ORIGINAL PAPER

International Journal of Occupational Medicine and Environmental Health 2024;37(5):545–556
https://doi.org/10.13075/ijomeh.1896.02472

# IMPACT OF BODY WEIGHT ON THE RELATIONSHIPS BETWEEN SLEEP QUALITY IN HEALTHCARE WORKERS AND THEIR SOMATIC HEALTH, SEXUAL LIFE, OCCUPATIONAL BURNOUT AND STRESS

**MACIEJ BIAŁORUDZKI[1,2], MICHAŁ UNDRA[1], and ZBIGNIEW IZDEBSKI[1,2,3]**

[1] University of Zielona Góra, Zielona Góra, Poland
Department of Humanization of Health Care and Sexology, Collegium Medicum
[2] Warsaw University, Warsaw, Poland
Department of Biomedical Aspects of Development and Sexology, Faculty of Education
[3] Warsaw University, Warsaw, Poland
Faculty of Medicine

**Abstract**
**Objectives:** Sleep disorders can significantly affect the performance and well-being of healthcare workers. This study explores the influence of body weight on the links between sleep quality and various self-reported health indicators – including somatic and mental health, sexual life, and work-related stress – among healthcare workers. **Material and Methods:** A national cross-sectional survey was conducted in February – April 2022 using a predominantly online, self-administered questionnaire. The group analyzed for this study included 1478 healthcare workers from 99 hospitals and specialized clinics across Poland. **Results:** Sleep disturbances, assessed via the 4-item *Jenkins Sleep Scale* scale, were reported by 16% of the participants. Over half (54.7%) of the respondents were categorized as overweight or obese based on their body mass index (BMI). A higher BMI was found to be associated with being male, age >50 years, working as a paramedic, possessing over ten years of work experience, and reporting poorer health and sexual life ($p < 0.001$). Sleep quality showed significant correlations with assessments of sexual life, stress levels, and occupational burnout ($p < 0.001$). These correlations remained significant after adjusting for BMI. Notably, in both univariate and adjusted models, sexual life assessment was a robust predictor of sleep quality across all BMI groups. For non-obese individuals, the impact of sexual life on sleep quality persisted even after adjusting for health indicators. **Conclusions:** The findings suggest that body weight may modulate how sleep quality is influenced by sexual life assessments, work-related stress, and somatic and mental health in healthcare workers. Int J Occup Med Environ Health. 2024;37(5):545–56

**Key words:**
**stress, sexual life, sleep disorders, body weight, occupational burnout, healthcare workers**

Funding: this study was supported by Agency Medical Science (project No. 2021/ABM/COVID19/UW entitled "Humanization of the Treatment Process and Clinical Communication Between Patients and Medical Personnel Before and During the COVID-19 Pandemic," project manager: Prof. Zbigniew Izdebski) and by University of Warsaw.
Received: June 26, 2024. Accepted: October 25, 2024.
Corresponding author: Maciej Białorudzki, University of Zielona Góra, Department of Humanization of Health Care and Sexology, Collegium Medicum, Licealna 9, 65-417 Zielona Góra, Poland (e-mail: M.Bialorudzki@inz.uz.zgora.pl).

## INTRODUCTION

High-quality sleep is crucial for maintaining overall health and well-being, playing a key role in regeneration, energy conservation, and survival [1]. Sleep disorders are linked to significant adverse health impacts, including increased mortality, cardiovascular diseases, heightened pain, and reduced stamina [2,3]. Moreover, sleep disorders negatively affect mental, social, and cognitive functioning [4]. The quality of sleep depends on a range of factors, including sleep continuity, regularity, duration, and diurnal effects (e.g., how well rested a person feels upon waking and throughout the day) [3,5].

Healthcare workers are notably at risk of sleep deprivation and reduced sleep quality due to such factors as shift work, long hours, professional responsibilities, and a tendency to take work home [6,7]. During the COVID-19 pandemic, healthcare workers reported poorer sleep quality and increased insomnia [8]. Insufficient sleep duration has been linked to impaired brain function, cognitive abilities, and working memory [9], which are critical for healthcare personnel who frequently make critical decisions, thereby increasing the potential risk of medical errors. Moreover, healthcare workers are also susceptible to burnout and elevated stress levels [10]. Research has identified a relationship between sleep disorders and occupational stress, increased stress levels, burnout, and overcommitment [11,12]. Additionally, a positive evaluation and satisfaction with sexual life have been found to be positively correlated with quality of life, including sleep quality [13]. Healthcare workers are also at risk of excessive body weight, which is associated with poorer physical, psychosocial, and sexual health [14,15]. Sleep disorders can affect dietary choices, promoting the consumption of processed and higher-calorie foods [16], increasing hunger and inhibiting satiety [17]. Consequently, sleep deficiencies are linked to obesity [18] and increased waist circumference [19]. Sleep restriction can also impede weight loss, leading to the loss of lean body mass rather than fat tissue [20]. It has been suggested that a higher body mass index (BMI) correlates with a higher frequency of sleep disorders [13], indicating a mutual correlation between BMI and sleep quality.

In this study, the authors utilized empirical data from a comprehensive survey conducted across 99 institutions in Poland in 2022, aiming to conduct a thorough assessment of various health parameters among healthcare workers. The objective in analyzing this data was to identify factors associated with the sleep quality of healthcare workers, particularly concerning their workload and self-assessed health in somatic, psychological, and sexual realms. The authors also aimed to test the hypothesis that the impact of these factors on sleep quality varies according to body weight.

