Original Article

Relationship Between Menstrual Distress and Occupational Risk Factors Among Nurses: A Survey in a Public Hospital

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Abstract

Background: Menstrual distress encompasses a range of uncomfortable symptoms associated with the menstrual cycle, which significantly impacts women's quality of life. This cross-sectional study investigates the influence of occupational hazards, anxiety, and sleep quality on menstrual distress among nurses in an Iranian hospital in 2024. **Material and Methods:** The study was a case-control design. Data for this study were collected using a demographic questionnaire, the Spielberger State-Trait Anxiety Inventory, the Pittsburgh Sleep Quality Index, and an occupational hazards assessment worksheet. The modified Moos Menstrual Distress Questionnaire was also used to measure menstrual distress. To analyze the relationships among demographic factors, anxiety, sleep quality, and menstrual distress, structural equation modeling was employed. **Results:** The study found significant associations between menstrual distress and various factors: a history of miscarriage ($p = 0.038$), smoking ($p = 0.023$), exposure to high noise levels ($p = 0.040$), vibration from equipment ($p = 0.003$), cold environments ($p = 0.028$), rotating shifts ($p = 0.024$), and patient handling ($p = 0.01$). Additionally, state and trait anxiety ($r = 0.612$, $p < 0.001$) and sleep quality ($r = 0.518$, $p < 0.001$) were closely linked to menstrual distress. **Conclusions:** Adverse working conditions and occupational stress can significantly impact the physical and mental health of nurses, which diminishes their quality of life. Future research should explore the biological mechanisms involved and develop interventions to alleviate menstrual distress among nurses.

Keywords: *Menstruation disturbances, nurses, occupational health, occupational stress, sleep-wake disorders*

Introduction

In today's fast-paced world, the provision of continuous 24-hour healthcare services has become essential, placing immense demands on healthcare professionals—particularly nurses, who represent one of the most vital and sought-after groups in the healthcare system.[1] Given their central role in patient care, safeguarding nurses' health and well-being is critical. Female nurses, in particular, face unique health challenges, among which menstrual distress stands out as a significant concern.[2] Characterized by symptoms such as abdominal pain, fatigue, mood swings, and sleep disturbances, menstrual distress can substantially impair daily functioning, reduce job satisfaction, increase absenteeism, and ultimately compromise the quality of care delivered to patients.[2,3] The severity and frequency of these symptoms are not solely biological but are also shaped by a range of psychological, social, and environmental influences.[4]

Nurses are especially vulnerable to menstrual distress due to the nature of their work environment, which often involves long hours, shift rotations, and constant exposure to occupational hazards.[1,5] These hazards are broadly categorized into physical, chemical, and ergonomic factors.[6,7] Physical stressors include noise, inadequate lighting, vibrations, extreme temperatures, and exposure to radioactive materials; chemical exposures involve contact with medications, disinfectants, and other hospital-based substances; and ergonomic risks arise from repetitive movements, prolonged poor postures, and frequent lifting of heavy loads. Chronic exposure to these workplace stressors can disrupt the endocrine system, interfere with circadian rhythms, and reduce sex hormone levels, all of which may contribute to

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menstrual irregularities and heightened distress.[5,8,9] Moreover, psychosocial pressures—such as high job demands, emotional exhaustion, and insufficient social support—further intensify these physiological disruptions, leading to a decline in overall well-being and increased work-related absenteeism among nursing staff.[10]

Shift work, a defining feature of nursing schedules, represents one of the most critical occupational risk factors.[11] Irregular shifts—including night duties and rotating timetables—disturb normal sleep-wake cycles and profoundly disrupt the body's circadian rhythm, which governs numerous physiological processes, including hormonal regulation.[9,12-14] This dysregulation can directly exacerbate menstrual symptoms. Additionally, chronic workplace stress and anxiety elevate cortisol levels, which may impair immune function and heighten pain sensitivity, thereby worsening menstrual distress.[15-17] Poor sleep quality, often a consequence of shift work and stress, further destabilizes hormonal balance and amplifies discomfort during menstruation.[18,19] Together, these interconnected occupational and psychological factors create a high-risk environment for menstrual health among female nurses, underscoring the need for comprehensive workplace interventions.

Given the scarcity of research examining the link between occupational hazards and menstrual distress among Iranian nurses, this study aims to investigate the association between specific workplace exposures—physical, chemical, and ergonomic—and the severity of menstrual distress among female nurses at a hospital affiliated with Shahid Beheshti University of Medical Sciences in Iran. Aligned with the study's objectives outlined in the abstract, the research seeks to: (1) determine the relationship between occupational exposures and menstrual distress, (2) assess the severity of menstrual distress in the study population, (3) evaluate the influence of demographic characteristics on symptom severity, (4) analyze the impact of anxiety and sleep quality on menstrual distress, and (5) specifically examine how physical, chemical, and ergonomic hazards contribute to menstrual symptomatology. By elucidating these relationships, the findings aim to inform targeted interventions that mitigate occupational stressors, improve menstrual health, and enhance the overall well-being and professional performance of nurses in Iran.

