

## Effect of shift-work on sleeping quality of male factory workers in aseer industrial area, khamis mushayte, KSA

Metrek Ali S AlMetrek<sup>1</sup>, Mohammed Y. Khan<sup>2</sup>, Amani Othman<sup>2</sup>, Moataz Abdel-Fattah<sup>3</sup>

<sup>1</sup>Aseer Joint Program of Family Medicine, Aseer province, KSA.

<sup>2</sup>College of Medicine, King Khalid University, KSA.

<sup>3</sup>Research center, Al-Hada armed forces hospital Taif, KSA.

### Abstract

**Objective:** To study and compare subjective sleep quality and the quality of life resulting from the volume of sleep over the last month among shift and non-shift workers.

**Methods:** A cross-sectional comparative study was adopted. It included a representative sample of male factory workers in Aseer Industrial City, Saudi Arabia during October 2011. Out of 35 factories, 14 factories were selected randomly, and then from each selected factory, 24 workers were randomly invited to participate in the study. Half of these workers must be within shift-workers group and another half within daytime work group. A self-administrated questionnaire was used for data collection including demographic characteristics, questionnaires of Pittsburgh Sleep Quality Index (PSQI) to measure the quality and patterns of sleep and Functional Outcome of Sleep Questionnaire (FOSQ) to measure the functional outcome resulting from sleep demand.

**Results:** The study included 291 factory workers out of 336 invited to participate in the study, giving a response rate of 86.6%. Workers with good sleep quality represent 79.7% of non-shift group compared to only 32.4% of work shift group,  $p < 0.001$ . The mean score of all components of PSQI were significantly higher among workers with shifts than those without shifts. In addition, the Global PSQI score was significantly higher among workers with shifts than those without shifts ( $7.0 \pm 4.1$  versus  $3.0 \pm 3.0$ ). The mean score of the components of activity level, general productivity, social outcomes, and vigilance of FOSQ as well as the total FOSQ score were significantly higher among workers without shifts than those with shifts. There was a significant negative correlation between PSQI score and FOSQ score among workers of both groups.

**Conclusion:** Findings of the present study showed that the sleep quality was significantly better in non-shift workers than shift workers. In addition, the functional outcome was significantly better among worker of non-shift group than those of shift group. Poor sleep quality among shift workers is significantly associated with greater dysfunction.

**Key Words:** Work-Shift, Sleep, Psqi, Fosq, Saudi Arabia.

### INTRODUCTION

Sleep helps humans to maintain optimal emotional and social functioning while they are awake by giving rest during sleep to the parts of the brain that control emotions and social interactions. Many studies showed that the metabolic activity of human brain decreases after 24 hours of sustained wakefulness. Sleep deprivation can cause a decrease in body temperature, a decrease in the release of growth hormone and a decrease in immune system function as measured by white blood cell count. For the nervous system to work properly, sleep is important demand.<sup>[1]</sup>

Symptoms similar to those seen in people with jet lag are common in people who work in shifts. Because the wake time conflicts with powerful sleep-regulating cues like sunlight, they often become uncontrollably drowsy during work or may have difficulty falling asleep during their off time. Their biological clocks want to do one thing, while they are doing something entirely different. People working in shifts have an increased risk of mental, heart, gastrointestinal, emotional, problems. All these problems may be related to the disruption of the circadian sleep rhythm.<sup>[1,2]</sup>

Shift-work is essential component of working pattern

### Address for correspondence\*

Moataz Abdel-Fattah

Preventive Medicine Department (Research Center)  
Al-Hada Armed Forces Hospital, Taif, Saudi Arabia.

across KSA industrial workforce and is therefore an integral part of the lifestyle of a large proportion of these populations.<sup>[3]</sup> However, the number of people working alternating shifts in social, communication, industrial, leisure, transportation, medical services and in factories is probably rapidly rising.<sup>[4]</sup>

Shift-work can be defined as "a way of organizing daily working hours in which different persons or teams work in succession to cover more than the usual 8-hour workday, up to and including the whole 24 hours".<sup>[4]</sup>

In practical terms, any work schedule is considered shift-work if they are not within the 09:00-17:00 or 08:00-16:00 time range. Recently, as a response to social and economic demands, the so-called '24-hour society' has dramatically evolved and expanded. According to surveys were done in European countries, USA and developing countries, approximately 20% of employees are working in alternating shifts.<sup>[5,6]</sup>

The effort to get adequate sleep at daytime when working nights is familiar to many of workers. In fact, 15 million workers or 20% of the American workforce work other than the typical 9 to 5 shift. The resulting sleep deprivation leads to increased short term illness and long term medical problems.

