Oral Health Status and Related Factors in Children with Visual Impairment Aged 7-11 Years: A Cross-Sectional Study

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Article Info	ABSTRACT
  * Corresponding author: Department of Community Oral Health, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran Email: k-sargeran@tums.ac.ir	**Objectives:** We aimed to investigate oral health, oral hygiene, and associated factors in children with visual impairment aged 7-11 years. **Materials and Methods:** This cross-sectional study was conducted on 47 children with visual impairment aged 7-11 years who were selected from all three schools available for visually impaired children in Tehran in December 2018. Questions regarding age, gender, status of visual impairment, level of education of the parents, self-reported dental and gingival health, oral health, and dietary habits were asked face-to-face using the World Health Organization oral health questionnaire for children. The decayed, missing, and filled teeth index for both primary (dmft) and permanent (DMFT) dentitions was determined by clinical examination. Simplified Oral Hygiene Index (OHI-S), and bleeding on probing (BOP) were also assessed. Linear and logistic regression tests were used for statistical analysis. **Results:** Over 70% of the children were satisfied with their dental and gingival health. Daily brushing was reported by 70.2%. Over half of the children reported daily consumption of fruits and jam/honey. The mean dmft and DMFT scores were 2.85±3.21 and 0.81±1.15, respectively. The mean OHI-S was 2.09±0.58. Also, 57.4% and 34% of the children had unrestored caries in their primary and permanent teeth, respectively. BOP was seen in 78.7% of the children. A significant correlation was observed between toothache in the past 12 months and dmft score (P<0.003). Daily tooth brushing was inversely correlated with OHI-S index (P=0.02). **Conclusion:** The results highlight an urgent need for implementation of oral health programs for visually impaired children. **Keywords:** Oral Health; Vision Disorders; Dental Caries; Oral Hygiene Index

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INTRODUCTION

Visual impairment is a rising disability specially in low- and middle-income regions [1]. At least 2.2 billion people suffer from vision impairment or blindness worldwide. Congenital cataract is the leading cause of vision impairment in children in low-income countries, while retinopathy of prematurity is the main cause in high-income countries [2]. In Iran, age-standardized prevalence of vision loss was reported to be 12.3% in 2015 [3]. The prevalence of visual impairment in seven–year-olds in Iran was 0.34% [4].

In eastern Mediterranean countries such as Iraq [5] and Turkey [6], children with visual impairment were shown to have a fair-to-poor level of oral hygiene. Most of these studies reported oral health status in school-aged children in a wide age range without attention to primary or mixed dentition. Studies indicate

poor oral health for children with visual impairment [6-11]. Even in case of fair oral hygiene, the rate of dental caries was still high. Early caries detection along with an oral health promotion program will be useful to raise the practical knowledge of such children [12]. It has been shown that children with visual impairment have high child oral impact on daily performance score and low oral health-related quality of life [13,14]. They have some difficulties in brushing of their teeth, especially in applying the toothpaste on the toothbrush [15] leading to inadequate plaque removal [7].

Previous studies showed that visually impaired children had poor oral hygiene [6,9,10]. Gingival inflammation was also frequently reported [8,9,16–18]. High prevalence of dental caries remains an oral health challenge in visually impaired children [6,9,10,16-18]. Infrequent dental visits is another problem in such patients that results in further deterioration of their oral health [9,10,17]. Unmet dental caries, along with toothache, may affect children's physical development and daily-life achievements [13,19]. In China, mother's low educational level and experience of toothache within the past year were indicated as the risk factors for dental caries in school children with visual impairment [17].

Studies about the oral health of children with visual impairment in Iran are limited. In Isfahan, high DMFT and gingival inflammation were reported in children with visual impairment [20]. Parental awareness was not related to DMFT, while high parental knowledge was associated with lower frequency of missed teeth and higher frequency of filled teeth in children with visual impairment [21]. Only one randomized clinical trial assessed the efficacy of oral health education for children with visual impairment in Iran [22].

To the best of our knowledge, no previous study has assessed all the oral health-related factors of the World Health Organization (WHO) oral health questionnaire in children with visual impairment. It is necessary to clarify the correlation between the oral health-related factors such as self-reported oral health, dietary habits, difficulties experienced because of oral health problems and the current oral health status. Assessment of oral health and evaluation of effective determinants would result in development of effective preventive programs and management of oral healthcare needs of children with visual impairment. Therefore, this study aimed to assess the oral health, oral hygiene status, and associated factors in school children aged 7-11 years with visual impairment.