Materials and Methods

This case-control study was conducted in a hospital affiliated with Shahid Beheshti University of Medical Sciences in Tehran, Iran, between February and June 2024 to assess menstrual distress and occupational hazard exposure in nurses. To reduce bias, several measures were taken. A well-defined set of inclusion and exclusion criteria was used to create a homogeneous study population and reduce confounding factors like gynecological or endocrine disorders. Administrative staff matched by workplace environment were used as a control group to account for environmental factors not related to clinical exposure. To minimize social desirability bias, all questionnaires were self-administered electronically and anonymously. Data analysts were blinded to group allocation to minimize observer bias. An occupational health specialist independently verified participant eligibility through a review of medical records. Staff involved in data collection and analysis received thorough training, and a review process was used to identify and resolve discrepancies.

To ensure a sufficient number of participants, the study's sample size was estimated using the Cochran formula, targeting 60 exposed nurses. This calculation was based on previous studies and accounted for an expected 10% attrition rate.[20] The control group consisted of 30 administrative staff members. Participants were selected using convenience sampling.

For clarity, the study population was divided into an exposed group and an unexposed group. The exposed group consisted of 60 nurses who had direct clinical responsibilities and were potentially exposed to occupational hazards such as night shifts, patient transfers, prolonged standing, and chemical agents. The unexposed group included 30 administrative staff members who performed office-based tasks and had no direct clinical exposure

The study was conducted in four stages: (1) observation and documentation of workplace hazards; (2) sample selection; (3) distribution and collection of electronic questionnaires; and (4) data analysis. Workplace hazards were assessed using annual measurements from authorized entities and were reviewed by the research team. Additionally, the research team directly observed factors like patient transfers, posture, and chemical exposure. Participants were informed about the study's objectives, and written informed consent was obtained from all of them. Confidentiality was assured.

The study's inclusion criteria required participants to be female, between 18 and 45 years old, with a minimum of 2 years of work experience. Participants also could not be currently pregnant, breastfeeding, or menopausal. If they had been pregnant, they must have been at least 6 months postpartum. Additionally, they could not have used steroid medications or oral contraceptives within the previous 6 months. Participants with pelvic diseases, a history of pelvic inflammatory disease, fibroids, tumors, polycystic ovaries, or recent significant stressful life events were excluded. These conditions were verified through a medical record review supervised by an occupational health specialist. Exclusion criteria also included having irregular menstruation or providing incomplete questionnaire data.

In this cross-sectional descriptive study, data were collected using several validated instruments. A demographic information worksheet was used to gather personal details such as age, education, work experience, marital status, number of children, history of miscarriage, and smoking habits. The Spielberger State-Trait Anxiety Inventory, a 40-item questionnaire validated and widely used in Iranian studies,[21] was employed to assess anxiety levels. The first 20 items measure state anxiety (i.e., how the individual feels "at this moment"), while the remaining 20 assess trait anxiety (i.e., general and habitual emotional tendencies). Responses were rated on a scale from "very little" to "very much," with reverse scoring applied to items indicating absence of anxiety. Interpretation of scores followed the criteria outlined in Table 1.[22]

Sleep quality was evaluated using the Persian version of the Pittsburgh Sleep Quality Index (PSQI), which has demonstrated good internal consistency (Cronbach's alpha = 0.82) and strong test-retest reliability ($r > 0.80$).[23] This instrument has also been successfully applied in prior research on sleep quality, job satisfaction, and quality of life among workers,[24] supporting its appropriateness for the current population. The culturally adapted, translated version used in this study is a self-reported questionnaire that assesses sleep quality over a 1-month period. It comprises 19 items rated on a 4-point Likert scale (0= "never" to 3= "very often"), yielding a total score ranging from 0 to 21, with higher scores indicating poorer sleep quality. The PSQI evaluates seven domains: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep medication use, sleep disturbances, and daytime dysfunction.

An Occupational Activities Questionnaire, adapted from standardized instruments used in previous Iranian occupational health research,[25] was also administered. Content validity was confirmed by a panel of occupational health experts and nursing faculty. The 14-item questionnaire captures key occupational exposures relevant to nursing practice, including shift work patterns (e.g. continuous day shifts, two- or three-shift systems, and continuous night shifts), physical workload, prolonged standing or sitting, frequency of patient and equipment handling, extended computer use (>20 hours/week), and overtime. It also assesses exposure to hazardous chemical agents commonly encountered in hospital settings—specifically anesthetic gases, anticancer drugs, and disinfectants—using a combination of self-reported data and records from the occupational health unit.

