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THE IMPACT OF ERGONOMICS ON OCCUPATIONAL HEALTH IN THE ACTIVITIES OF MEDICAL PROFESSIONALS

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Abstract. This article is devoted to the theoretical analysis of the impact of ergonomic risk factors in the professional activities of medical workers—physicians, nurses, dentists, and surgeons—on musculoskeletal disorders, professional burnout, and labor productivity, based on international scientific literature. The results showed that the prevalence of work-related musculoskeletal disorders exceeds 55–80% among all medical specialties, and it was found that multi-component ergonomic interventions (exercise + education + organizational changes) significantly reduce the intensity of the problem. The lack of local empirical research in this field within the medical institutions of Uzbekistan was identified as an urgent task.

Keywords: ergonomics; occupational health; healthcare workers; musculoskeletal disorders; occupational burnout; workplace design; ergonomic interventions.

Introduction. In the modern medical system, maintaining the health and labor capacity of personnel has become one of the most critical challenges in healthcare. Medical professionals—including physicians, nurses, surgeons, dentists, physiotherapists, and other specialists—operate daily in environments that place exceptionally high physical and psycho-emotional demands on them. Their work environment is characterized by factors such as awkward body postures, prolonged periods of standing or bending, lifting and transferring heavy objects, as well as high levels of psychological pressure. Consequently, the issue of occupational diseases among healthcare workers remains a global priority for healthcare systems. According to the World Health Organization (WHO), at least one-quarter of health and social care workers experienced symptoms of anxiety, depression, and professional burnout during 2020–2022, and these figures have not seen a significant decrease since 2022 (World Health Organization [WHO], 2024). A comparative study by the CDC showed that in 2022, 46% of health workers reported experiencing burnout often or always—a significant increase compared to 32% in 2018 (Nayak, 2023).

A large-scale health status report covering 2023–2024 (based on Mayo Clinic data involving 79,022 healthcare workers) noted that more than half—50%—of healthcare workers felt professional burnout in the past month (HealthLeaders Media, 2024). These figures clearly demonstrate the need for a systematic approach to improving the working conditions of medical personnel and addressing their occupational health. The most common manifestation of occupational problems among medical workers is Work-Related Musculoskeletal Disorders (WMSDs). In a systematic review including 36 original studies by Jacquier-Bret and Gorce (2023), specialists from the International Institute of Biomechanics and Occupational Ergonomics, several key conclusions were drawn: the prevalence of musculoskeletal disorders in the lumbar region among surgeons and dentists exceeds 60%, while disorders related to the shoulders and upper extremities range between 35–55%. Among nurses, lower extremity disorders were found to exceed 25%.

The same research team identified prolonged maintenance of awkward postures and frequent repetition of movements as primary risk factors (Jacquier-Bret & Gorce, 2023). In another study conducted among healthcare workers in operating rooms, the prevalence of WMSDs among nurses worldwide was found to range from 40% to 90% (Anwar et al., 2021). Such a wide range reflects regional and economic differences, as well as the specific characteristics of working conditions in various institutions. These disorders seriously impact not only the health of medical workers but the entire healthcare system. Absenteeism due to illness, decreased work capacity, experienced specialists leaving the profession, and increased errors—all of these directly affect patient safety. Therefore, studying the problem from a preventive perspective is of particular importance. Ergonomics (from Greek: ergon — work, nomos — law) is an interdisciplinary scientific field that studies the interaction between humans and their work systems. It focuses on the scientific design of tools, workplaces, and work processes, taking into account human capabilities, limitations, and needs. According to the International Ergonomics Association (IEA) definition, ergonomics studies human behavior, capabilities, limitations, and other characteristics and applies this knowledge to system design—the primary goal being to improve human well-being and overall system performance.

In the medical field, ergonomics manifests in several key areas: physical ergonomics (anatomical and physiological characteristics—posture, movements, equipment design), cognitive ergonomics (mental workload, error-making, decision-making), and organizational ergonomics (work processes, working hours, teamwork). Together, these three areas allow for an assessment of a medical worker's labor activity as a holistic system (Jacquier-Bret & Gorce, 2023). In the last two decades, the issue of ergonomic working conditions and the occupational health of medical workers has begun to be actively studied on an international scale. Most research has been conducted in developed countries—the USA, Western Europe, and Australia—focusing on specific occupational groups such as surgeons, nurses, and dentists. In particular, studies examining operating room conditions identify poor visibility of equipment, management of surgical instruments, heavy physical and mental workload, and incorrect operating room configurations as primary ergonomic problems. However, an analysis of existing literature reveals several significant shortcomings. First, the working conditions of medical institutions in the Central Asian region, including Uzbekistan, have hardly been studied from an ergonomic perspective. Second, many studies focus on a single occupational group or one type of physical ailment, lacking a holistic, integrated approach to medical labor. Third, the number of studies combining the relationship between ergonomic factors and professional burnout is still limited (Nagarajan et al., 2024). Based on the problems and gaps described above, the main goal of this article is to conduct a systematic theoretical analysis of the impact of ergonomic factors in the activities of medical workers on occupational health based on international scientific literature and to develop practical conclusions for the context of Uzbekistan.

