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Shift work sleep disorders and associated factors among nurses at federal government hospitals in Ethiopia: a cross-sectional study

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ABSTRACT

Objective The current study was conducted to assess the prevalence and associated factors of shift work sleep disorder among nurses working at Ethiopian federal government hospitals in Addis Ababa.

Methods An institutional-based, cross-sectional study was conducted from April to June 2018 using self-administered structured questionnaires. Computer-generated simple random sampling technique was used to select a total of 422 nurses as study participants. The International Classification of Sleep Disorders - Third Edition, Bargen Insomnia Scale and/or Epworth Sleepiness Scale were used to measure the outcome shift work sleep disorder. Descriptive statistics and bivariate and multivariate binary logistic regression were used. OR with 95% CI was used to measure the strength of association, and a p value <0.05 was considered statistically significant in multivariate analysis.

Results About a quarter (25.6%) of the study participants have shift work sleep disorder. The average number of nights per month for the last 1 year (adjusted OR=6.3, 95% CI 3.513 to 12.35) and working in three-shift rotation (adjusted OR=3.1, 95% CI 1.68 to 5.83) were significantly associated with shift work sleep disorder.

Conclusion A quarter of shift worker nurses are suffering from shift work sleep disorder. The number of nights on average per month for the last 1 year and working in three-shift rotation were significantly associated with shift work sleep disorder. Shift working conditions should be improved to provide less stressful conditions for nurses, ensuring at the same time an appropriate quality of care over a 24-hour period. More studies are necessary to better highlight the burden of shift work on the health and well-being of both nurses and patients.

BACKGROUND

The National Sleep Foundation defines shift work as a work that takes place on a schedule outside the traditional 09:00–17:00 daily. It can involve evening or night shifts, early morning shifts, and rotating shifts. It also defines shift work sleep disorder (SWSD) as a chronic condition that is directly related to a person's work schedule. SWSD is considered

Strengths and limitations of this study

► This study uses three distinct tools, that is, the International Classification of Sleep Disorders - Third Edition, Bargen Insomnia Scale and/or Epworth Sleepiness Scale, to measure the outcome shift work sleep disorder and determine relatively the true prevalence.
► Tools were well validated and facilitated approximating the prevalence of symptoms-based shift work sleep disorder.
► Assessment was not used to minimise recall bias.
► The major limitation is the nature of the study design, which cannot establish a temporal relationship between the predictors and the outcome variable, and cannot perform clinical interviews, actigraphic assessment or administer sleep diaries.

a 'circadian rhythm sleep disorder' by the International Classification of Sleep Disorders - Third Edition (ICSD-3). A circadian rhythm is an oscillating biological rhythm that changes every 24 hours.[1 2] Shift work is a term that refers to a broad range of non-standard work schedules, ranging from occasional on-call overnight duty, to rotating timetables, to stable, permanent night work, and to programmes demanding an early awakening from nocturnal sleep.[3] Misalignment between core circadian physiology and the necessary work schedule is thought to be a primary cause of shift work schedule-induced sleepiness and sleep disruption.[4]

Results of studies indicated that a huge number of nurses engaged in shift works were found to be affected by shift work-related sleep disorders. Studies conducted in Norway found that 32.4%–37.6% met the minimal criteria for SWSD. Another study conducted in New York on 3345 individuals reported that 40% of employees on fixed night and rotating shifts were most likely to

sleep less than 6 hours, and 20% of workers exhibited excessive daytime sleepiness in circumstances requiring high attention.[5] A study in Brazil among intensive care unit nurses showed that 59% among evening shift workers complained of severe sleeplessness and 42% reported insomnia.[6] The prevalence of sleep disturbance among the nurses of Imam Khomeini Hospital in Tehran was 87.7%.[7] A census report on 2000 nurses in Norway reported that 14% of nurses working in rotation and 10% of night shift working nurses had a true SWSD.[8]

