

Effect of Daily Water Intake on Periodontal Health and Dental Caries: A Cross-Sectional Study

Saira Khalid¹, Mehreen Imran², Hammad Hassan³, Ramsha Khalid⁴, Wardah Nisar⁵, Varda Hussain⁶

Associate Professor, Department of Science of Dental Materials, University of Health Sciences, Lahore Pakistan

1 *Conception & design, Critical revision of the manuscript for important intellectual content, Statistical expertise, Methodology, Investigation, Data curation, Draft preparation*

Associate Professor, Department of Dental Materials, Peshawar Dental College, Prime foundation Peshawar, Riphah International, Pakistan

2 *Conception & design, Analysis and interpretation of data, Drafting of the article, Investigation, Data curation, Draft preparation*

Assistant Professor, Department of Science of Dental Materials, University of Health Sciences, Lahore Pakistan

3 *Critical revision of the manuscript for important intellectual content, Statistical expertise Drafting of the manuscript, Data curation*

MDS Post Graduate Trainee, Department of Prosthodontics, de' Montmorency College of Dentistry, Lahore Pakistan

4 *Data collection, Data analysis, Interpretation of results*

Lecturer, Nutrition, University of Health Sciences, Lahore Pakistan

5 *Collection & assembly of data, Interpretation of results*

MDS Post Graduate Trainee, Department of Prosthodontics, de' Montmorency College of Dentistry, Lahore Pakistan

6 *Data collection, Data Curation*

CORRESPONDING AUTHOR

Dr. Saira Khalid

Associate Professor, Department of Science of Dental Materials, University of Health Sciences, Lahore, Pakistan
Email: saira.dentmat@gmail.com

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ABSTRACT

Background: Water is crucial for maintenance of human body health. **Objective:** The study aimed to determine the effect of water intake on oral health and to compare the water intake behaviors in people of different age groups, genders, and professions. **Study Design:** Cross-sectional study. **Settings:** Study was conducted in the outpatient department of Punjab Dental Hospital through systemic random sampling. **Duration:** November 02, 2022 to January 03, 2023. **Methods:** A close-ended questionnaire was designed and administered; the later clinical examination was performed, and findings were recorded. Data were analyzed using SPSS version 23. **Results:** DMFT score was highest among those aged between 45 to 54 years, males, having elementary school education, unemployed, and having sedentary job activity level. Males (33.6%) were consuming more water. Respondents drinking adequate water had coral pink gingiva (25.6%), whereas those who were consuming less water had red gingiva (25.6%), bleeding on probing (37.6%), and supra gingival calculus (33.6%). The main reasons for not drinking adequate water were forgetfulness, followed by adipsia and fear of polyuria. Most respondents (72.8%) preferred drinking water at home rather than at work. Most respondents (72.8%) do not drink water at their workplace as they preferred (32%) to drink home-filtered water. Most respondents (83.2%) used only water for oral cleaning. **Conclusion:** Those consuming less than 1 liter of water daily had an increased prevalence of supragingival calculus, bleeding gums, and dark red gingiva. The mode of intervention should be mass education regarding water consumption, as per guidelines of WHO and ADA.

Keywords: Awareness, Carbonated drinks, Oral health, Periodontal disease, Water consumption.

INTRODUCTION

Water is crucial for maintaining the overall health of the human body.¹ There is no consensus regarding adequate water intake as it depends on various factors such as sex, weight, and activity level of an individual as well as the climate. There is a concept of the 8x8 rule, which promotes the intake of at least 8- 8-oz glasses of water per day.² The National Health Service (NHS) recommends an intake of 2 liters of water per day in accordance with the climate of the United Kingdom. According to global dietary guidelines, the adequate water intake for men is 3.7 liters per day, while for

women, it is 2.7 liters/per day. 81% of this water comes from drinking water.³ Different types of water available include tap, mineral, bottled water, spring water, and distilled water. All these waters have different fluoride content. According to WHO, 0.5-1ppm is the standard fluoride content in drinking water.⁴

Water not only plays a significant role in maintaining the oral environment, but it is also vital for maintaining tooth structure.⁵ Studies show that as the moisture content in an endodontically treated tooth is less than that of a vital tooth, it becomes more brittle and prone to fracture.⁶ Adequate saliva production is important for preserving

and maintaining oral tissues. Water plays a part in saliva production as well.⁷ Saliva in the oral cavity modulates oral microflora; it contains proteins that inhibit the growth and attachment of several bacteria in the oral cavity.⁸

