 07-AD-3» (Inkart, 俄罗斯圣彼得堡) 进行每日 ECG 监测。结果。在两组患者中,均观察到 SDNN、SDANN、LF 显著下降和 HF 增加,第 2 组更为明显。第 1 组和第 2 组之间的 SDNN 差异为 63.8% ( $p < 0.001$ ); SDANN - 51.8% ( $p < 0.001$ ); LF - 54.4% ( $p < 0.001$ ); HF - 51.3% ( $p < 0.001$ ); LF/HF - 47.0% ( $p < 0.001$ )。结论。对于缺血性冠状动脉疾病的老年患者,使用坎地沙坦 3 个月可伴有整体心率变异性及其副交感神经成分的潜在有利变化,这些变化比依那普利治疗更明显。

关键词:慢性心力衰竭、心率变异性、老年。

**Annotation.** Coronary artery disease (CAD) is one of the main causes of chronic heart failure (CHF) in the Russian Federation. Previous studies indicate a reliable relationship between the state of autonomic nervous regulation, the activity of the renin-angiotensin-aldosterone system (RAAS) and cardiovascular complications. The aim of the study was to investigate the effect of candesartan on heart rate variability in elderly patients with CHF of ischemic genesis. Material and methods. The study included 67 patients aged 60-70 years (mean  $64.5 \pm 2.6$  years) with CHF IIFC according to NYHA with a moderately reduced left ventricular ejection fraction (LVEF 40-49%), in the presence of stable sinus rhythm. Depending on the use of RAAS blockers, patients were divided into 2

groups: Group 1 - 34 people who took the ACE inhibitor enalapril at a dose of 20 mg per day, Group 2 - 33 people who, due to intolerance to ACE inhibitors, were prescribed candesartan at a daily dose of 16 mg. To assess the HRV, daily ECG monitoring was performed on the Cardiotechnica device - 07-AD-3» (Inkart, St. Petersburg, Russia) before therapy and after 3 months of treatment. Results. In both groups of patients, a significant decrease in SDNN, SDANN, LF and an increase in HF were noted, which was more pronounced in group 2. The difference between groups 1 and 2 for SDNN was 63.8% ( $p<0.001$ ); for SDANN - 51.8% ( $p<0.001$ ); for LF - 54.4% ( $p<0.001$ ); HF - 51.3% ( $p<0.001$ ); LF/HF - 47.0% ( $p<0.001$ ). Conclusion. The use of candesartan for 3 months in elderly patients with coronary artery disease of ischemic genesis was accompanied by potentially favorable changes in the overall heart rate variability and its parasympathetic component, which were more pronounced than with enalapril therapy.

**Keywords:** chronic heart failure, heart rate variability, old age.

Coronary heart disease (CHD) is one of the main causes of chronic heart failure (CHF) in the Russian Federation [1]. According to WHO statistics, 7.4 million people die from CHD every year, of which about 50% due to sudden cardiac death (SCD) [2]. Previous studies indicate a reliable relationship between the state of autonomic nervous regulation, the activity of the renin-angiotensin-aldosterone system (RAAS) and complications of the cardiovascular system [3]. The study of heart rate variability (HRV) in elderly people with CHF of ischemic genesis is a promising method for diagnosing the state of autonomic regulation [4]. Changes in HRV are a universal response of the body to environmental influences. The probability of SCD increases in patients with CHF and low heart rate variability, which indicates that changes in heart rate (HR) can be a prognostic marker of survival in patients with CHF. Already at the early stage of CHF, the mechanism of activation of the tissue renin-angiotensin system (RAAS), in particular angiotensin (AT)-II, which mediates inflammation and vascular fibrosis, is triggered [5]. Blockade of RAAS leads to a decrease in hemodynamic load, slowing down myocardial remodeling, anti-ischemic and coronary lytic effects, which can directly or indirectly affect heart rhythm disturbances in CHF and positively affect HRV [6, 7].

The aim of the study was to investigate the effect of candesartan on heart rate variability in elderly patients with CHF of ischemic origin.

Material and methods of the study. The study included 67 patients aged 60-70 years (mean  $64.5\pm 2.6$  years) with CHF IIFC according to NYHA with moderately reduced left ventricular ejection fraction (LVEF 40-49%), in the presence of stable sinus rhythm. The following were excluded: 1) persons over 71 years of age, 2) those who had acute myocardial infarction or stroke less than 6 months before inclusion in the study, 3) those who had hypotension with systolic blood pressure less than 100 mm Hg; 4) severe liver and kidney dysfunction.

