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IMPACT OF SHIFT WORK, SLEEP PROBLEMS ON THE OCCUPATIONAL PERFORMANCE OF FACTORY WORKERS.

By

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Abstract

Introduction: Sleep disturbances are an important health issue among shift workers that can impact their occupational performance. **Aim of Work:** To determine the percentage of poor sleep quality, excessive daytime sleepiness, and insomnia among factory workers and their relation to shift work. Additionally, to examine the impact of sleep problems on occupational performance. **Materials and Methods:** A cross-sectional study was conducted in a privately owned plastics manufacturing factory in Dakahlia governorate, Egypt between April 1st and June 30th, 2021. Workers were asked to fill out a questionnaire that included the Pittsburg Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Insomnia Severity Index (ISI), and Occupational Impact of Sleep Questionnaire (OISQ). **Results:** A total of 159 workers were included in the current analysis. Approximately 70 (44.1%) workers had shift work. Workers had a high burden of sleep problems; poor sleep quality (74.2%), excessive daytime sleepiness (22.6%), and clinical insomnia (10.1%). Shift workers had significantly higher poor sleep quality (p=0.001), excessive daytime sleepiness (p=0.019), and insomnia (p=0.036) compared to non-shift workers. In addition, several sociodemographic characteristics were independently associated with sleep problems. All sleep problems especially poor sleep quality negatively affected occupational performance. The negative impact was similar in both shift and non-shift workers. **Conclusion and Recommendations:** Shift workers had a significantly higher percentage of poor sleep quality, excessive daytime sleepiness, and insomnia. All studied sleep problems had a significant negative occupational impact. Thus, adjustable work schedules, proper sleep routines, and coping ways such as napping are some interventions that could help shift

workers improve their sleep quality.
Keywords: Shift work, Sleep, Occupational performance, Pittsburg Sleep Quality Index (PSQI), and Epworth Sleepiness Scale (ESS).

Introduction

Twenty-four-hour jobs are a crucial component of the modern economy. In many countries, about 20% of the labors work outside regular hours including shift work, night work, irregular, and flexible working hours. In service occupations, the rates of shift work are even higher (25-50%) (Wickwire et al., 2017).

These nontraditional work hours entail a new sleep-wake schedule that contradicts the natural circadian rhythm. Shift workers usually suffer from difficulty falling asleep, sleep deprivation, difficulty staying asleep, short, fragmented, poor sleep, fatigue, and daytime sleepiness (Costa, 2015). Good sleep is essential for human physical and mental health and efficient routine daily performance as it plays a crucial role in systemic physiology as well as brain and different body systems functioning. Thus, sleep disturbances cause substantial alterations in individuals' physical, and cognitive functioning, and impair neuro-behavioral performance. They can also cause difficulties with social interactions and decreases the quality of life as well. Moreover, several studies had linked sleep disturbances with increased mortality, adverse physical (cardiovascular diseases, stroke, and metabolic diseases), and psychological outcomes (anxiety and depression) (Magnavita and Garbarino, 2017; Medic et al., 2017; Chattu et al., 2019).

Moreover, work performance is highly affected by sleep including the ability to remain attentive and alert, appropriate auditory and visual perception, reaction time, rapid responses to changing work needs, and ability to think clearly and make decisions. Thus, the level of sleep disturbance can greatly impact occupational functioning. Workers with sleep problems showed a decrease in job-related performance and an increased tendency for errors. It has also been associated with increased accidents and injuries during and outside of work hours. Besides, it is also related to absenteeism and decreased productivity in the workplace (Magnavita and Garbarino, 2017; Pilcher and Morris, 2020).

Despite the high percentage of sleep disturbances among shift workers, it is often undiagnosed. There are limited studies conducted in Egypt to study the occupational impact of sleep quality among shift workers.

Aim of Work

To determine the percentage of poor sleep quality, excessive daytime sleepiness, and insomnia among factory workers and their relation to shift work. Additionally, to examine the impact of sleep problems on occupational performance.

Materials and Methods

Study design*:* This is a comparative cross-sectional study.

Place and duration of the study: The study was conducted in a plastics manufacturing factory in Dakahlia governorate, Egypt during the period from April 1st to June 30th, 2021. The factory is privately owned and run by 200 employees distributed in three shifts.

Study sample: The current study targeted all workers of the factory who were employed for at least one year.

