Assessing quality of sleep, its functional outcome and excessive day time sleepiness in shift workers and non-shift workers

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Abstract

Background and Aims: .
Shift work has been growing more prevalence and involves irregular working hours when compared to daytime work schedule. This study aims to assess sleep quality, its functional outcome, excessive daytime sleepiness and incidence of obstructive sleep apnea between shift and non-shift workers.

Methods:
The study candidates were randomly drawn Nepalese, from age 18 years and older, and were enrolled between January 2018 to January 2019. The subjects were divided into either: Shift work or Non-Shift work. The assessment measures were done with Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), STOP-BANG and FOSQ-10 (Functional Outcome of Sleep Quality – 10), using a standard form.

Results:
A total of 358 participants were included in the main study (176 Non-shift workers, and 182 Shift-workers). The mean BMI among the two group were not significantly different (p =0.43). There was significant difference with 25% Non-Shift workers and 41.21% of Shift workers were found to have Abnormal Sleepiness in the Epworth Sleepiness Scale score (p=0.004). Shift workers showed comparatively higher values for Epworth Sleepiness scale compared to Non-Shift workers in Mann-Whitney analysis, with mean rank 194.11 versus 164.39, respectively, p=0.006. Similarly, 26.29% Non-Shift workers and 36.72% Shift workers were found to have abnormal FOSQ-10 scores, $\chi 2$ (1) =4.44, p=0.035. 7.95% of Non-Shift workers and 6.59% of Shift-workers were found to have high risk of OSA in STOP BANG questionnaire, with no significant association, p=0.725

Conclusions:
Shift work caused excessive daytime sleepiness and had worse functional outcome but did not increase probability of obstructive sleep apnea.

Introduction

Shift work' involves irregular or unusual hours, compared to those of a normal daytime work schedule.[1] Any 24 hour job mandates shift work and rotating duties. Changing hours of duties and night shifts have direct impact on sleep rhythm, quality of sleep and sleep related abnormalities.[2] With the decreased sleep quality and duration, shift work has been associated with excessive daytime sleepiness. It contributes towards the negative impacts of shift work. There may be association of other sleep disorders and sleep related breathing abnormalities with shift work sleep disorder.[3] Hence, assessing sleep quality and its functional outcome is important in order to identify potential medical condition associated with it and increase efficiency of work.

According to 3rd European Survey on Working conditions, the classical working day that comprises of 7-8 a.m. to 5-6 p.m., Monday to Fridays work only encompasses around 27% of employed and 8% of self-employed population.[4] Hence majority of works, according to recent data, are mostly those with shift duties, night duties, that can include prolonged duty periods, which can be around 12 hours night shifts.[5]

Innumerable jobs operate shift-wise and innumerable people work day in and day out. In particular night shifts bring changes in circadian rhythm. Professions that are associated with shift work include drivers, nurses, doctors, laboratory technicians, paramedics, pilots, air traffic controllers, industrial workers, guards, and police officers.5 Junior doctors, trainees, nurses and paramedical staff spend maximum amount of their early carriers in shift duties including nights. Ill formulated night shifts can have negative effects on professional, educational and social aspect of their lives.[6]

There is a range of health problems associated with shift work, which includes conditions like insomnia, constipation, as well as severe problems such as depression, metabolic syndrome, cardiovascular diseases & cancer. Mental problems associated with rotating duties can consist of anxiety, mood disorders, and fatigue-related accidents; and "the length of hours is a key factor for fatigue-related disorders".[7] Biochemically, nocturnal sleep disturbance has been positively correlated with levels of inflammatory markers like TNF alpha.[8]

Risk of near driving accidents and actual accidents are reported in night shift workers after returning home from work.[9]

In light of growing prevalence of shift work and its already massive impact on health and social life, we intend to assess sleep quality, its functional outcome, excessive daytime sleepiness and incidence of obstructive sleep apnoea between shift and non-shift workers. All four measures are standard access points in sleep disorders and are assessed by standard tools.

