Menstrual characteristics and night work among nurses

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Abstract: Night work has been associated with adverse effects in terms of reproductive health. Specifically, menstruation has been suggested to be negatively impacted by night work, which again may influence fertility. This study investigated whether working nights is related to menstrual characteristics and if there is a relationship between shift work disorder (SWD) and menstruation. The study was cross-sectional, response rate 38%. The sample comprised female nurses who were members of the Norwegian Nurses Association; below 50 yr of age, who were not pregnant, did not use hormonal pills or intrauterine devices and who had not reached menopause (n=766). The nurses answered a postal survey including questions about night work and menstrual characteristics. Fifteen per cent reported to have irregular menstruations. Thirty-nine per cent of the nurses were classified as having SWD. Logistic regression analyses concerning the relationship between irregular menstruations and night work did not show any associations. Furthermore, no associations were found between cycle length or bleeding period and night work parameters. No associations were found between menstrual characteristics and SWD.

Key words: Menstruation, Menstrual irregularities, Night work, Nurses, Shift work

Introduction

Menstrual cycle characteristics have been shown to have implications for the fecundability of women[1–3]. The menstrual cycle is a hormonally controlled process, and previous studies show that the cycle might be influenced by a variety of factors, especially environmental stress-

ors[4]. One such stressor is shift work, and numerous studies have shown that shift work is associated with a variety of negative health effects[5–10]. A recent meta-analysis identified shift work as a risk factor for preterm delivery; however shift work was neither related to small for gestational age nor to birth weight[11]. However, very few studies have investigated the relationship between shift work and menstrual cycles. With an increasing number of women in the work force of most countries, and with an increase in shift work more information on this topic is warranted.

Most studies concerning menstrual cycles and shift work have examined nurses. A study among nurses from

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Taiwan, using questionnaire and diaries to obtain information, indicated that nurses working night shifts had shorter menstrual cycles than nurses without night work[12]. In another study from Taiwan, body temperature was measured daily in 151 nurses to study the ovarian cycle. It was concluded that working rotating shifts was related to an irregular ovarian cycle pattern[13]. A cross-sectional study among 71,077 nurses from US showed an association between rotating shift work and extremely short (<21 d) or extremely long cycles (51+ d)[14]. Although the studies do indicate an adverse effect of shift work on menstrual cycles, the studies are few, and more studies are needed from more research groups and countries before the results can be used to influence the working schedules for women.

The mechanisms by which shift work could affect reproduction and menstrual periods are elusive. Hormonal disturbances might play a role. It has been hypothesised that disruption of the circadian rhythm, which often takes place when working nights, may interfere with the hormonal cycles and may cause disruption of the menstrual cycle[15]. In the light of this hypothesis, it seems relevant to focus upon night work as the most important exposure factor, not the different types of shift schedules. However, previous studies in this area have typically used shift schedule as the exposure variable, instead of the number of night shifts.

It has further been suggested that sleep disturbances, like curtailed sleep and insomnia, might be related to changes in menstruations[16]. Some shift workers develop shift work disorder (SWD). The diagnosis of SWD, defined by the International Classification of Sleep Disorders-2[17], is based on criteria including complaints of insomnia or excessive sleepiness temporally associated with a recurring work schedule that overlaps the usual time for sleep. Relatively few prevalence studies of SWD exist and in those the prevalence ranges from 10 to 44%[18–21]. The relationship between SWD and menstruation has to our knowledge not been examined previously, but seems relevant to consider if an association between night work and menstrual irregularities exists. It can be hypothesised that employees with SWD more easily develop menstrual disturbances.

In a population of nurses, this study investigated the association between working nights and menstrual characteristics and also the association between SWD and menstruation.