A number of factors were found to affect SWSD. It was indicated that age, night work, number of shifts separated by less than 11 hours of time off, number of nights worked over the last 12 months and insomnia were positively associated, whereas flexibility and gender remained negatively associated.[9] The average daily sleep hours for nurses working on morning, afternoon and night shifts were 6.99, 6.79 and 4.66 hours, respectively. The middling sleep hours in nurses working on night shifts were meaningfully less than other nurses. There was no significant difference between nurses' sleep problems in the two-shift or three-shift schedule. However, sleep quality among nurses with fixed working hours was better than nurses with a rotating shift.[8]

A meta-analysis from the Netherlands reports caffeine, a well-known antagonist of adenosinergic receptors, can be used successfully to modulate our mental state. Caffeine is found to be beneficial in restoring low levels of wakefulness and to counteract deteriorations in task performance related to sleep scarcity. However, the study also indicates that caffeine may produce harmful effects on the following sleep, resulting in daytime sleepiness.[10] A systematic review of 24 studies, 13 for non-shift and 11 for shift Japanese workers, reported that alcohol or medication use aids in inducing sleep, and that smoking was suggested as the usually accepted risk factor for insomnia and sleepiness in some nurses.[11] Italian studies report that nurses working in rotating night shift more frequently present sleep disorders in comparison with day shift workers.[12] In particular, counter-clockwise rotating shift schedule seems to be characterised by higher sleep disturbances.[13] A simulation study on eight men in Italy noted additional benefit in the ability to stay alert during the night shift, but an experimental study conducted in the USA saw no changes in manifest sleepiness after triazolam administration for 15 shift workers. These divergent findings may represent different effects on these two dimensions of sleepiness.[14 15]

One cross-sectional study among 895 shift worker nurses and then a meta-analysis from the USA report that nurses who worked on prolonged shifts (≥12.5 hours) experience trouble staying awake at work at almost one of every three shifts worked, compared with nurses who worked less than 12.5 hours.[16 17] It is also known that rapidly rotating shift is a risk factor that can lead to SWSD.[18]

The diagnosis of SWSD apparently applies to a subset of shift workers who meet the ICSD-3 diagnostic criteria.[19] Previous studies have identified many adverse health problems associated with long-standing participation in shift work schedules. These included the higher risk of anxiety, depression, insomnia, chronic fatigue, as well as different cardiovascular and gastrointestinal disorders.[20] Studies highlighted that shift work was associated with increased risk for obesity, diabetes and cardiovascular diseases as a result of disruption in the circadian rhythm.[21] In particular, sleep alteration could negatively affect the expression of circadian genes, which eventually leads to impaired β cell failure and insulin resistance.[22] Moreover, in accordance with some recent studies, circadian misalignment can deteriorate cognitive performance in chronic shift workers[23] and increase the rate of depressive symptoms in nurses working night shifts.[24]

Nursing overtime, both mandatory and voluntary, is prevalent in the healthcare industry as a solution for managing staff shortages and high census episodes. There is sufficient evidence on the negative impact of this practice on nurses' personal wellness and risk for workplace injury, patient outcomes, and nursing turnover to warrant the continued attention of policymakers.[25] Although shift working is a rapidly growing system in African and Ethiopian hospitals, there is no study that determines the prevalence of SWSD and its associated factors. Therefore, the current study was conducted to contribute data on this issue.

METHODS

Study design and setting

An institutional-based, cross-sectional study was conducted from April to May 2018. The study was conducted in federal hospitals in the capital city of Ethiopia. These include St Paul's Hospital Millennium Medical College, St Peter TB Specialized Hospital and Amanuel Mental Specialized Hospital. A total of 746 nurses work in these three federal hospitals.

Selection of study participants

Study participants were selected using single population proportion formula assuming that 50% of nurses might suffer from SWSD at 95% CI, 5% margin of error and adding 10% non-response rate. A total of 423 nurses were proportionally selected from the three hospitals. Computer-generated simple random sampling method was employed to select nurses. Nurses with diagnoses of any types of sleep disorder and working in a standard day or night programme were excluded.

Patient and public involvement

No patients were involved.