Table 1: Interpretation of Spielberger state-trait anxiety inventory

Scale	Level	Score
State anxiety	None or minimal	20–30
	Mild	31–42
	Moderate	43–53
	Severe	54+
Trait anxiety	None or minimal	20–34
	Mild	35–45
	Moderate	46–56
	Severe	57+

Finally, menstrual distress was measured using a modified 16-item Persian version of the Moos Menstrual Distress Questionnaire (MMDQ), which was culturally adapted to reflect symptoms relevant to the local population. Content validity was established by a panel of reproductive health specialists and gynecologists.[26] The MMDQ assesses physical and psychological symptoms across three menstrual phases: 1 week before, during, and after menstruation. Participants rated each symptom on a 4-point Likert scale (1 = no symptoms, 4 = severe symptoms). The included symptoms were muscular aches, weakness, dizziness, abdominal bloating, breast tenderness, fatigue, cramps, leg swelling, back pain, general discomfort, headaches, skin sensitivity, cold sweats, nausea, palpitations, and hot flashes. Total scores range from 16 to 192, with higher scores indicating greater menstrual distress.[27]

For statistical analysis, the Kolmogorov-Smirnov test was used to assess the normality of quantitative variables. Descriptive statistics, such as mean, standard deviation, frequency, and percentage, were also employed. The study employed a range of statistical methods to analyze the collected data. An independent *t*-test was used to compare mean menstrual distress scores between groups defined by categorical variables such as smoking status. A one-way analysis of variance (ANOVA) was applied to examine differences in mean menstrual distress across multiple categories of educational level. Pearson's correlation coefficient was calculated to assess the strength and direction of linear relationships between menstrual distress and continuous variables, including age, weight, height, and work experience. Finally, structural equation modeling (SEM) was utilized to explore the complex interrelationships between menstrual distress and various occupational exposures, while simultaneously accounting for the mediating or moderating effects of sleep quality, perceived stress, and key demographic characteristics.

All analyses were conducted using IBM SPSS Statistics software (version 26; IBM Corp., Armonk, NY, USA) and Smart PLS version 3. The partial least squares (PLS) method was chosen for SEM because it does not require a large sample size or strictly quantitative variables. All significance tests were performed at a 95% confidence level.

To handle missing data, the dataset was first checked for completeness. Cases with missing important variables or incomplete questionnaires were not included in the analysis.

Although imputation techniques were considered for variables with intermittent missing values, a complete-case analysis was primarily used due to the small percentage of missing data. These precautions ensured that missing data did not skew the findings or reduce statistical power.

Ethical considerations

Ethical approval for this study was obtained from Shahid Beheshti University of Medical Sciences, code IR.SBMU.PHNS.REC.1402.093. All participants have filled out the consent form approved by the ethical committee, confirming their understanding of the study's purpose, procedures, potential risks, and benefits, as well as their right to withdraw at any time without penalty.

Results

The final sample consisted of 90 participants: 60 nurses in the exposed group and 30 administrative staff in the unexposed (control) group. The study had very little missing data, with a complete-case analysis used due to the rare and randomly distributed nature of the omissions. No core outcome measures, occupational exposure indicators, or key demographic factors had missing values. Two participants had single-item omissions on the PSQI, and one participant's response was missing from the occupational activities' questionnaire. Occupational exposures were evaluated using a validated Occupational Activities Questionnaire, institutional records, and observational data. The main exposures investigated included chemical exposures (disinfectants, anesthetic gases, antineoplastic medications), environmental factors (noise, cold/heat, vibration), physical demands (heavy lifting, prolonged standing), and ergonomic stressors (poor posture, computer use). The primary source for exposure data was institutional occupational health reports, which were cross-referenced with participant self-reports. Potential confounding variables, identified from existing literature, included age, marital status, work experience, history of miscarriage, smoking status, and shift work. These variables were collected through medical records and a demographic survey. Bivariate analysis showed that a history of smoking, miscarriage, vibration and noise exposure, and cold-working conditions had a significant relationship with menstrual distress [Table 2]. These factors were later included in multivariate models.

The mean (SD) age of the nurses was 35.46 (6.66) years, and their mean (SD) work experience was 10.28 (6.52) years. The mean (SD) height was 164.80 (4.79) cm, and the mean (SD) weight was 69.05 (10.55) kg. Most participants (73.3%) held a bachelor's degree, 58.3% were married, and 6.7% were smokers.

