

The association between work schedule, oral health, and oral health-related quality of life

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Original Article

Abstract

BACKGROUND AND AIM: Shift work has become common in today's society which causes a higher incidence of several systemic disorders. Although the consequences of shift work on general health have been investigated, there is no study investigating the relationship between shift work and oral health. The purpose of this investigation is to compare the oral health condition of shift workers with that of daytime workers to determine whether there is any effect of shift work on oral health and oral health-related quality of life (OHRQOL).

METHODS: In this cross-sectional study, a total of 612 (294 shift workers and 318 daytime workers) individuals who attended to School of Dentistry, Usak University, Usak, Turkey were evaluated between March 2019 and October 2019. Their decayed, missing, and filled teeth (DMFT) index and periodontal clinical parameters that include plaque index (PI), gingival index (GI), attachment loss (AL), and probing depth (PD) were recorded, and all participants were administered Oral Health Impact Profile (OHIP-14) questionnaire. Data analysis was performed using the SPSS software and the statistical significance level was set at 0.05. The mean scores of periodontal clinical parameters, DMFT and OHIP-14 questionnaire, for groups were analyzed by using analysis of covariance (ANCOVA) test with adjustment for age, gender, education level, and monthly income.

RESULTS: The mean DMFT score of daytime workers was statistically lower than that of shift workers ($P < 0.05$). The mean PI, GI, PD, and AL of shift workers were meaningfully higher than those of daytime workers ($P < 0.05$). There was no statistically difference between shift and daytime workers in terms of mean OHIP-14 score ($P > 0.05$).

CONCLUSION: Although the clinical parameters related to oral health of the shift workers were statistically worse than daytime workers, the mean OHIP-14 score of the shift workers did not show a significant difference from daytime workers.

KEYWORDS: Work Schedule; Periodontal Diseases; Dental Caries; Oral Health; Quality of Life

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Shift work is a work schedule that occurs between 7 p.m. and 6 a.m. It includes any type of work that differs from regular daytime work and affects about 15 to 20 percent of the working population in developed countries.¹ Shift work has been implicated as an emerging risk factor for long-term health and safety due to disruption of the circadian rhythm and sleep patterns.² Increased risks for myocardial infarction (MI), diabetes mellitus (DM), hypertension (HTN), and cancer have been reported among shift workers.³

Oral health, an important part of general wellness, has a considerable effect on people's well-being and quality of life (QOL). Dental caries and periodontal diseases are widely prevalent oral pathologies. Dental caries is an infectious disease mediated by bacterial interaction with carbohydrates that can lead to tooth loss. Periodontal diseases which affect supporting tissues of teeth are inflammatory disorders caused by pathogenic bacteria.^{4,5}

The examination of dental caries and periodontal diseases plays the key role in oral

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health evaluation. The DMFT index which expresses the mean number of decayed (D), missing (M), and filled (F) teeth has been widely used for measuring dental caries.⁶ Periodontal clinical parameters that include plaque index (PI), gingival index (GI), attachment loss (AL), and probing depth (PD) are relevant tools in the monitoring of periodontal diseases.⁷ Oral health-related QOL (OHRQOL) comprehensively reveals individuals' subjective perception about their health condition.⁴ Various methods have been developed to assess the effect of oral diseases on OHRQOL. One of the most commonly-used and well-validated measures is the Oral Health Impact Profile (OHIP-14).⁸

Shift working hours do not match with diurnal and daily life rhythms. Shift work causes adverse effects on the health of the workers. Although shift work enhances the risk for several systemic disorders, there is no information about the impact of shift work on oral diseases. To address this shortage of research data, the purpose of this research is to equate the oral health status and OHRQOL of shift workers with daytime workers.

Methods

This cross-sectional research was applied on patients who underwent periodontal treatment in Department of Periodontology, School of Dentistry, Usak University, Usak, Turkey, between March 2019 and October 2019. A total of 612 individuals (294 shift workers and 318 daytime workers) were willing to participate in this randomized clinical trial (RCT). All individuals provided written informed consent, which was reviewed and approved by the Ethics Committee of Usak University and was in line with the ethical standards established by the Declaration of Helsinki (ethical number: 124-06-14/2019).