## MATERIAL AND METHODS

### Study design

The data for this analysis was gathered through a nationwide cross-sectional survey conducted in Poland, as part of the project titled "Humanization of the Treatment Process and Clinical Communication Between Patients and Medical Personnel Before and During the COVID-19 Pandemic." This survey was carried out February 21 – April 28, 2022, with the University of Warsaw as the lead research institution. The project included healthcare staff members (physicians, nurses, paramedics) employed at 99 healthcare units across the country, including 94 hospitals. The survey utilized a combination of computer-assisted web interviewing (CAWI) and traditional paper-and-pencil interviewing (PAPI) methods. A total of the respondents (N = 1478) participated in the analyses, with the exclusion criteria being missing data for the variables analyzed. The details of the participant demographics and other relevant data are presented in Table 1 in the Results section.

The questionnaire comprised primarily closed questions, employing nominal or ordinal scales. The questions covered various topics such as self-assessment of life, includ-

**Table 1.** Sample characteristics by body mass index (BMI) categories, survey of healthcare workers 2021–2023, Warsaw, Poland

| Variable | Participants (N = 1478) [n (%)] | | | | $\chi^2$ |
|---|---|---|---|---|---|
| | total | BMI | | | |
| | | norm (N = 669, 45.3%) | overweight (N = 546, 36.9%) | obesity (N = 263, 17.8%) | |
| Socio-economic | | | | | |
| gender | | | | | <0.001 |
| male | 331 (22.4) | 93 (28.1) | 175 (52.9) | 63 (19) | |
| female | 1147 (77.6) | 576 (50.2) | 371 (32.3) | 200 (17.4) | |
| age | | | | | <0.001 |
| 20–29 years | 156 (10.6) | 102 (65.4) | 37 (23.7) | 17 (10.9) | |
| 30–49 years | 641 (43.4) | 324 (50.5) | 226 (35.3) | 91 (14.2) | |
| ≥50 years | 681 (46.1) | 243 (35.7) | 283 (41.6) | 155 (22.8) | |
| Work-related | | | | | |
| profession | | | | | <0.001 |
| doctor | 407 (27.5) | 208 (51.1) | 149 (36.6) | 50 (12.3) | |
| nurse | 928 (62.8) | 414 (44.6) | 331 (35.7) | 183 (19.7) | |
| paramedic | 143 (9.7) | 47 (32.9) | 66 (46.2) | 30 (21) | |
| work experience | | | | | <0.001 |
| ≤10 years | 340 (23) | 204 (60) | 102 (30) | 34 (10) | |
| >10 years | 1138 (77) | 465 (40.9) | 444 (39) | 229 (20.1) | |
| Medical | | | | | |
| sleep | | | | | 0.113 |
| no sleep problems | 1242 (84) | 571 (46) | 461 (37.1) | 210 (16.9) | |
| sleep problems | 236 (16) | 98 (41.5) | 85 (36) | 53 (22.5) | |
| occupational burnout | | | | | 0.072 |
| no burnout | 959 (64.9) | 447 (46.6) | 358 (37.3) | 154 (16.1) | |
| risk of burnout | 296 (20) | 131 (44.3) | 110 (37.2) | 55 (18.6) | |
| confirmed burnout | 223 (15.1) | 91 (40.8) | 78 (35) | 54 (24.2) | |
| stress | | | | | 0.628 |
| low | 774 (52.4) | 357 (46.1) | 277 (35.8) | 140 (18.1) | |
| high | 704 (47.6) | 312 (44.3) | 269 (38.2) | 123 (17.5) | |
| sexual life assessment | | | | | <0.001 |
| good | 927 (62.7) | 465 (50.2) | 328 (35.4) | 134 (14.5) | |
| poor | 551 (37.3) | 204 (37) | 218 (39.6) | 129 (23.4) | |
| health assessment | | | | | <0.001 |
| good | 1048 (70.9) | 521 (49.7) | 383 (36.5) | 144 (13.7) | |
| average | 292 (19.8) | 106 (36.3) | 118 (40.4) | 68 (23.3) | |
| poor | 138 (9.3) | 42 (30.4) | 45 (32.6) | 51 (37) | |

ing sexual life and health, as well as issues related to the humanization of medicine and patient-medical staff communication. On average, participants completed the online survey in 23.74 min, with a median completion time of 20.75 min. The survey was conducted anonymously, allowing respondents the freedom to withdraw at any time without needing to provide a reason.

The ethical considerations for the survey, including the study's thematic scope, methodology, and the process for obtaining informed consent, were approved by the Ethics Committee of the Faculty of Education at the University of Warsaw, Poland (decision No. 2021/8).

**Research tools**

Sleep

Sleep disturbances over the past month were evaluated using the 4-item *Jenkins Sleep Scale* (JSS-4). This scale includes questions like: "How often did you have trouble falling asleep?" [21]. Originally developed in English, the scale was translated into Polish and back-translated to ensure accuracy. Responses ranged from 0 (not at all) to 5 (22–31 days over the past month), with the total possible score ranging 0–20. Scores between 1–11 suggest minor sleep disturbances, while scores of ≥12 indicate severe sleep disturbances [22]. The scale's homogeneity was confirmed through principal component analysis (PCA), showing factor loadings 0.84–0.92, and it demonstrated high internal consistency with a Cronbach's α of 0.90. The distribution was found to deviate from normal.

