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Association between self-reported menstrual disorders and occupational exposures in female healthcare workers: a university hospital experience from Turkey

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ABSTRACT

Objectives: This study aims to demonstrate the relationship between menstrual disorders and occupational exposures in female healthcare workers, and to contribute to the regulation and improvement of working conditions of female healthcare workers.

Methods: A cross-sectional study among 503 female healthcare workers at university hospital in Turkey was conducted during December 2020-April 2021. The questionnaire prepared using the Google Forms program was sent electronically.

Results: Prevalence of dysmenorrhea was 59%, abnormal amount of menstrual bleeding 48.7%, abnormal menstrual duration 32%, and abnormal menstrual cycle length 154 30.6% in 503 participants. Dysmenorrhea risk was 0.79-fold (95% CI = 0.64-0.83) lower in those with advanced age and 1.56-fold (95% CI = 1.02-2.37) higher in smokers; risk of abnormal amount of menstrual bleeding was 3.91-fold (95% CI = 1.24-12.30) higher in those with total employment time of ≥ 20 years and 1.56-fold (95% CI = 1.07-2.26) higher in those who worked with display screens for > 20 hours a week; risk of abnormal menstrual cycle length was 3.46-fold (95% CI = 1.41-8.43) higher in technicians, 2.86-fold (95% CI = 1.24-6.61) higher in nurses, 2.63-fold (95% CI = 1.19-5.79) higher in other healthcare workers, and 2.14-fold (95% CI = 1.42-3.21) higher in those who were unsatisfied with their job.

Conclusions: It was found that occupational exposures may increase the risk of menstrual disorders. A plan of action is needed to reduce the frequency of menstrual disorders by preventing occupational exposures experienced by healthcare workers.

Keywords: Healthcare workers, menstrual disorders, occupational exposures

Women employed in health and social service jobs in Turkey constitute 7.3% of the total female workforce [1]. Feminization of the workforce has occurred in field of health, as half or even over half of the general workforce is comprised of women. The traditional acceptance of nursing and midwifery professions as women's work has an important role in the high number of women in the health sector. Due to the

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increase in maternal age and decline in fertility rates in recent years, the preservation of female reproductive health and fertility has become as important as maintaining pregnancy and safe birth [2]. Menstrual cycle regularity is a primary indicator of female reproductive health [3]. Irregular menstrual cycle may cause anovulation and infertility [4]. The menstrual cycle varies according to the balance between the hypothalamus-pituitary-ovarian axis and endogenous hormones. Changes in this hormonal axis can affect menstrual cycle pattern, length, and amount of bleeding [5, 6]. Dysmenorrhea and abnormal bleeding are common problems among young women and may negatively affect quality of life, work productivity, or access to healthcare [7]. Changes in the menstrual cycle have been associated with several factors such as age, smoking, body weight, exercise, race, life events, perceived stress, physiological state (such as cold), work environment (work shift, noise/ vibration/ exposure to organic solvents) [8]. Although occupational hazards associated with the menstrual cycle have been categorized as chemical, biological, psychosocial, and physical hazards, many studies have focused on chemical hazards [9, 10].

There is limited available evidence on the association between occupational exposures and menstrual disorders, and it is unclear how working conditions affect the menstrual cycle. However, chronic inflammation caused by occupational exposures is the most likely mechanism in the relationship between work-related factors and irregular menstrual cycle. Many studies have shown that occupational hazards are associated with reproductive health in female nurses [11, 12]. In studies on nurses in China, the prevalence of irregular menstrual cycles wasreported as 41%, and the prevalence of dysmenorrhea was reported as 70.7% [13, 14]. In Turkey, the prevalence of dysmenorrhea was reported as 69.9% [15]. Occupational exposure to antineoplastic drugs is reportedly associated with menstrual irregularity in nurses working in the United States [16]. Long working hours, and overtime and night shifts are common occurrences among health workers. Working night shifts can disrupt the circadian rhythm, which is effective in ovulation, and as a result, it may cause an irregularity in the menstrual cycle. In the largest epidemiological study comprising of 71.011 nurses in the USA, it was reported that there was a relationship between shift work and menstrual cycles lasting 40 days or more, and a 25% increased risk of change in cycle duration for every 12-month shift work [17]. The number of studies that include all female health workers and investigate the relationship with occupational exposures is limited. This study aims to demonstrate the relationship between menstrual disorders and occupational exposures in female health workers, and to contribute to the regulation and improvement of working conditions of female health workers.