MATERIALS AND METHODS

This study was approved by the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.DENTISTRY.REC.1397.104). Before the study, written informed consent was obtained from the parents. The children gave assent to participate in the study.

Study design and population:

The present study was an analytical cross-sectional study conducted on 47 children with visual impairment (aged 7-11 years) who were in the mixed dentition period, in Tehran, Iran in December 2018.There are only three schools for such children in Tehran with 48 children in the first to fifth grades. Therefore, all of them were assessed for the eligibility criteria (census sampling). The inclusion criteria were studying in the first to the fifth grade (aged 7-11 years) and having the parents' consent for participation in the study. Children who were either absent or highly uncooperative or had mental disabilities were excluded. Ultimately, one child was excluded because of being absent during the data collection time, and 47 children were enrolled included 17 children from a girls' school in the north of Tehran, 12 children from a boys' school in the center of Tehran, and 18 children from a boys' school in the west of Tehran.

Data collection:

The WHO oral health questionnaire for children [23] was used as a standard structured questionnaire to collect demographic and oral health behavioral information. The WHO questionnaires have been pilot-tested in a wide range of countries across the world. This questionnaire was previously used in 6- and 12-year-old Iranian children [24]. A pilot study

was conducted earlier on 20 children with visual impairment in other grades in the same schools to check the validity and comprehensibility of the questionnaire. One of the authors who was a PhD candidate in community oral health, read the questions one by one with all answer choices clearly for each child in the classroom. The results showed an acceptable clarity through face-to-face interview with an intraclass correlation coefficient of 1 for the test-retest reliability. Finally, two oral health experts confirmed the questionnaire's validity.

The demographic characteristics included age, gender, grade, status of visual impairment, and educational level of the fathers and mothers. In this study, visual impairment status was categorized into two groups of low vision (for moderate and severe vision impairments) or blind (for blindness) [16,25]. The educational level of the fathers and mothers was categorized into two groups of lower than high-school diploma or high-school diploma and higher. Oral health-related questions asked about the self-reported dental health status, self-reported gingival health status, tooth brushing habits and materials, dental visits, and reasons for dental visits in the past 12 months, medical conditions, dietary habits (nine items) and six statements about difficulties experienced because of oral health status.

Self-reported responses were dichotomized into two groups of satisfied (excellent, very good, and good) or dissatisfied (average, poor, very poor, and I don't know). The frequency of tooth brushing was categorized into two groups of at least once a day or less. Use of toothbrush, toothpaste, and dental floss was also asked by yes/no questions.

Dental visits in the past 12 months were also asked by yes/no questions. The reason for dental visits in the past 12 months was categorized into two groups of pain and others. Dietary habits were assessed by asking the frequency of consumption of nine items: 1. Fresh fruit, 2. Biscuits, cakes, cream cakes, 3. Sweet pies, 4. Buns, 5. Jam or honey, 6. Chewing gum containing sugar, 7. Sweets/candy, lemonade, cola or other soft drinks, 8. Tea with sugar, and 9. Coffee with sugar. To assess the association between dietary habits and oral

health status, the Likert answers were scored and the sum of the scores for the nine questions for each child was reported in a range of 0-100. Then, the median score of sugar consumption was considered as a threshold to divide the results into two groups of low sugar consumption and high sugar consumption.

Clinical examination:

Clinical examination was performed with respect to decayed, missing, and filled teeth index for primary (dmft) and permanent (DMFT) teeth, the Simplified Oral Hygiene Index (OHI-S), and bleeding on probing (BOP). One of the authors who was a PhD candidate in community oral health examined the children on a chair using disposable gloves, disposable dental mirror, a dental explorer, a WHO periodontal probe, and a headlamp. Caries was assessed using the DMFT/dmft index based on the WHO criteria for oral health surveys [26]. The components of dmft/DMFT including dt, mt, ft, DT, MT, and FT were also reported separately. To assess the OHI-S, six permanent teeth (8, 3, 14, 19, 24, and 30) or six primary teeth (A, E, F, K, O, and P) were examined on a scale of 0 to 3 to obtain their debris index (DI) and calculus index (CI). The sum of DI and CI shows the OHI-S score [27,28]. The presence or absence of bleeding was assessed on buccal and mediobuccal areas of all teeth using the WHO periodontal probe [29].