Body weight

Respondents reported their body weight in kilograms and height in centimeters, which was used to calculate their BMI as weight divided by height squared (kg/m$^2$). Body mass index categories were defined as follows: 18.5–24.99 kg/m$^2$ for normal weight, 25–29.99 kg/m$^2$ for overweight, and >30 kg/m$^2$ for obesity.

Assessment of sexual life

Sexual life was evaluated by asking: "How do you rate your sexual life?" and "How do you rate your sexual performance and capabilities?" – using a scale from 1 (very good) to 5 (very poor). The scoring range was 2–10, with higher scores indicating poorer sexual life. Scores were categorized into good or poor evaluations, a method consistent with other Polish studies [14]. Principal component analysis confirmed the scale's homogeneity, with factor loadings of 0.93, and it exhibited excellent internal consistency (Cronbach's α 0.93).

Health assessment

Health status was assessed by asking, "How do you rate your health status?" – with responses ranging from 1 (very good) to 5 (very poor). These were recoded into 3 categories: good, average, and poor health.

Occupational burnout

Burnout was assessed using the 12-item *Burnout Assessment Tool* (BAT-12) scale, a shortened version of the original BAT-23 developed by Schaufeli et al. [23]. This scale, translated into Polish for this project, includes items rated from 1 (never) to 5 (always), with higher scores indicating greater burnout. The BAT-12 encompasses 4 dimensions – exhaustion, mental distance, cognitive impairment, and emotional impairment – but an overall index is also used. Internal consistency was very good (Cronbach's α 0.93). Burnout levels were classified into 3 levels: no burnout, risk of burnout, and confirmed occupational burnout, with thresholds at 2.54 pts and 3.02 pts per item, respectively, based on Schaufeli et al. [23].

Stress

Stress was measured using the 4-item *Perceived Stress Scale* (PSS-4), also known as Cohen's scale [24]. This scale includes 4 questions reflecting experiences over the past

month on a 5-point scale from "never" to "very often." Negative items were scored 0–4, and positive items were reverse scored. Total scores range 0–16, with scores of ≥6 indicating increased stress levels, consistent with other Polish studies [15]. Principal component analysis showed the scale is bifactorial, with factor loadings between 0.91–0.92 and a reliability of 0.57. Despite lack of homogeneity single factor model is widely used in the literature [15].

In addition, demographic and social characteristics were included in the analyses:

- gender, categorized into men and women;
- age, divided into 3 categories: 20–29 years, 30–49 years, and ≥50 years;
- relationship status, categorized into people living in relationships and single;
- profession, divided into doctors, nurses, and paramedics;
- work experience, categorized into ≤10 years and >10 years in the profession.

**Statistical analysis**

To ensure the reliability of the JSS-4, sexual life assessment, PSS-4, and BAT-12, Cronbach's α was utilized. The factor structure of these scales was evaluated using PCA.

The non-parametric Mann-Whitney U-test (2 independent samples) or Kruskal-Wallis H-test (3 independent samples) were employed to compare means, while descriptive analysis was conducted using the $\chi^2$ test to assess the correlations between variables.

The potential associations between the assessment of sexual activity and BMI were evaluated using the Pearson's correlation coefficient.

Descriptive statistics were performed using the $\chi^2$ test to determine the relationships between variables. For more in-depth analysis, hierarchical linear regression models were estimated for the dependent variable of sleep quality. The results of this 4-step regression are presented as standardized β coefficients, with significance assessed at the 95% level. The quality of each model's fit was evaluated based on the $R^2$ coefficient.

All data analyses were conducted using the Statistical Package for the Social Sciences (SPSS) v. 29.0 (IBM SPSS Statistics for Windows, Armonk, NY, USA). A significance threshold of $p < 0.05$ was set for all tests within the study.

## RESULTS

The survey participants were healthcare workers from various regions of Poland, with a significant representation of women (77.6%), individuals aged >50 years (46.1%), and those in nursing roles (62.8%). A majority of the respondents (77%) had >10 years of professional experience. More than half of the participants (54.7%) were classified as overweight or obese based on their BMI. Sleep disturbances, as measured by the JSS-4 scale, were reported by 16% of the participants.

The prevalence of excess body weight was notably higher among men, individuals aged ≥50 years, paramedics, those with extensive work experience, and participants who rated their sexual life and health poorly ($p < 0.001$).

In Table 2, below the diagonal, potential correlations between the following variables are presented using Pearson's correlation coefficients ($r_{xy}$): sleep, sexual life assessment, stress, occupational burnout, age, and BMI. Shown above the diagonal, in turn, are potential correlations between sleep, sexual life assessment, stress, occupational burnout, and age, adjusted for BMI ($r_{xy}$, BMI).

As a continuous variable, BMI significantly relationships with sexual life assessment and age ($p < 0.001$). For occupational burnout, the positive relationship is statistically significant but weaker ($p = 0.021$). Introducing BMI as a controlling factor results in the greatest change in the relationship levels between sexual life assessment and age, as well as between occupational burnout and age.