METHODS

Study Design

This cross-sectional study was planned to to evaluate the relationship between menstrual disorders and occupational exposures in female healthcare workers at one of the largest public university hospital in Turkey.

Measurement Tools

A questionnaire designed by occupational diseases specialists was administered to the participants. The questionnaire form consists of three parts. The first part of the questionnaire consisted of 8 items related to sociodemographic data (age, marital status, education level, occupation, smoking and alcohol use, past pregnancies and age of menarche). Participants were classified and evaluated in 4 groups according to occupation: nurse, technician, doctor, others (medical secretary, dentist, dietician, administrative staff, etc.). Age of menarche was classified as 9-11, 12-13, and ≥ 14 years.

The second part of the questionnaire was composed of 18 questions related to working conditions and occupational hazards. To evaluate working conditions, total working time, institution (public, private), work pattern (shift work, permanent day shift, permanent night shift), weekly working hours (< 40 hours and ≥ 40 hours), perceived workload, perceived job stress, perceived job satisfaction, use of personal protective equipment, working time with display screens, long periods of standing, carrying heavy loads (manually carrying loads of ≥ 20kg) were questioned. Workload was defined as the stress perceived by the person due to intense tasks in a professional capacity [18]. A 5-point Likert scale was used to measure work stress. A score of 1-2 was considered mild, 3 as mod-

erate, and 4-5 as intense work-related stress. Working with display screens was defined as working with a computer at least 20 hours a week [19], while long periods of standing was defined as standing for at least 8 hours a day [20]. To assess occupational hazards in the workplace, they were asked whether they were exposed to noise, ionizing radiation, antineoplastic drugs, anesthetic gases, and whether they used vibrating tools, disinfectants, and sterilizing agents.

The third part of the questionnaire consisted of 4 questions to evaluate data related to the menstrual cycles of the participants. Participants who experienced back/abdominal pain that prevented them from doing routine work or pain that required medication in the last 3 months were evaluated as the dysmenorrhea group [21]. Participants were asked to describe the amount of menstrual blood bleeding as low, moderate, heavy, or very heavy for the last three months. Those who described their menstrual bleeding as low, heavy, or very heavy were considered participants with abnormal amount of menstrual bleeding. As for duration of menstrual bleeding of the last three months, 3-7 days was considered normal, while < 3 days and > 7 days was considered abnormal menstrual duration [22]. According to menstrual cycle length of the last three months, 21-35 days was considered normal, < 21 days or >35 days was considered irregular menstrual cycle length [23].

Data Collection

No sample was selected in this study. Between December 2020 and April 2021, the questionnaire prepared using the Google Forms program was sent electronically to 2462 female healthcare workers working at one of the largest public university hospital in Turkey. After clicking on the link sent to them via mobile phone, tablet or computer, the participants consent to participate in the questionnaire and were able to voluntarily complete it out. 556 employees completed the questionnaire completely (22.5%). Of the 556 people who participated in the questionnaire, five (0.9%) participants were excluded from the study due to incomplete responses, three (0.5%) due to menopause, 10 (1.8%) due to history of hysterectomy operation, 24 (4.3%) due to contraceptive use and 11 (1.9%) due to pregnancy. In total, 503 people were included in the evaluation.

Ethical Considerations

The study was approved by Istanbul University-Cerrahpaşa, Cerrahpaşa Medical Faculty Hospital Ethics Committee (Date: 17.11.2020, No. 151643). Informed consent was obtained via a form on the survey website.

