

Research Article

Association of Sleep Duration and BMI with Periodontitis in Nurses Working in Day and Night Shifts and Its Impact on Co-morbidities

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Abstract

Background: Gender imbalances persist in high-ranking leadership roles, particularly in Aim: To evaluate the association between duration of Sleep and Body-Mass Index (BMI) as potential risk factors with Periodontitis and other co morbidities in duty nurses.

Methodology: An observational study was carried out on 42 duty nurses working in hospital. Two Questionnaires (PSQI) Pittsburgh Sleep Quality Index and (ESS) Epworth-Sleepiness Scale were subjectively filled. Study was conducted in 2 phases in the same duty nurses. Phase 1 Duty nurses in morning shift underwent evaluation for periodontal health, BMI and Waist - Hip ratio was recorded. Blood Samples were drawn for analysis of C-Reactive protein, lipid profile and Fasting Blood Sugar. Participants were asked to maintain sleep diary for 6 months. Phase 2: Same Duty Nurses working in Night Shift after 6 months of sleep diary maintenance underwent evaluation of same parameters as phase 1. All-the data were tabulated and sent for statistical-analysis.

Results: The result showed that, the association of duration of sleep to Periodontitis was statistically significant in the morning-shift and night-shift ($p=0.001$), although association of Body Mass Index to periodontitis was statistically significant in the night shift with p value= 0.001 than in the morning-shift. The association of Plaque Index and Gingival-Index with duration of sleep and BMI was statistically significant. The parameters taken to study the co-morbidities showed statistical significant difference between the two shifts except WHR ratio, LDL, HDL, Triglyceride, Plaque index.

Conclusion: There is an association of Duration of Sleep and Body Mass Index as a potential risk factor for periodontitis and other co-morbidities (Cardiovascular disease and Diabetes) in duty nurses, however the association is much stronger in duty nurses working in night shift

than morning shift.

Keywords: Sleep Duration; Shift Workers; Periodontitis; Body Mass Index; Duty Nurses

Introduction

Periodontal disease, characterized by inflammation of the gingiva, alveolar bone and periodontal ligament, is multifactorial, influenced by various lifestyle choices, systemic conditions and environmental factors. While established risk factors like smoking, poor oral hygiene and diabetes are well-documented, emerging research is shedding light on the role of sleep disturbances, stress, diet and obesity in periodontal health [1,2].

Inadequate sleep, defined as less than 7 hours per day, has been associated with a 1.34 times higher risk of periodontitis [3]. Sleep deprivation compromises immunity and increases inflammation, akin to chronic periodontitis. Conversely, both insufficient and excessive sleep have been linked to elevated risks of mortality, diabetes, obesity and cardiovascular disease, suggesting a U-

shaped correlation between sleep duration and health outcomes [5-9].

Disruption of circadian rhythms due to shift work, common among nurses, contributes to sleep deprivation and poor sleep quality [11]. Nurses experiencing reduced sleep are susceptible to cognitive decline, fatigue and various health issues [11]. Neglecting sleep may increase BMI and contribute to periodontitis, potentially indicating systemic inflammation [12, 13].

Furthermore, among nurses working varying shifts, understanding the interplay between sleep duration, BMI and Periodontitis is essential for addressing oral health disparities. Despite the growing body of evidence linking sleep duration, BMI and Periodontitis, there is a paucity of research focusing on nurses, especially those engaged in shift work. Therefore, This study aims to explore the association between sleep duration, BMI and their impact on Periodontitis and comorbidities among duty nurses.

Methods

This cross-sectional observational study was conducted among 42 Duty nurses, working in JSS Medical Hospital, Mysuru.

Inclusion criteria for the study encompass duty nurses aged 30 to 45, employed at JSS Hospital, with 3 to 5 years of professional experience and possessing a minimum of 20 teeth. Exclusion criteria include pregnant or lactating women, smokers, recent medication use of certain drugs within three months, diagnosed medical conditions like diabetes, arthritis, tuberculosis or gastritis, as well as liver diseases, fatty liver diseases or recent periodontal treatment. In phase 1, participants with C-Reactive Protein (CRP) levels exceeding 10mg/dl were excluded.

Participants were given to fill two questionnaire: "Pittsburgh Sleep Quality Index" for sleep quality assessment in which a total score of "5" or greater is indicative of poor sleep quality and "Epworth Sleepiness Scale" was used to measure the 'daytime sleepiness' for adults.