Next, hierarchical regression analyses were conducted to explore the impact of sexual life assessment and oth-

**Table 2.** General ($r_{xy}$ – below the diagonal) and partial correlations, adjusted for body mass index (BMI) ($r_{xy}$, BMI – above the diagonal), between sleep and other variables, survey of healthcare workers 2021–2023, Warsaw, Poland

| Variable | Score (M±SD) | 1 | | 2 | | 3 | | 4 | | 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | correlation | p | correlation | p | correlation | p | correlation | p | correlation | p |
| 1. Sleep | 5.37±5.07 | 1 | | 0.279 | **<0.001** | 0.275 | **<0.001** | 0.515 | **<0.001** | 0.017 | 0.507 |
| 2. Assessment of sexual life | 4.49±1.86 | 0.280 | **<0.001** | 1 | | 0.242 | **<0.001** | 0.429 | **<0.001** | 0.104 | **<0.001** |
| 3. Stress | 5.75±2.94 | 0.275 | **<0.001** | 0.240 | **<0.001** | 1 | | 0.420 | **<0.001** | –0.113 | **<0.001** |
| 4. Occupational burnout | 2.29±0.68 | 0.516 | **<0.001** | 0.432 | **<0.001** | 0.419 | **<0.001** | 1 | | –0.078 | **0.003** |
| 5. Age | 46.74±11.24 | 0.024 | 0.355 | 0.131 | **<0.001** | –0.110 | **<0.001** | –0.063 | **0.015** | 1 | |
| 6. BMI constant | 2600±4.34 | 0.034 | 0.192 | 0.139 | **<0.001** | 0.002 | 0.934 | 0.060 | **0.021** | 0.212 | **<0.001** |

Bolded are statistically significant values.

er variables on sleep quality across different BMI categories. Table 3 presents 4 regression models, each adjusted for profession.

In the first model, sexual life assessment emerged as a significant predictor of sleep quality. The fit of the model was better for individuals with obesity compared to those with normal body weight ($R^2 = 0.118$ vs. 0.069, $\beta = 0.87$ vs. 0.70).

In the second model, introducing the stress variable led to a significant change in $R^2$ for all 3 body weight groups. The most robust model fit was again observed in individuals with excess body weight (overweight and obesity).

In the third model, the health assessment variable was added, which turned out to be a stronger predictor than sexual life assessment and stress. As before, introducing this variable increased $R^2$ across all 3 body weight groups. Sexual life assessment remained a significant predictor of sleep quality for individuals with normal and overweight body weight. As in models 1 and 2, the best model fit was noted for individuals with obesity.

In the fourth model, the occupational burnout variable was added, leading to a further significant increase in $R^2$. Occupational burnout proved to be a significant predictor of sleep quality. Additionally, health assessment was a significant predictor for individuals with excess body weight. Once again, the $R^2$ reached its highest value for individuals with obesity.

## DISCUSSION

The main objective of this study conducted among 1478 healthcare workers was to analyze the role of sexual life satisfaction and workload as determinants of sleep disorders. Professional burnout was identified as a major predictor. Moreover, namely this factor eliminated the association with perception of sex life. In addition, the importance of body weight cannot be ignored, as evidenced by analyses stratified by BMI level. Results confirmed by the hierarchical regression shows that although body weight does not directly correlate with sleep disorders, excessive body weight increases the negative impact of factors such as stress, burnout and self-perceived health status.

Many factors affect sleep, and sleep disorders are considered a public health issue that impacts both society and individuals [25–27]. Healthcare workers appear to be particularly vulnerable to sleep disorders and poor-quality sleep [28]. However, the reported prevalence of these sleep disorders varies across different studies. Some studies, especially during the COVID-19 pandemic, have reported sleep disturbance rates as high as 96% among healthcare workers [29], others indicate a prevalence of shift work-related sleep disorders

**Table 3.** Hierarchical linear regression (corrected for professional group, age, and gender) for sleep quality variability stratified by body mass index (BMI) category, survey of healthcare workers 2021–2023, Warsaw, Poland

| Model | BMI | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | norm | | | overweight | | | obesity | | |
| | β | p | $R^2$ | β | p | $R^2$ | β | p | $R^2$ |
| Model 1 | | | 0.069 | | | 0.084 | | | 0.118 |
| constant | 0.384 | 0.774 | | 0.162 | 0.912 | | 3.127 | **0.026** | |
| assessment of sexual life | 0.695 | **<0.001** | | 0.800 | **<0.001** | | 0.871 | **<0.001** | |
| Model 2 | | | 0.120 | | | 0.113 | | | 0.188 |
| constant | –1.218 | 0.359 | | –1.763 | 0.247 | | 0.512 | 0.826 | |
| assessment of sexual life | 0.541 | **<0.001** | | 0.692 | **<0.001** | | 0.590 | **<0.001** | |
| stress | 0.384 | **<0.001** | | 0.316 | **<0.001** | | 0.510 | **<0.001** | |
| Model 3 | | | 0.139 | | | 0.184 | | | 0.267 |
| constant | 2.993 | 0.081 | | 6.834 | **<0.001** | | 7.405 | **0.004** | |
| assessment of sexual life | 0.416 | **<0.001** | | 0.352 | **0.004** | | 0.233 | 0.173 | |
| stress | 0.343 | **<0.001** | | 0.209 | **0.005** | | 0.413 | **<0.001** | |
| assessment of health | –1.285 | **<0.001** | | –2.476 | **<0.001** | | –2.139 | **<0.001** | |
| Model 4 | | | 0.272 | | | 0.313 | | | 0.375 |
| constant | –3.553 | **0.035** | | –1.011 | 0.601 | | 0.524 | 0.840 | |
| assessment of sexual life | 0.065 | 0.529 | | 0.073 | 0.539 | | –0.111 | 0.505 | |
| stress | 0.123 | **0.044** | | 0.015 | 0.837 | | 0.149 | 0.157 | |
| assessment of health | –0.774 | **0.013** | | –1.837 | **<0.001** | | –1.514 | **<0.001** | |
| occupational burnout | 3.206 | **<0.001** | | 3.222 | **<0.001** | | 3.331 | **<0.001** | |

Bolded are statistically significant values.

ranging 34–80% [30–31]. This study, in contrast, found that only 16% of medical workers reported sleep disturbances. This discrepancy highlights the influence of various factors, including the timing of data collection, pandemic-related workload, and the methodologies employed for assessing sleep quality.