All patients received basic therapy for CHF in accordance with national recommendations. Depending on the use of RAAS blockers, patients were divided into 2 groups: Group 1 - 34 people who took the ACE inhibitor enalapril at a dose of 20 mg per day, Group 2 - 33 people who, due to intolerance to ACE inhibitors, were prescribed candesartan as a RAAS blocker at a daily dose of 16 mg. To assess the HRV, daily ECG monitoring was performed on the Cardiotechnica device - 07-AD-3" (Inkart, St. Petersburg, Russia) before the start of therapy and after 3 months of treatment [4]. The following parameters were calculated: standard deviation of the duration of RR intervals between sinus contractions (SDNN), standard deviation of the average values of RR intervals calculated for 5-minute intervals (SDANN), the power of oscillations in the duration of RR intervals in the range of low (LF) and high (HF) frequencies.

Results of the study. All patients participating in the study showed an increase in the HRV parameters in general and the parasympathetic component in particular after 3 months of therapy. The initial values of the standard deviation of the duration of RR intervals between sinus contractions (SDNN) were  $85 \pm 9.4$  ms, after 3 months of therapy the SDNN indicator in group 1 was  $104 \pm 7.6$  ms ( $\Delta 18.3\%$ ,  $p < 0.01$ ), in the second group  $172 \pm 8.2$  ms ( $\Delta 50.6\%$ ,  $p < 0.001$ ); the initial values of SDANN were  $68 \pm 5.2$  ms, after 3 months, depending on the therapy, an increase in group 1 to  $76 \pm 4.1$  ms ( $\Delta 10.5\%$ ,  $p < 0.05$ ), in group 2 - up to  $87 \pm 6.3$  ( $\Delta 21.8\%$ ,  $p < 0.01$ ). When assessing the parameters of the spectral analysis of HRV, the initial values of the power of RR interval oscillations in the low-frequency range were  $605 \pm 34$  ms<sup>2</sup>. After 3 months of therapy, a decrease to  $509 \pm 29$  ms<sup>2</sup> ( $\Delta 15.9\%$ ,  $p < 0.05$ ) was noted in group 1, in group 2 it was  $394 \pm 28$  ms<sup>2</sup> ( $\Delta 34.9\%$ ,  $p < 0.01$ ). The initial values of the power of RR interval oscillations in the high-frequency range were  $160 \pm 31$  ms<sup>2</sup>. After 3 months of therapy in group 1, the indicator increased to  $204 \pm 30$  ms<sup>2</sup> ( $\Delta 21.6\%$ ,  $p < 0.01$ ), in group 2 to  $288 \pm 30$  ms<sup>2</sup> ( $\Delta 44.4\%$ ,  $p < 0.001$ ). The initial LF/HF ratio was 3.78. Depending on the therapy, the LF/HF ratio decreased to 2.50 in group 1 ( $\Delta 33.8\%$ ,  $p < 0.01$ ) and to 1.37 in group 2 ( $\Delta 63.8\%$ ,  $p < 0.001$ ), which indicates a more pronounced increase in parasympathetic activity, which in turn indicates an indirect decrease in the risk of possible arrhythmias in elderly patients with CHF of ischemic genesis.

Conclusion: The use of candesartan for 3 months in elderly patients with coronary heart disease of ischemic genesis was accompanied by potentially favorable changes in the overall variability of the heart rate and its parasympathetic component, more pronounced than with enalapril therapy.



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纤维增生性阴茎硬结症治疗的新进展  
**NEW ASPECTS OF THE TREATMENT OF FIBROPLASTIC  
PENILE INDURATION**

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Fibroplastic induration of the penis (Peyronie's disease) is one of the most complex pathologies in urological practice. Its prevalence among men ranges from 2.5% to 10% aged 27 to 70 years. This disease is characterized by the formation of fibrous plaques in the tunica albuginea of the penis.

The main factor in the development of Peyronie's disease is trauma to the penis with the formation of hematomas, leading to delamination of the tunica albuginea. The addition of infection and the development of inflammation at the site of injury leads to the destruction of elastic fibers and the release of collagen, which in turn stimulates the formation of coarse keloid scars. The issue of treating this disease, despite the successes in discovering the etiopathogenetic mechanisms of development, remains one of the most problematic to this day.

Many literary sources still indicate insufficient satisfaction with the results of surgical treatment and a high percentage of relapses. At the current stage of development of medical science, there is no single concept that allows determining treatment tactics. Key words: Peyronie's disease, erectile dysfunction, penile deformity, surgical treatment.