Periodontal disease, one of the most common chronic disorders, affects the gingiva, supporting connective tissue and alveolar bone, which supports the teeth in the jaws. According to the global burden disease study, oral diseases affect close to 3.5 billion people worldwide.⁹ Two billion people globally suffer from caries of permanent teeth, while five hundred and twenty million children suffer from caries of primary teeth. Previous research reported that morning bad breath scores significantly decreased after drinking a glass of water.¹⁰ There is limited data regarding the impact of water intake on the prevalence of dental diseases in the Asian population. A study conducted in Korea reported that toothache was prominent among the groups who consumed less than 1 cup of water per day.^{11,12}

This study aims to determine the effect of daily water intake on oral health by comparing the prevalence of periodontal diseases and dental caries in people having different water intakes. This study will also help to assess and compare the water intake behaviors in people of different age groups, genders, and professions.

METHODS

This questionnaire-based cross-sectional observational study was carried out after receiving approval from the ethical board of de' Montmorency College of Dentistry/Punjab Dental Hospital (PDH) Lahore (IRB Letter No.4780/DCD Dated 31-10-2022). The study was conducted from 2 November 2022 to 3 January 2023 in the outpatient department of Punjab Dental Hospital.

Individuals who were completely edentulous and had any systemic disease or tooth developmental disorder were excluded from the study. A questionnaire proforma was designed by the authors after a thorough literature review. The questionnaire consisted of two sections. The first section comprised data about demographics, oral hygiene practices, and lifestyle of the participants. The second part consisted of a clinical examination of the oral cavity of the participants. A pilot study was carried out on 30 participants, and required modifications were made. The questionnaire was tested for safe validity and content validity and approved by a panel of three researchers. A sample size of 120 patients was calculated using the WHO calculator. Written and informed consent was taken from all the participants. All the questionnaires were filled out, and clinical examination was done by two clinicians not taking part in the research. The color and appearance of the gingiva were visually examined and

recorded. DMFT (Decayed, Missing, and Filled Teeth) score of each patient was calculated by adding the number of decayed, missing, and filled teeth in the oral cavity.¹³ The subjects were examined for the presence of calculus and bleeding response by probing using a Michigan Williams dental probe. CPITN (Community Periodontal Index of Treatment Needs) index was used to assess the periodontal health status of teeth using the WHO/CPITN probe.¹⁴

The data was analyzed using the IBM Statistical Package for the Social Sciences (SPSS version 26, IBM Corporation, USA, New York). The normality of data was assessed, and the parametric test, independent sample T-test, and One-way ANOVA were used to compare the means. Categorical variables were compared by applying the Chi-Square test. A significance level of 0.05 or below was considered statistically significant.

RESULTS

A total of 125 participants took part in this study. The response rate was 95%. The demographics and their comparison with DMFT and CPITN scores have been tabulated in Table 1.

There was a significant difference in DMFT scores of the respondents when it came to different age groups ($p < 0.001$), gender ($p = 0.029$), education levels ($p < 0.001$), and job activity level ($p = 0.002$). People with older age groups had higher DMFT scores. Male respondents had higher DMFT scores. Respondents from elementary schools had higher DMFT scores. Moreover, those who had sedentary job activity had higher DMFT scores (Table 1).

CPITN scores showed significant variation between different age groups ($p = 0.04$), educational levels ($p = 0.008$), and job activity. Older age groups, especially 45-55 years older, showed higher CPITN scores. Elementary school children showed higher CPITN scores, and those with sedentary job activity showed higher CPITN scores (Table 1).

There was a weakly significant difference between males and females regarding water intake ($\chi^2 = 7.42$, $p = 0.05$) shown in table 2.

The comparison of water intake with oral gingival health has been exhibited in Table 3. For respondents who were consuming 1 liter or less water per day, a significant majority of them had red (25.6%) or dark red (5.6%) colored swollen gingiva (28%) ($p < 0.001$). The significant majority of the respondents who were consuming less water showed bleeding on probing ($p < 0.001$) and had supra gingival calculus ($p = 0.047$) (Table 3).

Table 1: Demographical data and its comparison with DMFT and CPITN scores

Demographics		n	%	DMFT	p	CPITN	P
Age	18-24	20	16.0	1.90	<0.001	0.75	0.04
	25-34	36	28.8	2.58		1.25	
	35-44	32	25.6	4.56		1.56	
	45-54	14	11.2	5.43		2.07	
	55 & above	23	18.4	5.17		1.96	
Gender	Male	63	50.4	4.37	0.029	1.46	0.916
	Female	62	49.6	3.18		1.48	
Education	Elementary School	32	25.6	5.38	<0.001	2.00	0.008
	Middle School	35	28.0	4.23		1.57	
	High School	30	24.0	2.63		0.97	
	University	28	22.4	2.61		1.29	
Employment Status	Employed	62	49.6	3.26	0.074	1.34	0.461
	Unemployed	58	46.4	4.43		1.62	
	Business Person	5	4.0	2.60		1.40	
Job Activity	Sedentary	16	12.8	6.44	0.002	2.31	0.031
	Lightly active	39	31.2	3.46		1.44	
	Moderately active	51	40.8	3.27		1.29	
	Highly active	19	15.2	3.53		1.32	
Total		125	100	3.78		1.47	