This study findings reinforce the notion that several factors – sexual life assessment, stress levels, health assessment, and occupational burnout – are significantly correlated with sleep quality. It is crucial for healthcare workers to recognize these factors and their potential impact on both clinical performance and personal health [32].

**Body weight and sleep**

Excess body weight poses a significant public health challenge and is known to correlate with a decreased quality of life [33]. In the authors' study, 54.7% of healthcare workers were either overweight or obese, corresponding well with prevalence rates seen in other Polish population studies [34]. Overweight and obesity were more frequently observed among men, those ≥50 years old, paramedics, and individuals with >10 years of professional experience or those who rated their sexual and overall health poorly ($p < 0.001$).

Although the research did not establish a direct link between body weight and sleep disturbances, other studies

have suggested that increased body weight, particularly within the overweight and obese populations, is associated with reduced sleep quality [35]. Moreover, the relationship between sleep and body weight appears to be bidirectional. Both reduced sleep duration and sleep disturbances have been implicated in contributing to weight gain [13,36,37], suggesting a complex interaction that may exacerbate the challenges faced by healthcare workers in maintaining a healthy weight and achieving optimal sleep quality.

**Sexual life assessment and sleep quality**

Sexual life is a crucial aspect of overall quality of life, influencing physical, mental, and social well-being [38]. In the authors' study, a majority of respondents, 62.7%, assessed their sexual life as good. This finding is slightly lower compared to another Polish study from 2021, where 76.1% of participants rated their sexual life as good or average [14]. Deficits in sexual functioning have been linked to an increased risk of mental health disorders, psychosomatic conditions, lowered self-esteem, occupations burnout, heightened stress levels, conflict and relationship tension, and irritability in interpersonal relationships and when working with patients. Consequently, improving sexual functioning has the potential to enhance overall health and well-being in numerous ways.

Deteriorated sexual life is associated with poorer sleep quality [39]. For example, women with poorer quality of sexual life reported worse sleep quality than women without sexual function issues [13]. Another study indicated that sexual practices, such as sexual activity, masturbation, and intimacy, positively affect sleep quality [40,41]. However, Oesterling et al. suggest that achieving orgasm during sexual activity is necessary for the improvement of sleep quality [42]. It also seems that the relationship may be bidirectional, with good sleep quality potentially increasing sexual drive [43]. In this study, sexual life assessment significantly correlated with sleep quality, especially in individuals with excess body weight. Moreover, in the model adjusted for stress and self-rated health, sexual life assessment remained a significant predictor of sleep quality, and this factor was only eliminated when occupational burnout was included in the model.

**Occupational burnout and sleep disorders**

Medical students, residents, and healthcare workers have been shown to be more susceptible to occupational burnout than professionals in other fields [44]. A meta-analysis of studies conducted before the pandemic showed that 30% of respondents reported burnout in at least one of its 3 dimensions [45]. The pandemic has exacerbated this issue, with >50% of healthcare workers reporting burnout during the COVID-19 pandemic [29]. In this study, the risk of burnout according to the BAT-12 scale was observed in 20% of healthcare workers, with 15.1% of respondents experiencing burnout.

In a study of doctors, 14.5% of respondents with low burnout and 70.7% of those with high burnout reported sleep problems (worse scores for sleep quality and its components). The same study indicated that healthcare workers with high burnout scores were more likely to suffer from insomnia [6]. The authors' study confirms that the burnout index correlates with sleep quality, even after eliminating the influence of BMI (Pearson's $r = 0.515$, $p < 0.001$). Additionally, regression results show that the burnout index significantly affected the variability of sleep quality ($p < 0.001$). Including the burnout index in the regression model also improved the model's fit ($R^2$) across all BMI categories.

**Stress and sleep disorders**

Healthcare workers, especially medical personnel, endure demanding clinical environments and heavy workloads. They frequently make critical decisions affecting the lives and health of patients and confront the emotions of patients and their families, leading to elevated stress levels [46].

In the authors' study, 47.6% of healthcare workers exhibited elevated stress levels according to the PSS-4 scale, a finding consistent with other studies indicating that healthcare workers are exposed to higher stress levels [47].

Daily stress affects physiology and sleep quality [48], and chronic stress is a major cause of persistent psychophysiological insomnia, a component of sleep quality [49]. The relationship between stress and sleep can also be bidirectional, with sleep disorders potentially increasing stress levels [12]. The authors' study confirms that the stress index correlates with sleep quality, even after eliminating the influence of BMI (Pearson's $r = 0.275$, $p < 0.001$). Furthermore, regression results confirm that the stress index significantly influenced the variability of sleep quality, This was particularly evident in model 2, which also included sexual life assessment across all BMI categories, and in model 3, after adding health self-assessment for individuals with excess body weight ($p < 0.001$). Including stress in the regression model also improved the model's fit ($R^2$) across all BMI categories.