The study found no statistically significant association between menstrual distress and certain demographic factors. One-way ANOVA showed that although the mean (SD) menstrual distress score varied across educational levels (e.g., bachelor's: 88.21 (25.43); master's: 92.05 (28.17)), the difference was not statistically significant ($p = 0.189$). Similarly, Pearson's correlation analysis revealed no significant relationship between menstrual distress and work experience ($r = 0.08$, $p > 0.05$).

However, independent samples t-tests indicated significant differences in menstrual distress based on several factors. Women with a history of miscarriage

Table 2: Demographic and occupational characteristics of participants in a study on menstrual distress

Type of variable	Variables	Menstrual distress		
		No	Yes	*p**
Demographic	Marital status	84.48 (22.98)	90.77 (27.32)	0.352
	History of miscarriage	87.58 (23.40)	91.00 (26.05)	0.031
	History of smoking	89.12 (26.20)	74.50 (5.15)	0.023
Occupational	Engaging in heavy physical activities	88.11 (24.61)	88.19 (27.32)	0.991
	Exposure to noise	85.90 (20.34)	92.65 (23.95)	0.040
	Working with vibrating equipment	85.55 (22.81)	124.50 (28.10)	0.003
	Cold work environment	86.80 (24.31)	107.00 (29.15)	0.028
	Hot work environment	90.07 (26.01)	73.57 (15.02)	0.109
	Exposure to radioactive radiation	87.29 (22.81)	91.58 (35.98)	0.608
	Exposure to anesthetic gases	87.71 (22.80)	91.00 (41.48)	0.738
	Exposure to anticancer drugs	89.98 (25.83)	71.66 (17.04)	0.097
	Exposure to disinfectants	87.94 (20.74)	88.52 (33.39)	0.935
	Poor condition of hands, feet, neck, and back	99.66 (30.17)	86.87 (25.03)	0.249
	Continuous day shift	98.42 (35.72)	85.02 (21.14)	0.086
	Two-shift system	87.37 (14.24)	92.55 (33.67)	0.024
	Standing for more than 8 hours a day	85.86 (20.88)	91.82 (31.94)	0.386
	Working on a computer for more than 20 hours a week	92.27 (34.55)	86.38 (20.90)	0.418
	Moving patients	84.42 (22.51)	106.80 (32.70)	0.010

*p-values were calculated using the independent samples t-test. Continuous variables are presented as mean (standard deviation)

had a higher mean (SD) distress score (91.00 (26.05)) compared to those without (87.58 (23.40); $p = 0.031$). Nonsmokers reported a significantly higher mean (SD) distress score (89.12 (26.20)) than smokers (74.50 (5.15); $p = 0.023$). Additional significant associations were observed for exposure to noise (92.65 (23.95) vs. 85.90 (20.34); $p = 0.040$), working with vibrating equipment (124.50 (28.10) vs. 85.55 (22.81); $p = 0.003$), cold work environments (107.00 (29.15) vs. 86.80 (24.31); $p = 0.028$), and patient handling (106.80 (32.70) vs. 84.42 (22.51); $p = 0.010$).

Based on the conceptual model of menstrual distress, construct reliability and validity were assessed using the partial least squares structural equation modeling (PLS-SEM) approach. As shown in Table 3, composite reliability (CR) and average variance extracted (AVE) values were computed to evaluate the measurement model.

Table 3: Composite reliability (CR) and average variance extracted (AVE) for the latent constructs in the conceptual model of menstrual distress

Latent construct	Composite reliability (CR)	Average variance extracted (AVE)
Demographics	0.72	0.61
Menstrual distress	0.81	0.71
Sleep quality	0.78	0.60
Anxiety level	0.87	0.54
Exposure	0.71	0.53

All latent constructs demonstrated acceptable reliability and convergent validity, with CR values exceeding the recommended threshold of 0.70 and AVE values surpassing the 0.50 criterion. These results confirm the adequacy of the measurement model. The structural model further indicates that menstrual distress is significantly associated with chemical, environmental, and ergonomic occupational exposures.

The fit indices for the structural equation model confirm its adequacy. All variables had a composite reliability above 0.70, and AVE values exceeded 0.50, both of which indicate a good model fit. Additionally, the standardized root mean square residual (SRMR) was 0.09, which is another indicator of good fit. The NFI index was 0.92, also suggesting the model's adequacy.

The conceptual model [Figure 1] demonstrated a direct and significant relationship between menstrual distress and anxiety ($r = 0.612$; $p < 0.001$). This indicates that as anxiety increases in nurses, so does menstrual distress. Additionally, there was a significant negative relationship between menstrual distress and sleep quality ($r = –0.518$; $P < 0.001$), suggesting that poorer sleep quality leads to increased menstrual distress. The relationship between menstrual distress and chemical, environmental, and ergonomic exposures was also found to be positive and significant ($r = 0.525$; $p < 0.001$). This suggests that exposure to harmful workplace factors contributes to increased menstrual distress in nurses.