Subjects and Methods

The data used in this study was obtained from "The Survey of Sleep, Shift work and Health" (SUSSH), a study focusing on sleep, shift work and several different aspects of health[20]. The data collection took part in the period December 2008 to March 2009 among nurses in Norway. The study design was cross-sectional. The population consisted of registered members of the Norwegian Nurses Organisation (NNO), which includes most of the nurses working in Norway today. A survey frame (N=6,000) comprising a total of five strata, each containing 1,200 nurses registered as holding at least a 50% work position was randomly selected from the member register of the NNO. The criteria for the different strata were time elapsed since graduation, in this case 0–11 months (stratum 1), 1–3 yr (stratum 2), 3.1–6 yr (stratum 3), 6.1–9 yr (stratum 4) and 9.1–12 yr (stratum 5). Older nurses were not included, as the sample was planned to form a cohort for future studies. Each nurse in the sample received a questionnaire by postal mail. After completion of the questionnaire the respondents could return them in a pre-paid envelope. Reminders were sent out twice, once in December 2008 and once in February 2009. An internet based version of the questionnaire was available for those who preferred to complete an online version of the questionnaire. A total of 600 letters were returned due to wrong addresses. Hence, the survey sample consisted of 5,400 nurses. A total of 2,058 nurses completed and returned the questionnaire, yielding a response rate of 38.0%. Only 22 responded via internet.

In the present study, the following participants were excluded: Male nurses (n=189), female nurses above 50 yr (n=128), nurses who did not have menstruation at all (n=168), pregnant nurses (n=127) and nurses using hormonal pills or intrauterine devices as contraceptives (n=680). This left us with a study sample of 766.

Questionnaire

Questions were asked about age, percentage of full time equivalent, smoking (yes/no), consumption of caffeine (cups of coffee, tea or cola daily) as well as for alcohol consumption (categories; never, monthly, 2–4 times per month, 2–3 times per week, more than four times per week and daily), height and weight (calculated to body mass index, BMI) and the type of shift schedule (three-shift schedule, day only, evening only, night only, day and evening only and other). In addition we asked if the nurse had ever been working nights, the number of years

of work periods including night shifts summarized for the whole life in five categories (less than 1 yr, 1–2 yr, 3–5 yr, 6–9 yr and above 10 yr) and how many nights the nurse had worked the past 12 months.

Based on the three questions regarding night shift work, three measures of exposure to night work were used:

a) Night work now or earlier (yes/no).

b) Number of years of work periods including night shifts summarized for the whole life. Three categories were constructed based on the five response alternatives in the questionnaire, as there were few who ticked off in two of the categories. The final categories used were: Less than 3 yr, 3–9 yr and above 9 yr.

c) Number of nights worked the past 12 months (two categories were used; 0–20 and above 20, as the median number of nights worked was 20).

The expression 'night work' was not defined in the questionnaire. However, the Norwegian Work Environment Act defines night work as work performed between nine o'clock in the evening and six o'clock in the morning.

Questions about menstruations were adapted from a menstrual distress questionnaire[22]. We asked "If your menstrual cycles are very irregular, cross here". The expression 'irregular' was not defined in the questionnaire. We also asked "How long do your menstrual periods normally last?" and "How long is the period between each menstrual period normally (counting from the last bleeding day to the first)? Based on these questions, three measures of menstrual cycles were used:

a) Irregular menstrual cycles (yes/no).

b) Cycle length (sum of days of duration of the bleeding period and days between two cycles). This variable was divided into three categories during data processing; below 25 d, 25–34 d and above 34 d. In the analyses, 25–34 d was used as a reference; as normal cycle length (23). As the number of persons with cycles below 25 d was low, these persons were excluded from the analyses of the association between cycle length and night work, and only two categories of cycle length were used in the final analyses (reference category and the category above 34 d).

c) Duration of the bleeding period. This variable was divided into three categories during data processing; below 5 d, 5–6 d and above 6 d due to the distribution of responses (20%, 60% and 20%, respectively). The length of 5–6 d was used as a reference in the analyses of the association between bleeding period and night work.

