VOLUME 10 ISSUE 1 2024

ISSN 2454 – 3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 10, No. 1, 77-83 (2024)

International Journal of Zoological Investigations

Contents available at Journals Home Page: www.ijzi.net

Editor-in-Chief: Prof. Ajai Kumar Srivastav

Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

Effect of Sleep Deprivation on Health Related Quality of Life in Shift Working Adults

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Received: 8th November, 2023; **Accepted:** 22nd December, 2023; **Published online:** 22nd January, 2024

https://doi.org/10.33745/ijzi.2024.v10i01.009

Abstract: The goal of the current study was to investigate the connection between shift working adults' HRQoL (health-related quality of life) and sleep deprivation. The Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale, Beck Depression Inventory, and Short Form Health Survey (SF-36) were completed by 295 participants between the ages of 20 and 50. The T-Square test developed by Hotelling was used to compare the results of good and poor sleepers. Body mass index (BMI) and sociodemographic information were acquired. The correlation between sleep deprivation and HRQoL was significant. The physical and mental component summaries (PCS, MCS) and all SF-36 components were much lower among those who had inadequate sleep. After confounding factors were controlled for, sleep quality significantly boosted the predictive ability of the model, with R^2 change (ΔR^2) of 2.8% for MCS and 3.6% for PCS, according to hierarchical analyses. Our findings reaffirm how critical sleep is to HRQoL. Our results strongly supports the association of sleep deprivation (poor quality, short duration) and health related quality of life. From the standpoint of public health, intervention programs aimed at improving sleep-related healthcare, particularly for shift workers, should be strengthened in developing nations.

Keywords: Sleep, Health related quality of life, Shift worker, Sleep deprivation, Poor sleep, Pittsburgh Sleep Quality Index, Epworth Sleepiness Scale, Beck Depression Inventory, Short Form Health Survey

Citation: Deshmukh S.A. and Sisodia S.S.: Effect of sleep deprivation on health related quality of life in shift working adults. Intern. J. Zool. Invest. 10(1): 77-83, 2024.

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Introduction

Sleep deprivation is a complicated health issue that lowers quality of life in shift workers. The environmental pressures brought about by Asia's rapid industrialization have further lowered people's sleep quality. A number of detrimental health consequences, including an increased risk of stroke, diabetes, and cardiovascular disease, and cognitive dysfunction, have been associated considering the overall long-term impact of sleep disturbances and sleep deprivation (Reimer and Flemons, 2003). It has also been connected to accidents, risk-taking behavior, increased death

rates, and a lower standard of living. Numerous sleep disturbances have the potential to worsen existing medical diseases and also decreases in areas of health-related quality of life (HRQoL) (Strine and Chapman, 2005). Growing comprehension of sleep and how it has related with health issues that lead to more people using medical services. Public health concerns have been brought up by the impact of both short-term and long-term sleep deprivation (Colten and Altevogt, 2006). According to a survey, nearly 30 per cent of Americans claimed to sleep for little more than 6 h per night (Hanlon and Caiuter, 2011). Those who slept for less than 6 h on work nights were far more likely to become obese than those who slept for at least 8 h, according to a poll of 1,000 adults (Spigel *et al.,* 1999). Youths who slept for less than 8 h a night were found in a major national cross-sectional study to have higher rates of substance use, suicidal ideation, feelings of sadness or hopelessness, lack of physical activity, and increased soda pop consumption (Mcknight *et al.*, 2011). Given everything at threat, it is critical to understand how sleep affects health. The evaluation of individuals' HRQoL (health-related quality of life) and sleep duration in poor nations has not received much attention. Therefore, the purpose of this study was to look at how shift workers' HRQoL is linked with sleep deprivation.

Materials and Methods

Study population design:

A cross-sectional study with 295 participants aged 20 to 50 years was carried out. The sample consisted of people living in the Nashik District of Mahrashtra, India.

Demogrphic measures:

Sociodemographic information, such as age, sex, marital status, and degree of schooling, including self-assessed financial position based on take-home pay, were submitted by each participant. The body mass index (BMI) was computed using the subjects' height and weight as well.