Introduction. The generally accepted definition of Peyronie's disease is a connective tissue disorder of the penis characterized by fibrous lesions of the tunica

albuginea with plaque formation and impaired elasticity, leading to penile deformity. In the 18th century, François Gigot de la Peyronie first described this disease and proposed some treatment methods. To date, there is no or no unified concept of the etiological, pathogenetic aspects of the disease and methods of treating patients. Therefore, fibroplastic induration of the penis remains a pressing issue [1].

The incidence of Peyronie's disease varies from 0.7–15% [2,3,4], and men aged 35 years and older are more likely to suffer.

The theory of the development of Peyronie's disease as a result of trauma or microtrauma has become the most widespread. In case of injuries, bruises of the penis or during intense sexual intercourse, macrotraumatization of the vascular network of the membrane occurs, which leads to the development of inflammation in this area. And the inflammatory process inhibits the processes of converting fibrinogen into fibrin, as a result of which the elasticity of the fibers of the white membrane decreases [5].

In the development of many chronic degenerative processes, the oxidative stress hypothesis works. It follows from it that lipid peroxidation, tissue damage, as well as increased activity of fibroblasts cause the release of free radicals, which activates fibrogenesis processes. The theory of autoimmune damage is based on the production of antibodies to elastin, which are normally present in every person, but in PD, high concentrations of antibodies to tropoelastin and anti- $\alpha$ -elastin are recorded. Elastin synthesis and TGF- $\beta$  fibroblast activity decrease during the inflammatory process. An important role is played by genetic factors of expression of TGF- $\beta$  genes responsible for the production of pro- and antifibrotic proteins, the MCP-1 gene, which stimulates the synthesis of white-chemoattractant monocytes and macrophages. Induction of the synthesis of protocollagenases - IV, responsible for the destruction of collagenase, leads to the formation of plaques [8,9,10].

The causes can also be diseases of the endocrine system (hypogonadism, diabetes mellitus), autoimmune disorders, smoking, alcoholism, hypertension, obliterating atherosclerosis of blood vessels [8], systemic fibromatosis, infections, trauma [1,12], surgical interventions on the penis [9,13].

Thus, modern data indicate a multifactorial, poly etiological nature of the development of Peyronie's disease. The following clinical symptoms are distinguished: deformation or curvature of the penis with the development of painful sensations during erection, compaction during palpation, and erectile dysfunction.

In Russia, the classification of V.E. Mazo is used [10,11,14,15]: at stage 1 of the disease, the patient is bothered by pain during erection, plaques are not determined; at stage 2, a fibrous-elastic formation is determined on the protein shell; at stage 3, denser fibers are formed; stage 4 of the disease - formation of calcifications.

European authors prefer the classification of Barra S. and Iacono F., which distinguishes three periods of disease development: up to six months, from 7 months

to a year and over 1 year. Depending on the size of the plaque and the severity of the angle of deformation: up to 30 ° - this is a slight curvature, while the plaque is up to 2 cm; average deformation - up to 60 °, plaque size up to 4 cm; more than 60 ° - severe curvature, plaque size more than 4 cm. [16]. For diagnostics, ultrasound examination with Dopplerography of the vascular network of the penis, CT of the penis, and cavernosography are used. With MRI of the penis, it is possible to obtain a layered image of tissues and organs, clarify the location and size of the plaque, and also assess the intensity of blood flow in the affected area [19]. A highly informative and sensitive diagnostic method for Peyronie's disease is MR tomography with contrast [14,15,20].

The problem of diagnosis and treatment of Peyronie's disease is still relevant, since many authors have not come to a consensus on this issue.

Conservative methods of treatment for Peyronie's disease are used in patients both during the period of active inflammatory reaction and during remission with the use of preventive measures for up to two months [6,17,21]. One of the drugs of choice in conservative treatment of Peyronie's disease is pentoxifylline (inhibits phosphodiesterase, stabilizes cAMP and reduces calcium levels in cells), has a vasodilator, angioprotective, antiaggregatory effect. Improving microcirculation, it promotes regression of fibrous plaques and a decrease in penile deformation [23,24]. Vitamin E, propionyl-L carnitine, acetyl-L carnitine, also in conservative treatment to stabilize the process. Although there is no convincing data on reducing penile deformation and reducing plaques, patients report a decrease in pain threshold and an improvement in their condition when taking these drugs [21,22, 25]. In order to reduce the inflammatory process and obtain positive results, foreign authors proposed using the drug colchicine. Colchicine reduces fibrous growths and collagen synthesis. But the latest data from testing in placebo-controlled groups showed an insignificant effect [27], so doctors refused to use this drug.