### Study limitations

Several limitations of this study should be noted. Comparing the results with data from other countries may be challenging due to socio-cultural factors, the distinctive nature of healthcare work, and the varied methodologies used to measure sleep disorders.

The authors' study was largely conducted online, which may be conducive to increased subjective responses that may not accurately reflect the actual situation. Nevertheless, online surveys are extensively utilized due to their simplicity and feasibility, especially relevant since this study was conducted during the COVID-19 pandemic. The fact that the study was carried out during the pandemic may have increased the incidence of sleep disorders, weight gain, burnout, poorer sexual life assessment, and higher perceived stress.

Additionally, the study sample of healthcare workers was predominantly comprised of nursing staff (who were mainly women). While this is representative of the healthcare employment structure [50], gender and professional group were nevertheless included as adjusting factors in the analysis.

Due to the cross-sectional nature of the study and the lack of longitudinal observation, the authors are unable to draw causal conclusions between variables or ascertain the long-term effects of sleep disorders and excess body weight.

## CONCLUSIONS

Early detection of sleep disorders and a comprehensive approach to intervention are particularly essential for healthcare workers. Training in coping strategies for challenging situations, including sleep disorders, preparation for professional support, and fostering a supportive work environment with a focus on self-care, should be integrated into healthcare education and practice settings [12].

The study, which aimed to identify how various factors influence sleep quality in healthcare workers depending on body weight, provides valuable information that can aid in the effective planning and implementation of strategies to address the sleep disorder crisis. Thus, equipping healthcare workers with better knowledge and resources to improve their health, particularly sleep quality, is vital for maintaining the stability of the healthcare system. Further research, especially longitudinal studies, is necessary to explore the relationships between various health dimensions (including sexual health) and working conditions on the sleep quality of healthcare workers. Better understanding these dynamics can help tailor interventions to improve health outcomes in this population.

**Author contributions**

**Research concept:** Maciej Białorudzki, Zbigniew Izdebski

**Research methodology:** Maciej Białorudzki

**Collecting material:** Maciej Białorudzki, Michał Undra, Zbigniew Izdebski

**Statistical analysis:** Maciej Białorudzki

**Interpretation of results:** Maciej Białorudzki
**References:** Maciej Białorudzki, Michał Undra, Zbigniew Izdebski

**REFERENCES**


1. Shepard JW, Buysse DJ, Chesson AL, Dement WC, Goldberg R, Guilleminault C, et al. History of the development of sleep medicine in the United States. J Clin Sleep Med. 2005; 1(1):61-82.
2. Itani O, Jike M, Watanabe N, Kaneita Y. Short sleep duration and health outcomes: a systematic review, meta-analysis, and meta-regression. Sleep Med. 2017;32:246-56. https://doi.org/10.1016/j.sleep.2016.08.006.
3. Watson NF, Badr MS, Belenky G, Bliwise DL, Buxton OM, Buysse D, et al. Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society on the Recommended Amount of Sleep for a Healthy Adult: Methodology and Discussion. J Clin Sleep Med. 2015;11(8): 931-52. https://doi.org/10.5665/sleep.4886.
4. Szentkirályi A, Madarász CZ, Novák M. Sleep disorders: impact on daytime functioning and quality of life. Expert Rev Pharmacoecon Outcomes Res. 2009;9(1):49-64. https://doi.org/10.1586/14737167.9.1.49.
5. Libman E, Fichten C, Creti L, Conrod K, Tran DL, Grad R, et al. Refreshing Sleep and Sleep Continuity Determine Perceived Sleep Quality. Sleep Disord. 2016;2016:7170610. https://doi.org/10.1155/2016/7170610.
6. Vela-Bueno A, Moreno-Jiménez B, Rodríguez-Muñoz A, Olavarrieta-Bernardino S, Fernández-Mendoza J, De la Cruz-Troca JJ, et al. Insomnia and sleep quality among primary care physicians with low and high burnout levels. J Psychosom Res. 2008;64(4):435-42. https://doi.org/10.1016/j.jpsychores.2007.10.014.
7. Dorrian J, Lamond N, van den Heuvel C, Pincombe J, Rogers AE, Dawson D. A pilot study of the safety implications of Australian nurses' sleep and work hours. Chronobiol Int. 2006;23(6):1149-63. https://doi.org/10.1080/07420520601059615.
8. Gupta B, Sharma V, Kumar N, Mahajan A. Anxiety and Sleep Disturbances Among Health Care Workers During the COVID-19 Pandemic in India: Cross-Sectional Online Survey. JMIR Public Health Surveill. 2020;6(4):e24206. https://doi.org/10.2196/24206.
9. Liew SC, Aung T. Sleep deprivation and its association with diseases- a review. Sleep Med. 2021;77:192-204. https://doi.org/10.1016/j.sleep.2020.07.048.
10. Izdebski Z, Kozakiewicz A, Białorudzki M, Dec-Pietrowska J, Mazur J. Occupational Burnout in Healthcare Workers, Stress and Other Symptoms of Work Overload during the COVID-19 Pandemic in Poland. Int J Environ Res Public Health. 2023;20(3). https://doi.org/10.3390/ijerph20032428.
11. Trockel MT, Menon NK, Rowe SG, Stewart MT, Smith R, Lu M, et al. Assessment of Physician Sleep and Wellness, Burnout, and Clinically Significant Medical Errors. JAMA Netw Open. 2020;3(12):e2028111. https://doi.org/10.1001/jamanetworkopen.2020.28111.
12. Scott AJ, Webb TL, Martyn-St James M, Rowse G, Weich S. Improving sleep quality leads to better mental health: A meta-analysis of randomised controlled trials. Sleep Med Rev. 2021;60:101556. https://doi.org/10.1016/j.smrv.2021.101556.
13. Martínez Vázquez S, Hernández Martínez A, Peinado Molina RA, Martínez Galiano JM. Association between sexual function in women and sleep quality. Front Med (Lausanne). 2023;10:1196540. https://doi.org/10.3389/fmed.2023.
14. Bialorudzki M, Mazur J, Haczyński J, Kozakiewicz A, Izdebski Z. Body weight and assessment of sexual life – a cross-sectional study. Ann Agric Environ Med. 2024 Jun 27;31(2): 212-218. https://doi.org/10.26444/aaem/173221.
15. Białorudzki M, Izdebski Z. Changes in the body mass of adult residents of rural and urban areas in the initial months of the COVID-19 pandemic vs. their mental, physical and sexual health. Ann Agric Environ Med. 2021;28(4):667-75. https://doi.org/10.26444/aaem/143561.
16. Greer SM, Goldstein AN, Walker MP. The impact of sleep deprivation on food desire in the human brain. Nat Commun. 2013;4:2259. https://doi.org/10.1038/ncomms3259.