Sleep quality measures:

The Pittsburgh Sleep Quality Index (PSQI) is accustomed to quantify the sleep quality (Buysse *et al*., 1989). Subjective quality index of sleep, subjective latency in sleep, subjective sleep duration, subjective sleep effectiveness, sleep disturbances, use of sleep medication, and malfunction during the day are the components that make up the 19-item subjective PSQI. It is an indicator of both quantitative and subjective features. The overall PSQI rating, which goes from 0 (excellent sleep) to 21 (bad sleep), is the total of seven components. Every component is assessed on a four-point scale (0–3). A PSQI score of five or higher globally indicates low sleep quality.

The Epworth Sleepiness Scale (ESS), comprising eight items, is a test designed to evaluate an individual's inclination to sign off in eight different settings that they would come across in their regular life (Johns, 2000). Each item receives a score between 0 (high possibility of sleeping) and 3. Consequently, the ESS has an overall score that goes from 0 to 24. Elevated ratings are linked to increased levels of increased diurnal sleepiness (EDS). The diagnosis of EDS in patients is made when the global score is higher than 10 (Hoddes *et al.*, 1973). The Beck Depression Inventory (BDI) was another tool used to detect sleep deprivation (Beck *et al*., 1961).

Health- related quality of life (*HRQOL*) *measures*:

The health survey SF-36 form was utilized in this study to measure a number of questions linked to health and sleep (Lam *et al.*, 1998). A self-completed survey consisting of 36 questions, the SF-36 gathers data on eight health domains--mental health (MH), bodily pain (BP), role restrictions brought on by physical health problems (RP), physical functions (PF), vitality (VT), general health (GH), role restrictions caused by emotional problems (RE), and social functionality (SF). Each component has a rating between 0 and 100, where a high rating shows good health. The SF-36 has been validated and is frequently employed for evaluation of health-

Table 1: Demographic characteristics

		All Participant (%) n= 295	Good Sleepers(%) n=62	Poor Sleepers (%) n=233	Test statistic
Sex	Female	252 (85.42)	47 (75.8)	205 (87.98)	$X^2(1)=6.21/0.02$
	Male	43(14.57)	15 (24.19)	28 (12.01)	
Marital Status	Married	99 (33.55)	24 (38.7)	75 (32.18)	$X^2(1)=2.01/0.17$
	Single/Divorced/Widowed	196(66.44)	38 (61.29)	158 (67.81)	
Educational Level	School	57 (19.32)	15 (24.19)	42 (18.02)	$X^2(2)=0.18/0.93$
	Graduate	136 (46.1)	28 (45.16)	108 (46.35)	
	Post Graduate	102 (34.57)	19 (30.64)	83 (35.62)	
Economical Status	Satisfactory	271 (92.88)	60 (96.77)	211 (90.55)	$X^2(1)=2.12/0.15$
	Unsatisfactory	24 (8.13)	2(3.22)	22 (9.44)	
Perceived Health	Fair , Good or excellent	226 (76.66)	56 (90.32)	170 (72.96)	$X^2(1)=8.21/0.003$
	Poor or very poor	69 ((23.38)	6 ((9.67)	63 (27.03)	
Chronic illness	Yes	105 (35.59)	20 (32.25)	85 (36.48)	$X^2(1)=2.01/0.17$
	No	190 (64.4)	42 (67.74)	148 (63.51)	
Sleep Duration (Hrs per day)	Median (IQR)	5.5 (1.0)	7.0 (1.0)	5.0 (2.0)	$Z=9.39 < 0.001$
	Range	2.0-9.5			

Good Sleeper: PSQI score < 5. Poor Sleeper: PSQI score ≥ 5

related quality of life in connection with other chronic conditions (Ware *et al.*, 2003). With the exception of physical functionality (range: 5–100), overall health (range: 10–100), and mental health (range: 16–100), participants' total on the subscales vary between 0 to 100. A more perceived quality of life is represented by higher scores for each domain. The techniques suggested by Ware *et al*. (2003) were used to determine the scores for each of the eight domains, and scoring mistakes were verified. Both the SF-36 and the SF-12 have been widely utilized to evaluate the relationship between HRQoL and sleep problems, despite the fact that neither instrument has items specifically related to sleep (Rosnow and Rosenthal, 2009).