For inclusion, participants met the following criteria: 1) age \geq 20 years old and 2) voluntary participation. Exclusion criteria included: 1) smokers, 2) those with DM, 3) those using any drug that may affect periodontal status, 4) those who were

periodontally treated in the last 6 months, 5) those working more than 48 hours a week, and 6) those who consumed alcohol.

Participants were categorized into two groups according to their current work schedule, through a face-to-face interview conducted by an investigator: group 1: daytime workers (those who work between 06:00 and 19:00 and who have no previous shift work history), group 2: shift workers (those who work night shifts). Shift work was defined as at least three night shifts per month, in addition to morning and evening shifts.⁹

Patients' education level was differentiated as primary school, secondary school, high school, or university. Monthly income of individuals was classified as low [$<$ 5000 Turkish Lira (TL)], middle (5000-10000 TL), and high ($>$ 10000 TL).

DMFT index and periodontal parameters were recorded by a calibrated single clinician who was blind to the work schedule of participants. The periodontal condition of individuals was determined by measuring PI, GI, AL, and PD. All measurements were obtained from six points of each tooth (except third molars) using the Williams probe calibrated in millimeters. The distance from cemento-enamel junction (CEJ) to the bottom of pocket was measured as AL. PD was also measured distance between gingival margin to the base of pocket. PI was measured by using PI of Silness-Loe (0 = no plaque, 1 = no visible plaque, 2 = visible plaque, 3 = spread plaque).¹⁰ GI was measured by using GI of Loe-Silness (0 = absence of inflammation, 1 = mild inflammation, 2 = moderate inflammation, 3 = severe inflammation).¹¹

OHIP-14 questionnaire, whose Turkish validity and reliability has been approved, was answered by the participants.¹² The OHIP-14 questionnaire which measures impact of oral disorders on individuals' social wellbeing has seven domains of OHRQOL. The OHIP-14 questionnaire's answers were calculated on a Likert scale coded 0 to 4. The total score of the answers ranges from 0 to 56, and with the increase of

the score, the patient's negative experience also increases.¹³

Data analysis was performed using the SPSS software (version 17.0, SPSS Inc., Chicago, IL, USA) and the statistical significance level was set at 0.05. Kolmogorov-Smirnov test (K-S test) and Shapiro-Wilk test were used for confirming the normality of data. The mean scores of periodontal clinical parameters, DMFT and OHIP-14, for groups were analyzed by using analysis of covariance (ANCOVA) test with adjustment for age, gender, education level, and monthly income.

Results

The study comprised 612 individuals, 318 daytime workers (168 men, 150 women) and 294 shift workers (174 men, 120 women). The mean age of daytime workers was 42.91 ± 7.95 years and their age ranged from 26 to 56 years. The mean age of shift workers was 40.43 ± 7.62 years, ranging from 27 to 54 years. The education level and monthly income of daytime and shift workers were shown in table 1.

The mean number of D, M, and F teeth of shift workers was significantly higher than daytime workers (P < 0.05, ANCOVA test). The mean DMFT score of daytime workers was statistically lower than that of shift workers (P < 0.05, ANCOVA test) (Table 2).

The means of PI, GI, PD, and AL of shift workers were meaningfully higher than daytime workers (P < 0.05, ANCOVA test) (Table 3).

The mean unadjusted OHIP-14 score of daytime workers was 15.67 ± 3.48, and the mean unadjusted OHIP-14 score of shift workers was 15.76 ± 3.81. There was no significant difference between shift and daytime workers (P > 0.05, ANCOVA test) (Table 4).