17. Spiegel K, Tasali E, Penev P, Van Cauter E. Brief communication: Sleep curtailment in healthy young men is associated with decreased leptin levels, elevated ghrelin levels, and increased hunger and appetite. Ann Intern Med. 2004; 141(11):846-50. https://doi.org/10.7326/0003-4819-141-11-200412070-00008.
18. Wu Y, Zhai L, Zhang D. Sleep duration and obesity among adults: a meta-analysis of prospective studies. Sleep Med. 2014;15(12):1456-62. https://doi.org/10.1016/j.sleep.2014.07.018.
19. Sperry SD, Scully ID, Gramzow RH, Jorgensen RS. Sleep Duration and Waist Circumference in Adults: A Meta-Analysis. Sleep. 2015;38(8):1269-76. https://doi.org/10.5665/sleep.4906.
20. Nedeltcheva AV, Kilkus JM, Imperial J, Schoeller DA, Penev PD. Insufficient sleep undermines dietary efforts to reduce adiposity. Ann Intern Med. 2010;153(7):435-41. https://doi.org/10.7326/0003-4819-153-7-201010050-00006.
21. Jenkins CD, Stanton BA, Niemcryk SJ, Rose RM. A scale for the estimation of sleep problems in clinical research. J Clin Epidemiol. 1988;41(4):313-21. https://doi.org/10.1016/0895-4356(88)90138-2.
22. Monterrosa-Castro Á, Portela-Buelvas K, Salguedo-Madrid M, Mo-Carrascal J, Duran-Méndez Leidy C. Instruments to study sleep disorders in climacteric women. Sleep Sci. 2016;9(3):169-78. https://doi.org/10.1016/j.slsci.2016.11.001.
23. Schaufeli W, de Witte H, Desart S. Burnout Assessment Tool 1 English Translation of the Dutch Manual Content [Internet]. Leuven, Belgium: 2019 [cited December 15, 2023]. pp. 1–111. Available from: http://burnoutassessmenttool.be/wpcontent/uploads/2019/04/Handleiding-BAT-engels-versie-1.2.pdf
24. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav. 1983;24(4):385-96.
25. Sancho-Domingo C, Carballo JL, Coloma-Carmona A, Buysse DJ. Brief version of the Pittsburgh Sleep Quality Index (B-PSQI) and measurement invariance across gender and age in a population-based sample. Psychol Assess. 2021;33(2):111-21. https://doi.org/10.1037/pas0000959.
26. Kwok CS, Kontopantelis E, Kuligowski G, Gray M, Muhyaldeen A, Gale CP, et al. Self-Reported Sleep Duration and Quality and Cardiovascular Disease and Mortality: A Dose-Response Meta-Analysis. J Am Heart Assoc. 2018;7(15):e008552. https://doi.org/10.1161/JAHA.118.008552.
27. Olfson M, Wall M, Liu SM, Morin CM, Blanco C. Insomnia and Impaired Quality of Life in the United States. J Clin Psychiatry. 2018;79(5). https://doi.org/10.4088/JCP.17m12020.
28. Zeng LN, Yang Y, Wang C, Li XH, Xiang YF, Hall BJ, et al. Prevalence of Poor Sleep Quality in Nursing Staff: A Meta-Analysis of Observational Studies. Behav Sleep Med. 2020;18(6):746-59. https://doi.org/10.1080/15402002.2019.1677233.
29. Stewart NH, Koza A, Dhaon S, Shoushtari C, Martinez M, Arora VM. Sleep Disturbances in Frontline Health Care Workers During the COVID-19 Pandemic: Social Media Survey Study. J Med Internet Res. 2021;23(5):e27331. https://doi.org/10.2196/27331.
30. Proserpio P, Zambrelli E, Lanza A, Dominese A, Di Giacomo R, Quintas R, et al. Sleep disorders and mental health in hospital workers during the COVID-19 pandemic: a cross-sectional multicenter study in Northern Italy. Neurol Sci. 2022;43(4):2241-51. https://doi.org/10.1007/s10072-021-05813-y.
31. Adane A, Getnet M, Belete M, Yeshaw Y, Dagnew B. Shift-work sleep disorder among health care workers at public hospitals, the case of Sidama national regional state, Ethiopia: A multicenter cross-sectional study. PLoS One. 2022;17(7):e0270480. https://doi.org/10.1371/journal.pone.0270480.
32. Chattu VK, Manzar MD, Kumary S, Burman D, Spence DW, Pandi-Perumal SR. The Global Problem of Insufficient Sleep and Its Serious Public Health Implications. Healthcare (Basel). 2018;7(1):1. https://doi.org/10.3390/healthcare7010001.
33. Upadhyay J, Farr O, Perakakis N, Ghaly W, Mantzoros C. Obesity as a Disease. Med Clin North Am. 2018;102(1):13-33. https://doi.org/10.1016/j.mcna.2017.08.004.
34. Białorudzki M, Haczyński J, Sierpiński R, Mazur J, Kozakiewicz A, Izdebski Z. Changes in body weight in various