Participants who were unable to complete the questionnaires or the interview due to medical conditions (such as cognitive impairment) were excluded from the study. Each and every participant provided informed consent.

Statistical Analysis:

The 295 individuals were divided into two categories based on their PSQI scores: bad (PSQI score ≥ 5) and good (PSQI score < 5). The chi-squared test and each independent sample, use the t-test to compare the demographic variables of these two groups. A bivariate analysis of the link between the quality of life and sleep domains is conducted. Hotelling's T-square test was utilized to compare the eight SF 36 domain scores of excellent with bad sleepers.

To calculate the clinical significance of SF variation 36 points, 95% confidence interval statistics and effect size were used to depict comparisons (Hoddes *et al.*, 1973). Hierarchical multiple linear regression evaluations were conducted with age, sex, status of marriage, BMI, qualifiation, economic situation, and BDI scores in step I and the elements of step I plus PSQI score in step II in order to ascertain the intensity of the relationship of quality of sleep and HRQoL. Regression coefficients are presented together with their 95% confidence intervals, R2 and corrected R2 values.

Ethical Consideration:

The Ethics Committee approved the Protocol, and the Helsinki Declaration was followed throughout the investigation.

Results

Participants Description:

Table 1 displays participant's demographic data. Among the participants were majority of female

Table 2: Demographic and health characteristics

	Mean	SD
Age (years)	35.6	7.5
BMI	24.2	4.3
BDI	4.1	4.2
HRQOL		
Physical Functioning	82.8	23.1
Physical role	74.2	21.3
Bodily pain	78.2	22.1
General health	51.3	24.6
Vitality	45.2	22.8
Social functioning	68.5	28.9
Emotional role	72.4	22.5
Mental health	64.8	22.5
	Mean (Range)	SD
PCS	51.5 (21.2-69.3)	6.8
MCS	46.2 (11.4-66.4)	9.8

BMI – body mass index; BDI- Beck depression inventory; HRQoL- health related quality of life, PCS- Physical component summary, MCS – Mental component summary

Table 3: Differences in the SF 36 derived HRQOL domain

SF 36	Sleep quality -PSQI (Mean , SD)		Daytime Sleepiness-ESS (Mean , SD)	
	PSQI score < 5	PSQI score ≥ 5	ESS score < 10	ESS score ≥ 10
Physical Functioning	87.9 (20.5)	77.1 (24.2)***	83.8 (21.6)	72.9(26.6)**
Role Physical	80.9(18.8)	65.8 (21.7)***	76.3(20.2)	65.8(24.9)**
Bodily Pain	87.9(16.9)	71.1(24.8)***	81.9(22.1)	73.9(28.1)**
General Health	60.1.9(22.9)	42.1(24.9)***	54.1(24.9)	43.9(27.1)**
Vitality	51.9(23.1)	39.1(22.9)***	46.9(24.1)	40.9(23.1)*
Social Functioning	77.9(24.9)	57.9(30.1)***	70.9(27.9)	62.1(31.1)*
Role Emotional	81.1(20.1)	64.1(24.8)***	75.1(22.9)	67.1(23.1)*
Mental Health	73.4(18.1)	54.1(23.9)***	65.9(22.9)	59.1(21.3)*
BDI	2.0(4.0)	5.0(8.0)***	3.0(4.0)	4.0(6.0)**
BMI	23.9(6.9)	25.1(7.1)	23.9(5.9)	26.9(9.1)***

*p< 0.05; **p < 0.01; *** p < 0.001 BDI - Beck depression inventory; BMI - body mass index. Data are presented as the median and interquartile range. Statistics are based on the Mann-Whitney test for BDI and BMI, and on t-test for SF-36 variables