Statistical Analysis

SPSS v21.0 (SPSS Inc., Chicago, IL, USA) package program was used to evaluate and analyze the data. Numerical variables were presented as mean and standard deviation, while categorical data were presented as number and percentage tables. Chi-square test was used to analyze the relationship between groups for categorical data. Student's t-test was applied to compare mean values between two groups. Univariate logistic regression analysis was used to calculate the odds ratios (OR) and 95% confidence intervals (CI) of risk factors associated with menstrual disorders. Variables that were found to be statistically significant ($p < 0.05$) as a result of this analysis were subjected to multivariate logistic regression analyzes. *P* value of < 0.05 was considered statistically significant.

RESULTS

Mean age of the participants was 35.04 ± 7.92 years. In total, 334 (66.4%) of the participants were married, 335 (66.6%) had undergraduate or higher diploma, and 242 (48.1%) were nurses; 162 (32.2%) of the participants were smokers, and 176 (35%) used alcohol; 305 (60.6%) had history of previous pregnancy and 318 (63.2%) had age of menarche of 12-13. Prevalence of dysmenorrhea was 297 (59%), prevalence of abnormal amount of menstrual bleeding was 245 (48.7%), prevalence of abnormal menstrual duration was 161 (32%), and prevalence of irregular menstrual cycle length was 154 (30.6%) (Table 1). Working conditions and occupational hazards of female health workers are shown in Table 2.

Bivariate Analysis between Demographic Data and Menstrual Disorders

Participants with dysmenorrhea had younger mean age than those without dysmenorrhea ($p < 0.01$). Dys-

Table 1. Distribution of demographic data and rates of menstrual disorders in female healthcare workers

Variables	Total[×] (n = 503)	Dysmenorrhea[×] (n = 297) (59%)	Abnormal amount of menstrual bleeding[××] (n = 245) (48.7%)	Abnormal menstrual duration[××] (n = 161) (32%)	Abnormal menstrual cycle length[××] (n = 154) (30.6%)
Age (years) ǂ	35.04 ± 7.92	33.66 ± 7.59 **< 0.001**	36.78 ± 7.89 **< 0.001**	37.40 ± 8.09 < 0.001	36.19 ± 8.59 **0.040**
Marital status[ⁱ]					
Married	334 (66.4)	192 (57.5)	170 (50.9)	120 (35.9)	102 (30.5)
Single	169 (33.6)	105 (62.1)	75 (44.4)	41 (24.3)	52 (30.8)
p value		0.317	0.167	**0.008**	0.958
Education[ⁱ]					
High school and below	30 (6)	18 (60)	20 (66.7)	13 (43.3)	10 (33.3)
Undergraduate	138 (27.4)	91 (65.9)	67 (48.6)	43 (31.2)	46 (33.3)
Graduate and above	335 (66.6)	188 (56.1)	158 (47.2)	105 (31.3)	98 (29.3)
p value		0.142	0.131	0.407	0.645
Occupation[ⁱ]					
Nurse	242 (48.1)	151 (62.4)	122 (50.4)	90 (37.2)	83 (34.3)
Technician	130 (25.8)	83 (63.8)	72 (55.4)	41 (31.5)	39 (30)
Doctor	60 (11.9)	25 (41.7)	23 (38.3)	12 (20)	9 (15)
Other	71 (14.1)	38 (53.5)	28 (39.4)	18 (25.4)	23 (32.4)
p value		**0.014**	0.054	**0.038**	**0.027**
Smoker[ⁱ]					
Yes	162 (32.2)	109 (67.3)	84 (51.9)	56 (34.6)	59 (36.4)
No	341 (67.8)	188 (55.1)	161 (47.2)	105 (30.8)	95 (27.9)
p value		**0.010**	0.331	0.396	0.052
Alcohol use[ⁱ]					
Yes	176 (35)	97 (55.1)	84 (47.7)	47 (26.7)	54 (30.7)
No	327 (65)	200 (61.2)	161 (49.2)	114 (34.9)	100 (30.6)
p value		0.188	0.747	0.061	0.981
Previous pregnancy[ⁱ]					
No	198 (39.4)	133 (67.2)	77 (38.9)	47 (23.7)	61 (30.8)
Yes	305 (60.6)	164 (53.8)	168 (55.1)	114 (37.4)	93 (30.5)
p value		**0.003**	**< 0.001**	**0.001**	0.940
Menarche age[ⁱ]					
9-11	90 (17.9)	60 (66.7)	43 (47.8)	28 (31.1)	28 (31.1)
12-13	318 (63.2)	184 (57.9)	149 (46.9)	104 (32.7)	97 (30.5)
≥14	95 (18.9)	53 (55.8)	53 (55.8)	29 (30.5)	29 (30.5)
p value		0.251	0.305	0.905	0.994