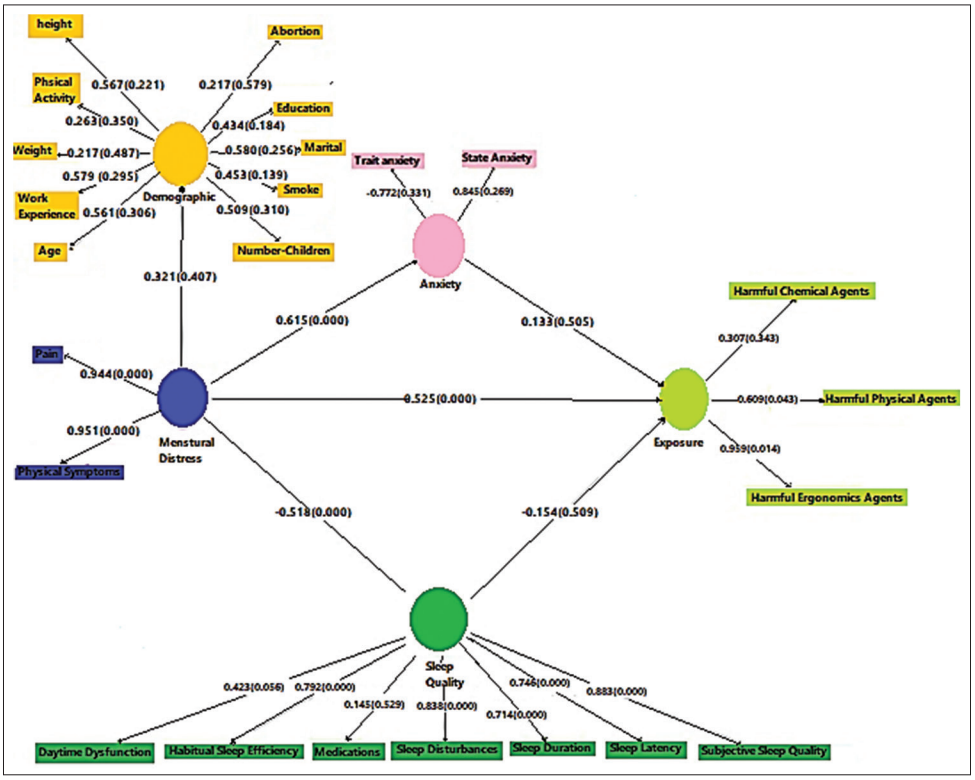

Figure 1: Conceptual model of menstrual distress

In conclusion, the study highlights the importance of addressing occupational hazards and their effects on menstrual distress among nurses. The findings suggest that interventions targeting anxiety management, sleep quality improvement, and reduction of harmful exposures could enhance the health and well-being of nursing professionals.

Discussion

The results of the conceptual model indicate that various occupational exposures significantly impact menstrual distress. These occupational exposures encompass a range of workplace hazards relevant to nursing practice. They include harmful chemical agents—such as anesthetic gases, anticancer drugs, and disinfectants—that nurses may encounter during routine clinical activities. Physical hazards are also present, notably noise from electrocardiogram monitors, vibrations from medical equipment, and exposure to hazardous radiation. Additionally, ergonomic hazards contribute significantly to occupational strain; these include repetitive wrist movements, prolonged standing during shifts, and the demands of shift work itself, which disrupts normal rest and activity cycles.

While research on the link between occupational exposures and menstrual disorders is limited, chronic inflammation from these exposures might be a key mechanism.[5] The structural equation model identified sleep quality and anxiety as significant factors in menstrual distress. As sleep quality declines, menstrual distress increases, and higher anxiety levels are correlated with greater menstrual distress. The model did not, however, find a significant effect of occupational exposures on either anxiety or sleep quality.

Generally, demographic characteristics did not significantly affect menstrual distress. Factors such as educational background, marital status, weight, height, and work experience showed no significant relationships with menstrual disorders. However, a history of miscarriage and smoking were statistically significant factors related to menstrual distress.

The study's results indicate that exposure to hazardous chemical, physical, and ergonomic agents significantly impacts menstrual distress among nurses. According to the conceptual model, menstrual distress is correlated with occupational exposures, suggesting that while individual harmful factors may not have a significant impact, these exposures collectively contribute to menstrual distress. These results align with earlier research that suggests cumulative job pressures may upset hormonal balance and exacerbate menstrual symptoms in healthcare workers, particularly nurses. For instance, research by Jiang *et al*.[20] has shown how exposure to hospital chemicals and ergonomic strain can contribute to menstrual irregularities.