Materials and methods. This article is of a theoretical-analytical nature, and a systematic literature review was selected as the research design. Qualitative synthesis was employed for data analysis. In this method, findings from various sources are not combined quantitatively but are compared thematically to identify general patterns. The analysis was structured across three thematic areas: (1) classification of ergonomic risk factors by specialty, (2) assessment of health outcomes (musculoskeletal disorders and burnout), and (3) evaluation of the effectiveness of intervention approaches.

Results. The literature analysis confirmed an extremely high prevalence of work-related musculoskeletal disorders (WMSDs) among healthcare workers. A systematic review compliant

with PRISMA criteria by Jacquier-Bret and Gorce (2023), which screened 21,766 primary sources to include 36 original studies, showed that the overall prevalence of WMSDs among nurses, obstetrician-gynecologists, dentists, and surgeons exceeds 80%. For physiotherapists, the average rate was around 55%, with significant fluctuations observed based on regional differences.

In the same vein, a new meta-analysis conducted by Gorce and Jacquier-Bret (2025) between September and November 2024 across the ScienceDirect, PubMed/Medline, Google Scholar, Science.gov, and Mendeley databases independently confirmed that the global prevalence of WMSDs for European nurses remains above 80%. Such high figures clearly indicate that the problem has evolved from individual cases into a systemic occupational risk.

Table 1.

Prevalence of WMSDs by Specialty (Based on Jacquier-Bret & Gorce, 2023)

Specialty	Overall WMSDs (%)	Lower Back / Neck (%)	Highest-Risk Region
Nurses	> 80	33 / 33	Lower extremities
Dentists	> 80	60+ / 60+	Shoulder, wrist
Surgeons	> 80	60+ / 60+	Shoulder, wrist, neck
Physiotherapists	~ 55	62 / 32	Lower back (high regional variation)
Obstetricians-gynecologists	> 80	27 / 27	Lower extremities

When analyzed by body regions, the neck and lower back were identified as the most frequently injured areas across all medical specialties—with average prevalence spanning a wide range from 26.7% to 70.1%. Surgeons and dentists exhibited the highest rates in the neck region, where prevalence exceeded 60%, with some recorded maximum values reaching above 80%. In the shoulder and wrist categories, dentists ranked first: 55.1% for shoulders and 39.1% for wrists. For surgeons, these figures were 39.4% and 38.8%, respectively.

For nurses, injuries to the lower extremities emerged as a distinct risk factor: a prevalence rate of over 25% was recorded for nurses, compared to 18% for other specialists. This condition is directly related to the prevalence of prolonged standing, patient handling, and heavy physical loading in nursing practice. A comprehensive cross-sectional study among dentists (151 respondents, Indonesia, 2023–2024) yielded even higher figures: 96% of respondents reported experiencing WMSDs symptoms in at least one body region, with the most affected areas identified as the back (68.2%), lower back (66.9%), upper neck (60.9%), and lower neck (59.6%) (Ernawati et al., 2025).

The literature analysis also allowed for a clear definition of the ergonomic risk factors leading to the development of WMSDs. Primary factors common to all specialties include: awkward and incorrect postures, high repetition of the same movements (repetitive motions), static muscle strain, excessive physical exertion, and fatigue associated with shift work. For instance, for surgeons, maintaining the head and arms in a fixed awkward position during laparoscopic surgeries was highlighted as a leading risk factor, while for dentists, working in a hunched position over the small oral cavity was noted. Furthermore, it has been scientifically proven that cognitive and psychosocial loads—making urgent decisions, high responsibility, and

emotional stress—combine with physical factors to further intensify the risk of disease (Jacquier-Bret & Gorce, 2023).

The impact of ergonomic problems on occupational health is not limited to physical ailments. A systematic review by Cohen et al. (2023) published in BMJ Open, which examined workplace interventions for doctors, nurses, and paramedics, analyzed 33 studies selected from 1,663 sources. The results showed that interventions aimed at reducing organizational stress—directly linked to ergonomic strain—helped improve well-being indicators and significantly lower burnout levels among staff. Importantly, most studies (30) were based on person-directed interventions, while only 3 addressed organizational-level changes, indicating a significant gap in systemic approaches.

