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**INFLUENCE OF PHYSICAL STRAIN ON THE INCIDENCE  
OF MUSCULOSKELETAL PAIN AMONG INTENSIVE CARE  
UNIT NURSES**


**Wpływ obciążenia fizycznego na występowanie dolegliwości bólowych układu  
mięśniowo-szkieletowego wśród pielęgniarek oddziału intensywnej terapii**

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A - Koncepcja i projekt badania, B - Gromadzenie i/lub zestawianie danych, C - Analiza i interpretacja  
danych, D - Napisanie artykułu, E - Krytyczne zrecenzowanie artykułu, F - Zatwierdzenie ostatecznej  
wersji artykułu

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**Abstract (in Polish):**

Cel pracy: Oddział intensywnej terapii realizuje specjalistyczne świadczenia w celu zapewnienia opieki pacjentom w stanach zagrożenia życia. Proces opieki nad pacjentem i związana z tym duża ilość czynności wymaga od pielęgniarek dobrej kondycji fizycznej i często jest przyczyną przeciążenia organizmu. Celem pracy była ocena wpływu obciążenia fizycznego na występowanie dolegliwości bólowych układu mięśniowo-szkieletowego wśród pielęgniarek oddziału intensywnej terapii.

**Materiał i metody:** Badania przeprowadzono metodą CAWI w grupie 184 pielęgniarek i pielęgniarzy czynnych zawodowo, pracujących w oddziale intensywnej terapii na terenie Polski. Narzędziem badawczym był autorski kwestionariusz ankiety i skala oceny poziomu bólu VAS (Visual Analogue Scale). Za poziom istotności statystycznej przyjęto  $p < 0,05$ .

**Wyniki:** Dolegliwości bólowe kręgosłupa odczuwało kiedykolwiek 82,6% badanych. Ból kręgosłupa najczęściej zlokalizowany był w badanej grupie kobiet go odczuwających w odcinku lędźwiowym (57,6%) oraz w odcinku szyjnym (23,8%). Z powodu dolegliwości bólowych kręgosłupa leczyło się kiedykolwiek 45,1% badanych. Dolegliwości bólowe odczuwane przez badane pielęgniarki ocenione w dziesięciopunktowej skali VAS były na średnim poziomie i wynosiły 5,62 pkt.  $\pm$  2,62 pkt.

**Wnioski:** W wyniku obciążenia fizycznego pielęgniarki odczuwają znaczny poziom bólu, z reguły zlokalizowany w odcinku lędźwiowym kręgosłupa. Wiek oraz staż pracy miały wpływ na nasilenie dolegliwości bólowych układu mięśniowo-szkieletowego w badanej grupie. Znajomość zasad ergonomii pracy nie ma większego wpływu na występowanie dolegliwości bólowych kręgosłupa, nieco większy ból odczuwają pielęgniarki rzadziej korzystające z przerw od pracy.

#### **Abstract (in English):**

**Aim:** Intensive care unit performs specialized services to provide care to patients in life-threatening conditions. The process of patient care and the associated high volume of activities requires nurses to be in good physical condition and is often the cause of overloading the body. The aim of this paper was to assess the impact of physical strain on the incidence of musculoskeletal pain among intensive care unit nurses.

**Material and methods:** The study was conducted using the CAWI method in a group of 184 active nurses working in an intensive care unit in Poland. The research tool was a proprietary survey questionnaire and the Visual Analogue Scale (VAS) pain rating scale. The level of statistical significance was taken as  $p < 0.05$ .

**Results:** Back pain was experienced by 82.6% of the respondents. Spinal pain was most often located in the examined group of women in the lumbar section (57.6%) and in the cervical section (23.8%). 45.1% of the respondents had ever been treated for back pain. Pain experienced by the surveyed nurses assessed on a ten-point VAS scale was at an average level and amounted to 5.62 points.  $\pm$  2.62pts.

**Conclusions:** As a result of physical strain, nurses experience a significant level of pain, generally localized to the lumbar spine. Age and length of service influenced the severity of musculoskeletal pain in the study group. Knowledge of the principles of ergonomics at work has no significant effect on the incidence of back pain, slightly more pain was experienced by nurses who took breaks from work less frequently.