A much higher incidence of accidents and mistakes are associated with sleep deprivation. The loss of productivity alone is estimated to be in the billions of dollars.<sup>[7-9]</sup>

The main objective of study is to assess the impact of shift-work on sleep quality among male factories workers.

## METHODOLOGY

A cross-sectional comparative study was conducted in Aseer Industrial City during October 2011. Aseer Industrial City is located in north of Khamis Masheet–AlAmmarah Road. It was started in 1410Hj (1990G) in 3 phases to reach a total area of 2.7 million square meters. It includes 35 factories. The industries permitted are divided into 3 categories food, metal and chemical. Around 1250 male workers, most of them can read and write English language. The most common nationalities are Arabs and South East Asian citizen.<sup>[3,10]</sup>

Assuming that sleep deprivation among factory workers as average as 50%. Setting the confidence interval of 95% and sample error of 5%, using the Raosoft sample size calculator program, the sample size calculation was 336 workers.<sup>[11]</sup>

Out of 1250 workers, 336 were selected using simple random sampling technique. The researcher selected 336 workers randomly by using a numbered list of workers name in all factories through online random number generator software.<sup>[12]</sup> Out of 35 factories, 14 factories were selected randomly, and then from each selected factory, 24 workers were randomly selected. Half of these 24 workers "12 workers" must be within shift-workers group and another half within daytime work group.<sup>[3]</sup>

The study questionnaires are composed of: 1. Demographic characteristic: age, nationality, marital status, type of occupation, type of accommodation, smoking status, taking sedatives or stimulant medications, past history of any medical or psychiatric disorders and duration of shift-working experience (in years). 2. PSQI which measures the quality and patterns of sleep. It differentiates "poor" from "good" sleep by measuring seven areas: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction over the last month. Scoring of answers is based on a 0 to 3 scale, whereby 3 reflect the negative extreme on the Likert Scale. A global sum of "5" or greater indicates a "poor" sleeper. Reliability and validity of PSQI produced a sensitivity of 89.6% and a specificity of 86.5% of patients versus control subjects. This cutoff score correctly identified 84% of patients with disorders of initiating or maintaining sleep, 89% of patients with disorders of excessive sleepiness, and 97% of depressed patients.<sup>[13,14]</sup> 3. Functional outcome of sleep which measures the functional outcome resulting from sleep demand accounting about 30 questions concerning activity level, vigilance, intimacy and sexual relationships, general productivity, social outcome. For scaling of items the respondents are asked to rate the difficulty of performing a given activity on a 4-point scale (no difficulty to extreme difficulty). For scoring mean-weighted item score for each subscale; subscale scores are totaled to produce a global score. Lower scores are associated with greater dysfunction. For reliability and validity, test-retest/reproducibility and Internal consistency is well reported and used by American Thoracic Society by its original language English. Content validity reported, seven judges rated clinical relevance.<sup>[15]</sup>

The Statistical Package for Social Sciences (SPSS version 18.0) was used for data entry and analysis. Descriptive statistics were computed in the form of frequency and percentage for categorical data and in the form of measures of central tendency (arithmetic mean and median) and measures of dispersion (standard deviation and range) for continuous variables. Regarding analytic statistics, chi-square test was utilized to test for the association and/or difference between categorical variables. Fischer's exact test was applied instead of chi-square

test, if the frequency in at least one cell was less than five. Mann Whitney non-parametric statistical test was applied to test for the difference between scores of PSQI and FOSQ in the two compared groups. In order to understand the relationship between dependent and independent variables, multivariate linear regression was carried out to measure the effect of workers' personal and medical characteristics on PSQI and FOSQ scores. The final model included only significant variable after control for confounding. Coefficient of determination (r-square) was computed to determine the variability in the dependent variable. Differences were considered as statistically significant when the p-value is less than 0.05.