[×] Column percentage, [××] Row percentage, ǂMean ± SD, [ⁱ] n (%)

Table 2. Distribution of working conditions, occupational hazards and menstrual disorders in female healthcare workers

Variables	Total [×]	Dysmenorrhea[××]	Abnormal amount of menstrual bleeding[××]	Abnormal menstrual duration[××]	Abnormal menstrual cycle length[××]
Total years of employment[±]					
1-5 years	107 (21.3)	74 (69.2)	35 (32.7)	20 (18.7)	33 (30.8)
5-10 years	102 (20.3)	68 (66.7)	42 (41.2)	28 (27.5)	25 (24.5)
10-20 years	175 (34.8)	95 (54.3)	88 (50.3)	56 (32)	45 (25.7)
≥ 20 years	119 (23.7)	60 (50.4)	80 (67.2)	57 (47.9)	51 (42.9)
p value		**0.006**	**< 0.001**	**< 0.001**	**0.008**
Institution[±]					
Public health institution	443 (88.1)	261 (58.9)	221 (49.9)	142 (32.1)	132 (29.8)
Private health institution	60 (11.9)	36 (60)	24 (40)	19 (31.7)	22 (36.7)
p value		0.984	0.150	1.000	0.350
Work shifts[±]					-
Rotating shifts	236 (46.9)	151 (64)	114 (48.3)	69 (29.2)	75 (31.8)
Permanent day	236 (46.9)	124 (52.5)	116 (49.2)	82 (34.7)	69 (29.2)
Permanent night	31 (6.2)	22 (71)	15 (48.4)	10 (32.3)	10 (32.3)
p value		**0.016**	0.983	0.439	0.818
Weekly work hours[±]					
< 40 hours	309 (61.4)	104 (53.6)	86 (44.3)	55 (28.4)	45 (23.2)
≥ 40 hours	194 (38.6)	193 (62.5)	159 (51.5)	106 (34.3)	109 (35.3)
p value		**0.049**	0.120	0.164	**0.004**
Perceived work-related stress[±]					
Mild	84 (16.7)	39 (46.4)	37 (44)	4 (28.6)	27 (32.1)
Moderate	293 (58.3)	184 (62.8)	139 (47.4)	91 (31.1)	88 (30)
Heavy	126 (25)	74 (58.7)	69 (54.8)	46 (36.5)	39 (31)
p value		**0.027**	0.251	0.417	0.930
Perceived workload[±]					
Yes	475 (94.4)	282 (59.4)	237 (49.9)	154 (32.4)	144 (30.3)
No	28 (5.6)	15 (53.6)	8 (28.6)	7 (25)	10 (35.7)
p value		0.683	**0.046**	0.542	0.696
Perceived job satisfaction[±]					
Yes	237 (47.1)	132 (55.7)	109 (46)	74 (31.2)	55 (23.2)
No	266 (52.9)	165 (62)	136 (51.1)	87 (32.7)	99 (37.2)
p value		0.149	0.250	0.722	**0.001**
Use of PPE[±]					
Yes	469 (93.2)	280 (59.7)	227 (48.4)	153 (32.6)	143 (30.5)
No	34 (6.8)	17 (50)	18 (52.9)	8 (23.5)	11 (32.4)
p value		0.352	0.739	0.364	0.972
Work with display screens[±]					
< 20 hours	214 (42.5)	126 (58.6)	93 (43.3)	67 (31.2)	67 (31.2)
≥ 20 hours	289 (57.5)	171 (59.4)	152 (52.8)	94 (32.6)	87 (30.2)
p value		0.862	**0.035**	0.726	0.818