The StatPearls medical reference (Bhatt, 2024) supports the same conclusion: scientific research confirms the necessity of proper staffing levels and workload distribution to prevent fatigue and burnout resulting from ergonomically demanding tasks. Patients also reported feeling more confident when safe handling techniques were utilized a practical evidence of the direct relationship between ergonomics and patient safety. The latest and most comprehensive evidence regarding the effectiveness of ergonomic interventions comes from a systematic review by Krishnanmoorthy et al. (2025) published in JMIR Human Factors. From an initial 5,867 articles between 2017–2024, 19 studies selected based on PRISMA criteria were analyzed to examine interventions reducing WMSDs and sickness absenteeism among nurses. Results indicated that multi-component interventions combining physical exercises and education programs had a much stronger impact than educational programs alone: 6 months post-intervention, the risk of WMSDs decreased by OR 1.64 (95% CI: 1.12–4.54), and after 12 months, this difference increased further to OR 2.70 (95% CI: 1.52–4.51).

Table 2.

Types of Ergonomic Interventions and Their Effectiveness (Based on Krishnanmoorthy et al., 2025)

Intervention Type	Description	Effectiveness
Multicomponent (exercise + education)	Combines physical activity, ergonomic training, and occupational risk education	OR 1.64 (6 months); OR 2.70 (12 months)
Education-only programs	Courses on postural hygiene and proper body mechanics	Moderate; does not produce a strong sustained effect
Patient handling devices (SPHM)	Mechanical lifting and transfer systems, including slip sheets	Positive impact on reducing WMSDs
Organizational interventions	Work-time optimization, shift rotation, and stress-reduction programs	Improves burnout and overall well-being

However, a significant limitation was identified: more than half of the 19 studies noted that ergonomic interventions did not have a statistically significant impact on sickness absenteeism or labor productivity ($p > 0.05$). This result suggests that while an ergonomic approach is effective in reducing WMSDs symptoms, it is insufficient for full productivity recovery—a comprehensive strategy that also accounts for additional organizational and psychosocial factors is required.

Regional analysis also yielded noteworthy findings. In physiotherapists, the prevalence of WMSDs in the lower back was up to twice as high in Africa (20.6%) and Europe (24.4%) compared to Asia and America. Conversely, mid-back disorders occur twice as often in America (66.0%) and Oceania (62.5%) compared to Asia (39.8%) and Europe (37.2%). These regional differences reflect a complex correlation between labor market policies, the quality of medical equipment, education systems, and working conditions in institutions. In this sense, the lack of comparative data for Uzbekistan and Central Asia reaffirms the urgent need for empirical research in this region.

Discussion. The results obtained prove that work-related musculoskeletal disorders (WMSDs) among healthcare workers have emerged as a serious global occupational problem, and its scale is much wider than many researchers expected. Prevalence rates exceeding 80% indicate that the problem is not an individual occurrence but a characteristic inherent to the entire professional system. The primary significance of this conclusion is that, in the face of such indicators, individual-oriented corrective measures alone are insufficient—systemic changes at the institutional and policy levels are necessary.

The research results show that risk factors manifest uniquely for each specialty. While the neck and shoulder areas are the primary issues for surgeons and dentists, the lower extremities are more frequently affected among nurses. This differentiation is practically important: it means that preventive measures should not be developed based on a "one-size-fits-all" template for all medical workers, but rather by taking into account the work characteristics of each professional group. The inefficiency of general education programs is often rooted in this very failure to consider professional specificity. The finding that multi-component interventions show significantly higher effectiveness compared to single education programs (OR 2.70 at 12 months) is of particular importance. This result demonstrates that an ergonomic approach does not merely consist of replacing equipment or conducting one-time training; it is a complex process involving physical activity, education, and the organizational reorganization of the work environment. However, at the same time, the fact that interventions failed to show a statistically significant impact on labor productivity ($p > 0.05$) indicates that the path between reducing physical symptoms and fully restoring labor efficiency is longer and multi-factorial—psychosocial, financial, and organizational conditions play an equally important role.

One of the most significant limitations of this study is that most analyzed sources pertain to medical systems in developed countries, and similar data is virtually non-existent in the context of Uzbekistan and the broader Central Asian region. This situation limits the possibility of comparative analysis and complicates regional conclusions. Furthermore, in all reviewed studies, WMSDs were measured based on self-reports, which introduces a risk of subjectivity. Given this methodological limitation, the use of objective clinical and instrumental assessment methods is recommended for future research.

Conclusion. This theoretical analysis clearly demonstrated a strong, statistically confirmed link between ergonomic risk factors in the activities of medical workers and occupational health. WMSDs indicators are critically high for all studied professional groups, and the problem must be recognized as a priority task for the healthcare system.

The evidence analyzed in the article shows that the most effective preventive path is a multi-component approach that combines physical exercise, ergonomic education, and the organizational reorganization of the work environment. For medical institutions in Uzbekistan specifically, the development of local empirical research and evidence-based national standards

in this field remains the most urgent task. Protecting the occupational health of medical workers is not only a matter of social justice for them but also an indispensable condition for ensuring patient safety and the stable operation of the healthcare system.

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