Conflicting results are noted when using drugs, omega three, coenzyme Q10 [15,16,17].

Many doctors in practice use local therapy: hydrocortisone applications, ultrasound with lidase, collagenase. These procedures do not give the desired effect, in addition, complications in the form of allergic reactions, skin maceration are common [20,21].

Physiotherapeutic aspects of treatment include shock wave therapy (SWT), which is used to reduce pain. The use of SWT together with the drug tadalafil significantly improves the erectile function indicator.

If the duration of the disease is more than a year, they resort to surgical intervention. The following surgical intervention techniques are distinguished:

- Shortening techniques (plication techniques)
- Plaque dissection and grafting techniques using a transplant

- Phalloendoprosthetics.

In the middle of the twentieth century, Nesbit first described and applied the surgical plication - shortening of the tunica albuginea technique. The method involved opening the tunica albuginea, and removing tissue in the form of an ellipse in the area diametrically opposite to the curvature. Today, there are many modified techniques of the Nesbit surgical manual (modifications of Lemberger, Yachia, Saalfeld, Hellstrom). The modifications of Lue, Shchepleva, Essed-Schroder involve opening the tunica albuginea without opening the cavernous and using sutures made of non-absorbable suture material. However, the negative result of these methods is a shortening of the penis length to 2 cm, and non-absorbable material causes the formation of dense granulomas, leading to pain. If the integrity of the tunica albuginea is compromised, there is a high probability of bleeding and hematoma formation. With the grafting technique, the plaque is dissected in the projection of the curvature of the penis, the resulting defect of the protein shell is covered with various tissues (autoskin, dura mater, large saphenous vein, buccal mucosa, pericardium).

Studies have shown that none of the implants used are recognized as a favorite for obtaining satisfactory results of plastic surgery, since they are not accessible or resistant to infections. Unfortunately, at present, there is no uniform data to determine the best type of transplant. After surgical interventions using a transplant, sexual rest is required for two months. Therefore, the use of this technique is limited, since there is a high risk of postoperative complications.

**Conclusion.** Thus, despite the wide variety of treatment options, choosing the best one is an urgent problem. Today, none of the methods for treating Peyronie's disease corresponds to the "gold standard". The effectiveness of conservative and surgical methods of treating this disease has not been sufficiently proven. All this determines the relevance of the problem in the medical community and requires further study.

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人工智能在预测风对高层建筑影响中的应用：传统模型与神经网络模型的比较分析

**APPLICATION OF ARTIFICIAL INTELLIGENCE FOR  
PREDICTING WIND EFFECTS ON HIGH-RISE BUILDINGS: A  
COMPARATIVE ANALYSIS OF TRADITIONAL AND NEURAL  
NETWORK MODELS**

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摘要。本文对传统和基于神经网络的人工智能 (AI) 模型进行了比较分析,以预测风对高层建筑的影响。该研究重点预测风流下产生的积分气动系数,即阻力系数 ( $C_d$ ) 和力矩系数 ( $C_m$ )。为了评估模型性能,使用了平均绝对误差 (MAE)、均方根误差 (RMSE) 和判定系数 ( $R^2$ ) 等指标。除了神经网络,特别是具有不同数量隐藏层的多层感知器 (MLP),还考虑了决策树、随机森林和梯度提升等传统模型。结果表明,传统模型提供了高精度,特别是在数据量较小的情况下,而神经网络表现出卓越的泛化能力并能捕捉复杂的依赖关系。这项研究强调了针对不同任务和目标变量量身定制的 AI 模型架构开发方法的重要性,以及 AI 在风荷载工程预测中的潜力。

关键词: 人工智能、神经网络、机器学习、建筑空气动力学、气动系数、风洞、工程预测。

**Abstract.** *This article presents a comparative analysis of traditional and neural network-based artificial intelligence (AI) models for predicting wind effects on high-rise buildings. The study focuses on forecasting integral aerodynamic coefficients, namely drag coefficient ( $C_d$ ) and moment coefficient ( $C_m$ ), generated under wind flow. To evaluate model performance, metrics such as Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and the coefficient of determination*



*(R<sup>2</sup>) were used. Traditional models such as Decision Tree, Random Forest, and Gradient Boosting were considered, alongside neural networks, specifically multilayer perceptrons (MLP) with varying numbers of hidden layers. The results show that traditional models provide high accuracy, particularly with small data volumes, while neural networks demonstrate superior generalization capabilities and capture complex dependencies. This study highlights the importance of a tailored approach to AI model architecture development for different tasks and target variables, as well as the potential of AI in engineering forecasting of wind loads.*