Table 2 contunied. Distribution of working conditions, occupational hazards and menstrual disorders in female healthcare workers

Variables		Total [×]	Dysmenorrhea[××]	Abnormal amount of menstrual bleeding[××]	Abnormal menstrual duration[××]
Long periods of standing[±]					
< 8 hours	165 (32.8)	87 (52.7)	79 (47.9)	50 (30.3)	44 (26.7)
≥ 8 hours	338 (67.2)	211 (62.4)	166 (49.1)	111 (32.8)	110 (32.5)
p value		**0.038**	0.795	0.567	0.179
Carrying heavy loads[±]					
Yes	137 (27.2)	91 (66.4)	70 (51.1)	54 (39.4)	37 (27)
No	366 (72.8)	207 (56.6)	175 (47.8)	107 (29.2)	117 (32)
p value		**0.045**	0.512	**0.029**	0.283
Exposure to vibration[±]					
Yes	78 (15.5)	44 (56.4)	42 (53.8)	28 (35.9)	20 (25.6)
No	425 (84.5)	254 (59.8)	203 (47.8)	133 (31.3)	134 (31.5)
p value		0.579	0.323	0.503	0.366
Exposure to noise[±]					
Yes	291 (57.9)	179 (61.5)	147 (50.5)	96 (33)	92 (31.6)
No	212 (42.1)	119 (56.1)	98 (46.2)	65 (30.7)	62 (29.2)
p value		0.225	0.342	0.580	0.569
Exposure to ionizing radiation[±]					
Yes	208 (41.4)	132 (63.5)	107 (51.4)	71 (34.1)	67 (32.2)
No	295 (58.6)	166 (56.3)	138 (46.8)	90 (30.5)	87 (29.5)
p value		0.106	0.303	0.391	0.515
Exposure to antineoplastic drugs[±]					
Yes	31 (6.2)	22 (71)	15 (48.4)	9 (29)	12 (38.7)
No	472 (93.8)	276 (58.5)	230 (48.7)	152 (32.2)	142 (30.1)
p value		0.237	1.000	0.867	0.419
Exposure to anesthetic gas[±]					
Yes	76 (15.1)	47 (61)	37 (48.1)	23 (29.9)	
No	427 (84.9)	251 (58.9)	208 (48.8)	138 (32.4)	123 (28.9)
p value		0.728	0.900	0.761	0.063
Exposure to disinfectants[±]					
Yes	435 (86.5)	265 (60.9)	216 (49.7)	146 (33.6)	139 (32)
No	68 (13.5)	32 (47.1)	29 (42.6)	15 (22.1)	15 (22.1)
p value		**0.031**	0.282	0.080	0.132
Exposure to sterilizing agents[±]					
Yes	152 (30.2)	96 (63.2)	79 (52)	56 (36.8)	46 (30.3)
No	351 (69.8)	201 (57.3)	166 (47.3)	105 (29.9)	108 (30.8)
p value		0.217	0.335	0.126	0.910

[×]Column percentage, [××]Row percentage, [±]n (%), PPE = personal protective equipment

menorrhea was more prevalent among technicians compared to other occupational groups ($p = 0.014$), among smokers ($p = 0.010$) and among those without history of pregnancy compared to those who had history of pregnancy ($p = 0.003$). Participants who had an abnormal amount of menstrual bleeding had a significantly older mean age than participants who did not ($p < 0.001$) and abnormal amount of menstrual bleeding was more prevalent among those with a history of pregnancy ($p < 0.001$). Participants who had abnormal menstrual duration had an older mean age than those with normal menstrual duration ($p < 0.001$). Abnormal menstrual cycle length was more prevalent among those who were married compared to those who were not married ($p = 0.008$), among nurses compared to other occupations ($p = 0.038$), and among those with a history of pregnancy ($p < 0.001$). Participants who had abnormal menstrual cycle length had an older mean age than those who did not ($p = 0.040$), and abnormal menstrual cycle length was more prevalent among nurses than other occupational groups ($p = 0.027$).