Physically demanding tasks, such as patient handling, are significantly associated with menstrual distress ($p = 0.01$). Previous research supports this link, showing that strenuous physical activity can interfere with ovarian function.[28] Interestingly, a negative correlation was found between intense recreational physical activity and irregular menstrual cycles, likely due to endorphin release during exercise, which reduces stress. Studies by Song *et al*. also confirm these results.[29]

Exposure to noise from medical equipment is another occupational hazard. Studies show that noise levels in operating rooms can go beyond recommended limits, leading to increased stress and menstrual disorders. Noise can trigger stress hormone release, affecting hormonal balance and menstrual regulation. This is consistent with previous research that found high noise levels in medical environments can increase psychological stress, which may lead to hormonal imbalance and menstrual dysfunction.[30]

Exposure to cold work environments was linked to increased menstrual distress ($p = 0.024$). This aligns with animal studies that indicate cold exposure disrupts hormonal balance and ovulation.[31] However, there is limited evidence on the effects of climate on menstrual distress.

Shift work significantly correlates with menstrual distress ($p = 0.028$). Nurses who worknight or rotating shifts sleep less and take longer to fall asleep, which disrupts their circadian rhythms and may lead to menstrual disorders. Studies by Labyak *et al*. have reported similar results.[32] This disruption can affect reproductive hormones and contribute to fatigue and cognitive impairment.

While there is limited evidence on the effects of disinfectants on menstrual disorders, some studies suggest a link between disinfectant exposure and menstrual cycle length. Although the exact mechanism is unclear, animal studies have indicated that ethanol can disrupt hormone levels.[33,34]

While some studies indicate that exposure to anesthetic gases like isoflurane can disrupt hormonal regulation and have genotoxic effects, this study found no significant link between isoflurane exposure and menstrual distress ($p = 0.738$). The same was true for anticancer drugs like Avastin (bevacizumab), which have been linked to genetic toxicity and ovarian dysfunction in previous research.[35] The current study, however, did not find a statistically significant relationship between exposure to these drugs and menstrual distress ($p = 0.097$).

The discrepancies between these findings and those of prior research may be attributed to several factors. First, the study population may have experienced low or infrequent levels of exposure to the occupational hazards in question, reducing the likelihood of observing significant associations. Second, the consistent and effective use of Personal Protective Equipment (PPE) and adherence to established safety protocols in the workplace could have

mitigated potential adverse effects. Third, the duration of exposure—or the cumulative dose over time—may have been insufficient to produce measurable health outcomes. Finally, reliance on self-reported data introduces the possibility of underreporting or misclassification of actual exposure levels, which could obscure true relationships between occupational hazards and health outcomes.

Working with dental drills was associated with menstrual distress ($p = 0.003$). While research on the effects of hand and arm vibration on menstrual health is limited, it is possible that vibrations disrupt hormonal balance. This is a relatively new finding, so it suggests that more research is needed to understand how occupational vibration exposure might affect reproductive health, particularly in women who are chronically exposed to high-intensity vibrations.

In the current study, there was no statistically significant association between menstrual distress and prolonged standing for more than 8 hours a day ($p = 0.386$), or working on a computer for over 20 hours per week ($p = 0.418$). This contrasts with some previous occupational studies, particularly in retail and healthcare, which have suggested that prolonged standing may increase the risk of dysmenorrhea, miscarriage, and other reproductive issues. This increased risk is thought to be caused by increased pelvic blood pooling, reduced uterine perfusion, and musculoskeletal fatigue.[36] The lack of an association in this study may be due to several factors. These include variations in how standing activities are defined and their intensity, and the possibility that other ergonomic or psychosocial factors have a stronger influence than standing by itself. Therefore, this finding contrasts with earlier studies and suggests that standing alone may not be a sufficient predictor of menstrual distress without other compounding factors.

Similarly, prolonged computer use was not associated with menstrual distress in this study. Existing literature in this area is limited and inconclusive. Some hypotheses propose that sedentary behavior and screen exposure may indirectly influence menstrual function by affecting sleep quality, stress, or melatonin production.[37] However, a direct link between screen time or computer works and menstrual distress has not been firmly established. The findings from the current study indicate that prolonged computer use, on its own, may not be a significant occupational hazard for menstrual health among nurses, possibly because of task variation and frequent breaks in clinical settings.

In summary, while this study identifies several occupational factors contributing to menstrual distress in nurses, further research is needed to fully understand these relationships and their implications for the health and well-being of nursing professionals.