**Keywords:** *artificial intelligence, neural networks, machine learning, building aerodynamics, aerodynamic coefficients, wind tunnel, engineering forecasting.*

## Introduction

Artificial intelligence (AI) technologies are currently transforming science and engineering, accelerating technological advancements and improving the quality of applied research [1, pp. 1-19]. Their impact is evident across all sectors, including the construction industry — one of the most conservative fields in the global economy [2]. Despite longstanding traditions and practices, this industry is gradually integrating AI technologies. Neural network models, with their high capacity to detect complex dependencies and hidden patterns in data, are becoming valuable tools for engineering forecasting, often outperforming traditional machine learning methods. However, the implementation of neural networks presents challenges such as significant computational demands, complex architecture tuning, and heavy reliance on large data volumes. The development of new optimization methods and the adoption of advanced machine learning techniques are helping to overcome these obstacles, making neural networks increasingly robust and suitable for engineering applications [3, pp. 275-285].

This study presents the results of training traditional and neural network AI models to predict aerodynamic coefficients of high-rise buildings, specifically  $C_d$  — the drag coefficient, and  $C_m$  — the moment coefficient under wind loading. The dimensionless integral aerodynamic coefficients  $C_d$  and  $C_m$  describe the cumulative impact of airflow forces on a structure, serving as key dimensionless indicators for evaluating wind loads on buildings [4].

The  $C_d$  coefficient reflects the magnitude of the building's drag force under airflow, indicating how effectively the structure resists directed wind movement. This coefficient is crucial for high-rise structures with a frame construction scheme, as its value directly influences the distribution of wind loads on façade systems and the building's load-bearing elements.

The  $C_m$  coefficient characterizes the moment generated by airflow around a given axis, primarily at the building's base. This parameter is essential for calcu-

lating the stability of tall structures, as it reflects the tendency of wind forces to cause the building to rotate or tilt.

**Data Description**

The AI models were trained using data obtained from tests on high-rise building models in the ZD-1 wind tunnel at Zhejiang University [5, pp. 137-145]. The models, made of ABS plastic with rectangular cross-sections, were constructed at a 1:300 scale and subjected to airflow at wind directions ranging from 0° to 180° in 10° increments (Figure 1). The building models had rectangular shapes with cross-sectional aspect ratios of 1, 1.5, 2, 3, 4, 6, and 8. The testing resulted in a dataset of over 45,000 rows, containing data on the distribution of pressure coefficients at measurement points ( $C_p$ ). These measurement points were uniformly distributed across the building façades and positioned at multiple levels  $j$  of varying heights.

Based on the experimental dataset, a new dataset was generated for training AI models by calculating the integral coefficients  $C_d$  and  $C_m$  using formulas (1) and (2).

The Drag Coefficient  $C_d$  was calculated as follows:

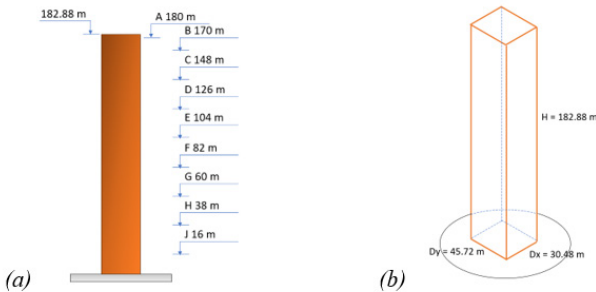
$$C_d = \frac{F}{\frac{1}{2}\rho V^2 A} \tag{1}$$

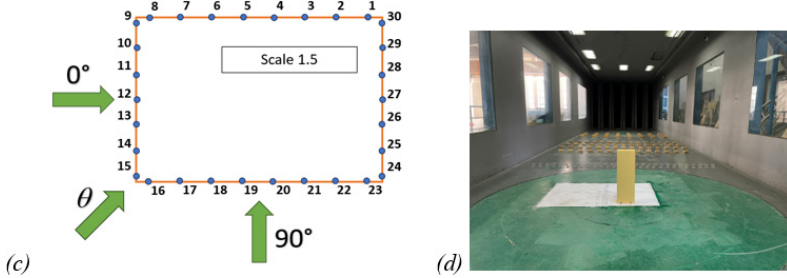
The Aerodynamic Moment  $C_m$  was calculated as follows:

$$C_m = \frac{M}{\frac{1}{2}\rho V^2 AH} \tag{2}$$

where:

- $F$  — aerodynamic drag force,
- $M$  — aerodynamic moment about the specified axis,
- $\rho$  — air density,
- $V$  — approach flow velocity,
- $A$  — characteristic projection area of the building,
- $H$  — characteristic dimension of the building (height).