Based on the minimal criteria from the Diagnostic and Coding Manual from the International Classification of Sleep Disorders-2[17, 19], three questions were specifically developed in order to make a diagnosis of SWD: 1) Do you experience either difficulties sleeping or experience excessive sleepiness? (yes or no), 2) Is the sleep or sleepiness problem related to the work schedule that makes you work when you normally would sleep? (yes or no), 3) Have you had this sleep or sleepiness problem related to the work schedule for at least one month? (yes or no). Subjects were classified as having SWD if they endorsed all three questions[17, 19].

Ethical considerations

This study was approved by the Regional Committee for Medical and Health Research Ethics, West Norway (REK-West; 088.08). Confidentiality was guaranteed throughout the research process, and all respondents provided written consent to participate in the study.

Statistics

Descriptive statistics were presented as mean value, standard deviation (SD), median as well as percentages for background variables and the menstrual characteristics.

Logistic regression analyses were used to examine the relationship between irregular menstrual cycles, menstrual cycle length, and night work exposure measure and SWD, odds ratios (OR) with 95% confidence interval (CI) were calculated. Evaluations of the relationship between the duration of bleeding period (in categories), and exposure measures and SWD were performed using multinomial logistic regression analyses. The variables age, BMI, alcohol consumption, cups of coffee/tea/cola daily and current smoking were adjusted for in the regression analyses, as these factors might influence menstrual regularity[23–25]. Additional regression analyses were performed using continuous variables for years in night work and number of night shifts the past year, instead of the categorical variables.

Some of the participants had not answered all questions in the questionnaire. The lack of response was counted as "missing" and the numbers of missing responses are given in the tables.

The data were analysed using IBM SPSS Statistics, version 21. The significance level was set to 0.05.

Results

The mean age of the 766 participating nurses was 33 yr, range 21–50 (Table 1). About half of the nurses worked more than 90% full time equivalent. Ten per cent were daily smokers (Table 1). The present work schedule was

Table 1. Description of baseline information and night work in a study population of nurses (n=766)

Variable	Mean (SD)	median (min–max)
Age (yr)	33 (7)	31 (22–50)
Body mass index	24 (4)	23 (17–50)
Cups of coffee/tea/cola daily	3.0 (2.5)	3.0 (0–20)
Number of nights worked the past 12 months	28 (28)	20 (0–200)
	n (%)	
Work week (% of full time)[1]		
< 50	25 (4)	
50–75	204 (29)	
76–90	113 (16)	
>90	360 (51)	
	n (%)	
Daily smokers	67 (9)	
Alcohol consumption[2]		
Never	86 (11)	
Less than once a month	195 (26)	
Once a month	149 (19)	
2–3 times a month	167 (22)	
Once a week	111 (15)	
2–4 times a week	56 (7)	
Daily	0	
Ever worked night shift (yes)	662 (86)	
Total period of working night shifts[3]		
<2 yr	231 (30)	
3–9 yr	365 (48)	
>10 yr	67 (9)	
Shift work disorder (yes)[4]	287 (39)	

Persons not answered the question: [1]64, [2]12; [3]103, [4]17. SD: standard deviation

Table 2. Description of menstrual characteristics among 766 nurses

Variable	Mean (SD)	median (min–max)
Days duration of bleeding period[1]	5.5 (1.4)	5.0 (2–12)
Days between bleeding periods[2]	26.5 (4.8)	27.0 (10–60)
Days of menstrual cycle length	31.9 (4.9)	32.0 (20–68)
	n (%)	
Cycle length[2]		
≤24 d	15 (2)	
25–34 d	578 (81)	
>34 d	120 (17)	
Duration of bleeding period[3]		
< 5 d	146 (19)	
5–6 d	451 (60)	
>6 d	149 (20)	
Irregular menstruation (yes)	115 (15)	

Persons not answered the question: [1]13, [2]53, [3]13. SD: standard deviation

three-shift schedule for 56%, day only for 7%, evening only for 0.5%, night only for 9%, day and evening only for 24%, whereas 3.5% had different other schedules.