Table 1. The education level and monthly income of the groups

Education level		Daytime workers	Shift workers
Primary school	n	114	111
	Row (%)	50.6	49.4
	Column (%)	35.8	37.7
Secondary school	n	98	99
	Row (%)	49.7	50.3
	Column (%)	30.8	33.6
High school	n	74	65
	Row (%)	53.2	46.8
	Column (%)	23.2	22.1
University	n	32	19
	Row (%)	62.7	37.3
	Column (%)	10.2	6.6
Monthly income			
Low	n	166	161
	Row (%)	50.7	49.3
	Column (%)	52.2	54.7
Middle	n	132	122
	Row (%)	51.9	48.1
	Column (%)	41.5	41.4
High	n	20	11
	Row (%)	64.5	35.5
	Column (%)	6.3	3.9

Discussion

The relationship between internal clock of body and environment can be disrupted by shift working and this may cause deleterious effects on adaptability to temporal changes.¹⁴

Table 2. The mean scores of decayed, missing, and filled teeth (DMFT) of groups

	Groups	n	Unadjusted (mean ± SD)	Adjusted [mean [#] (95% CI)]	P
DMFT	D Daytime workers	318	2.94 ± 1.13	2.66 (2.04-3.34)	0.001*
	Shift workers	294	4.78 ± 1.53	4.29 (3.87-4.87)	
M	Daytime workers	318	1.72 ± 1.32	1.55 (0.92-2.22)	0.001*
	Shift workers	294	5.41 ± 2.18	5.22 (4.59-5.93)	
F	Daytime workers	318	6.38 ± 1.52	5.95 (5.73-6.59)	0.001*
	Shift workers	294	4.80 ± 1.38	4.34 (4.02-5.03)	
DMFT	Daytime workers	318	11.04 ± 2.86	10.63 (10.31-11.02)	0.001*
	Shift workers	294	14.98 ± 3.44	14.04 (13.54-15.34)	

*P < 0.05, analysis of covariance (ANCOVA test); [#]Adjusted for age, gender, education level, and monthly income

DMFT: Decayed, missing, and filled teeth; D: Decayed; M: Missing; F: Filled; CI: Confidence interval; SD: Standard deviation

Table 3. The mean scores of clinical periodontal parameters of groups

Groups		n	Unadjusted (mean ± SD)	Adjusted [mean [#] (95% CI)]	P	
Periodontal clinical parameters	PI	Daytime workers	318	2.26 ± 0.39	2.01 (1.78-2.43)	0.011*
		Shift workers	294	2.47 ± 0.23	2.25 (1.96-2.56)	
	GI	Daytime workers	318	2.02 ± 0.36	1.91 (1.78-2.33)	0.003*
		Shift workers	294	2.31 ± 0.23	2.22 (2.03-2.47)	
	PD	Daytime workers	318	3.23 ± 1.08	3.02 (2.84-3.45)	0.009*
		Shift workers	294	3.81 ± 1.16	3.56 (3.37-3.97)	
AL	Daytime workers	318	3.77 ± 1.69	3.49 (3.12-4.02)	0.001*	
	Shift workers	294	4.64 ± 1.59	4.43 (4.19-4.76)		

*P < 0.05, analysis of covariance (ANCOVA) test; [#]Adjusted for age, gender, education level, and monthly income

CI: Confidence interval; SD: Standard deviation; PI: Plaque index; GI: Gingival index; PD: Probing depth; AL: Attachment loss

Although shift work has been implicated as a risk factor for a number of chronic diseases,¹⁵ no research study has investigated the association between oral health and shift work. In this context, oral health and OHRQOL of shift workers and daytime workers were compared to determine whether there are effects of shift work on oral health.

The mean numbers of D, M, F teeth and the mean DMFT score of shift workers were higher than those of daytime workers. These results can be explained by unhealthy behaviors that are more frequently observed among shift workers, caused by eating more carbohydrates¹⁶ and increased fat intake.¹⁷ The scientific basis for the relationship between tooth decay and nutrition state is that reducing the intake of carbohydrates decreases the formation of dental caries.¹⁸ It has also been reported that dental caries is widely seen in high-carbohydrate-consuming societies.¹⁹ These disturbances, in turn, may lead to higher DMFT index scores in shift workers. In addition to poor eating habits, the secretory level of saliva, an important factor in effective self-defense of the oral cavity, is influenced by the circadian rhythm, and is thus affected by shift working.²⁰ Higher DMFT indices with shift work may

also derive from disruption of social life. Shift working, which does not fit well with the workers' social and family commitments, can lead to a poor work-life balance and reduce the time available for recreation.²¹ This conflict between work and life can be associated with poor oral health behavior and irregular dental check-ups.