2 | METHODOLOGY:

Subjects:

All subjects were required to be 18 years or older consenting to the study. Nepali males and females of different ethnicities were enrolled in the study. Subjects were drawn randomly from different working sectors in Kathmandu, Nepal. Standard forms were used primarily as a mode for data collection, with English as being the primary language of the forms. For subjects who were not apt with the English language, printed format of the same form was used with appropriate translation in Nepali language.

We contacted 500 eligible candidates for the study, of these 359 completed the interview and were enrolled in the study between Jan 2018 to Jan 2019. All who completed the study were Nepalese by nationality. We reached out to random working population in Kathmandu, since it is the capital city and people working here represent all of the country geographically. All the 4 questionnaire tools were completed by all the subjects. There was no incidence of not understanding the questions in the forms by the any subjects. The subjects were not paid for the study.

Definitions:

Household workers were included as Non-Shift workers, together with daytime job holders working 9 AM to 5 PM were included in Non-shift workers. Shift workers included medical staffs, including interns, trainees and junior faculties.

Variables:

The independent variable in the study was type of work, with the subjects divided into either: Shift work or Non-Shift work. Both shift workers with night duties and Shift workers without night duties were included in Shift work group. The assessment measures were done with Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), STOP-BANG and FOSQ-10 (Functional Outcome of Sleep Quality – 10).

Assessment:

Email, telephone were used as initial assessment. Personal visit to staffs of medical teams for consent was also carried out. Subjects were asked to select the category that best described their current work schedule. Response choices included "Non-Shift work", "Shift work without night duties" and "Shift work with night duties". Standard set of PSQI questions were asked the Google form, the total score of PSQI was calculated using online calculator, provided by the original researcher. The absolute total score was assessed and individual data were categorically divided into: Normal (Total PSQI score<5) and Abnormal (Total PSQI score≥5).

For ESS, a composite total score was manually calculated for all the data. Then the data were divided categorically into Normal Sleepiness (ESS total score<7), Average Sleepiness (ESS total score 7-8) and Abnormal "Probably pathological" Sleepiness (ESS total Score ≥9).

STOP-BANG questions included "Yes or No" questions to Snoring, Tiredness, Observed breathing cessation while asleep, treated for high blood pressure and shirt collar size greater than or smaller than 16 inches. Weight in kilograms and height in feet and inches were asked and after conversion to meters, BMI were calculated for each participants. The total STOPBANG score was assessed and then categorically divided into: Low Risk of OSA (STOPBANG total score ≤2), Intermediate risk of OSA (STOPBANG total score 3-4) and High risk of OSA (STOPBANG total score ≥5).

Functional outcome of Sleep Questionnaire -10 (FOSQ-10) was used as the shorter version of standard FOSQ. Excel file to use for scoring that will calculate the sub-scores and Total Score of FOSQ was done with calculator provided by the original researcher.

The normality test was conducted using the Shapiro-Wilk test for four variables, namely, Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), STOP BANG score and Functional Outcomes of Sleep Questionnaire – 10 (FOSQ-10) for all 3 study groups – Non-Shift workers, Shift workers without night duties and Shift workers with night duties. All variables were non-normal in their distribution. Hence, non-parametric statistical tests were run for the analysis. For the non-parametric test Chi-square test was conducted for the categorical data derived from the absolute total score for each parameters. Degree of freedom was also reported with Chi-square, Effect size was reported with Cramer's V. P-value of <0.05 was concluded as being statistically significant. For the absolute total score of the parameters, mean ranks were calculated and analysis was done with Mann-Whitney U test.

3 | RESULTS:

An overview on the demographics of the participants of the study is provided by Table 1. A total of 358 participants were included in the main study. There were 176 Non-shift workers, and 182 Shift-workers which included 118 Shift-workers with night duties.

The mean BMI among the two group were not significantly different (p =0.43). In the entire study cohort, 34 (9.5%) were obese, BMI ≥ 30kg/m2 (10.2% of Non-Shift workers versus 8.8% of Shift-workers; p = 0.64). A total of 15 participants (4.2%) reported to have used over the counter medicine to fall asleep in the past month of study with no significant difference between the two groups (2.8% of Non-Shift workers versus 5.5% of Shift workers; p = 0.168).