Eighty-six per cent had ever been working night shifts, and 9% had been working night shifts for more than nine years. Eighty per cent had been working night shifts the past year, and the mean number of nights worked the past 12 months was 28 (Table 1). Thirty-nine per cent of the nurses were classified as having SWD (Table 1). The median duration of the menstrual period was five days, and the median cycle length was 32 d (Table 2). Fifteen per cent reported to have irregular menstruations.

Logistic regression analyses of the relationship between irregular menstruations and the three measures of night work (night work ever, years of night work and number of night shifts the past year) did not show any significant associations between the parameters (Table 3). The results from the regression analyses revealed no associations between cycle length above 34 d and the night work parameters (Table 3). Also, no association was found between duration of neither bleeding period below five days nor bleeding period above six days and night work (Table 3). Table 3 shows crude results from the analyses. Including BMI, alcohol consumption, cups of coffee/tea/cola and current smoking in the models did not change the results (adjusted data not shown).

Analyses of years of night work and irregular menstrual cycles, cycle length and duration of bleeding period were also performed with years of night work as a continuous variable (data not shown). The results were similar as when using categorical variables, with no significant associations. Also, analyses of number of night shifts the past year and irregular menstrual cycles, cycle length and duration of bleeding period were performed with number of night shifts as a continuous variable. No significant associations were found in these analyses either (data not shown).

There was no association between irregular menstruations and SWD (Table 3), and between cycle length, length of the bleeding period and SWD, neither for crude values (Table 3) nor when including BMI, alcohol consumption, cups of coffee/tea/cola and current smoking in the adjusted analyses (adjusted data not shown).

Discussion

In the present study, no associations were found between night work and menstrual cycle length or menstrual regularity among nurses. Similar studies relating night

Table 3.   The relationship of various menstrual characteristics and different measures of night work as well as shift work disorder (SWD); odds ratios (OR) with corresponding 95% confidence intervals (CI)

Exposure variables	Irregular menstrual cycles (yes/no)[1]		Menstrual cycle length >34 d[2]		Duration of bleeding period			
					<5 d		>6 d[3]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Night work ever (n=663)								
No	Ref		Ref		Ref		Ref	
Yes	1.0	0.5–1.8	1.4	0.7–2.6	0.7	0.5–1.2	0.8	0.5–1.2
Years of night work (n=663)								
Less than 3 yr	Ref		Ref		Ref		Ref	
3–9 yr	1.2	0.6–2.7	0.7	0.4–1.4	1.0	0.5–1.7	1.1	0.5–1.7
More than 9 yr	1.1	0.5–2.3	1.1	0.5–2.2	1.0	0.6–1.9	1.1	0.7–1.9
Number of night shifts the past year (n=759)								
0–20	Ref		Ref		Ref		Ref	
More than 20	1.3	0.9–2.0	1.0	0.9–1.0	0.8	0.6–1.2	0.9	0.7–1.2
SWD (n=561)								
No	Ref		Ref		Ref		Ref	
Yes	1.3	0.9–2.0	0.4	0.0–3.4	1.5	0.4–5.6	0.7	0.3–1.6

[1]OR estimated by logistic regression. [2]OR estimated by logistic regression, reference category represented by menstrual cycle length 25–34 d (15 persons with cycle length ≤24 d were excluded in this analysis). [3]OR estimated using multinomial logistic regression, reference category represented by duration of bleeding period 5–6 d.

work to menstruations have not been found. Other studies concerning shift work and reproductive health, using different methods as well as different measures for shift work show other results than ours. Short menstrual cycles were suggested to be related to night work among nurses from Taiwan[12], but only twelve nurses working nights participated in that study. Another study from Taiwan concluded that 53% of nurses working rotating shifts exhibited irregular ovarian cycle pattern[11]. Also in that study the number of "exposed" nurses was low, only 50 nurses in the study worked rotating shift. That study also included 29 nurses working evening or night shift only, but there was no specific ovarian cycle irregularities found related to this group. A cross-sectional study among 71,077 nurses from US showed an association between rotating shifts and menstrual cycle lengths in a regression model with age-adjustment[13]. However, when the authors of this US study performed the analyses excluding all nurses who worked permanent night shifts (7,639), they found a similar association between rotating shift and cycle lengths as when the night workers were included[14]. This might indicate that the cycle characteristics were associated to factors related to the rotating shift work schedule, not the night work specifically. Neither information about number of nights worked, number of years, nor ever working nights were registered. The results are therefore difficult to compare to our findings. Another US study suggested that