Table 4: Physical and mental component summary scores

SF 36		Physical Component Summary-PCS (Mean , SD)		Mental Component Summary -MCS (Mean, SD)	
		Mean (SD)	Effect Size (95% CI)	Mean (SD)	Effect Size (95% CI)
Sleep quality -PSQI	Good (score <5)	51.9(6.1)	4.1(2.5-5.4)***	49.1 (7.9)	8.1 (6.4-10.2)***
	Poor (score ≥ 5)	47.9(8.1)		39.9 (9.9)	
Excessive daytime sleepiness-EDS	No (score < 10)	50.9(7.1)	3.6 (1.6-5.2)***	46.1(9.9)	3.1(0.4-5.4)*
	Yes (score ≥ 10)	48.1(8.1)		43.1 (9.0)	

* p< 0.05; *** p < 0.001 ; CI – confidence interval

Table 5: Hierarchical multiple regression analyses of the associations between sleep quality and HRQoL scales

Outcome variables	Step I				Step II (Variables in step I plus PSQI score)				
	F	R^2	Adjusted R^2	Δ F	Adjusted R^2	Δ R^2	B for PSQI	β	95% CI
Physical Functioning	8.11***	0.2	0.19	12.09**	0.21	0.023	-1.42	-0.21	-2.19/-0.59**
Physical role	11.98***	0.31	0.28	10.42**	0.3	0.021	1.21	-0.19	-2.0/-0.5**
Bodily pain	11.91***	0.31	0.24	25.81***	0.29	0.051	2.01	-0.28	-2.7/-1.17***
General health	17.01***	0.32	0.31	29.01***	0.4	0.051	1.98	-0.28	-2.9/-1.36***
Vitality	6.02***	0.2	0.18	11.99**	0.21	0.026	1.43	-0.21	-2.28/-0.59**
Social functioning	15.99***	0.32	0.33	7.98**	0.29	0.016	1.23	-0.16	-2.21/-0.39**
Emotional role	11.98**	0.3	0.24	17.01***	0.31	0.03	1.65	-0.19	-2.3/-0.79***
Mental health	30.11***	0.5	0.46	22.99***	0.51	0.03	1.62	-0.19	-2.15/-0.9***
Physical Component Summary	10.99**	0.31	0.22	19.01***	0.31	0.036	0.51	-0.21	-0.69/-0.30***
Mental Component Summary	29.99**	0.44	0.44	22.01***	0.51	0.03	0.59	-0.19	-0.89/-0.40***

F- test of overall model significance; R^2 - coefficient of determination; B - regression coefficient; β- standardized regression coefficient; Δ F - F change; Δ R^2- change in R^2 value; CI - confidence interval ** p < 0.01; *** p < 0.001

(85.42 %), and the median age was 35.6 years (SD = 7.5). Many of participants were married (80.67%) and had higher qualifications (33.55%). The participant's financial situation revealed average status (92.88%). The study participants slept for 5.5 ± 1.0 h on average per night (ranging from 1.5 to 9.5 h).

Health related quality of life (*HRQoL*):

Groups based on quality of sleep (good vs poor) and sleepiness during the day status were examined to see if life's quality in a number of health components varied with relation to SF-36 BDI and BMI values. According to the PSQI, among the 295 individuals, good sleepers scored higher than poor sleepers for all SF-36 categories (F8301 =2004.1, p<0.001), with the social function domain showing the largest difference (77.9 vs 57.9) and the vitality domain showing the smallest difference (51.9 vs 39.1). The physical functioning domain showed the highest difference (83.8 vs72.9) in the ESS, whereas the vitality domain showed the least change (46.9 vs. 40.9) (Table 2).

For the BDI score, a significant difference was seen, but not for the BMI. Likewise, there were notable differences between the patients who experienced daytime sleepiness and those who did not on all SF-36 measures, BDI score, and BMI value. For all PCS and MCS scores, the overall pattern of differences was the same (Table 3).

A minor but clinically significant reduction in life quality, both mentally and physically was linked to poor sleep quality, according to the effect on sizes of mean PCS and MCS score variances (Table 4).