The accumulation of plaque can lead to caries and periodontal diseases; the removal of plaque is an essential and effective way to prevent these diseases.²² Considering the role of plaque in the pathogenesis of caries and periodontal diseases, PI, a widely-used and respected scoring system of plaque, was examined in this study. The mean PI of shift workers was statistically higher than daytime workers. This might be caused by poor lifestyle-related habits,²³ such as lack of tooth brushing and carelessness about oral health. Shift workers generally have lower socioeconomic status than daytime workers, which might be another contributing factor for higher PI.²⁴

Gingival bleeding after probing is a widely-used and more objective clinical marker of periodontal inflammation. GI is the most prominent and frequently-used index in clinical trials to examine gingival inflammation.²⁵

Table 4. The comparison of mean scores of Oral Health Impact Profile (OHIP-14) of groups

Groups		n	Unadjusted (mean ± SD)	Adjusted [mean [#] (95% CI)]	P
OHIP-14	Daytime workers	318	15.67 ± 3.48	13.24 (11.19-18.32)	0.782*
	Shift workers	294	15.76 ± 3.81	13.36 (11.24-19.01)	

*P > 0.05, analysis of covariance (ANCOVA) test; [#]Adjusted for age, gender, education level, and monthly income

OHIP: Oral Health Impact Profile; CI: Confidence interval; SD: Standard deviation

The mean GI of shift workers was statistically higher than daytime workers. The reason for this may be related to the higher PI of shift workers, but it can also be speculated that disturbed sleep and short-duration sleep caused by shift working are related to increased inflammation.²⁶ Low-grade inflammation, established as a risk factor for periodontal diseases, can be related to disturbed sleep in shift workers.²⁷ Poor sleep quality resulting from shift work increases the level of C-reactive protein (CRP), proinflammatory cytokines, and leukocyte values which are independent risk components for several infectious diseases including periodontal diseases.²⁸

PD and AL are the standard measurements used to assess the diagnosis of periodontal diseases.²⁹ A statistically significant higher mean was noted for AL and PD for shift workers than that noted in daytime workers. Circadian rhythm disruption, which includes sleep deprivation and various stress reactions, can explain the mechanism by which shift work increases AL and PD.³⁰ Multiple confounders, such as job stress, poor nutrition, and work intensity may contribute to shift work-related onset and progression of periodontal diseases.³¹ Another possibility is that melatonin secretion may affect the periodontal condition of shift workers. It is known that lower light exposure at night reduces melatonin production; several studies have found evidence of the positive contribution of melatonin in the oral cavity.³² An additional possibility is that increased oxidative stress is involved, which is known to play a significant role in several diseases pathogenesis among shift workers, as reported by a few studies.^{33,34}

Since clinical parameters alone are not enough to determine the health status of a person, the effect of disease on the QOL should also be considered in the evaluation of health outcomes.³⁵ OHRQOL, which includes the effect of oral health on daily well-being, is a concept dealing with people's perspectives.³⁶

In this study, although the DMFT score and periodontal clinical parameters of shift workers were higher than those of daytime workers, there was no significant difference between the groups in terms of OHRQOL. This may be clarified with this fact that clinical indicators of caries or periodontal involvement do not reflect shift workers' self-esteem and their social interaction. In addition, shift workers may tend to underestimate their dental treatment needs, and the oral diseases we measured were not the same, conceptually and empirically, as illness self-assessed by shift workers.³⁶ Another explanation is that shift workers may accept their poor oral health status as a part of their normal lives, and they may not feel discomfort about it.

The research has some limitations. This study is a cross-sectional analysis, not designed to establish a causal relationship between work schedule and oral health. The risk factors of periodontal diseases and dental caries are multifactorial involving psychosocial stress, socio-economic status, genetic factors, and obesity.³⁷ Examining the effects of shift work on oral health by eliminating all possible risk factors is highly unlikely due to the complexity of being human. In this study, although we did not include workers with DM or cigarette smokers, both considered major risk factors for poor periodontal health, we might not be able to eliminate individual risk factors arising from employees' personal characteristics.