Table 1. Demographic characteristics of study population with baseline characteristics

	Non-Shift Workers	Shift-Workers	p Value
Mean age, years	31.02 ± 13.31	27.81 ± 7.87	0.06
Female, %	35.8	46.2	0.046
Mean BMI, kg/m2	23.91 ± 5.87	23.67 ± 4.9	0.43
Sleep Duration, hours	6.66	6.68	0.906
Use of prescribed medicine to fall asleep in the past month, %	2.8	5.5	0.168
Obesity, %	10.2	8.8	0.64

BMI, Body Mass Index

The comparisons percentage of participants above and below the cut-off range for all the 4 questionnaires used – PSQI, ESS, STOP BANG and FOSQ – 10, between Non-Shift workers and Sift workers are shown in Table 2.

Analysing the Epworth Sleepiness Scale score as shown in Table 2, 25% Non-Shift workers and 41.21% of Shift workers were found to have Abnormal Sleepiness. A significant association between Shift workers and abnormal level of ESS score was found, $\chi 2$ (2) = 10.902, p=0.004, Effect size=0.175. There were 55.11% Non-Shift workers and 45.05% Shift workers with Normal Sleepiness in ESS. Similarly there were 19.89% Non-Shift workers and 13.74% Shift workers with average sleepiness.

For the FOSQ -10, 73.71% of Non-Shift workers and 63.28% Shift workers were found to have Normal values. 26.29% Non-Shift workers and 36.72% Shift workers were found to have abnormal FOSQ-10 scores. A significant level of association was found between Shift workers and abnormal level of FOSQ-10, $\chi 2$ (1) =4.44, p=0.035, Effect size=0.112.

Comparing the PSQI, 45.45% of Non-Shift workers and 39.01% of Shift workers were found to have normal values. 54.55% Non-Shift workers and 60.99% of Shift workers were found to have abnormal PSQI. There was no significant association between the two groups, $\chi 2$ (1) = 1.523, p=0.217, Effect size=0.065.

Similarly, 72.16% of Non-Shift workers and 75.83% of Shift-workers were found to have Low Risk of OSA in STOP BANG questionnaire. 19.89% Non-Shift workers and 17.58% Shift workers had intermediate risk, and 7.95% Non-Shift workers and 6.59% Shift workers had high risk. There was no significant association between type of work and STOP BANG scores, $\chi 2$ (2) = 0.644, p=0.725, effect size= 0.042.

Mann-Whitney analysis together with median, interquartile range and minimum-maximum value for Shift and Non-Shift workers for all 4 questionnaires was used and shown in Table 3. Shift workers showed comparatively higher values for Epworth Sleepiness scale compared to Non-Shift workers, mean rank 194.11 versus 164.39,

Table 2. Comparisons percentage of participants above and below the cut-off range for all the 4 questionnaires used – PSQI, ESS, STOP BANG and FOSQ – 10, between Non-Shift workers and Sift workers with Chi-square evaluation and effect size.

Test	Assessment	Non-Shift Worker	Shift Worker	$\chi 2$(dF)	p-value	Effect Size (Cramer's V)
PSQI	Normal, %	45.45	39.01	1.523 (1)	0.217	0.065
	Abnormal, %	54.55	60.99	N		
ESS	Normal Sleepiness, %	55.11	45.05	10.902 (2)	0.004	0.175
	Average Sleepiness, %	19.89	13.74			
	Abnormal (possibly pathological) Sleepiness, %	25	41.21			
STOP BANG	Low, %	72.16	75.83	0.644 (2)	0.725	0.042
	Intermediate, %	19.89	17.58			
	High, %	7.95	6.59			
FOSQ – 10	Normal, %	73.71	63.28	4.44 (1)	0.035	0.112
	Abnormal, %	26.29	36.72			

respectively, p=0.006, Effect size=0.166.

Table 3. Mann-Whitney analysis for all 4 variables with p-value

Test	Measure	Non-Shift workers	Shift workers	p-value	Effect Size
PSQI	Mean Rank	174.34	182	0.349	0.042
ESS	Mean Rank	164.39	194.11	0.006	0.166
STOP BANG	Mean Rank	185.86	173.35	0.234	0.07
FOSQ – 10	Mean Rank	185.99	167.12	0.082	0.11

4 | Discussion:

In this study we have tried to distinguish differences in quality of sleep between shift workers and non-shift workers through four standard questionnaires: PSQI, ESS, STOP BANG and FOSQ-10.