**Keywords (in Polish):** pielęgniarki, obciążenie fizyczne, oddział intensywnej terapii.

**Keywords (in English):** nurses, physical strain, intensive care unit.

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### Short title

Dolegliwości bólowe kręgosłupa wśród pielęgniarek

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## Introduction

Diseases and ailments of the musculoskeletal system, including the spine, are a well-known problem not only because of the therapeutic aspect, but primarily because of their social and economic dimensions. Spinal pain syndromes are a heterogeneous group of conditions with diverse etiologies. The main mechanism causing spinal pain is considered to be a mechanical factor causing functional disorders of the spine and structures anatomically and functionally connected to it. This occurs when static and dynamic loads exceed the adaptive threshold and resistance of the spine and surrounding tissues to the acting forces [1]. The substrate for the occurrence of back pain is closely related to the nature of nurses' work, associated with activities such as lifting, remaining in a forced body position for long periods of time and frequent bending. Hence, nowadays back pain syndromes are considered a para-occupational disease, where working conditions are one of the serious factors contributing to the manifestation of pain. An additional factor that contributes to the development of spinal disorders is the working hours, which are significantly extended in relation to the statutory requirements, often reaching 12 hours a day. Of course, a number of other factors also determine the possible occurrence of back pain. Among the most important are an individual's characteristics, level of physical activity, genetic factors, past injuries and concomitant diseases. The overlap of several of the aforementioned factors is likely to result in a more frequent manifestation of spinal disorders [2].

Nursing is a profession that plays an extremely important role in society. Common health risks for nurses include musculoskeletal overload leading to pain even in those with short work experience. Nowadays, more and more attention is being paid to the problem of nurses' workload. The process of caring for a patient and the large number of activities involved require, first of all, good physical fitness [3]. Nurses' workload is an important factor that can affect patient safety and the quality of nursing services in the hospital environment. The workload is related to obtaining the necessary level of basic clinical skills required to perform daily nursing activities [4]. Nurses working in the ICU spend the most time on direct patient care and are therefore exposed to a higher workload than nurses in other units [5].

Workload is defined as *“the system of external and internal forces actively affecting a person in a work situation, which results in the expenditure of his psychophysical energy and fatigue”*. Another definition considers this type of load as *“the discrepancy between the requirements of the job and the level of resources that the employee has”* [6]. Depending on the type of activities performed, the physical load on the body and the mental load are distinguished. In turn, the magnitude of these burdens depends on the effort put into the activity being performed [7].

The direct cause of back pain among nurses is considered to be, its static and dynamic loads. Their magnitude is influenced by behavior contrary to the principles of prevention and ergonomics of work, as well as a deficit in the professional group of nurses [5,8]. Deficiencies in equipment to facilitate patient care also play a major role. Musculoskeletal ailments are closely related to the need to stay in a forced position for several hours, to move patients, to carry both them and various types of medical apparatus, and to perform nursing and hygienic activities [9].

The nursing profession, especially anesthesiology, is characterized by highly dynamic and static workloads. Elements of static work occur during motor activities, such as manual lifting and carrying of loads, which involve extended positions of body segments (e.g., caring for recumbent, often obese patients). The above activities contribute to prolonged fatigue, reduced physical performance and weakness in the musculoskeletal system. These weak points are particularly susceptible to mechanical stresses and injuries most often manifested by muscle and joint pain, especially in the spine [10]. Nurses are considered essential personnel in the health care sector, in whom certain factors, such as improper posture during work activities, repetitive body movements, prolonged and constant pressure on muscles, are responsible for the development of these disorders among nurses. Depending on the work situation, nurses are responsible for important duties such as psychological and physical care that require long-term flexibility. In addition, activities that are performed to transport patients that involve patient movement or support, such as carrying, pushing, pulling, lifting and lumbar movements. Compared to carrying objects, moving a patient or person is complicated and unpredictable due to his weight and weak grip. What's more, he or she may be hit while being transported, leading to a lot of damage to the nurse [11].

The aim of this paper was to evaluate the effect of physical strain on the incidence of musculoskeletal pain among intensive care unit nurses.