Instruments

This study employs three questions previously developed and used specifically to assess/diagnose SWSD in epidemiological studies.[26] These questions adhere to the symptoms/criteria listed in the ICSD-3: (1) Do you experience difficulties with sleeping or excessive sleepiness? (yes/

no); (2) Is the sleep or sleepiness problem related to a work schedule where you have to work when you would normally sleep? (yes/no); (3) Has this sleep or sleepiness problem related to your work schedule persisted for at least three months? (yes/no). Respondents had to answer 'yes' to all three questions in order to fulfil the criteria for shift work sleep disorder caseness.[27] Tools to assess insomnia and sleepiness were included. The Bargen Insomnia Scale (BIS) is a self-administered insomnia scale with symptom-related questions based on the American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders-IV-text revision (DSM-IV-TR).[28] The scale has six items which are scored along an 8-point scale indicating the number of days per week for which a specific symptom is experienced (0–7 days, total scores ranging from 0 to 42). Scoring 3 or more on at least one of items 1–4, and 3 or more on at least one of items 5 and 6, of the BIS was considered as having insomnia. The scale has been validated and has a Cronbach's alpha ranging from 0.79 to 0.87.[29] The Cronbach's alpha for the BIS was 0.89 in the current study. The Epworth Sleepiness Scale (ESS) describes eight situations, and respondents estimate the likelihood of dozing off in each of these situations using a 4-point scale, ranging from 0=would never doze to 3=a high chance of dozing. The total score can range from 0 to 24. The ESS score (clinical cut-off ≥11) has been shown to allow for distinctions to be made between patients with various sleep disorders and healthy subjects. The tool has good reliability, including in Ethiopia (Cronbach's alpha=0.75).[30] The Cronbach's alpha for the ESS was 0.784 in the current study. Fulfilling the criteria of ICSD-3 and BIS and/or ESS was declared as having SWSD in this study.

Independent variables
Sociodemographic factors.
► Age.
► Sex.
► Religion.
► Marital status.
► Number of children.
► Ethnicity.
► Childhood residence.
► Department.
► Income.
► Level of education.
Insomnia.
Excessive daytime sleepiness.
Substance-related factors.
► Alcohol.
► Khat.
► Cigarette.
► Caffeine
► Others.
Shift work-related factors.
► Length of night shift.
► Number of shift per day.
► Number of night shift per month.

► Nap.
Clinical factors.
► Family history of mental illness.
► History of mental illness.
► Chronic medical illness.
Sleep medication-related factor.
► Prescribed sleep pill use.
► Non-prescribed sleep pill use.
► Use of prescribed and non-prescribed sleep injectable sleep medication.

Data quality control
To produce quality data, the study used validated assessment tools and in local language. Data collectors were trained on assessment tools and how to collect data using the tools. Pretest was done before the actual study on 5% of the people who had similar characteristics with the study participants. Data obtained from the pretest were not included in the main study. Data were also double-entered in SPSS version 23 and were checked and corrected before statistical analysis.

Statistical analysis
Descriptive statistics, bivariate analysis and multivariate binary logistic regression were used. Sociodemographic characteristics of respondents were analysed by descriptive statistics (percentage, mean SD). Bivariate analysis was used to see the association between the dependent variable (SWSD) and independent variable. Variables whose p value was <0.05 were entered into multivariate binary logistic regression using the default enter method to control for confounding factors. Significance was declared at p value <0.05. To determine an association between dependent and independent variables, adjusted ORs (AORs) at 95% CI were declared statistically significant. Results were presented in tables using frequency and summary statistics such as mean and percentage to describe the study population in relation to relative variables, and were discussed with previous results.

RESULTS
Sociodemographic characteristics
From a total of 423 respondents, the response rate was 94% (N=399). The mean age of the respondents was 27.48 (SD±5.6) years and ranges from 20 to 58 years. Nearly half of the participants (209, 52.5%) were included in the 22–33 years age group. About 217 (54%) of the study participants were female. About 240 (60%) of the participants reported that they grew up in urban areas. Majority of the participants (257, 64.4%) were single, 221 (55.1%) were orthodox followers and about 172 (43.1%) were Amhara by ethnicity. With regard to their educational status, most of the participants were degree holders. About 44 (11%) of the participants reported that they have had one child. About a quarter (98, 24.6%) of nurses are working at the medical ward, 73 (18%) at the surgical ward and 41 (10%) at the psychiatric ward (table 1).