Sample size calculation: Previous studies showed that the mean (standard deviation) score of the Occupational Impact of Sleep Questionnaire was 27.2 (9.8) among shift workers and 16.1 (10.3) among non-shift workers (Yazdi et al., 2014). Using similar assumptions, 95% power, 99% confidence level, and equal group assumption, the sample size per group was estimated to be 30 workers. The sample was increased by 20% (to be at least 36 per group) to compensate for incomplete data. The sample size calculation was done using the Open Epi program (https://www.openepi.com/Menu/OE_Menu.htm). Out of the total factory workforce (No=200), an overall of 159 workers agreed to participate in the study with a 79.5 % response rate. They were divided into two groups according to their shift work; 70 shift and 87 non shift workers.

Study methods*:* Each participant received a predesigned **self-administered questionnaire** and completed it during work hours. It included: (a) *Sociodemographic and occupational data:* including age, gender, residence, marital status, smoking status, education, height, weight [Body Mass Index (BMI) was calculated from height and weight by SPSS program], medical history, type of work, work duration, and details of shift

work. (b) *Pittsburg Sleep Quality Index (PSQI):* The details of the questionnaire have been mentioned elsewhere (Buysse et al., 1989). It assesses sleep quality and disturbances over 1 month. It contains 19 self-rated questions (included in the scoring) and 5 questions rated by the bed partner (not included in the scoring). Items 1-4 are open questions, while items 5-19 are rated on a four-point Likert scale. All items create seven scores: *subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction.* All components' scores are added to give a global score (0-21), with a score ≥5 indicating poor sleep quality. Global PSQI score >5 had a diagnostic sensitivity of 89.6% and specificity of 86.5% (Buysse et al., 1989). The Arabic version had been validated and has acceptable psychometric properties (Suleiman et al., 2010). (c) *Epworth Sleepiness Scale (ESS):* The details of the questionnaire have been mentioned elsewhere (Johns, 1991). It measures the general level of an individual's daytime sleepiness. It includes 8 items rated on a 4-point Likert scale from 0 to 3; with total scores of 0-24. The higher the score, the higher the risk of unexpectedly falling asleep. Scores ≥10 are indicative of excessive daytime sleepiness (Johns, 1991). The Arabic version had been validated and has high internal consistency (α= 0.89) and reliability (α= 0.86) (Ahmed et al., 2014). (d) *Insomnia Severity Index (ISI):* The details of the questionnaire have been mentioned elsewhere (Morin, 1993). It is designed to assess insomnia. It comprises seven items rated on a 5-point Likert scale from 0 to 4 from less to more severe generating a total score ranging from 0 to 28 with higher scores indicating more severe insomnia. Scores ≥15 indicate clinical (moderate/severe insomnia) (Morin, 1993). Arabic version is valid and reliable (Suleiman and Yates, 2011). Permission to use ISI was obtained from Mapi Research Trust, Lyon, France, "https://eprovide.mapi-trust.org" on January 25th, 2021. (e) *Occupational Impact of Sleep Questionnaire (OISQ):* The details of the questionnaire have been mentioned elsewhere (David, 2008). It evaluates the impact of sleep on working functions. It consists of 24 items. Each item is rated on a 5-point Likert scale (from 0 to 4) with a total score of 0-96 with higher scores entailing a higher chance of working dysfunction. The OISQ shows a satisfactory level of reliability and validity (David, 2008). As the

OISQ was not validated in the Arabic language, the OISQ was translated by a bilingual expert panel of occupational and sleep medicine specialists. Then it was back-translated into English by two translators, who didn't take part in any of the previous steps. Finally, the original OISQ was compared with the final back-translated form via English fluent individuals. The OISQ's internal consistency was high (α= 0.83).

Ethical Approval

The proposal was approved by the Institutional Research Board (IRB), Faculty of Medicine-Mansoura University (Reference number R.21.01.1183). Additional approval was obtained from the factory administration.

Consent

Informed consent was obtained from each participant before filling out the questionnaire and after clarification of the study objectives.

Data Management

Qualitative data were described using numbers and percentages. Data were tested for normality using the Kolmogorov-Smirnov test. Quantitative data were described using median and mean. Chi-Square and Fischer exact tests were used for qualitative data comparison. Binary stepwise logistic regression analysis was used for the prediction of independent variables of each domain. Crude odds ratios (COR) and 95% confidence interval (CI) were calculated. A regression model using forward Wald method/Enter was used. Adjusted odds ratios (AOR) and 95% CI were calculated. Spearman's rank-order correlation was used to determine the strength and direction of a linear relationship between OISQ and each of PSQI, ESS, and ISI. P-value $\leq$ 0.05 was considered significant. SPSS software (release 22.0, Armonk, NY: IBM Corp) was used for all statistical analyses.