Conclusion

Although the clinical parameters related to oral health of the shift workers were statistically worse than daytime workers, the mean OHIP-14 score of the shift workers did not show a significant difference from daytime workers. Further studies with larger representative populations, studies on the mechanisms, and longer follow-ups are also recommended to better understand the difference between shift work and daytime work.

Conflict of Interests

Authors have no conflict of interest.

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References

1. Straif K, Baan R, Grosse Y, Secretan B, El Ghissassi F, Bouvard V, et al. Carcinogenicity of shift-work, painting, and fire-fighting. *Lancet Oncol* 2007; 8(12): 1065-6.
2. Bambra CL, Whitehead MM, Sowden AJ, Akers J, Petticrew MP. Shifting schedules: The health effects of reorganizing shift work. *Am J Prev Med* 2008; 34(5): 427-34.
3. Folkard S, Lombardi DA, Tucker PT. Shiftwork: Safety, sleepiness and sleep. *Ind Health* 2005; 43(1): 20-3.
4. Sischo L, Broder HL. Oral health-related quality of life: What, why, how, and future implications. *J Dent Res* 2011; 90(11): 1264-70.
5. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. *Bull World Health Organ* 2005; 83(9): 661-9.
6. Eslamipour F, Borzabadi-Farahani A, Asgari I. The relationship between aging and oral health inequalities assessed by the DMFT index. *Eur J Paediatr Dent* 2010; 11(4): 193-9.
7. Teles R, Sakellari D, Teles F, Konstantinidis A, Kent R, Socransky S, et al. Relationships among gingival crevicular fluid biomarkers, clinical parameters of periodontal disease, and the subgingival microbiota. *J Periodontol* 2010; 81(1): 89-98.
8. Santos CM, Oliveira BH, Nadanovsky P, Hilgert JB, Celeste RK, Hugo FN. The Oral Health Impact Profile-14: A unidimensional scale? *Cad Saude Publica* 2013; 29(4): 749-57.
9. Sallinen M, Kecklund G. Shift work, sleep, and sleepiness - differences between shift schedules and systems. *Scand J Work Environ Health* 2010; 36(2): 121-33.
10. Silness J, Loe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontol Scand* 1964; 22: 121-35.
11. Loe H, Silness J. Periodontal disease in pregnancy. I. Prevalence and severity. *Acta Odontol Scand* 1963; 21: 533-51.
12. Mumcu G, Inanc N, Ergun T, Ikiz K, Gunes M, Islek U, et al. Oral health related quality of life is affected by disease activity in Behcet's disease. *Oral Dis* 2006; 12(2): 145-51.
13. Slade GD, Spencer AJ. Development and evaluation of the Oral Health Impact Profile. *Community Dent Health* 1994; 11(1): 3-11.
14. Lee HJ, Son KL, Bang YR, Jeon HJ, Lee K, Yoon IY. The association between shift work-related sleep complaints and shift work intolerance. *Sleep Biol Rhythms* 2019; 17(1): 3-10.
15. James SM, Honn KA, Gaddameedhi S, Van Dongen HPA. Shift work: Disrupted circadian rhythms and sleep-implications for health and well-being. *Curr Sleep Med Rep* 2017; 3(2): 104-12.
16. Kecklund G, Axelsson J. Health consequences of shift work and insufficient sleep. *BMJ* 2016; 355: i5210.
17. Chen Y, Lauren S, Chang BP, Shechter A. Objective food intake in night and day shift workers: A laboratory study. *Clocks Sleep* 2018; 1(1): 42-9.
18. Zia K, Rajan JS, Khan SQ, Siddiqui T. Effect of dietary and Oral hygiene pattern on incidence of dental caries among a population from Riyadh, Saudi Arabia. *Ann Jinnah Sindh Med Univ* 2018; 4(1): 30-4.
19. Hujoel PP, Lingstrom P. Nutrition, dental caries and periodontal disease: A narrative review. *J Clin Periodontol* 2017; 44(Suppl 18): S79-S84.
20. Roestamadji RI, Nastiti NI, Surboyo MDC, Irmawati A. The risk of night shift workers to the glucose blood levels, saliva, and dental caries. *Eur J Dent* 2019; 13(3): 323-9.
21. Shiffer D, Minonzio M, Dipaola F, Bertola M, Zamuner AR, Dalla Vecchia LA, et al. Effects of clockwise and counterclockwise job shift work rotation on sleep and work-life balance on hospital nurses. *Int J Environ Res Public Health* 2018; 15(9).
22. Marsh PD, Zaura E. Dental biofilm: Ecological interactions in health and disease. *J Clin Periodontol* 2017; 44(Suppl 18): S12-S22.
23. Bae MJ, Song YM, Shin JY, Choi BY, Keum JH, Lee EA. The association between shift work and health behavior: Findings from the Korean National Health and Nutrition Examination Survey. *Korean J Fam Med* 2017; 38(2): 86-92.
24. Etindele Sosso FA. Insomnia, excessive daytime sleepiness, anxiety, depression and socioeconomic status among customer service employees in Canada. *medRxiv* 2019; 19003194.
25. Valkenburg C, Van der Weijden FA, Slot DE. Plaque control and reduction of gingivitis: The evidence for dentifrices. *Periodontol* 2000 2019; 79(1): 221-32.
26. Irwin MR, Olmstead R, Carroll JE. Sleep disturbance, sleep duration, and inflammation: A systematic review and meta-analysis of cohort studies and experimental sleep deprivation. *Biol Psychiatry* 2016; 80(1): 40-52.