Every participants will undergo 2 phases of evaluation.

Phase 1: duty nurses working in morning shift

Phase 2: after 6 months of sleep diary maintainance, same duty nurses working in night shift

Phase 1: Duty Nurses Working In Morning Shift

The Periodontal status of the participants were recorded by evaluating Probing Depth (PD) and Clinical Attachment Level (CAL) and were categorized into gingivitis and Mild/Moderate/Severe periodontitis using the Centers for Disease Control and Prevention American Academy of Periodontology (CDC/AAP) definitions of periodontal disease as described by Eke, et al., (1) mild periodontitis, defined as two or more interproximal sites with CAL ≥ 3 mm and at least two interproximal sites with PD ≥ 4 mm (not on the same tooth) or one site with ≥ 5 mm; (2) moderate periodontitis, defined as two or more interproximal sites with CAL ≥ 4 mm (not on the same tooth) or two or more interproximal sites with PD ≥ 5 mm, also not on the same tooth; (3) severe periodontitis, defined as two or more interproximal sites with CAL ≥ 6 mm (not on the same tooth) and on more interproximal site(s) with PD > 5 mm [14].

To evaluate the oral hygiene status "Plaque Index" (Silness and Loe), "Gingival Index" (Loe and Silness), were recorded Body Mass Index (BMI) was recorded using objectively measured height (cm), weight (kg) and waist : hip ratio following the guidelines of anthropometry procedure manual. BMI was categorized according to World Health Organisation (WHO) Asian.

BMI Classification

Participants Venous blood Samples was drawn after a minimum of 8 hrs of overnight fasting for analysis of C-Reactive protein, lipid profile (HDL, LDL, triglycerides) and Fasting Blood Sugar (FBS).

Participants maintained a sleep diary for 6 months, recording sleep and wake times daily during morning and night shifts. Diary entries were reviewed weekly for accuracy and consistency. The duration of Sleep were then categorized into 3 categories : 2-6 hours as sleep deficient, 7-8 hours as sleep adequate and 9-12 hours as sleep excessive.

Phase 2: After 6 Months Of Sleep Diary Maintainance, Same Duty Nurses Working In Night Shift

After 6 months of maintaining the sleep diary, during the night shift working schedule, again same duty nurses periodontal status were recorded that is probing depth and clinical attachment loss. Oral hygiene Indicators-PI, GI were recorded.

Body Mass Index was recorded and participants blood sample was collected after an overnight fasting period of 8 hours for CRP, Lipid profile and (FBS) that were collected and analysed in the JSS Medical Hospital, Mysuru. Comparative Data of the investigations done in morning shift and in night shift were analysed.

Statistics

All the data was collected and fed into an MS Excel sheet, categorized and analyzed using SPSS for Windows (Statistical Package for Social Sciences, SPSS Inc.) Version 29.0. The values obtained from the examination was subjected to Descriptive statistics and Chi square test statistical analysis. Chi- Square test was done for association of all the parameters with morning and night shift with p-value set at 0.05.

Result

A total of 42 duty nurses gave consent, filled the questionnaire and underwent examination in 2 phases: in morning shift and in night shift with a gap of 6 months of sleep diary maintenance. In analyzing the Pittsburgh Sleep Quality Index, 57.1% of duty nurses exhibited poor sleep quality, scoring above 5. Additionally, the Epworth Sleepiness Scale indicated that 49.4% of duty nurses experienced average to excessive daytime sleepiness. Categories for poor sleep quality and daytime sleepiness severity were determined based on PSQI and ESS scores, as detailed in Table 1.

	Score		Frequency	Percentage
PSQI	0 - 4	Very good sleep quality	18	42.90%
	05-Oct	Moderate sleep disturbances	11	26.20%
	Nov-15	Poor sleep quality	8	19.00%
	16 -21	Very poor sleep quality	5	11.90%
ESS	0 - 7	Unlikely that you are abnormally sleepy	21	50.00%
	08-Sep	Average amount of daytime sleepiness	9	21.40%
	Oct-15	Excessively sleepy depending on the situation	4	9.50%
	16 - 24	Excessively sleepy and should consider seeking medical attention	8	19.00%

Table 1: Descriptive statistics of PSQI AND ESS questionnaire.