Table 1 Sociodemographic characteristics of shift worker nurses working at federal government hospitals in Addis Ababa, Ethiopia, 2018 (N=399)

Variables	Categories	Frequency	Percentage
Age	20–24	112	28.1
	25–29	209	52.4
	>29	78	19.5
Sex	Male	182	45.6
	Female	217	54.4
Ethnicity	Amhara	172	43.1
	Oromo	106	26.6
	Tigre	61	15.3
	Gurage	56	14
	Others*	4	1
Religion	Orthodox	221	55.1
	Muslim	61	15.3
	Protestant	106	26.6
	Other†	12	3
Marital status	Ever married	142	35.6
	Never married	257	64.4
Number of children	One child	44	11
	Two children	40	10
	Three and more children	28	7
Educational status	Diploma	38	9.5
	Degree	349	87.5
	Master's	12	3
Department	Psychiatry	41	10.3
	Medical	98	24.6
	Surgical	73	18.3
	Gynaecology/ Obstetrics	38	9.5
	Paediatrics	28	7.0
	Intensive care unit	46	11.5
	Emergency	36	9.0
	Toxicology	22	5.5
	Others‡	17	4.3

*Affar, Ethio Somalia.
†catholic, gohva witness.
‡Liaison, dialysis and orthopaedics.

Most of the shift worker nurses (280, 70.2%) were working in a two-shift working programme, and the majority of the respondents (275, 68.9%) worked for >12 hours on a single night shift. Most of the participants (307, 77%) were working 8–11 days night shift per month, and most of the night worker nurses (318, 79.7%) take a nap during their night shift. Most (88, 86.3%) of the shift worker nurses who have SWSD take a nap during their night shift (table 2).

Few respondents (25, 6.3%) were reported to have known chronic medical illness, and only 14 (3.3%) were reported to have previously diagnosed mental illness on follow-up. About 14 (3.5%) of the respondents reported a history of mental illness, whereas 12 (3%) reported a family history of mental illness.

About 49 (12.3%) of the participants use sleep medication which is prescribed by a physician, whereas almost the same number of nurses use sleep medication without the order of a physician. About 334 (83.7%) of the participants drink caffeine at least once a day, and about 105 (26.3%) reported use of alcohol within the last 1 month. Within the last 1 month, 43 (10.8%) of the respondents reported khat use and 28 (7%) reported smoking a cigarette.

The prevalence of SWSD among shift worker nurses was 25.6% (n=102) (95% CI 21.6 to 30.3) (figure 1). Nearly half of the shift worker nurses experience difficulties with sleeping or excessive sleepiness (196, 49.1%). About 134 (33%) and 108 (28.8%) of the shift worker nurses reported sleep or sleepiness problem related to work schedule, and the sleep or sleepiness problem related to work schedule persisted for at least 3 months, respectively (figure 2). Nearly half (193, 48.1%) of the respondents reported insomnia, and about a quarter (115, 28.6%) of the shift worker nurses also reported daytime excessive sleepiness. About 83 (20.8%) of the participants reported both daytime sleepiness and insomnia. From participants who reported daytime sleepiness, 47 (46.1%) fulfilled the criteria for SWSD. Similarly, from respondents who reported insomnia, 82 (80.4%) met the criteria for SWSD.

Crude binary logistic regression analyses (table 3) showed a significant relation between SWSD, having known medical illness, having known mental illness, working in three shifts, working >11 days on average over 1 year, >12.5 hours length of night shift, use of non-prescribed sleep medications, use of injectable sleep medications, ever use of khat and ever use of tobacco. According to the adjusted analysis (table 3), SWSD was associated with the number of nights on average per month for the last 1 year and working in three-shift rotation.