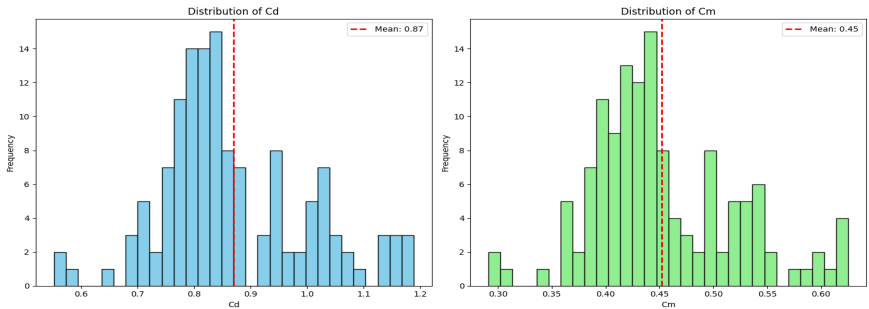




**Figure 1. Schematic of Models and Testing:**

- (a) Arrangement of measurement levels  $j$  for pressure points,
- (b) Sketch of the building model, (c) Wind direction scheme and point locations at a scale of 1.5 for the building model, (d) Example of model placement in the wind tunnel.

The resulting dataset includes the features: model scale (aspect ratio of the building’s cross-section) and wind direction angle, with the target variables being the coefficients  $C_d$  and  $C_m$ . Unlike the experimental dataset, the final dataset contains only 132 rows, which presents certain challenges for model training and is likely to impact the accuracy of predictions. Therefore, one of the objectives of this study is to assess the feasibility of effectively training both traditional and neural network AI models to predict wind effects on high-rise buildings with a limited dataset.



**Figure 2. Histograms of the Distribution of Target Variables  $C_d$  and  $C_m$  in the original scale.**

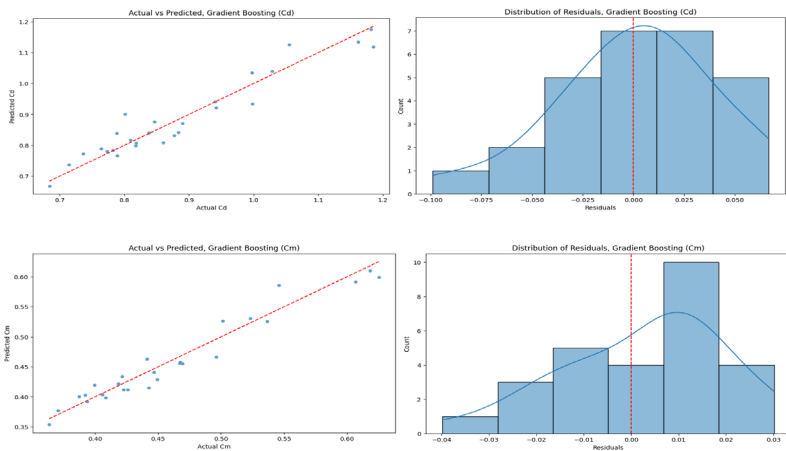
The histograms of the target variables are shown in Figure 2. The distributions of  $C_d$  and  $C_m$  exhibit a shape close to normal, with primary peaks around the

mean values of  $Cd = 0.87$  and  $Cm = 0.45$ . However, data gaps are observed in certain ranges for both target variables. This is likely due to the limited dataset size, leading to an incomplete coverage of possible  $Cd$  and  $Cm$  values. Such limitations may reduce the accuracy and generalizability of the models, particularly when predicting values within these unrepresented ranges. Nonetheless, we believe that this dataset possesses sufficient informational value for research purposes and can yield meaningful results.

**Models, Metrics, and Training**

For model training, traditional regression models such as Decision Tree, Random Forest, and Gradient Boosting were used. These models have proven effective in regression tasks and are well-suited for smaller datasets.

The Decision Tree model was configured with a maximum tree depth of 10 to maintain a balance between predictive accuracy and model robustness. The minimum samples per leaf were set to 5, and the minimum samples required to split a node were set to 2. For the Random Forest model, an ensemble of 100 decision trees with a maximum depth of 10 was used. The minimum samples required for node splitting and leaf size were set to 2 and 1, respectively. A method of random feature selection was applied at each node split. The Gradient Boosting model was configured with 325 trees, a maximum depth of 8, and a learning rate of 0.25. Figure 3 provides example training results for the Gradient Boosting model, and the performance of all traditional models is summarized in Figure 5.