sleep disturbances may lead to menstrual irregularities[16]. That study was small, only 68 nurses participated. Thirty-six of the nurses reported to have menstrual changes related to shift work, like variations in menstruation cycle length. These nurses reported more sleep disturbances than the others. However, the study did not define sleep disturbances, and did not use a SWD diagnosis as in the present study, thus neither that study is comparable to the present one.

In general, there are few studies regarding shift work and menstruation. This might be caused by a lack of interest concerning this topic in occupational health, but can also be a result of publication bias. Previous negative studies might not have been published. Also, the findings from the aforementioned studies are not clearly conclusive. It is not obvious that there really is a relationship between night work and menstrual irregularities. Also, if an association should be present related to any shift work schedule, it has not been shown that this is related to night work specifically. It has been speculated that the relationship between shift work and reduced fecundity, estimated by time to pregnancy, might be an artefact[26]. Our present study is in line with such suggestions.

An asset of the present study concerns the information about menstruations, obtained from the nurses themselves. In Norway, little information on menstruation irregularities is found in health registers. Therefore, self-report is a

good method for obtaining information about this topic. Questionnaires, like the ones used in the present study, also make it possible to obtain data on background, work situation, and life-style. On the other hand, it is a weakness that the study did not include objective data, like for instance regarding sleep. However, we have used a definition of SWD which is built on an international definition[17], which has been operationalized in the same way as in the present study in several previous studies[19, 27]. A weakness with the present questionnaire is the lack of historical data on reproductive health and use of hormonal pills. Some nurses may have used such pills to reduce the problem with irregular menstruations, which may have reduced the prevalence of such problems in the present population. This may, for instance, have contributed to a low number of nurses reporting short menstrual cycle length (below 25 d). Due to this, the present study cannot provide information about the association between short cycles and night work.

A general disadvantage with postal surveys is the risk of low response rates, which was evident in the present study at baseline. Our study distributed the questionnaire all over the country, recruiting participants by postal mail only. A different approach for recruitment might have improved the response rate[28].

The presence of a recall bias cannot be ruled out, especially for the life-time data[29]. The reported duration of menstruation periods and cycle length, show similar figures as in other studies of menstrual cycle characteristics[30], which suggest that the obtained information is valid.

It is difficult to know if the results from the present study are valid for other nursing populations. Nurses in other countries may have other schedules with less time for restitution. Also, a "healthy worker effect" cannot be ruled out. Nurses experiencing reproductive problems might avoid shift work and they can actually be advised by medical personnel to engage in other types of jobs. The low response rate at baseline may have caused an additional selection effect. However, it is not possible to know if the participating nurses had more or less menstrual problems than the non-responders. This project was a part of a large study on shift work and health, and reproduction was only one variable among many. Thus, it is not likely that nurses responding to the study were selected mainly due to reproductive problems. Also, as we sought to find associations between night work and the menstruations, not prevalence figures, the response rate was of less importance.

In conclusion, our study did not show any association between night work and menstrual irregularities or menstrual cycle length. Moreover, we did not find any association between SWD and menstrual irregularities. As there are few studies of this type, we suggest that similar studies should be performed in other countries as well, both among nurses and other occupational groups, preferably with a longitudinal study design and larger numbers of participants. Also, it must be underlined that the present study was designed to investigate the associations between night work and menstrual cycle characteristics, and further studies are needed to confirm whether different shift work schedules (e.g. rotating shift work) are related to menstrual cycle length or irregular menstrual cycles.

Acknowledgements

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