DISCUSSION

The prevalence of SWSD among shift worker nurses was 25.6% (n=102) (95% CI 21.6 to 30.3). The finding of the current study was similar to a study carried out in Sweden with a prevalence of 23.3% among oil rig workers.[26] However, the finding of the current study was lower than the prevalence in studies done in Iran (87.7%),[8] Brazil (42%),[7] USA (40%)[6] and Norway (10%).[9] The possible reasons for this difference might include study design, study setting, study population and assessment tools used to screen SWSD. For example, studies done in Iran and Brazil used the Pittsburgh Sleep Quality Questionnaire to assess the prevalence of SWSD,[7 8] whereas the study

Table 2 Shift work characteristics of shift worker nurses working at federal government hospitals in Addis Ababa, Ethiopia, 2018 (N=399)

Variable	Categories	Frequency	Percentage	SWSD
Frequency of rotation per day	Two shifts	280	70.2	60 (58.8)
	Three shifts	119	29.8	42 (41.2)
Length of night shift in a time	<9 hours	23	5.8	0
	9–12 hours	101	25.3	22 (21.6%)
	>12 hours	275	68.9	80 (79.4%)
Number of night shift per month	<7 days	44	11	6 (5.9%)
	8–11 days	307	77	64 (62.7%)
	>11 days	48	12	32 (31.4%)
Taking a nap	Yes	318	79.7	88 (86.3%)
	No	81	20.3	12 (13.7%)

SWSD, shift work sleep disorder.

from USA used sleep logs, actigraphy and the Morningness-Eveningness Questionnaire.[6] Differences in study population could also have contributed to the discrepancy. For example, nurses working only in intensive care units were included in the Brazil study, while the current study includes nurses from all departments.[7] A study done in Norway which reported a lower prevalence than the current study used a very restricted measurement and a larger sample size (N=2597). It assessed sleepiness using the ESS (cut-off of 0.13) and insomnia using symptom-based questions. The prevalence was calculated as the difference in prevalence between shift and day workers. The study used the ICSD-2 criteria and the DSM-IV functional disability criteria for circadian rhythm sleep disorder shift work type.[9] According to the ICSD-2, SWSD symptoms should not be better accounted for by other diagnoses/health issues which may affect sleep. Thus, having other health issues or sleep disorders does not imply that one may not also suffer from SWSD. According to the ICSD, sleep disorders can be diagnosed usually by history. The symptom questions specifically ask whether individuals experience these symptoms in

relation to their work schedule. These are the same questions a clinician would ask in a clinical assessment.