## RESULTS

The study included 291 factory workers out of 336 invited to participate in the study, giving a response rate of 86.6%. Table 1 presents the personal characteristics of the participants according to their work shift. Age of workers in non-shift group was slightly higher than that of those in the work shift group (35.7±8.8 versus 34.0±10.4 years). However, this difference was not statistically significant. Saudi workers represent 21.7% of non-shift group compared to 31.8% of work shift group with no statistically significant difference, p=0.052. Married workers represent 72% of non-shift group compared to 64.2% of work shift group with no statistically significant difference, p=0.15. Production workers represent 42% of non-shift group compared to 47.3% of work shift group. This difference was statistically significant, p=0.02.

As shown in table (2), smoker workers represent 4.5% of work shift group compared to 26.6% of work non-shift group, p=0.01. Workers with history of intake of sedatives/stimulants represent 20.9% work shift group compared to only 4.2% of work non-shift group, p<0.001. History of diabetes mellitus, hypertension, and bronchial asthma were not significantly associated with work shift while workers with other chronic diseases (cancer, chronic hepatic diseases, renal diseases, etc) represent 22.4% of work non-shift group compared to 8.8% of work shift group, p=0.001. History of depression or anxiety were not significantly associated with work shift while workers with other psychological problems represent 23.8% of work non-shift group compared to 7.4% of work shift group, p<0.001. Workers with both physical and psychological problems represent 23.8% of work non-shift group compared to 8.8% of work shift group. The difference was statistically significant. P=0.001.

From table (3), it is obvious that sleep latency time was longer among workers of work shift group compared to work non-shift group (46.8±34.8 versus 22.8±18.6 minutes). This difference was statistically significant, p<0.001. On the other hand, the actual sleep time was longer among workers of non-shift group than among workers of work shift group (7.6±1.2 versus 7.2±1.5 hours). This difference was statistically significant, p=0.001. Workers with good sleep quality represent 79.7% of non-shift group compared to only 32.4% of work shift group, p<0.001.

As shown in table (4), the mean score of all components of PSQI (last month overall sleep quality, sleep latency, actual sleep, sleep hours, last month trouble sleeping, last month intake of medicine to sleep and last month trouble staying awake) were significantly higher among workers with shifts than those without shifts. In addition, the Global PSQI score was significantly higher among workers with shifts than those without shifts (7.0±4.1 versus 3.0±3.0).

Table (5) shows that the mean score of the components of activity level, general productivity, social outcomes, and vigilance

of FOSQ as well as the total FOSQ score were significantly higher among workers without shifts than those with shifts. There was no statistically significant difference between score of intimacy and sexual relations between both groups of workers.

As shown in table (6), after control for confounding, married workers versus singles, non-shift workers versus shift workers, non-smoker workers versus smokers, workers without physical problems versus those with physical problems and workers without psychological problems versus those with psychological problems had significantly better quality of sleep. All together were responsible for 31% variability of the PSQI score (r-square=0.31). Worker's age, nationality, residence and crowding index were not significantly associated with PSQI score.

As shown in table (7), after control for confounding, single workers versus married, non-smoker workers versus smokers, workers reside inside Khamis versus those reside outside Khamis and those having lower PSQI versus those having higher PSQI score had significantly better functional outcome of sleep All together were responsible for 42% variability of the FOSQ score (r-square=0.42). Worker's age, nationality, crowding index, history of physical problem and history of psychological problem were not significantly associated with FOSQ score.