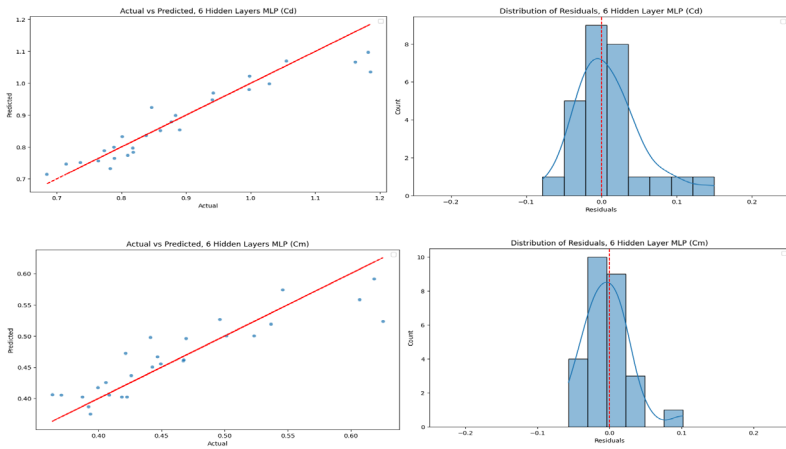


*Figure 3. Training Results of Gradient Boosting model*

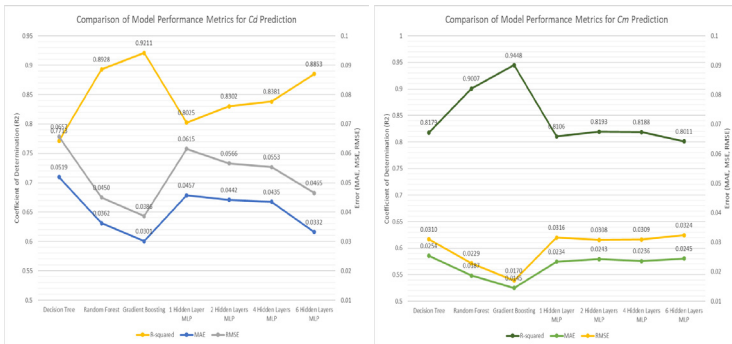
Neural network models based on multilayer perceptron (MLP) were trained on the same dataset. The MLP architectures included networks with 1, 2, 4, and 6 hidden layers, each containing 160 neurons, to evaluate how network depth affects

predictive accuracy and adaptability with limited data. Optimization was carried out using the Adam optimizer with a learning rate of 0.001, Mean Squared Error (MSE) as the loss function, and early stopping (patience = 30 epochs) to prevent overfitting.

The metrics used to assess the accuracy of both traditional and neural network AI models included Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and the coefficient of determination ( $R^2$ ). The dataset was randomly split into training and test sets in an 80/20 ratio. To visualize the results, “Actual vs Predicted Values” and “Distribution of Residuals” plots were created for the target variables  $Cd$  and  $Cm$ . Figure 4 displays training results for the MLP model with 6 hidden layers, while the training data for all MLP models is shown in Figure 5.