The assessment of factors associated with SWSD found that the number of nights on average per month for the last year was significantly associated with SWSD. This finding is consistent with a study done in South Korea which assessed shift work tolerance among rotating shift worker nurses.[31] Participants working >11 days night shifts per month were 6.3 times more likely to develop SWSD as compared with respondents working ≤11 number of night shift per month (AOR=6.3, 95% CI 3.5 to 12.35). The possible reason might be that a shorter length of off-time leads to reduced sleep duration and may end up with circadian sleep disorder shift work type. While night work in itself does not necessarily limit nurses' time to rest, a frequent night shift by itself restricts nurses' opportunity for sleep and may spend many times for non-work activity in between nights.[31] The rotating type of shift work is found to be significantly associated with SWSD. This finding is consistent with a report on the revision of ICSD-3 in the USA.[18] Rotating shifts are often associated with shorter-than-normal and disrupted sleep periods at an adverse circadian phase. Rotating shifts, including night shifts, can cause changes in the secretion of hormones as shift work has a significant correlation with the serum levels of the thyroid hormone and prolactin. Thus, long night-time working hours and the resulting interference with circadian rhythms are associated with the occurrence of shift work disorder among nurses on rapid rotation schedules. In the current study, the odds of developing SWSD among respondents who work in three-shift schedule were 3.1 times higher as compared with working in two-shift schedule (AOR=3.1, 95% CI 1.68 to 5.83). This finding was against many other studies which found no associations. The possible reasons for the differences might be that shift worker nurses studied in other countries are different from shift worker nurses in our country in terms of shift schedule and length of night shift. In our study population, although they rotate in three shifts, they are supposed to spend more time in
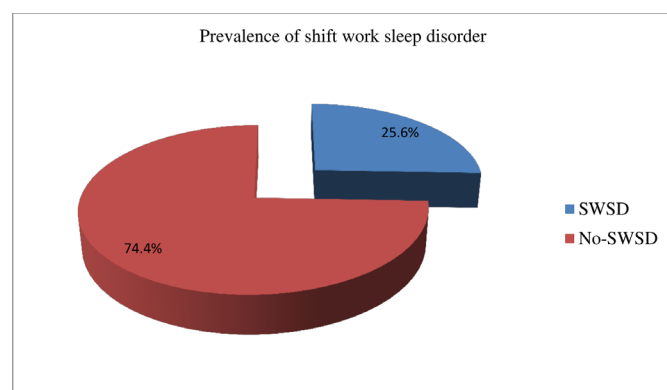
Figure 1 Prevalence of shift work sleep disorder among shift worker nurses working at St Paul's Hospital Millennium Medical College, St Peter TB Specialized Hospital and Amanuel Mental Specialized Hospital in Addis Ababa, Ethiopia, 2018 (N=399). SWSD, shift work sleep disorder.
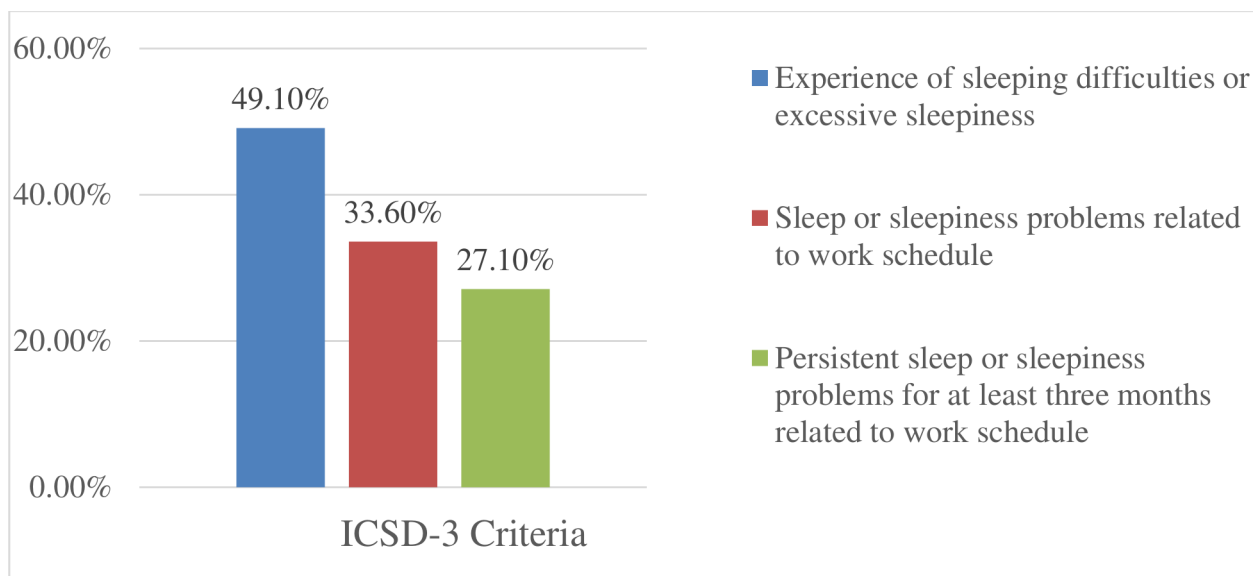
Figure 2 ICSD-3 criteria of shift worker nurses working at St Paul's Hospital Millennium Medical College, St Peter TB Specialized Hospital and Amanuel Mental Specialized Hospital in Addis Ababa, Ethiopia, 2018 (N=399). ICSD-3, International Classification of Sleep Disorders - Third Edition.

Table 3 Bivariate and multivariate logistic regression outputs of shift worker nurses working at federal government hospitals in Addis Ababa, Ethiopia, 2018 (N=399)