27. Bonaccio M, Di CA, Pounis G, De CA, Costanzo S, Persichillo M, et al. Relative contribution of health-related behaviours and chronic diseases to the socioeconomic patterning of low-grade inflammation. *Int J Public Health* 2017; 62(5): 551-62.
28. Atrooz F, Salim S. Sleep deprivation, oxidative stress and inflammation. In: Donev R, editor. *Advances in protein chemistry and structural biology inflammatory disorders*. Philadelphia, PA: Elsevier; 2020. p. 309-36.
29. Tonetti MS, Greenwell H, Kornman KS. Staging and grading of periodontitis: Framework and proposal of a new classification and case definition. *J Periodontol* 2018; 89(Suppl 1): S159-S172.
30. Steinach M, Gunga HC. Circadian rhythm and stress stress. In: Chouker A, editor. *Challenges and immunity in space*. Berlin, Germany: Springer Berlin; 2020. p. 145-79.
31. Badar A. Circadian rhythm in health and disease. *J Pak Med Assoc* 2018; 68(6): 833-4.
32. Sankari M, Meenakshi SS. Melatonin in Periodontal Diseases: A review. *Biomed Pharmacol J* 2019; 12(1): 3-6.
33. Benedusi M, Frigato E, Romani A, Bertolucci C, Valacchi G. Circadian clock and oxidative Stress: functional cross-talk in skin homeostasis. *Free Radic Biol Med* 2018; 120: S161.
34. Teixeira KRC, Dos Santos CP, de Medeiros LA, Mendes JA, Cunha TM, De AK, et al. Night workers have lower levels of antioxidant defenses and higher levels of oxidative stress damage when compared to day workers. *Sci Rep* 2019; 9(1): 4455.
35. Dorfer C, Benz C, Aida J, Campard G. The relationship of oral health with general health and NCDs: A brief review. *Int Dent J* 2017; 67(Suppl 2): 14-8.
36. Fuller J, Donos N, Suvan J, Tsakos G, Nibali L. Association of oral health-related quality of life measures with aggressive and chronic periodontitis. *J Periodontal Res* 2020.
37. Fleming EB, Nguyen D, Afful J, Carroll MD, Woods PD. Prevalence of daily flossing among adults by selected risk factors for periodontal disease-United States, 2011-2014. *J Periodontol* 2018; 89(8): 933-9.