p-values were generated using independent sample T-test and one-way ANOVA

Table 2: Daily water intake and its comparison with DMFT and CPITN Scores

Water Intake	n	%	DMFT	p	CPITN	P
1 liter or less	53	42.4	3.43	0.582	1.72	0.05
2-3 liters	52	41.6	4.23		1.44	
3-4 liters	18	14.4	3.50		1.00	
4 liters or more	2	1.6	3.50		0.00	

p-values were determined using the one-way ANOVA

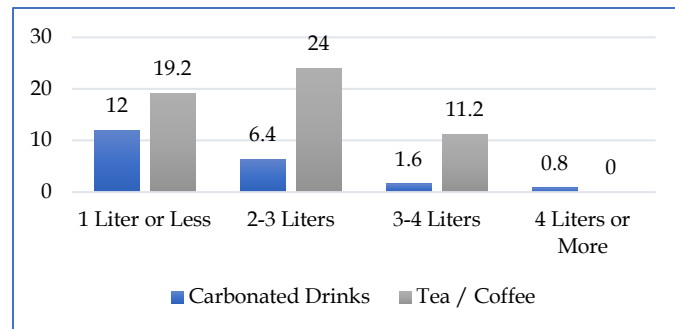
Table 3: Gingival health and its association with daily water intake

Variables	%	Water Intake				X2	P
		1L or less	2L-3L	3L-4L	4L or more		
Color of Gingiva	Coral pink (50.4)	14 (11.2)	32 (25.6)	15 (12)	2 (1.6)	24.8	<0.001*
	Red (40.8)	32 (25.6)	16 (12.8)	3 (2.4)	0 (0)		
	Dark red (8.8)	7 (5.6)	4 (3.2)	0 (0)	0 (0)		
Appearance of Gingiva	Stippled (57.6)	18 (14.4)	36 (28.8)	16 (12.8)	2 (1.6)	23.6	<0.001*
	Swollen (42.4)	35 (28)	16 (12.8)	2 (1.6)	0 (0)		
Bleeding on Probing	Yes (64.0)	47 (37.6)	25 (20)	8 (6.4)	0 (0)	26.2	<0.001*
	No (36.0)	6 (4.8)	27 (21.6)	10 (8)	2 (1.6)		
Supra-gingival Calculus	Present (74.4)	42 (33.6)	36 (28.8)	15 (12)	0 (0)	7.9	0.047
	Absent (25.6)	11 (8.8)	16 (12.8)	3 (2.4)	2 (1.6)		
Sub-gingival Calculus	Present (32.0)	21 (17)	11 (9)	5 (4)	0 (0)	2.2	0.527
	Absent (68.0)	36 (28.8)	33 (26.4)	14 (11.2)	2 (1.6)		

(L = Liters), p-values were determined using the Chi-Square Test

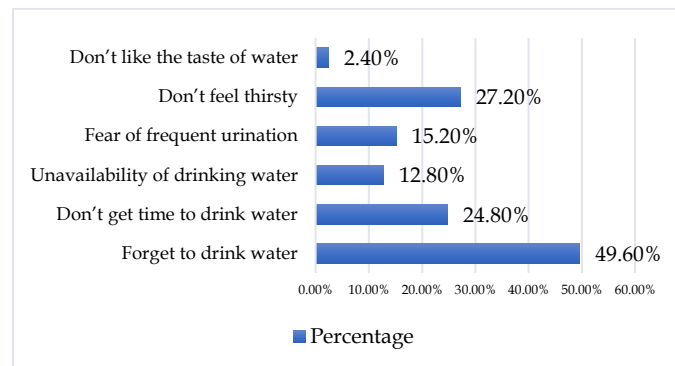
The comparison of frequent carbonated beverage drinkers and tea/coffee drinkers with water consumption has been illustrated in Figure 1. Those consuming less water were more frequent beverage and coffee/ tea drinkers.

Figure 1: Comparison of carbonated beverage and tea / coffee intake with the water intake



The reasons for consuming less water (less than two liters) per day have been illustrated in Figure 2.

Figure 2: Reasons for consuming less water (less than two liters) per day



The oral hygiene practices of respondents and their frequency of visits to the dentist have been tabulated in Table 4.

