RESEARCH ARTICLE

Effect of Shift-Work on Sleeping Quality of Male Factory Workers in Saudi Arabia

Metrek Ali S AlMetrek

Health Promotion and Education Administration, MOH, Abha, Saudi Arabia

Correspondence to:
Metrek Ali S AlMetrek
(almetrek421@hotmail.com)

Received: 05.08.2013
Accepted: 10.08.2013

DOI: 10.5455/njppp.2014.4.100820131

ABSTRACT

Background: Shift-work is essential component of working pattern across KSA industrial workforce and is therefore an integral part of the lifestyle of a large proportion of these populations. However, the number of people working alternating shifts in social, communication, industrial, leisure, transportation, medical services and in factories is probably rapidly rising.

Aims & 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.

Materials and 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 ± 4.1 versus 3.0 ± 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; Pittsburgh Sleep Quality Index (PSQI); Functional Outcome of Sleep Questionnaire (FOSQ); Saudi Arabia

INTRODUCTION

Seep 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 works properly, sleep is important demand.[1]

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.[1,2]

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

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".[4] 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.[5,6]

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.[7-9]

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

MATERIALS AND METHODS

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. Around1250 male workers, most of them can read and write English language. The most common nationalities are Arabs and South East Asian citizen.[3,10]

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.[11]

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.[12] 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.[3]

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.[13,14] (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.[15]

The Statistical Package for Social Sciences (SPSS version 20.0) 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.

Table-1: Comparison of the Personal Characteristics of Shift and Non-Shift Workers

Personal Characteristics		Work shifts: Yes (n=148) No.	Yes (n=148) %	No (n=143) No.	No (n=143) %	χ^2 Test	p-value
Age (years)	<30	56	37.8	41	28.7	3.43	**0.33**
	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			
Nationality	Saudi	47	31.8	31	21.7	3.77	**0.052**
	Non-Saudi	101	68.2	112	78.3		
Marital Status	Single	53	35.8	40	28.0	2.06	**0.15**
	Married	95	64.2	103	72.0		
Profession	Clerical	18	12.2	29	20.3	9.46	**0.02***
	Production	70	47.3	60	42.0		
	Delivery	23	15.5	33	23.1		
	Security	37	25.0	21	14.7		
Residence	Inside Khamis	123	83.1	119	83.2	0.01	**0.98**
	Outside Khamis	25	16.9	24	16.8		
Housing	Villa	5	3.4	8	5.6	10.41	**0.01***
	Flat	26	17.6	21	14.7		
	Accommodation	113	76.4	97	67.8		
	Other (traditional house)	4	2.7	17	11.9		

Table-2: Comparison of Medical History and Habits of Shift and Non-Shift Workers

Medical History and Habits		Work shifts: Yes (n=148) No.	Yes (n=148) %	No (n=143) No.	No (n=143) %	χ^2 Test	p-value
Smoking	No	88	59.5	105	73.4	6.35	**0.01***
	Yes	60	40.5	38	26.6		
Intake of Sedatives/ Stimulants	No	117	79.1	137	95.8	18.39	**<0.001***
	Yes	31	20.9	6	4.2		
History of	Diabetes Mellitus	1	0.7	3	2.1	Fisher	**0.36**
	Hypertension	12	8.1	6	4.2	1.92	**0.17**
	Bronchial Asthma	12	8.1	6	4.2	1.92	**0.17**
	Others	13	8.8	32	22.4	10.26	**0.001***
	Total Physical Problems	38	25.7	46	32.2	1.49	**0.22**
	Depression	2	1.4	0	0.0	Fisher	**0.50**
	Anxiety	0	0.0	1	0.7	Fisher	**0.50**
	Others	11	7.4	34	23.8	14.86	**<0.001***
	Total Psychological Problems	13	8.8	35	24.5	13.00	**<0.001***
	Total Physical/ Psychological Problems	38	25.7	47	32.9	1.82	**0.18**
Physical/ Psychological Problems	None	110	74.3	96	67.1	14.04	**0.001***
	Either	25	16.9	13	9.1		
	Both	13	8.8	34	23.8		

* Statistically significant at p<0.05

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.

Table-3: Comparison of Sleep Latency, Time, and Quality of Shift and Non-Shift Workers

Characteristics		Work shifts: Yes (n=148) No.	Yes (n=148) %	No (n=143) No.	No (n=143) %	Test	p-value
Sleep Latency Time (min)	<=15	37	25.0	69	48.3	t = 47.09	**<0.001***
	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			
	Median	30		20			
Actual Sleep Time (hours)	Range	3-12		3-10		t = 10.17	**0.001***
	Mean ± SD	7.2±1.5		7.6±1.2			
	Median	7		8			
Total Sleep Quality	Good	48	32.4	114	79.7	χ^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: Yes (n=148) Mean ± SD	Yes (n=148) Median	No (n=143) Mean ± SD	No (n=143) Median	Mann Whitney Test	p-value
Last month overall sleep quality	0.8±1.1	0.0	0.2±0.5	0.0	36.62	**<0.001***
Sleep latency	2.0±0.9	2.0	1.0±0.9	1.0	65.69	**<0.001***
Actual sleep	0.5±0.9	0.0	0.3±0.7	0.0	7.45	**0.006***
Sleep Hours / hours in bed	0.3±0.6	0.0	0.0±0.3	0.0	19.06	**<0.001***
Last month trouble sleeping	1.5±0.9	1.0	1.0±0.7	1.0	28.37	**<0.001***
Last month intake of medicine to sleep	1.3±0.9	1.0	0.4±0.7	0.0	79.49	**<0.001***
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: Yes (n=148) Mean ± SD	Yes (n=148) Median	No (n=143) Mean ± SD	No (n=143) Median	Mann Whitney Test	p-value
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

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 diseases 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.