Results

A total of 159 workers were included in the current study analysis. Those who worked in shifts were 70 workers representing 44.1% while those who worked usual schedules were 89 workers representing 55.9%. The mean age of shift workers was 35.1± 8.2 years and of non-shift workers was 35.9± 9.5 years with nearly two-thirds of both groups ≤ 35 years old (62.9%, 60.7%, respectively). Almost all shift workers (95.7%) and most of the non-shift workers (73%) were males. Workers of both groups were mainly from urban residences (60%, 70.8%, respectively). Most of both groups were currently married (65.7%, 69.7%, respectively) and having children (77.1%, 75.3%, respectively). The majority of both groups were currently non-smokers (67.1%, 82%, respectively) and not obese (82.9%, 62.9%, respectively). A small percentage of both groups had comorbidities (21.4%, 15.75%, respectively) and were on prescribed medications. Both groups had a median employment duration of 8 years and 8-hour median daily working hours. The majority of shift workers (90%) and most of the non-shift workers (67.4%) had manual work. Among shift workers, the median work duration in shifts was 7 years. In addition, 51 workers (72.8 %) worked in periodic shifts and 72.5% of those workers reported increased perceived stress during night shifts (Non tabulated data).

Table 1: Measured sleep-related scores among factory workers by shift work.

Score	Shift work (No=70)	Non-shift work (No=89)	p-value
I. Global PSQI Score a	7.11±2.55	6.26±2.78	**0.04***
Poor sleep quality [b]	61 (87.1)	57 (64)	**0.001***
Good sleep quality [b]	9 (12.9)	32 (36)	
Subjective Sleep quality [a]	0.6±0.5	0.8±0.6	0.14
Proportion with a score ≥2 [b]	3 (4.3)	5 (5.6)	0.70
Sleep latency [a]	1.4±0.6	1.2±0.8	**0.032***
Proportion with a score ≥2 [b]	36 (51.4)	36 (40.4)	0.17
Actual sleep duration [a]	0.8±1.0	1.2±0.9	**0.019***
Proportion with a score ≥2 [b]	18 (25.7)	38 (42.7)	**0.026***

Sleep efficiency [a]	0.1±0.3	0.2±0.5	0.49
Proportion with a score ≥2 [b]	1 (1.4)	6 (6.7)	0.11
Sleep disturbances [a]	1.7±0.7	1.7±0.5	0.85
Proportion with a score ≥2 [b]	42 (60)	58 (65.2)	0.50
Use of sleep medication [a]	0.9±1.1	0.7±0.9	0.26
Proportion with a score ≥2 [b]	27 (38.6)	26 (29.2)	0.21
Daytime dysfunction [a]	1.2±0.7	1.1±0.6	0.11
Proportion with a score ≥2 [b]	30 (42.9)	23 (25.8)	**0.024***
II. ESS score [a]	7.7±4.1	6.6±3.6	0.08
Excessive Daytime Sleepiness [b]	22 (31.4)	14 (15.7)	**0.019***
III. ISI score [a]	7.5±5.5	7.2±3.9	0.71
Clinical insomnia [b]	11 (15.7)	5 (5.6)	**0.036***
IV. OISQ score [a]	48.6±27.2	29.7±29.3	**<0.001***

ESS: Epworth Sleepiness Scale; ISI: Insomnia Severity Index; No: Number; [a]: Mean ±SD; OISQ: Occupational Impact of Sleep Questionnaire; p: probability; PSQI: Pittsburg Sleep Quality Index; SD: Standard deviation; [b]: Number and %; *: Statistically significant.

Regarding measured sleep-related scores among studied workers, mean global PSQI=6.6 (non tabulated data). In addition, both groups had high mean global PSQI scores (7.11±2.55, and 6.26±2.78, respectively) with significantly higher mean among shift workers (p=0.04). In addition, a significantly higher percentage of shift workers scored poor sleep quality than non-shift workers (87.1% vs 64%, p=0.001). Moreover, there was a significant difference between both groups in the actual sleep duration, sleep latency and daytime dysfunction components of PSQI (Table 1). There was a non-significant difference between shift and non-shift workers in the mean score of ESS and ISI, however, a significantly higher percentage of shift workers (compared to non-shift workers) had excessive daytime sleepiness (EDS) (31.4% vs 15.7%, p=0.019) and clinical insomnia (15.7% vs 5.6%. p=0.036). Lastly, shift workers had a significantly higher mean OISQ score compared to non-shift workers (48.6±27.2 vs 29.7±29.3, p=<0.0001) (Table 1).

Table 2: Significant independent predictors of poor sleep quality among factory workers (No=159).