### **Material and methods**

The survey was conducted among 184 active nurses working in an intensive care unit in Poland. It was completed using the CAWI method via social networks of anesthesia nurses. The participation of nurses in the study was voluntary and anonymous. Completion of the survey questionnaire was tantamount to consent to the study, which was approved by the Bioethics Committee of the State Academy of Applied Sciences in Przemyśl (KB/PANS No. 3/2023). The study was conducted between January and February 2023. The study was conducted by a diagnostic survey method, using a survey technique. The research tool was a survey questionnaire consisting of a section containing questions about sociodemographic data, an author's survey questionnaire containing questions about the specifics and workload in the intensive care unit, and the VAS scale. Statistical analysis of the collected material was carried out using descriptive statistics, Mann-Whitney and Kruskal-Wallis U tests. The correlation of two variables not meeting the criterion of normality of distribution was determined using Spearman's rank correlation coefficient. The level of statistical significance was taken as  $p < 0.05$ .

### **Results**

A total of 184 nurses participated in the study, 92.9% of them were women. Nurses were classified into four age ranges. There were 14.7% in the 20 to 30 age bracket, 43.0% in the 31 to 40 age bracket, 32.6% in the 41 to 50 age bracket and 9.7% in the over 50 age bracket. Job tenure of up to

5 years was held by 15.8% of the respondents, job tenure of up to 10 years was held by 20.1% of the respondents, up to 15 years was held by 40.2% of the respondents, up to 20 years was held by 13.0% of the respondents and over 20 years was held by 10.9% of the respondents. All respondents worked in shifts (12-hour) or single shifts (7.35). According to 78.0% of respondents, there were usually four nurses on duty supported by nurses working in the morning (7.35), 20.6% of respondents indicated a smaller number of staff. The average number of beds in the units where respondents worked was 8.

Spinal pain was ever experienced by 82.6% of the subjects. Spinal pain was most often localized in the surveyed group of women experiencing it in the lumbar (57.6%) and cervical (23.8%) regions. 45.1% of the subjects had ever been treated for back pain. The pain complaints experienced by the nurses surveyed as assessed on the ten-point VAS scale were at an average level of 5.62 pts. ± 2.62 pts.

**Table 1. Perception of back pain by respondents.**

VAS	Descriptive statistics							
	n	$\bar{x}$	Me	Min.	Max.	Q1	Q3	SD
[1-10 pts.]	184	5.62	6.00	1.00	10.00	3.50	8.00	2.62

n – numer of observations;  $\bar{x}$  - arithmetic mean; Me - median; Min. - minimum; Max. - maximum; Q1 - lower quartile; Q3 – upper quartile; SD – standard deviation

Source: own.

All respondents declared knowledge of the principles of ergonomics at work and patient handling aids were used by 94.0% of respondents. As the correct way to perform an activity requiring lifting, respondents most often indicated performing it on the inhale (55.4% of people), on the exhale was indicated by 20.1% of respondents, while for the remaining 24.5% of respondents the breathing phase was not important. The presence of a statistically significant correlation between the age of the female subjects and their length of service and the intensity of their back pain complaints was confirmed ( $p < 0.001$ ). Both correlations had a positive orientation ( $R = 0.54$  and  $R = 0.41$ ). This means that the older the subjects were, or the longer their length of service, the higher the intensity of their perceived back pain complaints. In most cases, ergonomics adherents and non-adherents experienced pain at similar levels. The greatest disparity in terms of pain intensity was observed among women taking a break from work and women taking a break from work sometimes or not at all, the relationship was close to the threshold of statistical significance ( $p = 0.062$ ).

**Table 2. Level of intensity of perceived back pain according to adherence to ergonomics at work (n=184).**

Variable		$\bar{x}$	Me	SD	Z	p
Use of patient handling equipment	Yes	4,74	5,00	3,22	0,37	0,704
	No	4,56	6,00	2,74		
Adjusting the height of the patient's bed to suit nurses' height	Yes	4,67	5,00	3,24	0,52	0,603
	No	5,43	6,00	2,15		
Adhere to the principles of correct body positioning while working	Yes	4,73	5,00	3,22	0,18	0,185
	No	4,63	5,00	2,67		
Break during work	Yes	4,39	4,00	3,20	-1,86	0,062
	No*	6,05	6,50	2,74		

$\bar{x}$  - arithmetic mean; Me - median; SD – standard deviation

Z – result of Mann-Whitney's test; p – significance level

\* no or sometimes

Source: own.