## DISCUSSION

There are various kinds of combination in work shift duration and rotation, so many different forms of shift-work schedules. Especially from the viewpoint of cross-cultural comparability, it is hard to examine the similarities and

**Table 1: Comparison of the baseline characteristics of shift and non-shift workers.**

Personal characteristics	Work shifts				$\chi^2$ Test	p-value
	Yes (n=148)		No (n=143)			
	No.	%	No.	%		
<b>Age (years):</b>						
<30	56	37.8	41	28.7		
30-	43	29.1	42	29.4		
40-	41	27.7	49	34.3		
=50	8	5.4	11	7.7		
Range	19.0-73.0		19.0-55.0			
Mean±SD	34.0±10.4		35.7±8.8		3.43	<b>0.33</b>
<b>Nationality:</b>						
Saudi	47	31.8	31	21.7		
Non-Saudi	101	68.2	112	78.3	3.77	<b>0.052</b>
<b>Marital status:</b>						
Single	53	35.8	40	28.0		
Married	95	64.2	103	72.0	2.06	<b>0.15</b>
<b>Job:</b>						
Clerical	18	12.2	29	20.3		
Production	70	47.3	60	42.0		
Delivery	23	15.5	33	23.1		
Security	37	25.0	21	14.7	9.46	<b>0.02*</b>
<b>Residence:</b>						
Inside Khamis	123	83.1	119	83.2		
Outside Khamis	25	16.9	24	16.8	0.01	<b>0.98</b>
<b>Housing:</b>						
Villa	5	3.4	8	5.6		
Flat	26	17.6	21	14.7		
Accommodation	113	76.4	97	67.8		
Other (traditional house)	4	2.7	17	11.9	10.41	<b>0.01*</b>

**Table 2: Comparison of medical history and habits of shift and non-shift workers.**

	Work shifts				$\chi^2$ Test	p-value
	Yes (n=148)		No (n=143)			
	No.	%	No.	%		
<b>Smoking:</b>						
No	88	59.5	105	73.4		
Yes	60	40.5	38	26.6	6.35	<b>0.01*</b>
<b>Intake of sedatives/stimulants:</b>						
No	117	79.1	137	95.8		
Yes	31	20.9	6	4.2	18.39	<b>&lt;0.001*</b>
<b>History of:</b>						
Diabetes mellitus	1	0.7	3	2.1	Fisher	<b>0.36</b>
Hypertension	12	8.1	6	4.2	1.92	<b>0.17</b>
Bronchial asthma	12	8.1	6	4.2	1.92	<b>0.17</b>
Others	13	8.8	32	22.4	10.26	<b>0.001*</b>
Total have physical problems	38	25.7	46	32.2	1.49	<b>0.22</b>
Depression	2	1.4	0	0.0	Fisher	<b>0.50</b>
Anxiety	0	0.0	1	0.7	Fisher	<b>0.50</b>
Others	11	7.4	34	23.8	14.86	<b>&lt;0.001*</b>
Total have psychological problems	13	8.8	35	24.5	13.00	<b>&lt;0.001*</b>
Total have physical/psychological problems	38	25.7	47	32.9	1.82	<b>0.18</b>
<b>Have physical/psychological problems:</b>						
None	110	74.3	96	67.1		
Either	25	16.9	13	9.1		
Both	13	8.8	34	23.8	14.04	<b>0.001*</b>

**Table 3: Comparison of sleep latency, time, and quality of shift and non-shift workers.**

	Work shifts				Statistical Test	p-value
	Yes (n=148)		No (n=143)			
	No.	%	No.	%		
Sleep latency time (min)						
<=15	37	25.0	69	48.3		
16-30	42	28.4	60	42.0		
31-60	41	27.7	10	7.0		
>60	28	18.9	4	2.8		
Range	0-180		5-120			
Mean±SD	46.8±34.8		22.8±18.6		t=47.09	<0.001*
Median	30		20			
Actual sleep time (hours):						
Range	3-12		3-10			
Mean±SD	7.2±1.5		7.6±1.2		t=10.17	0.001*
Median	7		8			
Total sleep quality:						
Good	48	32.4	114	79.7	$\chi^2=65.90$	<0.001*
Poor	100	67.6	29	20.3		

(\*) Statistically significant at  $p < 0.05$ **Table 4: Comparison of Pittsburgh Sleep Quality (PSQI) components of shift and non-shift workers.**