The study indicates that smoking, as a potent oxidizing agent, contributes to menstrual distress.[38] Research links smoking to shorter, irregular menstrual cycles and increased dysmenorrhea. Nicotine specifically has antiestrogenic effects and can cause vasoconstriction, which reduces blood flow to the uterine wall and leads to dysmenorrhea. The observed relationship between smoking and menstrual distress is consistent with other research that connects nicotine and tobacco toxins to irregular, shorter cycles and dysmenorrhea.[39,40] The biological mechanism for this may involve the toxic effects of cigarette components on the ovaries and the disruption of sex hormone regulation by the central nervous system.

A history of miscarriage is significantly associated with menstrual distress ($p = 0.031$), which suggests that nurses with higher levels of menstrual distress might also have a higher risk of miscarriage. However, the study notes that further longitudinal research is needed to establish a causal relationship.[36] Additional occupational factors, such as high noise levels, prolonged standing, and heavy lifting, are considered potential risk factors for miscarriage in nurses. The study's findings are supported by the fact that stress and anxiety are significantly associated with menstrual disorders and can contribute to miscarriage.[15]

Marital status can also influence menstrual distress, as hormonal changes in married women may affect menstrual characteristics. However, this study did not find a significant association between marital status and menstrual distress ($p = 0.352$). Future research should compare menstrual characteristics and hormonal profiles between married and unmarried women in age-matched groups for more accurate results.[41]

Assessing stress with a single item may not accurately reflect its relationship with menstrual disorders because stress is multifactorial. This study comprehensively evaluated factors affecting anxiety. A significant correlation was found between the anxiety index and menstrual distress ($r = 0.612$, $p < 0.001$). Both state and trait anxiety in the nurses were associated with menstrual distress.

These findings are consistent with existing literature that suggests occupational stress can alter the hypothalamic–pituitary–adrenal (HPA) axis, impairing gonadotropin secretion and changing prostaglandin synthesis.[42]

Work-related stress can disrupt the menstrual cycle by affecting the hypothalamic-pituitary-adrenal axis, inhibiting follicle-stimulating hormone and luteinizing hormone secretion. This impairment leads to changes in progesterone synthesis and affects prostaglandin activity. Stress hormones like adrenaline and cortisol also influence prostaglandin synthesis in the myometrium. Previous studies also support the effect of anxiety on menstrual disorders, indicating that long-term exposure to high-stress work environments can lead to irregularities and menstrual distress.[43] Additionally, occupational stressors like noise can indirectly affect hormone secretion and synthesis.[44]

Sleep quality significantly mediates the relationship between occupational stress and menstrual disorders like menstrual distress in nursing.[45] A positive linear relationship exists between sleep quality and premenstrual syndrome.[46] While the physiological mechanisms are not fully understood, sleep disturbances can disrupt menstruation in several ways.[47] For people with long-term insomnia, activation of the hypothalamic-pituitary-adrenal axis inhibits the secretion of corticotropin-releasing hormone (CRH) and gonadotropin-releasing hormone (GnRH), which leads to menstrual disorders. Additionally, sleep deprivation increases thyroid-stimulating hormone (TSH) and estradiol levels. Women with irregular sleep patterns show higher estradiol levels. Luteinizing hormone (LH) secretion decreases during sleep and increases upon waking.[48] Some menstrual disorders are linked to elevated TSH and altered LH and estradiol levels, which disrupts the timing of hormones needed for ovulation.[49] This study found a significant negative correlation between sleep quality and menstrual distress in nurses ($r = –0.518$, $p < 0.001$). Sleep deprivation also negatively impacts the immune system.[50]

Future studies should consider using a larger sample size to better reflect the population. They should also use random sampling and more rigorous matching procedures to improve the comparability of groups. To strengthen the validity of the findings, future research could incorporate objective quantitative measures such as sex hormone profiling, blood parameters, and biological monitoring of hormonal and oxidative stress markers. To better understand causal relationships, longitudinal, case-control, or interventional studies are needed. Future research could also investigate the influence of dietary habits, lifestyle factors, work patterns, psychological well-being, and socioeconomic status on menstrual distress. This integrative approach could help healthcare managers and policymakers develop interventions and policies to improve nurses' health and quality of life.