population groups in Poland during the COVID-19 pandemic – a comparison of two cross-sectional studies. Ann Agric Environ Med. 2024 Sep 25;31(3):362-370. https://doi.org/10.26444/aaem/186466.

35. Tang Y, Dai F, Razali NS, Tagore S, Chern BSM, Tan KH. Sleep quality and BMI in pregnancy- a prospective cohort study. BMC Pregnancy Childbirth. 2022;22(1):72. https://doi.org/10.1186/s12884-022-04414-7.
36. Watanabe M, Kikuchi H, Tanaka K, Takahashi M. Association of short sleep duration with weight gain and obesity at 1-year follow-up: a large-scale prospective study. Sleep. 2010;33(2):161-7. https://doi.org/10.1093/sleep/33.2.161.
37. Chaput JP, Bouchard C, Tremblay A. Change in sleep duration and visceral fat accumulation over 6 years in adults. Obesity (Silver Spring). 2014;22(5):E9-12. https://doi.org/10.1002/oby.20701.
38. Paszyńska W, Zborowska K, Czajkowska M, Skrzypulec-Plinta V. Quality of Sex Life in Intestinal Stoma Patients – A Literature Review. Int J Environ Res Public Health. 2023;20(3). https://doi.org/10.3390/ijerph20032660.
39. Pallesen S, Waage S, Thun E, Andreassen CS, Bjorvatn B. A national survey on how sexual activity is perceived to be associated with sleep. Sleep Biol Rhythms 2020;18:65-72. https://doi.org/10.1007/s41105-019-00246-9.
40. Dueren AL, Perach R, Banissy JFM, Bowling NC, Gregory AM, Banissy MJ. Associations between tactile intimacy and sleep quality in healthy adults: A systematic review. J Sleep Res. 2022;31(3):e13504. https://doi.org/10.1111/jsr.13504.
41. Kling JM, Kapoor E, Mara K, Faubion SS. Associations of sleep and female sexual function: good sleep quality matters. Menopause. 2021;28(6):619-25. https://doi.org/10.1097/GME.0000000000001744.
42. Oesterling CF, Borg C, Juhola E, Lancel M. The influence of sexual activity on sleep: A diary study. J Sleep Res. 2023;32(4):e13814. https://doi.org/10.1111/jsr.13814.
43. Kalmbach DA, Arnedt JT, Pillai V, Ciesla JA. The impact of sleep on female sexual response and behavior: a pilot study. J Sex Med. 2015;12(5):1221-32. https://doi.org/10.1111/jsm.12858.
44. Shanafelt TD, West CP, Sinsky C, Trockel M, Tutty M, Satele DV, et al. Changes in Burnout and Satisfaction With Work-Life Integration in Physicians and the General US Working Population Between 2011 and 2017. Mayo Clin Proc. 2019;94(9):1681-94. https://doi.org/10.1016/j.mayocp.2018.10.023.
45. Gómez-Urquiza JL, De la Fuente-Solana EI, Albendín-García L, Vargas-Pecino C, Ortega-Campos EM, Cañadas-De la Fuente GA. Prevalence of Burnout Syndrome in Emergency Nurses: A Meta-Analysis. Crit Care Nurse. 2017;37(5):e1-9. https://doi.org/10.4037/ccn2017508.
46. Wallace JE, Lemaire JB, Ghali WA. Physician wellness: a missing quality indicator. Lancet. 2009;374(9702):1714-21. https://doi.org/10.1016/S0140-6736(09)61424-0.
47. Chang BP. The Health Care Workforce Under Stress-Clinician Heal Thyself. JAMA Netw Open. 2022;5(1):e2143167. https://doi.org/10.1001/jamanetworkopen.2021.43167.
48. Vandekerckhove M, Cluydts R. The emotional brain and sleep: an intimate relationship. Sleep Med Rev. 2010;14(4):219-26. https://doi.org/10.1016/j.smrv.2010.01.002.
49. Sheldon SH, Kryger MH, Ferber R, Gozal D. Principles and Practice of Pediatric Sleep Medicine: Expert Consult-Online and Print. Elsevier Health Sciences; 2014.
50. Małyszko K, Pędziński B, Maślach D, Krzyżak M, Marcinowicz L. Medical staff in Poland in 2012–2022 – challenges related to the distribution of human resources. Ann Agric Environ Med. 2024 Sep 25;31(3):382-7. https://doi.org/10.26444/aaem/186636.