Components	Work shifts				Mann Whitney Test	p-value
	Yes (n=148)		No (n=143)			
	Mean±SD	Median	Mean±SD	Median		
1: last month overall sleep quality	0.8±1.1	0.0	0.2±0.5	0.0	36.62	<0.001*
2: sleep latency	2.0±0.9	2.0	1.0±0.9	1.0	65.69	<0.001*
3: actual sleep	0.5±0.9	0.0	0.3±0.7	0.0	7.45	0.006*
4: hours sleep / hours in bed	0.3±0.6	0.0	0.0±0.3	0.0	19.06	<0.001*
5: last month trouble sleeping	1.5±0.9	1.0	1.0±0.7	1.0	28.37	<0.001*
6: last month intake of medicine to sleep	1.3±0.9	1.0	0.4±0.7	0.0	79.49	<0.001*
7: last month trouble staying awake	0.6±1.0	0.0	0.1±0.4	0.0	44.66	<0.001*
Global PSQI score	7.0±4.1	6.0	3.0±3.0	2.0	80.97	<0.001*

(\*) Statistically significant at  $p < 0.05$ **Table 5: Comparison of Functional Outcomes of Sleep Questionnaire (FOSQ) components of shift and non-shift workers.**

Components	Work shifts				Mann Whitney Test	p-value
	Yes (n=148)		No (n=143)			
	Mean±SD	Median	Mean±SD	Median		
Activity level	2.7±0.5	2.60	3.1±0.6	3.10	37.10	<0.001*
General productivity	2.4±0.7	2.30	3.0±0.8	2.90	39.08	<0.001*
Social outcomes	1.9±0.6	2.00	2.4±0.7	2.35	26.19	<0.001*
Vigilance	2.0±0.9	1.70	2.6±1.0	2.30	31.50	<0.001*
Intimacy/sexual relations	1.4±1.6	0.25	1.5±1.8	0.00	0.24	0.63
Total FOSQ score	2.3±0.6	2.25	2.8±0.7	2.70	34.21	<0.001*

(\*) Statistically significant at  $p < 0.05$

**Table 6: Best fitting multiple linear regression model for Pittsburgh Sleep Quality (PSQI) score.**

	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Constant	11.559	.989		11.692	.000	9.613	13.505
<b>Marital status</b> (reference: single)	-1.104	.446	-.125	-2.478	.014	-1.981	-.227
<b>Shift</b> (reference: non)	-3.649	.422	-.442	-8.640	.000	-4.480	-2.818
<b>Smoking</b> (reference: non)	1.046	.455	.120	2.297	.022	.150	1.942
<b>Physical problem</b> (reference: non)	2.609	.622	.286	4.198	.000	1.386	3.833
<b>Psychological problem</b> (reference: non)	-2.100	.779	-.189	-2.697	.007	-3.633	-.568

r-square=0.31 Model ANOVA: F=25.03, p<0.001

Variables entered and excluded: Age, and nationality

**Table 7: Best fitting multiple linear regression model for Functional Outcomes of Sleep Questionnaire (FOSQ) score.**

	Unstandardized Coefficients		Standardized Coefficients	t-test	P-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Constant	14.713	.791		18.601	.000	13.156	16.269
Marital status: (reference: single)	1.171	.341	.158	3.434	.001	.500	1.842
Smoking: (reference: non)	-.954	.339	-.130	-2.813	.005	-1.621	-.286
Residence: (reference: inside)	-1.273	.422	-.138	-3.021	.003	-2.103	-.444
PSQI score:	-.455	.039	-.543	-11.656	.000	-.532	-.378

r-square=0.31 Model ANOVA: F=25.03, p<0.001

Variables entered and excluded: Age, and nationality

differences in the prevalence of sleep problems between the studies conducted in and outside KSA. As suggested by Smith et al.<sup>[16]</sup> the situation is not entirely straightforward and consideration has to be given to working conditions and the nature of the job being done as well.