Characteristics	Poor sleep quality (No=118) (74.2%)				
	No (%)	COR (95%CI)	p-value	AOR (95%CI)	p-value
Age (years) (≤35 vs >35)	94 (95.9) **vs** 24 (39.3)	36.23(11.77-111.57)	**<0.001***	52.35(13.06-209.78)	**0.001***
Educational level Illiterate& Primary Secondary University or higher	51 (85.0) 37 (77.1) 30 (58.8)	3.97 (1.61-9.77) 2.35 (0.98-5.64) Reference	**0.001*** 0.052 -	5.19 (1.13-23.74) 4.01 (0.934-17.20) Reference	**0.034*** 0.062 -
BMI Obese vs Not obese	40 (88.9) **vs** 78 (68.4)	3.69 (1.34-10.14)	**0.008***	3.51 (1.21-10.19)	**0.02***
Shift work Yes vs NO	61 (87.1) **vs** 57 (64.0)	3.81 (1.67-8.67)	**0.001***	3.01 (1.25-5.78)	**0.001***
Work duration (years) (≤8 vs >8)	71 (82.6) **vs** 47 (64.4)	2.62 (1.26-5.46)	**0.009***	2.87 (1.31-6.29)	**0.008***
Periodic shift	44 (86.3)	2.89 (1.18-7.07)	**0.017***	2.69 (1.08-6.67)	**0.03***
Stressful shift Night vs Morning	34 (91.9) **vs** 12 (52.2)	10.47 (2.47-43.68)	**0.001***	8.39 (2.15-44.97)	**0.001***

BMI: Body Mass Index; AOR: Adjusted Odds Ratio; COR: Crude Odds Ratio; CI: Confidence Interval; No: Number; p: probability; *: Statistically significant.

Out of all factory workers ,74.2% reported poor sleep quality. Workers with poor sleep quality were more likely to be younger (≤35 y), with lower education level, obese, shift workers, with shorter duration of employment (≤8 y), work in periodic shifts, and perceived night shifts as more stressful (Table 2). They were, as well, from rural residences, currently married, and current smokers (Non tabulated data).

Logistic regression of those factors showed that the odds of workers' poor sleep quality increases by younger age (AOR, 52.35; 95% CI, 13.06-209.78, p=0.001),

lower educational level (AOR, 5.19; 95% CI, 1.13-23.74, p=0.034), obesity (AOR, 3.51; 95% CI,1.21-10.19, p=0.02), shift work (AOR, 3.01; 95% CI, 1.25-5.78, p=0.001), short employment duration (AOR, 2.87; 95% CI, 1.31-6.29, p=0.008), working periodic shifts (AOR, 2.69; 95% CI, 1.08-6.67, p=0.03), or stressful night shifts (AOR, 8.39; 95% CI, 2.15-44.97, p=0.001) (Table 2).

Table 3: Significant independent predictors of excessive daytime sleepiness among factory workers (No=159).

Characteristics	Excessive Daytime Sleepiness (EDS) (No =36) (22.6%)				
	No (%)	COR (95%CI)	p-value	AOR (95%CI)	p-value
Residence Rural vs Urban	22 (40.7) **vs** 14 (13.3)	4.47 (2.05-9.77)	**<0.001***	3.98 (1.65-9.58)	**0.002***
Educational level Illiterate& Primary Secondary University or higher	 8 (13.3) 10 (20.8) 18 (35.3)	 Reference 1.71 (0.617-4.74) 3.55 (1.38-9.08)	 - 0.298 **0.006***	 Reference 1.25 (0.89-5.28) 3.12 (1.02-8.79)	 - 0.89 **0.02***
Children (Yes)[a]	22 (18.2)	2.63 (1.17-5.87)	**0.016***	2.97 (1.29-6.84)	**0.038***
Comorbidities (Yes)[a]	11 (37.9)	2.57 (1.08-6.11)	**0.03***	2.97 (1.21-7.32)	**0.017***
Shift work (Yes)[a]	22 (31.4)	2.45 (1.146-5.26)	**0.019***	2.57 (0.964-6.86)	**0.059**

BMI: Body Mass Index; AOR: Adjusted Odds Ratio; COR: Crude Odds Ratio;
[a] Compared to No; CI: Confidence Interval; No: Number;
p: probability; *: Statistically significant

The overall prevalence of EDS was 22.6%. Workers with EDS were more likely to be from rural residences, with a higher educational degree, having children, have comorbidities, and work in shifts. The odds of EDS between workers significantly increased by being from rural residence (AOR, 3.98; 95% CI, 1.65-9.58, p=0.002), higher educational level (AOR, 3.12; 95% CI, 1.02-8.79, p=0.02), having children (AOR, 2.97; 95% CI, 1.29-6.84, p=0.038), or comorbidities (AOR, 2.97; 95% CI, 1.21-7.32, p=0.017) (Table 3).