We used hierarchical regression analysis in order to assess links among various characteristics of sleep and individual SF-36 component and the dependent variables are summary scores in order to determine how sleep affects HRQoL. Even after adjusting for the demographic variables BMI and BDI, hierarchical regression analysis revealed that poor sleep quality was still a significant predictor of each of the SF-36 scores. Predictive power of model significantly improved when the PSQI score was included in the second stage of analysis, with R^2 change (Δ R^2) of 2.8% for MCS and 3.6% for PCS; gains in predictive power were variable for the other SF-36 component scores, ranging from 1.4% to 4.6% (Table 5).

Discussion

Our recruitment of participants at hospitals where female nurses are more frequently employed likely influenced the sample's under representation of men and overrepresentation of women, which constrained the study. The

information that is currently available indicates a connection between poor sleep and decreased HRQoL. Among patients with inadequate sleep, we found a statistically significant decrease in each SF-36 domain and summary scores. A precise description of a clinically significant alteration is still missing from HRQoL studies. A one-point fall in SF-36 scores was shown to be linked to an additional risk of up to 9% for death and 12% for employment impairment in individuals with diabetes (Bjorner *et al*., 2013). In order to establish standards for the interpretation of changes, research on HRQoL has concentrated on the idea of the minimally important difference (MID). It is generally advised that MID values between 2 and 4 points be regarded as clinically significant (Maruish, 2011). In individuals with and without EDS, the impact size estimates for the utilization of HRQoL studies on racial/ethnic sleep were 1.5 for physical well-being and -2 for mental health. Thus, our findings suggest that poor sleep quality and There are medically significant variations in HRQoL among individuals with and without EDS.

There is a statistically significant relationship of HRQoL measures with sleep quality was discovered in current investigation, which was attributed to sociodemographic variables and BMI. It is crucial to include socioeconomic position, cultural factors, health covariates, and other variables that have been demonstrated to impact HRQoL in context with the association between sleep problems and HRQoL outcomes. Small impact sizes identified in this study are probably clinically significant because certain possible cofounders were examined in our regression analysis. We can speculate that some general sociological factors leading to an elevated risk of psychosocial instability may have some impact on the relationship between inadequate sleep and every aspect of HRQoL identified here. This perspective is in accordance with research that demonstrates the detrimental effects with a low social and economic status on sleep quality on general health. Some of these research' findings imply that sleep might operate in the role of moderator in the connection within ill health and socioeconomic position. The results of the study demonstrated a strong relationship between economic status and the mental component summary score. Several studies have also demonstrated a negative correlation between HRQoL and socioeconomic level. The extent to which the variation in sleep's impact on HRQoL may be explained by the economic patterning of sleep remains undetermined. However, these results highlight the significance of thoroughly examining sleep issues and its consequences on HRQoL among individuals from poor socioeconomic backgrounds, especially considering that poor sleep is statistically most strongly predicted by economic status. The gradual inclusion of each sleep-related variable considerably enhanced predictibility in every model, and we found that the variance inflation factor for each variable was less than or equal to 2. Thus, our findings demonstrate that subjective sleep problems are universally linked to a decline in HRQoL. There is a clear need for more focus on sleep care because sleep deprivation is a big issue globally, but its incidence and the degree to which it affects HRQoL are not well documented in developing nations.

It is important to recognize some of this study's shortcomings like data was collected based on self-reported questionnaires. One other restriction is that certain medical conditions and lifestyle choices may have an impact.

Conclusion

This study looked at the connection between night shift workers, HRQoL and sleep deprivation. Our results provide strong evidence that HRQoL is negatively impacted by sleep deprivation, including low subjective quality and brief duration. The significance of sleep for health and well-being is further supported by these data, which also corroborate and expand on observations from the developing world. This association is noteworthy in lower income circumstances, where there is likely to be a substantial effect of economic condition on the

strain of sleep issues and, in turn, HRQoL as far as the public's wellness is concerned, interference initiatives targeted at enhancing healthcare associated with sleep, particularly for shift workers, should be strengthened in developing nations where individuals are less likely to report sleep related issues and may not even be aware that sleep deprivation is a serious health risk that negatively affects HRQoL.

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