By analyzing the results of the questionnaire, it was found that the respondents' level of musculoskeletal pain complaints was at an average level (49.3%). It was shown that age had the most significant effect on musculoskeletal complaints in all analyzed ranges. Respondents in older age groups are characterized by higher levels of pain complaints. The correlation is statistically significant and characterized by a clear strength of the relationship (Kendall's tau-c 0.297).

### Discussion

Our own study showed that the workload of nurses employed in the intensive care unit due to the nature of their work was high, which is confirmed by the studies of other authors [4,5,10]. The age of the respondents has a significant impact on musculoskeletal pain complaints. Those in the age range of 41 - 50 and 50 and older are characterized by a higher degree of disability. The severity of pain complaints averaged 5.62 points on the VAS scale. Our study also shows that the level of disability among active nurses due to pain complaints is at a mild level, which is confirmed by other studies [12]. A significant factor that aggravated it was the age of the respondents adversely affecting the musculoskeletal system, in addition, significant workload and the time factor in life-threatening situations of the patient, which is also mentioned by other authors [13,14]. Juraszek et al. analyzed the most common causes that caused back pain. The vast majority, 90.5%, indicated that it was related to overload at work in the nurse's position. Most of the nurses surveyed believe they know the principles of ergonomics at work, but as many as 38% of the respondents use them rarely, and 7% of the respondents never. Moreover, only half of the respondents adopt the correct body position when manually lifting and moving patients [2]. In the study by Sierakowska et al. 57.0% of the respondents reported musculoskeletal pain, the vast majority of which involved the lumbar spine. Persistent complaints were characteristic of nurses with a mean age of 49.5 years, with work experience of more than 27 years and a BMI value  $\geq 25$  kg/m<sup>2</sup> ( $p = 0.0038$ ). Studies have shown that pain increasing with age and length of service was a significant factor in reducing nurses' quality of life [15], which is supported by other studies [16,17].

A study by van den Oetelaar et al. found that, in addition to modeled workload, work resource support from co-workers and the need for direct patient care had the greatest significant impact on perceived workload [18], which is supported by other studies of our own [19-20]. Work by other authors shows that the lowest and highest prevalence of musculoskeletal complaints were 44.1% and 82.7%, respectively [21]. Negash et al. found that nurses were more likely to suffer from sacroiliac pain than other professionals because work-related factors mainly included activities that required back bending, lifting, pulling objects and manual patient handling [22-26].

Rypicz et al. showed that nurses experienced many episodes of musculoskeletal pain, occurring most often in the spinal region (lower and upper back and neck). It is crucial to determine the actual causes of musculoskeletal pain and take appropriate preventive measures to improve ergonomics at work [10]. On the basis of a study by other authors, it was proven that nurses had a higher prevalence of lower back disorders (88.33%). In addition, a significant relationship was observed between pain complaints in different areas of the body with age, gender, and seniority and working hours [11].

The introduction of ergonomic principles at work greatly helps relieve the musculoskeletal system. The assimilation of these principles does not involve effort, but the development of a few very important habits that are worth introducing during work and everyday life [27, 28]. A very important role is played by resting and maintaining the correct body position while performing

activities. Education on biomechanics and ergonomics should be implemented in workplaces, especially where non-physiological body positions are adopted very often. It is very important to ensure that the correct body position is maintained, as it has a very strong influence on structural changes in the spine and muscle overload [29,30].

## Results

1. As a result of physical strain, nurses experience a significant level of pain, generally localized to the lumbar spine.
2. Age and length of service influenced the severity of musculoskeletal pain in the study group.
3. Knowledge of the principles of ergonomics at work has no significant effect on the incidence of back pain, slightly more pain was experienced by nurses who took breaks from work less frequently.

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