Bivariate Analysis between Working Conditions/Occupational Hazards and Menstrual Disorders

Dysmenorrhea was prevalent among those with total working experience of 1-5 years ($p = 0.006$), those who worked permanent night shifts ($p = 0.016$), those who worked 40 hours or more per week ($p = 0.049$), those who experienced moderate workrelated stress ($p = 0.027$), those who worked stood for ≥ 8 hours a day (p = 0.038), those who lifted heavy loads ($p = 0.045$), and those who were exposed to disinfectants in the workplace ($p = 0.031$). Abnormal amount of menstrual bleeding was more prevalent among those with total working experience of over 20 years ($p < 0.001$), those who perceived workload ($p = 0.046$), and those who worked with display screens for at least 20 hours a week ($p = 0.035$). Abnormal menstrual duration was more prevalent among those with total working experience of over 20 years ($p < 0.001$) and those who carried heavy loads ($p = 0.029$). Abnormal menstrual cycle length was more prevalent among those with total working experience of over 20 years ($p = 0.008$), those who worked over 40 hours a week ($p = 0.004$), and those were unsatisfied with their job ($p = 0.001$) (Table 2).

Logistic Regression Analysis between Demographic Variable, Occupational Exposures and Menstrual Disorders

Univariate logistic regression analysis was performed between menstrual disorders and demographic, occupational exposure variables of the participants who demonstrated a statistically significant difference. Multivariate logistic regression analyzes were applied to the variables that were statistically significant ($p < 0.05$) as a result of this analysis. A significant correlation was found between the rate of dysmenorrhea and age ($p = 0.007$) and smoking ($p = 0.037$). The risk of dysmenorrhea was found to be 0.79-fold (95% Cl = 0.64-0.83) lower in the elderly and 1.56-fold (95%CI = 1.02-2.37) higher in smokers. The rate of abnormal amount of menstrual bleeding significantly correlated with total years of employment ($p = 0.02$) and working long periods with display screens ($p = 0.018$). Risk of abnormal amount of menstrual bleeding was 3.91-fold (95% CI = 1.24-12.30) higher in those with total work experience of 20 years of more and 1.56-fold (95% CI = 1.07-2.26) higher in those who worked with display screens for over 20 hours a week. Prevalence of abnormal menstrual cycle length was significantly associated with occupation ($p = 0.016$, $p = 0.014$, $p = 0.006$, $p < 0.001$) and job satisfaction ($p < 0.001$). Risk of abnormal menstrual cycle length in technicians was found as 3.46-fold (95% Cl=1.41-8.43), in nurses 2.86-fold (95% Cl = 1.24-6.61), in other occupations 2.63-fold (95% Cl = 1.19-5.79), and in those who were unsatisfied with their job 2.14-fold (95% Cl = 1.42-3.21) (Table 3).

DISCUSSION

This study demonstrates the relationship between menstrual disorders and occupational hazards in female health workers in Turkey. Menstrual disorders included dysmenorrhea, abnormal amount of menstrual bleeding, abnormal menstrual duration, and abnormal menstrual cycle length. In our study, rates of dysmenorrhea, abnormal amount of menstrual bleeding, abnormal menstrual duration, and abnormal menstrual cycle length in female health workers were 59%, 48.7%, 32%, and 30.61%, respectively.

Table 3. Multivariate regression analysis of risk factors for menstrual disorders in female healthcare workers