**Figure 4.** Training Results of 6 Hidden Layer MLP



**Figure 5.** Comparison of Model Performance Metrics for Cd u Cm Prediction

### Training Results

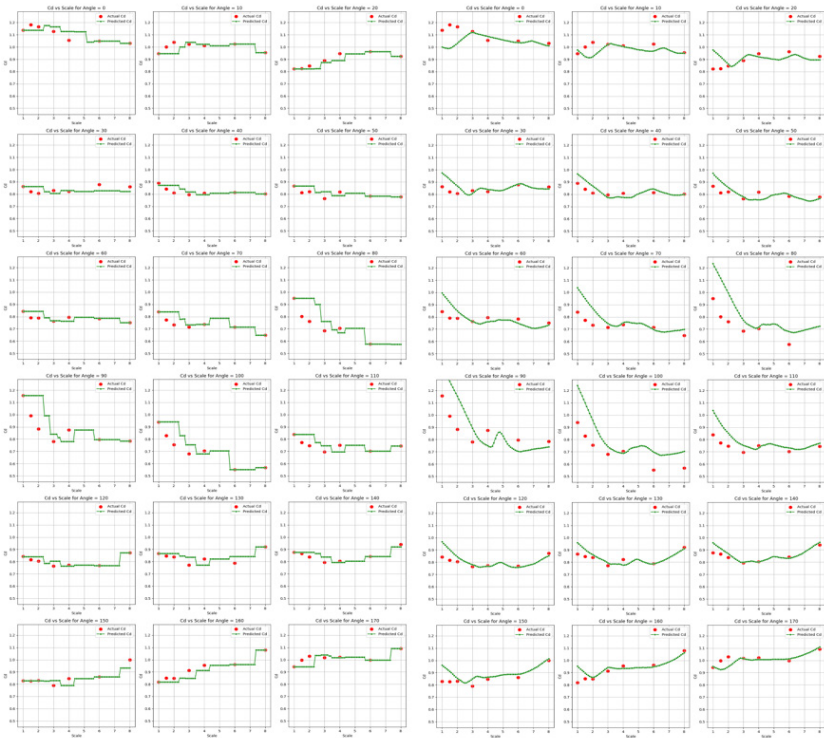
Key insights from the training results for  $Cd$  and  $Cm$  prediction highlight those traditional algorithms like Gradient Boosting and Random Forest delivered top performance. Gradient Boosting achieved the highest  $R^2$  values, with 0.9211 for  $Cd$  and 0.9448 for  $Cm$ , demonstrating strong capability in capturing complex dependencies and aligning well with actual values. Random Forest also maintained high accuracy, only slightly behind.

MLP neural network models showed reliable performance, with one- and two-layer architectures offering a good balance between accuracy and interpretability. For  $Cd$ , the MLP with six hidden layers achieved  $R^2 = 0.8853$ , MAE=0.0332 and RMSE=0.0465; for  $Cm$ , the two-layer MLP reached  $R^2 = 0.8193$ , MAE=0.00243 and RMSE=0.0308. Notably, MLP models behaved differently depending on the target variable: while increasing hidden layers improved  $Cd$  predictions, it led to higher errors for  $Cm$ , even with stable  $R^2$ . This underscores the need for individualized architecture and hyperparameter tuning for each variable, as optimal design can significantly enhance prediction accuracy, especially with limited data. Overall, MLP models demonstrated strong predictive power even with a small dataset, reinforcing their versatility, provided careful architectural and parameter adjustments are applied.

### Comparative Model Analysis

To better assess the predictive abilities of the trained models, graphs of experimental and predicted values were plotted. Figure 5 shows results for the target variable  $Cd$  for the Gradient Boosting model and the MLP with six hidden layers. Each graph displays the  $Cd$  dependency on model scale (Scale) at specific wind flow angles (Angle). Red dots represent actual  $Cd$  values, while the green line shows model predictions.

The analysis indicates that both models generally capture the trend of  $Cd$  variations with Scale, though accuracy varies by Angle. For certain angles, like  $10^\circ$ ,  $20^\circ$ , and  $40^\circ$ , predictions align closely with actual values, but for others, such as  $80^\circ$  and  $130^\circ$ , larger deviations appear, suggesting challenges in these cases. Additionally, noticeable differences emerge in prediction behaviors: Gradient Boosting shows a step-like pattern due to the discrete decision-making of ensemble trees, resulting in distinct “staircase” transitions. In contrast, the MLP model provides smoother predictions, facilitated by continuous training and activation functions that allow for smooth interpolation. While Gradient Boosting can precisely fit individual data regions, it may struggle with continuous approximation, whereas the MLP risks losing detail with abrupt changes, underscoring the need for tailored model design based on data characteristics.



**Figure 5.** Comparison of Experimental and Predicted Values for the Target Variable Cd for Gradient Boosting (left) and MLP with 6 Hidden Layers (right)

### Conclusion

This study shows that both traditional and neural network AI models can effectively capture data relationships and predict target variables, even with limited data. Traditional models like Gradient Boosting and Random Forest exhibited high accuracy with low error values and strong  $R^2$  scores. However, a comparative analysis of experimental and predicted values revealed the unique advantage of MLP neural networks in data generalization, providing smoother approximations and capturing complex nonlinear dependencies. Fine-tuning architectures and hyperparameters may further enhance AI models' predictive quality.

AI models in building aerodynamics offer significant potential for predicting wind effects on structures, including high-rise and complex architectural designs, enabling precise modeling of aerodynamic interactions. AI-based methods

achieve high reliability even with limited data, making them especially valuable when experimental resources are constrained. With minor adaptations, these approaches can extend to other engineering tasks, establishing AI as a universal tool in engineering analysis and design, promising substantial impacts on the construction industry's future.

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