Table 4: Oral hygiene practices of respondents and their frequency of visit to the dentist

Variables	Frequency	Percentage	
Oral Cleaning	Rinsing with water	104	83.2%
	Toothbrush	106	84.8%
	Floss	8	6.4%
	Mouthwash	18	14.4%
Brushing frequency	Once a day	69	55.2%
	Twice a day	35	28.0%
	After every meal	3	2.4%
Brush Type	Never	18	14.4%
	Soft	58	46.4%
	Medium	37	29.6%
Visit to Dentist	Hard	12	9.6%
	Once in six months	2	1.6%
	Once a year	19	15.2%
	Rarely	27	21.6%
Never	77	61.6%	

The type of water preferred by the respondents and the location at which they preferred drinking water had the following results:

“Type of Water Intake” showed that the largest percentage, 32% of people, drink tap water. This is followed by filtered water (home filter) at 29.6%, bottled water (mineral water) at 22.4%, and boiled water at 16%.

The Preferred Location by the vast majority, 72.8% of people prefer to drink water at home. Only 27.2% of people prefer to drink water at the office or workplace.

DISCUSSION

Dental cavities and periodontal disease are among the world’s most common health issues caused by a combination of factors. Literature has shown a significant impact of socioeconomic inequalities on health status.^{15,16} The present study has shown that older age groups had higher DMFT scores. A cross-sectional survey involving adults of Rijeka, Croatia, showed that both decayed tooth and plaque index score was poor among low-economic status households.¹⁷ The present study also indicates that people having elementary and middle school education and those who were unemployed had higher DMFT Scores.

Nowadays, in developing and undeveloped countries, water is fortified with fluoride. Drinking fluoridated water can be helpful for good oral health. One of the studies conducted in the United Kingdom shows that water intake had less impact on oral health. Higher intake of saturated fats is strongly correlated with increased gums and tooth disease.¹⁸ The present study shows that the periodontal health of respondents was directly affected by water intake, as participants consuming less than a liter of water per day had the highest CPITN scoring.

The current study highlighted that tea was the most preferred drink of people. Recent studies on the consumption of tea show that tea contains various phytochemicals and polyphenols that have a positive impact on health from the heart to the skin.¹⁹ Excessive consumption of tea due to high tannin and caffeine content can cause staining of gums and teeth.

Home filters mostly have reverse osmosis technology that filters out lead, sulfates, chlorine, and other related contaminants and fluoride. The present study reported that the majority preferred as well as consumed home-filtered water. A similar search in Great Britain in 2020 shows that an estimated 4.33 million people consumed mineral water more than once a day, set criteria by the U.S. Food and Drug Administration.²⁰ Most of the participants preferred water at home rather than at their workplace. Research carried out by Yin Lou states that

water intake programs and the introduction of reminders through different apps and electronic cups significantly increased water intake among the workers and consequently improved their performance as well.²¹

People with strenuous and outdoor jobs tend to feel thirstier than those with sedentary jobs.²² Moreover, according to a study carried out in Mexico, the outdoor temperature was found to have the strongest impact on water intake quantity.²³ In the present study, the most common reasons were forgetfulness and not feeling thirsty at all.

This study shows that men have higher DMFT scores than women, and the most common technique used by participants for oral cleaning was rinsing and tooth brushing. Research shows that subgingival and supragingival plaque accumulation was significantly reduced by brushing teeth. Flossing and other methods of oral cleaning have an adjunctive value but are not enough on their own to clean the oral cavity.²⁴ Oral hygiene practices and water intake both have a direct impact on oral health and together play an important role in maintaining a healthy oral environment.

CONCLUSION

Participants consuming less than one liter of water per day had an increased prevalence of supragingival calculus, bleeding gums, and dark red gingiva. The mode of intervention should be mass education regarding the consumption of adequate amounts of water, as suggested by the World Health Organization and the American Dental Association. Awareness related to the importance of regular oral cavity brushing twice a day should be inculcated among the general public.

LIMITATIONS

Although the study controlled for various demographic and lifestyle factors, there may be other unmeasured confounders, such as dietary habits and access to healthcare, that could influence the results. Moreover, the study largely relied on self-reported data from questionnaires which can introduce bias due to inaccurate recall or social desirability. Longitudinal studies are needed to determine the directionality and causality of the observed associations.

SUGGESTIONS / RECOMMENDATIONS

Future recommendations prioritize longitudinal studies to elucidate the causal relationships between dietary habits in addition to water intake on oral health outcomes, ensuring informed strategies for promoting long-term public health.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare no conflicts of interest.

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The authors have no funding to report.

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