	Dysmenorrhea		Abnormal amount of menstrual bleeding		Abnormal menstrual duration		Abnormal menstrual cycle length	
	AOR	95% CI	AOR	95% CI	AOR	95% CI	AOR	95%CI
Age	**0.79**	0.64-0.83	0.99	0.94-1.04	1.04	0.98-1.10	1.03	0.98-1.09
Occupation								
Doctor	Ref		**NS**		Ref		Ref	
Other	1.81	0.83-3.93			0.63	0.26-1.49	**2.63**	1.19-5.79
Nurse	0.70	0.37-1.32			1.20	0.62-2.29	**2.86**	1.24-6.61
Technician	0.70	0.36-1.36			1.14	0.57-2.26	**3.46**	1.41-8.43
Total years of employment								
1-5	1.75	0.50-6.13	Ref		Ref		1.81	0.91-3.61
5-10	1.37	0.50-3.71	1.38	0.73-2.61	1.23	0.59-2.56	Ref	
10-20	1.19	0.60-2.35	1.82	0.80-4.14	1.23	0.49-3.12	0.89	0.44-1.77
≥20	Ref		**3.91**	1.24-12.30	1.51	0.43-5.30	1.50	0.54-4.11
Smoking								
Yes	**1.56**	1.02-2.37	**NS**		**NS**		**NS**	
No	Ref							
Job satisfaction								
Yes	**NS**		**NS**		**NS**		Ref	
No							**2.14**	1.42-3.21
Work with display screens								
< 20 hours	**NS**		Ref		**NS**		**NS**	
≥ 20 hours			**1.56**	1.07-2.26				

AOR = Adjusted Odds Ratio, CI = Confidence Interval, *Significant (p value < 0.05), Ref = Reference (lowest prevalence), NS = Nonsignificant

In a study conducted on nurses in China, the rate of menstrual disorders was reported as 41% [13]. Menstrual disorders vary among women with different sociodemographic characteristics such as marital status, birth, and age. Significant differences have been found between married and unmarried women in terms of menstrual characteristics [24]. In a study conducted in China, it was found that women in the 45-50 age group were associated with general menstrual disorders and irregular menstrual cycles, especially heavy menstrual bleeding or hypomenorrhea formation [13]. This may be due to menopausal effects and decreased ovarian function, estrogen, and progesterone levels during the perimenopausal period [25]. In our study, it was observed that rates of abnormal menstrual bleeding, abnormal menstrual duration, and abnormal menstrual cycle length increased with age. Studies conducted in Taiwan and Thailand reported dysmenorrhea prevalence as 70.2% and 70.7%, respectively [14, 26]. A study on nurses in our country reported a dysmenorrhea prevalence of 69.9% [15]. Dysmenorrhea emerged as the most common menstrual disorder in our study. Dysmenorrhea prevalence was relatively lower in our study (59%) compared to other studies, while, in terms of occupation, dysmenorrhea was most common among technicians (63.8%).

According to the literature, prevalence of dysmenorrhea may vary according to study population and definition of dysmenorrhea [7, 26]. In our study, women with dysmenorrhea had higher mean age than women without dysmenorrhea, which was consistent with the literature [27-29]. This result may be related to the fact that young women are unaware of the factors that increase or cause dysmenorrhea and therefore do not use effective coping methods [30]. Smoking is among the modifiable risk factors for dysmenorrhea. In our study, a significant relationship was observed between smoking and dysmenorrhea, and the prevalence of dysmenorrhea was found to be higher in smokers, in line with the literature [31]. Previous studies in the literature have not presented clear evidence of a relationship between dysmenorrhea and childbirth. There are studies reporting that dysmenorrhea is less prevalent among women who have given birth [32], more prevalent among women who have given birth [7, 15, 33] and unrelated [28]. In our study, prevalence of dysmenorrhea was observed to be lower among health workers with history of pregnancy, which was consistent with the literature.

The menstrual cycle is reflective of circadian rhythm in women. Shift work can disrupt the circadian rhythm. An impaired sleep/wake cycle and an impaired circadian rhythm can alter the pattern of the menstrual cycle [34]. One meta-analysis reported increased prevalence of abnormal menstrual cycle length in shift workers, even after adjustment for confounders [35]. In addition, in our study, dysmenorrhea prevalence was found to be higher in those who worked at night shifts permanently and in those who work at rotating shifts. This finding is consistent with the results of the study by Chiu *et al*. [14] and inconsistent with the results of the study by Chuamoor *et al*. [26]. These conflicting results may be due to differences in perceived stress levels, mean ages of the study groups, pain perception, and methods of coping with pain.