On analysis of the periodontal status, there was an increase in moderate Periodontitis in duty from 19% in duty while working in morning shift to 31% in night shift. Also, Severe Periodontitis increased from 0.00% in morning shift to 21.40% in night shift but there was a significant difference in the periodontal status of duty nurses in morning shift to night shift with $p=0.001$ given. Association of Plaque Index (PI) with Morning and Night shift groups showed no statistical significance whereas on Associating Gingival Index (GI) with Morning and Night shift groups showed statistical significance ($p=0.011^*$) (Table 4).

The result showed that among the duty nurses working in the morning shift, 31% of duty nurses were sleep deficient which had increased to 50% of duty nurses while working in night shift but the difference was statistically not significant (Table 4).

The association of Duration of sleep with Plaque Index, Gingival Index and gingivitis/mild, moderate severe Periodontitis was statistically significance in night shift. In morning shift, gingival index didn't show statistical significance with duration of sleep, Plaque Index and Gingivitis, mild/ moderate/severe Periodontitis showed statistical significance (Table 2).

			Average duration of sleep						χ ² Value	P Valu e
			Sleep Deficient		Sleep Adequate		Sleep Excessive			
			N	%	N	%	N	%		
Morning Shift	PLAQUE INEX (PI)	Good	3	23.10 %	16	72.70 %	6	85.70 %	10.75 2	0.005 *
		Fair	10	76.90 %	6	27.30 %	1	14.30 %		
		Poor	0	0.00%	0	0.00%	0	0.00%		
	GINGIVAL INDEX (GI)	Mild	11	84.60 %	18	81.80 %	7	100.00 %	1.452	0.484
		Moderate	2	15.40 %	4	18.20 %	0	0.00%		
		Severe	0	0.00%	0	0.00%	0	0.00%		
	GINGIVITIS OR MILD / MODERATE / SEVERE PERIODONTITIS	GINGIVITIS	0	0.00%	10	45.50 %	7	100.00 %	20.63 2	0.001 *
		MILD	10	76.90 %	7	31.80 %	0	0.00%		
		MODERATE	3	23.10 %	5	22.70 %	0	0.00%		
Night Shift	PLAQUE INEX (PI)	Good	3	14.30 %	12	80.00 %	5	83.30 %	19.02	0.001 *
		Fair	16	76.20 %	3	20.00 %	1	16.70 %		
		Poor	2	9.50%	0	0.00%	0	0.00%		
	GINGIVAL INDEX (GI)	Mild	7	33.30 %	15	100.00 %	6	100.00 %	21	0.001 *
		Moderate	6	28.60 %	0	0.00%	0	0.00%		
		Severe	8	38.10 %	0	0.00%	0	0.00%		
	GINGIVITIS OR MILD / MODERATE / SEVERE PERIODONTITIS	GINGIVITIS	0	0.00%	10	66.70 %	4	66.70 %	29.19	0.001 *
		MILD	2	9.50%	2	13.30 %	2	33.30 %		
		MODERATE	10	47.60 %	3	20.00 %	0	0.00%		
		SEVERE	9	42.90 %	0	0.00%	0	0.00%		

Table 2: Association of average duration of sleep to PI, GI and Periodontitis in morning and night shift.

On Association of BMI to Periodontitis in the Duty nurses while working in night shift showed statistical significance with $p=0.001$ while it showed no statistical significance in night shift with $p=0.074$. The oral Hygiene indicators, PI and GI on association with BMI showed statistical significance both while working in morning and night shift (Table 3).

On Analyzing the BMI, the result showed that the percentage of overweight individuals increased from 23.80% to 38.10%, 7% to 11% in obese I category and from 0% to 4.8% in obese II category in the morning shift to night shift though there was no statistical difference of BMI in morning and night shift ($p=0.113$) (Table 4).

The Descriptive statistics of all the parameters in morning shift and night shift is given in Table 4. The result showed there was no statistically significant difference in Waist Hip Ratio, BMI, LDL, HDL, Triglyceride, Plaque Index, Average duration of sleep while other parameters like C-reactive protein, Fasting Blood sugar levels, duration of sleep, Gingival index and Gingivitis / Periodontitis had a statistically significant difference in night shift than morning.