Table-6: Best Fitting Multiple Linear Regression Model for Pittsburgh Sleep Quality (PSQI) Score

	U. CoE		S. CoE	t-test	p-value	95% CI for B	
	B	S. E				Lower	Upper
Constant	11.56	0.99		11.69	0.000	9.61	13.51
Marital Status (reference: single)	-1.10	0.45	-0.13	-2.48	0.014	-1.98	-0.23
Shift (reference: non)	-3.65	0.42	-0.44	-8.64	0.000	-4.48	-2.82
Smoking (reference: non)	1.05	0.45	0.12	2.30	0.022	0.15	1.94
Physical problem (reference: non)	2.61	0.62	0.29	4.20	0.000	1.39	3.83
Psychological Problem (reference: non)	-2.10	0.78	-0.19	-2.70	0.007	-3.63	-0.57

U. CoE: Unstandardized Coefficients; S. CoE: Standardized Coefficients; S. E: Standard Error; r-square=0.31; CI: Confidence Interval; Model ANOVA: F=25.03, p<0.001; Variables entered and excluded: Age, nationality and crowding index

Table-7: Best Fitting Multiple Linear Regression Model for Functional Outcomes of Sleep Questionnaire (FOSQ) Score

	U. CoE		S. CoE	t-test	p-value	95% CI for B	
	B	S. E				Lower	Upper
Constant	14.71	0.79		18.60	0.000	13.16	16.27
Marital Status (reference: single)	1.17	0.34	0.16	3.43	0.001	0.50	1.84
Shift (reference: non)	-0.95	0.34	-0.13	-2.81	0.005	-1.62	-0.29
Smoking (reference: non)	-1.27	.042	-0.14	-3.02	0.003	-2.10	-0.44
Physical problem (reference: non)	-0.46	0.04	-0.54	-11.65	0.000	-0.53	-0.38
Psychological Problem (reference: non)	14.71	0.79		18.60	0.000	13.16	16.27

U. CoE: Unstandardized Coefficients; S. CoE: Standardized Coefficients; S. E: Standard Error; r-square=0.42; Model ANOVA: F=50.97, p<0.001; Variables entered and excluded: Age, nationality, crowding index, shift, physical problem, psychological problem

From table 3, it is obvious that sleep latency time was longer among workers of wok 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 ± 4.1versus 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 differences in the prevalence of sleep problems between the studies conducted in and outside KSA. As suggested by Smith et al.[16], 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.[17,18] According to a review article by Doi Y, 2005[9], 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.[20] 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.[21] 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.[22,23] 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.[19] Previous research well documented the adverse effects of shift working.[24] 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.[25] 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.[26]

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.[27-30]

Circadian rhythms have been found to be associated with changes in mental and physical performance.[31] 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.[31]

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.