It is reported that heavy working conditions and work-related stress disrupt the menstrual cycle and cause dysmenorrhea [33]. There is a theory that stress affects the menstrual cycle through the hypothalamic–pituitary–adrenal (HPA) axis. When stress levels are high, HPA activity is disrupted. Therefore, women who experience significant stress may experience more irregular menstruation than those who are not under stress [36]. Stress causes disruption of follicular development by preventing the release of follicle stimulating hormone and luteinizing hormone. This can alter progesterone synthesis and release, which can affect prostaglandin activity. Besides progesterone, stress-related hormones such as adrenaline and cortisol also appear to affect prostaglandin synthesis and/or its binding in the myometrium [7]. In line with this theory, in our study, it was observed that rates of dysmenorrhea was higher in healthcare workers who experienced moderate and severe work-related stress, and prevalence of abnormal menstrual bleeding were increased among those who perceived workload and among those who worked with display screens for more than 20 hours per week. Long working hours and short rest periods increase the employee's anxiety and dissatisfaction, which can affect the menstrual cycle [37]. In our study, prevalence of abnormal amount of menstrual bleeding was higher among those who were unsatisfied with their job. In a study by Lawson *et al*. [38], prevalence of abnormal menstrual cycle length was 19% in nurses, and even higher among nurses who worked night shifts, ≥ 40 hours a week, and carried heavy loads. Intense physical activity has been identified as a risk factor for menstrual disorders and a significant association was found between intensity of physical exercise (hours/week) and menstrual disorders [39]. In our study, there was more frequent dysmenorrhea and abnormal menstrual cycle length in participants who worked ≥ 40 hours a week, and a higher prevalence of dysmenorrhea and abnormal menstrual duration in healthcare workers carrying heavy loads [15].

Disinfectants are widely used among all health institutions. It is reported that 78% of nurses in the United States are exposed to disinfectants in their daily work through inhalation and dermal absorption [40]. The use of disinfectants has been listed among the risk factors for menstrual disorders. Although studies suggest that disinfectants may cause menstrual disorders by affecting the hypothalamic-pituitary-gonadal axis and causing changes in reproductive hormone profiles, there is insufficient evidence that disinfectants can affect menstrual disorders [13]. In our study, prevalence of dysmenorrhea was significantly higher among healthcare workers exposed to disinfectants.

Strenghts and Limitations

Our study had several strenghts and limitations. Studies investigating menstrual disorders in nurses have been conducted by other researchers. However, to the best of our knowledge, this is the first study that has included female healthcare workers of different occupations and investigated the relationship between occupational hazards and menstrual disorders. Studies on menstrual disorders in healthcare workers worldwide have generally been conducted among nurses, and very few studies have included female healthcare workers of different occupations. We used a self-report questionnaire to reach as many participants as possible and minimize face-to-face interviews during pandemic conditions. Recall bias from self-reporting of exposure and outcomes may influence odds ratios among participants who believe that occupation is the primary contributor to their menstrual disorders. The cross-sectional design of our study in unable to provide a causal relationship. Personal factors such as sleep and obesity, which may also be related to menstrual disorders, were not investigated.

CONCLUSION

Menstrual disorders are a significant indicator of existing and potential health problems. Therefore, it is necessary to evaluate factors related to menstrual disorders in order to determine the necessary strategies for prevention and treatment. Our study revealed that occupational exposures may increase the risk of menstrual disorders. The underlying mechanisms of menstrual disorders due to occupational exposures are still unclear. The results of our study demonstrate the need for further research in this field in order to reduce the negative effects of menstrual disorders among female healthcare workers in Turkey and worldwide. A plan of action is needed to reduce the frequency of menstrual disorders by preventing occupational exposures experienced by healthcare workers.

Authors' Contribution

Study Conception: NG, SK; Study Design: NG, SK; Supervision: NG, SK; Funding: N/A; Materials: NG, SK; Data Collection and/or Processing: NG, SK; Statistical Analysis and/or Data Interpretation: NG, SK; Literature Review: NG, SK; Manuscript Preparation: NG, SK and Critical Review: NG, SK.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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