			BMI								χ^2 Value	P Value
			Normal Weight		Over Weight		Obese I		Obese II			
			N	%	N	%	N	%	N	%		
Morning Shift	PLAQUE INEX (PI)	Good	22	75.90%	2	20.00%	1	33.30%	0	0.00%	10.551	0.005*
		Fair	7	24.10%	8	80.00%	2	66.70%	0	0.00%		
		Poor	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	GINGIVAL INDEX (GI)	Mild	28	96.60%	7	70.00%	1	33.30%	0	0.00%	11.52	0.003*
		Moderate	1	3.40%	3	30.00%	2	66.70%	0	0.00%		
		Severe	0	0.00%	0	0.00%	0	0.00%	0	0.00%		
	GINGIVITIS OR MILD / MODERATE / SEVERE PERIODONTITIS	GINGIVITIS	16	55.20%	1	10.00%	0	0.00%	0	0.00%	8.517	0.074
		MILD	9	31.00%	6	60.00%	2	66.70%	0	0.00%		
		MODERATE	4	13.80%	3	30.00%	1	33.30%	0	0.00%		
Night Shift	PLAQUE INEX (PI)	Good	15	78.90%	4	25.00%	0	0.00%	1	50.00%	16.951	0.009*
		Fair	4	21.10%	11	68.80%	4	80.00%	1	50.00%		
		Poor	0	0.00%	1	6.20%	1	20.00%	0	0.00%		
	GINGIVAL INDEX (GI)	Mild	19	100.00%	9	56.20%	0	0.00%	0	0.00%	35.044	0.001*
		Moderate	0	0.00%	5	31.20%	1	20.00%	0	0.00%		
		Severe	0	0.00%	2	12.50%	4	80.00%	2	100.00%		
	GINGIVITIS OR MILD / MODERATE / SEVERE PERIODONTITIS	GINGIVITIS	11	57.90%	3	18.80%	0	0.00%	0	0.00%	33.865	0.001*
		MILD	5	26.30%	1	6.20%	0	0.00%	0	0.00%		
		MODERATE	3	15.80%	9	56.20%	1	20.00%	0	0.00%		
SEVERE		0	0.00%	3	18.80%	4	80.00%	2	100.00%			

Table 3: Association of BMI to PI, GI and Periodontitis in morning and night shift.

		Groups				χ2 Value	P-value
		Morning Shift		Night Shift			
		N	%	N	%		
WAIST - HIP RATIO	Normal Range	26	61.90%	21	50.00%	1.208	0.272
	High risk Range	16	38.10%	21	50.00%		
BMI	Normal Weight	29	69.00%	19	45.20%	5.968	0.113
	Over Weight	10	23.80%	16	38.10%		
	Obese I	3	7.10%	5	11.90%		
	Obese II	0	0.00%	2	4.80%		
C-Reactive Protein mg/L	Moderate	34	81.00%	24	57.10%	5.57	0.018*
	High risk	8	19.00%	18	42.90%		
LDL mg/dL	Normal	1	2.40%	1	2.40%	4.509	0.342
	Borderline High	19	45.20%	10	23.80%		
	High	13	31.00%	18	42.90%		

	Very High	5	11.90%	6	14.30%		
	Extremely High	4	9.50%	7	16.70%		
HDL mg/dL	Poor	5	11.90%	11	26.20%	2.871	0.238
	Better	32	76.20%	26	61.90%		
	Best	5	11.90%	5	11.90%		
TRIGLYCERIDE mg/dL	Normal	5	11.90%	4	9.50%	1.37	0.504
	Borderline High	26	61.90%	22	52.40%		
	High	11	26.20%	16	38.10%		
FASTING BLOOD GLUCOSE mg/dL	Normal	3	7.10%	0	0.00%	8.696	0.013*
	Prediabetic	37	88.10%	32	76.20%		
	Diabetic	2	4.80%	10	23.80%		
PLAQUE INEX (PI)	Good	25	59.50%	20	47.60%	2.799	0.247
	Fair	17	40.50%	20	47.60%		
	Poor	0	0.00%	2	4.80%		
GINGIVAL INDEX (GI)	Mild	36	85.70%	28	66.70%	9	0.011*
	Moderate	6	14.30%	6	14.30%		
	Severe	0	0.00%	8	19.00%		
GINGIVITIS OR MILD / MODERATE / SEVERE PERIODONTITIS	GINGIVITIS	17	40.50%	14	33.30%	15.742	0.001*
	MILD	17	40.50%	6	14.30%		
	MODERATE	8	19.00%	13	31.00%		
	SEVERE	0	0.00%	9	21.40%		
AVERAGE DURATION OF SLEEP	Sleep Deficient	13	31.00%	21	50.00%	3.28	0.194
	Sleep Adequate	22	52.40%	15	35.70%		
	Sleep Excessive	7	16.70%	6	14.30%		

Table 4: The descriptive statistics of all the parameters in morning shift and night shift.