The differences in sleep quality among Non-Shift and Shift workers in Nepalese population has not been reported till date. We have conducted the research in Kathmandu, a major hub for patients from throughout the country. Sleep medicine is a new frontier in health context of Nepal. Work is an important aspect of life and can have direct effect to health of an individual.

Among the patients (aged 5 years and older) visiting health care facilities in Nepal, 17.1% of males and 11.3% females presents with respiratory symptoms[10] and more than half the patients have some form of sleep disturbance.[11] With such a large contribution of sleep disturbances towards negative health outcomes, further data regarding sleep disturbances is lacking. With such a huge impact of health and relatively no studies, our research aims to bridge the gap and also open up possibilities for future research in the field.

We selected four questionnaires for our study, all 4 have been used in clinical settings and validated. The first one, Pittsburgh Sleep Quality Index (PSQI) measures sleep quality and disturbances over a one-month time interval with its seven components yielding one global score. A global PSQI score greater than 5 was found to have diagnostic sensitivity of 89.6% and specificity of 86.5% (kappa = 0.75, p less than 0.001) in distinguishing good and poor sleepers.[12]

Similarly, Murray Johns in 1991 devised Epworth Sleepiness Scale (ESS) as a numerical scale through a subjective assessment of daytime sleepiness.[13] We found a significant difference in daytime sleepiness between Shift and Non-Shift workers through ESS (mean rank 194.11 versus 164.39, respectively, p=0.006, Effect size=0.166). There were 25% of Non-shift workers and 41.21% of Shift workers with abnormal (possibly pathological) Sleepiness on ESS (χ2=10.902; p-value=0.004). Alshahrani et al. conducted a similar research on Shift health care workers in Saudi Arabia. The total mean score of ESS in the shift work group was found to be 8.5 versus 7.13 in Non-shift workers (p=0.003).[14]

Next tool we used was STOP-BANG questionnaire. STOP-BANG has been in use in clinical settings and its validity has been tested in wide sets of research works to identify Obstructive sleep apnea. The sensitivity and specificity of the STOP-BANG was found to be 91.6 and 45.2 %, respectively, at AHI ≥ 5, 97.1 and 35.2 %, respectively, at AHI ≥ 15, and 98 and 29.4 %, respectively, at AHI ≥ 30.[15]

The Functional Outcome of Sleep Questionnaire (FOSQ) is the gold standard tool for assessing impact of sleepiness on ability to conduct daily activities.[16] The FOSQ-10 is a shorter version to the Functional Outcomes of Sleep Questionnaire (FOSQ) and has similar psychometric performance with minimum information to its longer version, providing a simple means for both clinical trial and health assessments.[17]

In the same study mean PSQI global score in 351 Shift workers was 7.409 ± 3.406 and in 159 Non-Shift workers was 6.271 ± 3.374 (p-value=0.001).[14] However, in our study we did not find any significant differences between Shift and Non Shift workers (χ2 = 1.523, p-value=0.217; Mean rank for non-shift workers=174.34 vs Shift workers=182; p-value=0.349).

In a recent study ESS was compared among day workers, night workers and rotating workers. The data presented as mean ± SD for ESS are 8±4.5, 9.2±5.2 and 8.6±4.6 respectively for Day workers, night workers and rotating workers, with post hoc comparison showing values for night and rotating workers more than the day workers.18

PSQI was also studied among retired Shift workers with retired non shift workers, and the effect of Shift work was also noted in retired workers with worse PSQI score by 0.94 PSQI units compared to non-shift retired personals (main effect p=0.005, post hoc Turkey-Kramer adjusted p<0.004).19

Conclusion

Shift works involving night duties have significant impact on daily activities. Shift work caused excessive daytime sleepiness and had worse functional outcome. However, Shift workers did not have worse sleep quality and shift work did not increase probability of obstructive sleep apnea.

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