Variables	Category	SWSD		COR	AOR
		Yes	**No**	**COR**	**AOR**
Age	20–24	18	99	0.44 (0.19–0.92)*	0.9 (0.32–2.56)
	25–29	70	164	1.03 (0.52–2.05)	1.4 (0.60–3.56)
	>29	14	34	1	1
Sex	Male	52	130	0.74 (0.73–0.19)	0.9 (0.56–1.66)
	Female	50	167	1	1
Known chronic medical illness	Yes	12	13	2.70 (1.28–6.61)*	1.6 (0.44–6.12)
	No	90	284	1	1
Known mental illness	Yes	8	6	4.12 (1.39–12.20)*	2.8 (0.50–15.38)
	No	94	291		
Frequency of rotation	Three shifts	42	77	2.00 (1.25–3.21)**	3.1 (1.68–5.83)***
	Two shifts	60	220	1	1
Use of non-prescribed sleep medication	Yes	22	28	2.64 (1.442–4.87)**	1.3 (0.554–3.254)
	No	80	269	1	1
Use of injectable non-prescribed sleep medication	Yes	14	16	2.79 (1.312–5.917)	1.8 (0.606–5.167)
	No	88	281	1	1
Ever use khat	Yes	32	49	2.31 (1.378–3.886)*	1.8 (0.783–3.955)
	No	70	248	1	1
Ever use of tobacco	Yes	18	22	2.71 (1.372–5.230)*	2.3(0.809–6.117)
	No	84	275	1	1
Length of night shift	>12.5 hours	80	195	1.90 (1.12–3.23)*	1.7 (0.841–3.45)
	≤12 hours	22	102	1	1
Average number of nights per month	≤11	54	237	1	1
	>11	48	60	3.50 (2.17–5.68)***	6.3 (3.20–12.35) ***

*P<0.05 (weak association), **p<0.01 (strong association), ***p<0.001 (very strong association).
AOR, adjusted OR; COR, crude OR; SWSD, shift work sleep disorder.

night shift, which eventually doubles the risk of developing SWSD.

Use of sleep medication (both prescribed injectable and over-the-counter) and use of caffeine were not related to symptoms of SWSD in the adjusted analyses. These variables showed significant relationships with SWSD in the crude analyses except for caffeine use. Most of the participants could have been more likely to use caffeine. However, only a small fraction of the sample as a whole used sleeping medications, and the associations were not significant in the adjusted analysis.

While interpreting the results of the current study, the following points need to be taken into consideration. The current study used self-administered questionnaire based on the ICSD-3 criteria and BIS and ESS assessment scales. Clinical interview was not performed and data from sleep diaries and objective actigraphic assessment were not used to minimise recall bias.

CONCLUSION

The prevalence of SWSD in this study was high. A quarter of shift worker nurses are suffering from SWSD. Symptoms indicative of SWSD were associated with the number of nights on average per month for the last 1 year and working in three-shift rotation. Shift working conditions should be improved to provide less stressful conditions for nurses, ensuring at the same time an appropriate quality of care over a 24-hour period. More studies are necessary to better highlight the burden of shift work on the health and well-being of both nurses and patients.