Discussion

Research conducted by Scott, et al., found that 65% of nurses working rotating shifts experienced poor sleep quality, Also Healthcare workers who work night shifts are more likely to experience insomnia, sleep disorders and excessive daytime sleepiness [15,17].) A large percentage of nurses were female and research on them revealed a link between sleep disturbance and psychological distress, particularly depression. highlighting the widespread issue of sleep disturbances in this population [18]. The outcome of the present study showed approximately overall 57.1% duty nurse had poor quality sleep with a score above 5 based on the PSQI. This is in accordance with a study by Grandner, et al, who examined sleep quality among shift workers using the PSQI and found that shift work was associated with poorer sleep quality and increased sleep disturbances. A study by Girschik, et al., gave similar results [20]. Epworth Sleepiness Scale showed that overall 49.4% duty nurses had average amount of daytime sleepiness to excessive daytime sleepiness. Chervin, et al., found that rotating shift workers had higher daytime sleepiness compared to day workers using the ESS. Similarly, Hayley, et al., reported increased daytime sleepiness among nurses on shift work, aligning with our study's findings [21,22]. Our study found a significant association between Gingival Index (GI) and shift groups ($p=0.011^*$), but no significance with Plaque Index (PI) ($p=0.247$). We observed that inadequate sleep was linked to poorer oral health among morning shift workers, aligning with previous studies by Suvan, et al., (2020) also support our findings regarding the impact of insufficient sleep on periodontal disease progression [23]. Our study found that among the 42 duty nurses working in the morning shift, 31% were sleep deficient. This increased to 50% among those working in the night shift, indicating a higher prevalence of sleep deficiency during night shifts compared to morning shifts (Table 4). This aligns with findings from, Flo, et al., who also reported shorter sleep durations among nurses working night shifts compared to those on day shifts [24]. Our study revealed significant differences in the periodontal status of nurses between morning and night shifts ($p = 0.001$). Significant associations ($p=0.001$) were found between sleep duration and gingivitis/mild or moderate periodontitis in both morning and night shifts. Similar conclusions were drawn in a systematic review by Aljehani, indicating an increased risk of periodontal disease among healthcare professionals [25].

Chaput, et al., linked sleep deprivation to increased eating and obesity risk in shift workers due to hormone dysregulation. Our study revealed, the association of BMI with gingivitis/periodontitis was not statistically significant in the morning shift but a significant association between BMI and gingivitis/periodontitis was seen among night shift nurses (Table 3). This aligns with findings from Al Amri, et al., El-Sayed, et al., and Zhang, et al., suggesting a link between shift work and increased BMI. Our study examined the impact of morning and night shift work on health parameters, including Waist-Hip Ratio (WHR), Body Mass Index (BMI), C-Reactive Protein (CRP) and fasting blood glucose levels. Night shift nurses showed a higher prevalence of elevated fasting blood sugar levels, with 76.2% falling into the pre-diabetic range. Morning shift workers had significantly higher moderate CRP levels compared to night shift workers ($p = 0.018^*$), suggesting increased inflammation among them. Additionally, night shift workers had a higher proportion of individuals in the high-risk CRP category, indicating a potential link between night shift work and increased inflammation (Table 4). These findings align with previous research by Kim, et al., and Lin, et al., which found elevated CRP levels in shift workers. Morning shift workers also exhibited a healthier metabolic profile, but concerns regarding cardiovascular health arose as 50% of night shift workers fell into the high-risk range for Waist-Hip Ratio [26-30].

Conclusion

In conclusion of the result of our study, there is an association of Duration of sleep and BMI as potential risk factors for Periodontitis. However, this association was more profound in night shift than in the morning shift. Also to study the comorbidities the parameters like c-reactive protein, Fasting Blood Glucose, Gingival Index and Gingivitis/ mild, moderate, severe periodontitis showed statistical significant difference. The other parameters like WHR ratio, LDL, HDL, Triglyceride, Plaque index showed no statistically significant difference. These findings underscore the importance of vigilance and proactive management strategies in maintaining oral health and systemic health especially among shift workers.

Conflict of Interests

The authors have no conflict of interest to declare.

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