REFERENCES

1. American Academy of Sleep Medicine, in association with the European Sleep Research Society, the Japanese Society of Sleep Research and the Latin American Sleep Society. The International Classification of Sleep Disorders: Diagnostic and Coding Manual. 2nd ed. IL, USA: American Academy of Sleep Medicine, 2005.
2. Russo MB, Vo A, Labutta R, Black I, Campbell W, Greene J, et al. Human biovibrations: assessment of human life signs, motor activity, and cognitive performance using wrist-mounted actigraphy. Aviat Space Environ Med. 2005;76(7 Suppl):C64-74.
3. Saudi Industrial Property Authority, Aseer Region. (cited 2013 March 23). Available from: URL: http://www.modon.gov.sa/English/IndustrialCities/Industri alCities/Pages/Assir.aspx.
4. United States Bureau of Labor Statistics. Workers on Flexible and Shift Schedules in May 2004. United States Department of Labor, Bureau of Labor Statistics, DC, USA. 2004
5. Costa G. Work-shift and occupational medicine: an overview. Occup Med. (Lond.) 2003;53(2):83-88
6. OECD Employment Outlook. Organization for Economic Cooperation and development, Paris, France, Chapter 1, 2004. (cited 2013 March 23). Available from: URL: www.oecd.org/dataoecd/8/5/34846847.pdf
7. Ohayon MM, Lemoine P, Arnaud-Briant V, Dreyfus M. Prevalence and consequences of sleep disorders in a workshifter population. J Psychosom Res. 2002;53(1):577-583
8. Drake CL, Roehrs T, Richardson G, Walsh JK, Roth T. Work-shift sleep disorder: prevalence and consequences beyond that of symptomatic day workers. Sleep. 2004;27(8):1453-1462
9. 9. Schwartz JR, Roth T. Work-shift sleep disorder: burden of illness and approaches to management. Drugs 2006;66(18):2357-2370
10. Central Department for Statics and Information in KSA, 2009. (cited 2013 March 23). Available from: URL: http://www.cdsi.gov.sa/2010-10-02-08-30-17
11. Online Roasoft sample size calculator. (cited 2013 March 23). Available from: URL: http://www.raosoft.com/samplesize.html.
12. Online random number generator. (cited 2013 March 23). Available from: URL: http://stattrek.com/Tables/Random.aspx.
13. Garbarino S. Sleep disorders and day sleepiness in a population of work-shifters of the State Police Centro di Medicina del Sonno, D.I.S.M., Università di Genova GItal Med Lav Ergon. 1999;21(1):13-9.
14. Rahman A. Workers' sleep quality as determined by shift system and demographic factors Int Arch Occup Environ Health. 1988; 60(6):425-9.
15. American Thoracic Society. Functional Outcomes of Sleep Questionnaire , 2007 (cited 2013 March 23). Available from: URL: http://qol.thoracic.org/sections/instruments/fj/pages/fosq.h tml#1
16. Smith L, Folkard S, Tucker P, Macdonald I. Work shift duration: a review comparing eight hour and 12 hour shift systems. Occup Environ Med. 1998; 55: 217–29.
17. Dinges DF, Ome MT, Whitehouse WG, Orne EC. Temporal placement of a nap for alertness: contributions of circadian phase and prior wakefulness. Sleep. 1987; 10:313-329.
18. Hamilton P, Wilkinson RT, Edwards RS. A study of four days partial sleep deprivation. In: Colquhoun WP, ed.

Aspects of Human Efficieny. London, England: English Universities Press, Ltd.; 1972:101-113.
19. Doi Y. An epidemiologic review on occupational sleep research among Japanese Workers; Review article. Industrial Health 2005; 43: 3–10
20. Åkerstedt T. Shift work and disturbed sleep/wakefulness. Occup Med. 2003; 53:89–94
21. Suzuki K, Ohida T, Kaneita Y, Yokoyama E, Miyake T, Harano S, et al. Mental health status, shift work, and occupational accidents among hospital nurses in Japan. J Occup Health. 2004; 46:448–54.
22. Dorrian J, Lamond N, van den Heuvel C, Pincombe J, Rogers AE, Dawson D. A pilot study of the safety implications of Australian nurses' sleep and work hours. Chronobiol Int. 2006; 23:1149–63
23. Kunert K, King ML, Kolkhorst FW. Fatigue and sleep quality in nurses. J Psychosoc Nurs Ment Health Serv. 2007; 45:30–37.
24. Monk TH. Shift work. In: Principles and practice of sleep medicine. eds. by Kryger MH, Roth T, Dement WC, 600–5, WB Saunders, Philadelphia, 2000.
25. Nakata A, Haratani T, Takahashi M, Kawakami N, Arito H, Fujioka Y, et al. Job stress, social support at work, and insomnia in Japanese shift workers. J Hum Ergol (Tokyo). 2001; 30: 203–9.
26. Kobayashi T, Kageyama T, Kaneko S, Tanaka M .A crosssectional survey on insomnia and depressive symptoms in Japanese male shift workers with various shit patterns. The Journal of Yamaguchi Prefectural University of Nursing. 2002;6: 21–7 (in Japanese).
27. Ohida T, Takemura S, Nozaki N, Kawahara K, Sugie T, Uehata T. The influence of lifestyle and nightshift work on sleep problems among female hospital nurses in Japan. Nippon Koshu Eisei Zasshi. 2001;48: 595– 603 (in Japanese).
28. Ohida T, Kamal AMM, Sone T, Ishii T, Uchiyama M, Minowa M, Nozaki S. Night-shift work related problems in young female nurses in Japan. J Occup Industrial Health. 2005; 43, 150–6.
29. Kageyama T, Nishikido N, Kobayashi T, Oga J, Kawashima M. Relationship between work stress and insomnia among female hospital nurses with irregularly rotating shiftwork. Kokorono Kenko. 2002; 17: 50– 7 (in Japanese).
30. Kageyama T, Nishikido N, Kobayashi T, Oga J, Kawashima M. Cross-sectional survey on risk factors for insomnia in Japanese female hospital nurses working rapidly rotating shift systems. J Hum Ergol (Tokyo). 2001; 30: 149–54.
31. Scott, A.J., and Ladou, J. Shiftwork: Effects on Sleep and Health With Recommendations for Medical Surveillance and Screening. Occup Med. 1999;5(2): 273-299.

Cite this article as: AlMetrek MAS. Effect of shift-work on sleeping quality of male factory workers in Saudi Arabia. Natl J Physiol Pharm Pharmacol 2014; 4:61-68.
Source of Support: **Nil**
Conflict of interest: **None declared**