Menstrual symptoms create a significant economic burden globally. A recent systematic review estimated the annual direct costs of treatment to range between $1 and $1.55 billion, with indirect costs—such as lost productivity—estimated between $12 and $36 billion globally.[51] Given the significant individual and societal impact of menstrual distress, addressing this issue among nurses is imperative not only for occupational health but also as a cost-effective strategy to enhance workforce well-being and healthcare system efficiency. Based on our findings and supported by existing literature, we propose a comprehensive set of targeted interventions aimed at reducing occupational contributors to menstrual distress among nursing professionals. First, organizational interventions are essential: workplace policies should be revised to minimize exposure to known risk factors, with particular attention to shift scheduling. Reducing reliance on night and rotating shifts can help preserve circadian rhythm integrity—whose disruption has a more profound impact on menstrual health than sleep loss alone. Additionally, integrating short rest breaks during high-demand tasks, limiting excessive overtime, and improving nurse-to-patient ratios are crucial steps to mitigate cumulative physical and psychological stress.[52]

Second, environmental optimization plays a key role in alleviating occupational strain. Enhancing physical work conditions—such as ensuring thermal comfort, adequate ventilation, and effective noise control (e.g., from monitors and equipment)—can reduce ambient stressors that exacerbate menstrual symptoms. Such improvements not only create a more supportive work atmosphere but may also contribute to hormonal stability and overall well-being. Third, ergonomic and biomechanical adjustments are vital: the routine use of mechanical patient transfer devices, antifatigue mats, and supportive footwear can significantly reduce musculoskeletal strain from prolonged standing and repetitive motions, thereby lessening physical stressors linked to menstrual distress and improving functional comfort during shifts.

Fourth, psychological support initiatives must be prioritized. Healthcare institutions should offer accessible, confidential counseling services and evidence-based stress management programs tailored to nurses' needs. Cultivating a supportive workplace culture that encourages open dialogue about menstrual health can reduce stigma, promote help-seeking behavior, and positively influence mental health, sleep quality, and menstrual symptom severity. Fifth, targeted protective measures for specific occupational exposures are warranted.[35] For instance, nurses handling anesthetic gases should benefit from strict adherence to ventilation standards, continuous environmental monitoring in operating rooms, and consideration of antioxidant supplementation (e.g., vitamins C and E) to counteract potential genotoxic effects. Similarly, cytotoxic drug handling must occur exclusively under laminar flow hoods with full personal protective equipment, and biological monitoring—such as measuring urinary trihalomethanes—should be implemented to verify exposure control.

Finally, policy development and implementation at the institutional and national levels are critical.[53] Drawing inspiration from international models like Spain's menstrual leave policy, healthcare systems should formally recognize menstrual distress as a legitimate occupational health issue. Enacting supportive policies—not as a form of special treatment but as a component of gender-responsive occupational health—can reduce workplace stigma, enhance inclusivity, improve nurse retention, and ultimately foster a healthier, more resilient nursing workforce.

The study has several limitations. First, the reliance on self-reported questionnaires may have introduced a response bias. The relatively small sample size, which was partially due to cultural factors, may also affect the generalizability of the findings. The selection of administrative staff as the

control group is another limitation. Although researchers tried to match the exposed and unexposed groups on key demographic and reproductive variables, complete matching was not possible because of the inherent differences in their occupational roles and the small sample size. The study's cross-sectional design also limits causal inference, as it is unclear whether factors like anxiety and sleep quality cause menstrual distress or are a result of it.

Conclusion

This study highlights significant links between occupational exposures and menstrual distress among female nurses, highlighting the complex interplay of workplace factors and psychological health. Exposure to various occupational hazards—including shift work, noise, cold working environments, and disinfectants—was significantly associated with higher levels of menstrual distress among female nurses. Psychological factors, particularly anxiety and poor sleep quality, emerged as critical mediators in the relationship between workplace exposures and menstrual symptoms. Among demographic variables, smoking and a history of miscarriage showed significant associations with increased menstrual distress, whereas factors such as marital status and educational level did not demonstrate statistically significant links.

These results underscore the need to integrate occupational reproductive health into nursing education curricula and provide ongoing training for practicing nurses on how workplace conditions—such as shift patterns, environmental stressors, and chemical exposures—interact with sleep quality and anxiety to influence menstrual health. At the organizational level, policies should be implemented to reduce exposure to harmful occupational factors. This includes minimizing night and rotating shifts, providing ergonomic equipment (e.g., patient lift devices, antifatigue mats), and improving the physical work environment through noise reduction, thermal comfort, and enhanced ventilation. Additionally, fostering a workplace culture that encourages open, nonstigmatizing conversations about menstrual health can empower nurses to seek timely support and care.

This study advances the understanding of the complex interplay between occupational stressors, psychological well-being, and menstrual health in nursing professionals. By identifying both direct and mediated pathways through which workplace conditions affect menstrual distress, it provides a robust evidence base for developing targeted, multidimensional interventions aimed at safeguarding the reproductive health, overall well-being, and professional sustainability of nurses.

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Conflicts of interest

Nothing to declare.

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