Table 4: Significant independent predictors of clinical insomnia among factory workers (No=159).

Characteristics	Clinical Insomnia (No=16) (10.1%)				
	No (%)	COR (95%CI)	p-value	AOR (95%CI)	p-value
Age (years) (≤35 vs >35)	15 (15.3) **vs** 1 (1.6)	10.84 (1.39-84.34)	**0.005***	-	-
Residence Rural vs Urban	13 (24.1) **vs** 3 (2.9)	10.78 (2.92-39.82)	**<0.001***	13.04 (2.43-69.91)	**0.003***
Educational level Illiterate& Primary Secondary University or higher	1 (1.7) 3 (6.2) 12 (23.5)	Reference 3.93 (0.39-39.08) 18.15 (2.27-145.28)	- **0.21** **<0.001***	Reference 21.42(1.29-354.78) 52.07(4.13-655.79)	- **0.032*** **0.002***
Marital status Single vs Married	9 (17.6) **vs** 7 (6.5)	3.09 (1.08-8.85)	**0.02***	5.74 (1.03-32.0)	**0.046***
Shift work Yes vs NO	11(15.7) **vs** 5 (5.6)	3.13 (1.03-9.49)	**0.036***	6.19 (1.66-23.11)	**0.007***
Work nature Office vs Manual	7 (19.4) **vs** 9 (7.3)	3.06 (1.05-8.90)	**0.03***	6.48 (1.78-23.57)	**0.005***

BMI: Body Mass Index; AOR: Adjusted Odds Ratio; COR: Crude Odds Ratio; CI: Confidence Interval; No: Number; p: probability; *: Statistically significant.

The overall prevalence of clinical insomnia was 10.1%. It was more likely to present in workers younger in age (≤35 y), from rural residences, with higher education levels, currently single, shift workers, work >8 hours/day, and have office work (Table 4). Being from rural residence (AOR, 13.04; 95% CI, 2.43-69.91, p=0.003), higher educational level (AOR, 52.07; 95% CI, 4.13-655.79, p=0.002), being currently single (AOR, 5.74; 95% CI, 1.03-32.0, p=0.046), working in shifts (AOR, 6.19; 95% CI, 1.66-23.11, p=0.007), or having office work (AOR, 6.48; 95% CI, 1.78-23.57, p=0.005) significantly increased the odds of clinical insomnia among studied workers (Table 4).

Table 5: Correlations between the occupational impact of sleep questionnaire (OISQ) and sleep-related measures (PSQI, ESS, ISI).

Sleep-related measures	OISQ					
	Total (No =159)		Shift work (No =70)		Non-shift work (No =89)	
	r	p	r	p	r	p
Global PSQI	0.911	**<0.001***	0.932	**<0.001***	0.899	**<0.001***
ESS	0.223	**0.005***	0.208	0.084	0.209	**0.049***
ISI	0.273	**<0.001***	0.259	**0.031***	0.370	**<0.001***

ESS: Epworth Sleepiness Scale; ISI: Insomnia Severity Index; No: number; p: probability; OISQ: Occupational Impact of Sleep Questionnaire; PSQI: Pittsburg Sleep Quality Index; r: Correlation coefficient; *: Statistically significant

Regarding the correlation between measured sleep-related scores and OISQ score, among all studied workers, there was a significant positive correlation between OISQ and each of global PSQI ($r=0.911$, $p\leq0.001$), ESS ($r=0.223$, $p=0.005$), and ISI ($r=0.273$, $p\leq0.001$). With exception of ESS, similar findings were seen after stratification by shift work (Table 5).

In addition, among all studied workers, there was a significant positive correlation between ISI and both ESS ($r=0.337$, $p\leq0.001$) and global PSQI ($r=0.245$, $p=0.002$) (non-tabulated data).

Discussion

Sleep disturbances are an important health issue among shift workers that can impact their occupational performance. The current study investigated some sleep disturbances, namely, sleep quality, excessive daytime sleepiness, and insomnia, among plastic factory workers, and their relation to shift work. Results of the current study showed that 74.2% of all factory workers reported poor sleep quality (Table 2) with a 6.6 mean global PSQI (non-tabulated data). In addition, the overall prevalence of EDS was 22.6% (Table 3) and that for insomnia was 10.1% (Table 4). Shift workers had significantly higher mean global PSQI and a higher prevalence of poor sleep quality, EDS and insomnia (Table1).