The results of this study demonstrated an inverse relationship between the quality of sleep and the functional outcomes scores among factory workers (For PSQI, greater score indicates a "poor" sleeper while for FOSQ, lower scores are associated with greater dysfunction). These are consistent with laboratory investigations that have demonstrated that sleep deprivation and misalignment of circadian phase as experienced during rotating shift work are each associated with frequent lapses of attention and increased reaction time, leading to increased error rates on performance tasks and low rate of productivity.<sup>[17,18]</sup> According to a review article by Doi Y, 2005,<sup>[9]</sup> poor sleep quality was proven to be related to perceived health, sick absence, occupational activities.

Irregular work hours seem to exert strong, acute effect on sleep and alertness in relation to night and morning work. The

effects seem, however, to linger, and also affect days off. The level of the disturbances is similar to that seen in clinical insomnia, and may be responsible for considerable human and economic costs due to fatigue related accidents and reduced productivity. The mechanism behind the disturbances is the sleep-interfering properties of the circadian system during day sleep and the corresponding sleep-promoting properties during night work.<sup>[20]</sup> In accordance with that finding, in the present study work-shift workers had bad quality of sleep and consequently bad functional outcomes.

In the present study, workers with good sleep quality represent 79.7% of non-shift group compared to only 32.4% of work shift group, p<0.001. This finding is in accordance with what has been reported in a study conducted in Japan that showed that Nurses working rotating shifts experienced more sleeping problems and sleepiness at work than nurses working continuous day/night shifts<sup>[21]</sup>. Furthermore, nurses in rotating shifts had more accidents or errors. Therefore, they recommended that rotating shifts should be avoided to assure safety of nurses and patients. In addition, other studies supported our finding.<sup>[22, 23]</sup>

In addition, among Japanese workers, for non-shift workers, poor sleep quality was 33 to 44% and 42 to 45% for men and women, and excessive daytime sleepiness was 7% and 13% for men and women, respectively.<sup>[19]</sup>

Previous research well documented the adverse effects of shift working.<sup>[24]</sup> for example, In a Japanese study, insomnia was more prevalent among shift workers than among non-shift ones (38% versus 26%); both groups were employed at the same company and assessed using the same instrument and definition of sleep complaints.<sup>[25]</sup> The other study also showed that two-rotating shift, fixed night shift and daytime works were in order of prevalence of sleep complaints and depression in male manual workers.<sup>[26]</sup>

In the present study, being single, with work shifts, smoker, having chronic physical problem or psychological problem were found to be risk factors for bad sleep quality among factory workers. In some other studies, short sleep duration, stress, younger age, having children, alcohol or medication use to aid induce sleep, smoking, the frequency of non-working days and night shifts, social support, patient-nurse communications and the severity of patient's health conditions were suggested as putative risk factors for insomnia and sleepiness in some nurse studies.<sup>[27-30]</sup>

Circadian rhythms have been found to be associated with changes in mental and physical performance.<sup>[31]</sup> In accordance with that, in the present study history of physical or psychological problems were significantly associated with sleep problems. Circadian rhythms may partly explain why job performance can vary over a 24-hour period, with a low point occurring very late at night or very early in the morning. Some basic human physiological functions are depressed during the night, which may suggest that people are not well suited for night work.<sup>[31]</sup>

A limitation of this study is that it was carried out on a given factory worker population in Aseer Industrial City, with a self-reported questionnaire, which might result in a biased reply from each respondent. In addition, it targeted a very limited sample of study subjects, full-time male workers employed at large-scale companies in Asser Industrial city. Therefore, generalizations should be made carefully and be limited only to the investigated population. This study was cross-sectional, and causation and the temporal order of sleep problems and risk factors cannot be determined.

## CONCLUSION

Conclusively, Poor sleep quality among shift workers is significantly associated with greater dysfunction. The finding of the present study encourages the need for early diagnosis and treatment of sleep disorders among industrial workers. Even if shifts lead to circadian rhythm disruption and accidents, factory administrators will have to determine their priorities: the staffing requirements of factories may limit the potential for altering factory schedules to improve the health of workers and their safety. Finally, further studies are needed to plan interventions that decrease burnout and improve sleep quality and productivity for shift-work factory workers. These interventions would likely improve workers' overall well-being and working conditions.

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