REFERENCES

1. Voigt RM, Forsyth CB, Green SJ, *et al*. Circadian disorganization alters intestinal microbiota. *PLoS One* 2014;9:e97500.
2. Shanmugam V, Wafi A, Al-taweel N. Review article disruption of circadian rhythm increases the risk of cancer, metabolic syndrome and cardiovascular disease. *J Local Glob Heal Sci* 2013;3:2–42.
3. Sack RL, Auckley D, Auger RR, *et al*. Circadian rhythm sleep disorders: Part I, basic principles, shift work and jet lag disorders. An American Academy of sleep medicine review. *Sleep* 2007;30:1460–83.
4. Åkerstedt T, Wright KP. Sleep loss and fatigue in shift work and shift work disorder. *Sleep Med Clin* 2009;4:257–71.
5. Sack RL, Auckley D, Auger RR, *et al*. Circadian rhythm sleep disorders: Part II, advanced sleep phase disorder, delayed sleep phase disorder, free-running disorder, and irregular sleep-wake rhythm. An American Academy of sleep medicine review. *Sleep* 2007;30:1484–501.
6. Guerra PC, Oliveira NF, Terreri MTdeSELRA, *et al*. Sleep, quality of life and mood of nursing professionals of pediatric intensive care units. *Rev Esc Enferm USP* 2016;50:279–85.
7. Sadat A, Roodbandi J, Feyzi V, *et al*. Sleep Quality and Sleepiness : A Comparison between Nurses with and without Shift Work, and University Employees. *Int J Occup Hyg* 2017;4:230–6.
8. Drake CL, Roehrs T, Richardson G, *et al*. Shift work sleep disorder: prevalence and consequences beyond that of symptomatic day workers. *Sleep* 2004;27:1453–62.
9. Magerøy N, Moen BE, Grønli J, *et al*. Shift work disorder in nurses – assessment, prevalence and related health problems. *journal.pone* 2012;7:1–9.
10. Snel J, Lorist MM. Effects of caffeine on sleep and cognition [Internet]. In: *Human sleep and cognition Part II: clinical and applied research*. 1st edn. Elsevier B.V, 2011: 105–17.
11. Doi Y. An epidemiologic review on occupational sleep research among Japanese workers. *Ind Health* 2005;43:3–10.
12. Ferri P, Guadi M, Marcheselli L, *et al*. The impact of shift work on the psychological and physical health of nurses in a general Hospital: a comparison between rotating night shifts and day shifts. *Risk Manag Healthc Policy* 2016;9:203–11.
13. Shiffer D, Minonzio M, Dipaola F, *et al*. Effects of clockwise and counterclockwise job shift work rotation on sleep and work-life balance on hospital nurses. *Int J Environ Res Public Health* 2018;15:2038.
14. Costa G. Multidimensional aspects related to shiftworkers' health and well-being. *Rev. Saúde Pública* 2004;38(suppl):86–91.
15. Volná J, onka K. Reaction time measurement in different periods of shift work at nurses. *Act Nerv Super Rediviva* 2010;52:125–9.
16. Scott LD, Hwang W-T, Rogers AE, *et al*. The relationship between nurse work schedules, sleep duration, and drowsy driving. *Sleep* 2007;30:1801–7.
17. Steven WSteven W, Lockley P, Jeffrey M. Effects of health care provider work hours and sleep deprivation on safety and performance. *Joint, Journal, Comm Safety, Patient* 2008;33.
18. Ferri MZ. *Assessment of sleep disorders and diagnostic procedures*. 3th edn. European Sleep Research Society, 2014: 95–107.
19. International Classification of Sleep Disorders. *International Classification of Sleep Disorders:Diagnostic and Coding Manual/ American Academy of Sleep Medicine*. Westchester: American Academy of Sleep Medicine, 2005.
20. Jafari NNH. Effect of shift work on the frequency of depression in nursing staff of Yazd University of medical sciences. *J Community Heal Res* 2012;1:104–9.
21. Engin A. Circadian rhythms in diet-induced obesity. In: *Obesity and lipotoxicity*. Springer, 2017: 19–52.
22. Stenvers DJ, Scheer FA, Schrauwen P, *et al*. Circadian clocks and insulin resistance. *Nature Reviews Endocrinology* 2018;1.
23. Chellappa SL, Morris CJ, Scheer FAJL. Effects of circadian misalignment on cognition in chronic shift workers. *Sci Rep* 2019;9:699.
24. Dai C, Qiu H, Huang Q, *et al*. The effect of night shift on sleep quality and depressive symptoms among Chinese nurses. *Neuropsychiatr Dis Treat* 2019;15:435–40.

25. Wheatley C. Excellence & Evidence in Nurse Staffing. *Nurs Econ* 2017;35:2013–7.
26. Waage S, Moen BE, Pallesen S, *et al*. Shift work disorder among oil rig workers in the North sea. *Sleep* 2009;32:558–65.
27. Medicine AAoS. *International classification of sleep disorders*. Diagnostic and coding manual, 2005: 51–5.
28. Association AP. *Diagnostic and statistical manual of mental disorders: DSM-IV-TR*. Washington, DC: American Psychiatric Association, 2000.
29. Pallesen S, Bjorvatn B, Nordhus IH, *et al*. A new scale for measuring insomnia: the Bergen insomnia scale. *Percept Mot Skills* 2008;107:691–706.
30. Manzar MD, Salahuddin M, Alamri M, *et al*. Psychometric properties of the Epworth Sleepiness scale in Ethiopian university students. *Health Qual Life Outcomes* 2019;17:30.
31. Jung H-S, Lee B. Contributors to shift work tolerance in South Korean nurses working rotating shift. *Appl Nurs Res* 2015;28:150–5.