Previous studies reported variable mean global PSQI and prevalence of poor sleep quality among different occupations. Hajaghazadeh et al. (2019) from Iran reported, a 6.88 mean global PSQI and a 74% prevalence of poor sleep quality among nurses. Meanwhile, a mean global PSQI of 5.5 and a poor sleep quality prevalence of 42.5% were reported among the working population in various jobs in Singapore (Visvalingam et al., 2020), and 69% of Iranian oil rig workers had poor sleep quality with a 6.73 mean global PSQI (Sadeghniiat-Haghighi et al., 2018). In addition, a higher overall EDS (51.8%) and insomnia (46.6%) prevalence was previously reported (Vallières et al., 2014; Gómez-García et al., 2016).

Regarding relation to shift work, a plethora of previous studies, in agreement with the current study, described a significantly higher mean global PSQI and/or prevalence of poor sleep quality among shift workers compared to non-shift workers in Malaysia (Lim et al., 2020) and Singapore (Thach et al., 2020). Likewise, a significantly higher mean score of ESS, ISI, and/or prevalence of EDS and insomnia among shift workers compared to non-shift workers was reported by Vidya et al. (2019) in India, and Ahmed and Hamed (2020) in Egypt.

The present work reported some factors favoring the occurrence of the studied sleep problems. As regard poor sleep quality, some studies described predictors similar to the findings detected (Table 2); including younger age in Iran (Saraei et al., 2018) and Thailand (Songkham et al., 2019), obesity, and/or increased BMI (Park et

al., 2018; Visvalingam et al., 2020), and shorter employment duration (Ahmed and Hamed, 2020).

Moreover, the current study found that shift work is a significant independent predictor of poor sleep quality and shift workers are three times more likely to experience poor sleep (Table 2). Comparable results were described by previous studies (Thach et al., 2020; Visvalingam et al., 2020). Furthermore, workers in periodic/rotating and night shifts were significantly more prone to poor sleep quality as was established by several authors (Songkham et al., 2019; Vidya et al., 2019).

Significant predictors of EDS described by the studied group were being from rural residence, with higher education, having children, or having comorbidities (Table 3). Likely, Yılmazel et al. (2017) from Turkey, found that higher EDS was observed in university graduates, more frequent among adults with children, and those with chronic diseases had a higher risk of EDS than those without chronic diseases. This also was in agreement with previous researches done in Iran by Kazemi et al., 2016 and Hajaghazadeh et al., 2019.

Regarding insomnia, the studied workers reported that rural residence, higher education, being single, or working in shifts increased its odds (Table 4). Tang et al. (2017) from China reported similar results regarding residence, educational status, and marital status, while shift work was found as a significant predictor of insomnia by other studies (Vallières et al., 2014; Yazdi et al., 2014).

The current study reported a significant positive correlation between ISI and both ESS and global PSQI (Table 5) as described by Yazdi et al. (2014) in Iran, and Ahmed and Hamed (2020) in Egypt. Atypical sleep schedules among shift workers result in disturbance of the natural endogenous rhythm of sleep leading to impairment in both sleep and wakefulness. Sleep becomes difficult to initiate, shorter, and fragmented (insomnia and poor sleep quality) and EDS during the day usually follows (Wickwire et al., 2017).

Furthermore, poor sleep quality, insomnia, and EDS (high PSQI, ISI, and ESS scores) were significantly positively correlated with negative occupational performance (higher OISQ score) among the studied groups (Table 5). Using different outcomes among

a variety of occupations, previous studies showed that sleep problems were significantly associated with absenteeism, presenteeism, fatigue, poor work ability and performance, decreased productivity, loss of concentration, and decline in a variety of cognitive and executive functions that play a crucial role in many tasks' performance. Similar to the current findings, all described adverse outcomes were significantly related to shift work (Athar et al., 2020; Gharibi et al., 2020). Additionally, previous studies that did similar work showed that shift workers endured more occupational impacts of sleep disturbances than non-shift workers (Verster et al., 2008; Yazdi, et al., 2014).

Study limitations: The current study used well-standardized tools to screen for sleep problems among factory workers and examined the impact of shift work using univariate and multivariate analysis. Nevertheless, some limitations should be acknowledged. The cross-sectional design cannot determine the temporal link between the outcome and the exposure. The data of the study were obtained from only one factory which may impact the generalization of the study. While the examined sample was enough to estimate the burden of sleep disorders, it may be not sufficiently powerful to determine all independent predictors of each sleep disorder. Nevertheless, the current findings are considered a good addition to the limited local data exploring the impact of shift work on sleep disturbance.

Conclusion: Poor sleep quality was prevalent among factory workers. Shift workers had a significantly higher prevalence of poor sleep quality, excessive daytime sleepiness, and insomnia. All studied sleep problems had a significant negative occupational impact.

Recommendations: Adjustable work schedules, proper sleep routines, and coping ways such as napping are some interventions that could help shift workers to improve their sleep quality. Therefore, we recommend workers to pay attention to their sleeping hours. Administrative regulation should be applied to alleviate undesirable effects of shift work on sleep quality through rotating shifts, managing time off, providing coordinated availability, organizing shift trade requests, and allowing employees to sign up for available shifts.

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Conflict of interest

The authors have no competing interests to declare.

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References

1. Ahmed AE, Fatani A, Al-Harbi A, Al-Shimemeri A, Ali YZ, et al. (2014): Validation of the Arabic version of the Epworth sleepiness scale. J Epidemiol Glob Health; 4 (4):297-302. https://doi.org/10.1016/j.jegh.2014.04.004
2. Ahmed AS and Hamed RA (2020): Sleep disorder among shift work nurses and its impact on their quality of life at Al Ahrar Governmental Hospital, Zagazig City, Egypt. Egypt J Psychiatry; 41(2): 117. https://doi.org/10.4103/ejpsy.ejpsy_6_20
3. Athar ME, Atef-Vahid MK and Ashouri A (2020): The Influence of Shift Work on the Quality of Sleep and Executive Functions. J Circadian Rhythms; 18(1): 4 https://doi.org/10.5334/jcr.194
4. Buysse DJ, Reynolds III CF, Monk TH, Berman SR and Kupfer DJ (1989): The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res; 28 (2):193-213. https://doi.org/10.1016/0165-1781(89)90047-4
5. Chattu VK, Manzar MD, Kumary S, Burman D, Spence DW et al. (2019): The global problem of insufficient sleep and its serious public health implications. Healthcare; 7 (1): 1. https://doi.org/10.3390/healthcare7010001
6. Costa G (2015): Sleep deprivation due to shift work. In: Lotti, M., Bleecker, M.L. (Eds.), Handbook of Clinical Neurology. Elsevier, pp. 437-46. https://doi.org/10.1016/B978-0-444-62627-1.00023-8
7. David BM (2008): Sleep quality and daytime functioning in primary insomnia: a prospective study (Doctoral dissertation, Loughborough University). Available at https://hdl.handle.net/2134/15745
8. Gharibi V, Mokarami H, Cousins R, Jahangiri M and Eskandari D (2020): Excessive daytime sleepiness and safety performance: comparing proactive and reactive approaches. Int J Occup Environ Med; 11 (2): 95. https://doi.org/10.34172%2Fijoem.2020.1872
9. Gómez-García T, Ruzafa-Martínez M, Fuentelsaz-Gallego C, Madrid JA, Rol MA et al. (2016): Nurses' sleep quality, work environment and quality of care in the Spanish National Health System: observational study among different shifts. BMJ open; 6 (8): e012073. http://doi.org/10.1136/bmjopen-2016-012073
10. Hajaghazadeh M, Zamanzadeh V, Ghofrani M and Orujlu S (2019): Morningness-Eveningness Chronotypes, sleep quality, and sleepiness among nurses. Open Public Health J; 12 (1): 414-9. https://doi.org/10.2174/1874944501912010414
11. Johns MW (1991): A new method for measuring daytime sleepiness: the Epworth sleepiness scale. Sleep; 14 (6): 540-5. https://doi.org/10.1093/sleep/14.6.540
12. Kazemi R, Haidarimoghadam R, Motamedzadeh M, Golmohamadi R, Soltanian, A et al. (2016): Effects of shift work on cognitive performance, sleep quality, and sleepiness among petrochemical control room operators. J circadian rhythms; 14:1. DOI: 10.5334/jcr.134
13. Lim YC, Hoe VC, Darus A and Bhoo-Pathy N (2020): Association between night-shift works, sleep quality and health-related quality of life: a cross-sectional study among manufacturing

workers in a middle-income setting. BMJ open; 10 (9): e034455. http://doi.org/10.1136/bmjopen-2019-034455

14. Magnavita N and Garbarino S (2017): Sleep, health and wellness at work: a scoping review. Int J Environ Res Public Health; 14 (11):1347. https://doi.org/10.3390/ijerph14111347
15. Medic G, Wille M and Hemels ME (2017): Short-and long-term health consequences of sleep disruption. Nat Sci Sleep; 9: 151. https://doi.org/10.2147/NSS.S134864
16. Morin CM (1993): Insomnia: psychological assessment and management. Guilford Press. The abstract is available at: https://psycnet.apa.org/record/1993-98362-000
17. Park SK, Jung JY, Oh CM, McIntyre RS and Lee JH (2018): Association between sleep duration, quality and body mass index in the Korean population. J Clin Sleep Med; 14 (8): 1353-60. https://doi.org/10.5664/jcsm.7272
18. Pilcher JJ and Morris DM (2020): Sleep and organizational behavior: implications for workplace productivity and safety. Front Psychol; 45. https://doi.org/10.3389/fpsyg.2020.00045
19. Sadeghniiat-Haghighi K, Zahabi A, Najafi A, Rahimi-Golkhandan A and Aminian O (2018): Sleep quality in shift workers of offshore petroleum industries. J Sleep Sci; 3 (1-2): 36-40.
20. Saraei M, Izadi N, Najafi A, Mohajeri M, Maruf M et al. (2018): The Relationship between Sleep Characteristics and Workplace Accidents. J Sleep Sci ; 3 (1-2):30-5.
21. Songkham W, Deeluea J, Suksatit B and Chaiard J (2019): Sleep quality among industrial workers: related factors and impact. J Health Res; 33 (2): 119-26. https://doi.org/10.1108/JHR-08-2018-0072
22. Suleiman KH, Yates BC, Berger AM, Pozehl B and Meza J (2010): Translating the Pittsburgh sleep quality index into Arabic. West J Nurs Res; 32 (2): 250-68. https://doi.org/10.1177%2F0193945909348230
23. Suleiman KH and Yates BC (2011): Translating the insomnia severity index into Arabic. J Nurs Scholarsh; 43 (1): 49-53. https://doi.org/10.1111/j.1547-5069.2010.01374.x
24. Tang J, Liao Y, Kelly BC, Xie L, Xiang YT et al. (2017): Gender and regional differences in sleep quality and insomnia: a general population-based study in Hunan Province of China. Sci Rep; 7 (1): 1-9. https://doi.org/10.1038/srep43690
25. Thach TQ, Mahirah D, Dunleavy G, Zhang Y, Nazeha N et al. (2020): Association between shift work and poor sleep quality in an Asian multi-ethnic working population: A cross-sectional study. PLoS One; 15 (3): e0229693. https://doi.org/10.1371/journal.pone.0229693
26. Vallières A, Azaiez A, Moreau V, LeBlanc M and Morin CM (2014): Insomnia in shift work. Sleep Med; 15(12): 1440-8. https://doi.org/10.1016/j.sleep.2014.06.021
27. Verster JC, David B, Morgan K and Olivier B (2008): Validation of the Dutch occupational impact of sleep questionnaire (OISQ). Ind Health; 46 (6): 601-6. https://doi.org/10.2486/indhealth.46.601
28. Vidya S, Patlolla VR, Kamuju NR, Ampalam P and Kalyan VK (2019): Impact of shift work on sleep and quality of life in industrial workers: A cross sectional study. Arc Ment Health; 20 (2): 45-9. https://doi.org/10.4103/AMH.AMH_3_19
29. Visvalingam N, Sathish T, Soljak M, Chua AP, Dunleavy G et al. (2020): Prevalence of and factors associated with poor sleep quality and short sleep in a working population in Singapore. Sleep Health; 6 (3): 277-87. https://doi.org/10.1016/j.sleh.2019.10.008
30. Wickwire EM, Geiger-Brown J, Scharf SM and Drake CL (2017): Shift work and shift work sleep disorder: clinical and organizational perspectives. Chest; 151 (5): 1156-72. https://doi.org/10.1016/j.chest.2016.12.007
31. Yazdi Z, Sadeghniiat-Haghighi K, Loukzadeh

Z, Elmizadeh K and Abbasi M (2014): Prevalence of sleep disorders and their impacts on occupational performance: a comparison between shift workers and non shift workers. Sleep Disord 2014. https://doi.org/10.1155/2014/870320 . Available at : http://eprints.qums.ac.ir/777/1/2025.pdf

32. Yılmazel G, Naçar M, Baykan Z and Çetinkaya F (2017): Excessive daytime sleepiness and related factors in adults. J Behav Health; 6 (1): 26-30. https://doi.org/10.5455/jbh.20161111013426

Z, Elmizadeh K and Abbasi M (2014): Prevalence of sleep disorders and their impacts on occupational performance: a comparison between shift workers and non shift workers. Sleep Disord 2014. https://doi.org/10.1155/2014/870320 . Available at : http://eprints.qums.ac.ir/777/1/2025.pdf

32. Yılmazel G, Naçar M, Baykan Z and Çetinkaya F (2017): Excessive daytime sleepiness and related factors in adults. J Behav Health; 6 (1): 26-30. https://doi.org/10.5455/jbh.20161111013426