Calibration:

For intra-examiner calibration, 10 children were examined for BOP, OHI-S, and DMFT by the examiner. To resolve previous bleeding after BOP assessment, a 30-minute break was considered (kappa=1). Although both DI and CI indices were examined for OHI-S, it was not possible to assess DI again because of removal by the explorer. Thus, intra-class correlation coefficient (ICC) was calculated only for CI (ICC=1). Calibration for DMFT/dmft was also done and the ICC was found to be 0.90.

Statistical analysis:

The data were analyzed using SPSS version 22 (IBM, Armonk, NY, USA). For non-normal quantitative variables (dmft/DMFT, dt/DT, OHI-S), the Mann-Whitney test was used. We also used the Chi-square test to assess the relationship between the qualitative binary

variables (BOP). The observed power was calculated for all the tests by PASS 11. P values less than 0.05 were considered statistically significant.

RESULTS

Descriptive results

Demographic characteristics:
In this study, 48 children with visual impairment aged 7-11 years attending three special schools for visually impaired children in Tehran were evaluated. One child was uncooperative and was excluded, and the data of 47 children were analyzed. The mean age of the children was 8.87±1.36 years. There were 29 boys (61.7%) and 18 girls (38.3%). Of all, 38.3% were blind and the rest had impaired vision (61.7%). Over 60% of the participants' mothers or fathers had high-school diploma or higher level of education (Table 1).

Table 1. General characteristics of 7-11-year-old visually impaired school children (N=47)

Variable		N	%
Gender	Male	29	61.7
	Female	18	38.3
Status of Visual impairment	Blind	18	38.3
	Low vision	29	61.7
Father's education	<12 years[a]	13	27.7
	≥12 years[b]	31	66
	Missing	3	6.4
Mother's education	<12 years[a]	17	36.2
	≥12 years[b]	29	61.7
	Missing	1	2.1

[a] Lower than high-school diploma,
[b] High-school diploma or higher

Oral health-related responses:
Most of the children were satisfied with their dental (70.2%) and gingival health (72.3%). Among the children, 70.2% brushed their teeth at least once a day. Only 14.9% brushed their teeth twice or more. Some children (6.4%) reported that they never brushed their teeth. Most of the children used toothbrush and toothpaste (91.5%). However, only 19.1% reported using dental floss to clean the interdental spaces. Among all the participants,

87.2% had no knowledge whether their toothpaste contained fluoride or not. Some children (25.5%) experienced toothache often or occasionally in the past 12 months; 17% of the children had never visited a dentist. Only 42.6% had a dental visit in the past 12 months, of which more than half reported that pain was the main reason for their dental visit.

Most of the children (n=42, 89.4%) were in good medical condition. However, 10.6% of the participants had medical problems including cardiac complications, epilepsy, gastrointestinal disease, or cancer. Children reported daily consumption of fruit (n=28, 59.5%), biscuits, cakes and cream (n=11, 23.4%), beverages (n=3, 6.4%), chewing gum (n=4, 8.5%), sweets (n=3, 6.4%), jam or honey (n=25, 53.2%), milk with sugar (n=5, 10.6%), tea with sugar (n=19, 40.4%), and coffee with sugar (n=1, 2.1%). The sugar consumption score ranged from 8.89 to 82.22. Cut-off categorization (median=33) showed that 53.2% consumed sugar more than the median cut-off. The frequency of experiencing difficulties because of oral problems was as follows: I am not satisfied with the appearance of my teeth (17%); I often avoid smiling and laughing because of my teeth (12.8%); other children make fun of my teeth (0%); toothache or discomfort forced me to miss classes at school or miss school for a whole day (2.1%); I have difficulty biting solid foods (25.5%); I have difficulty in chewing (19.1%).

Oral examinations:
The mean dmft and DMFT scores were 2.85±3.21 and 0.81±1.15, respectively. The dt and DT had the greatest share in both indices. Only 23.4% of the children were caries-free. The frequency of unrestored caries in primary and permanent teeth was 57.4% and 34%, respectively.

The mean OHI-S was 2.09±0.58, with DI having a greater share. BOP was seen in 78.7% of the children (Table 2).

Analytical results:
To identify the factors affecting DMFT/dmft, DT/dt, OHI-S, and incidence of BOP, we analyzed the collected data (including gender, status of visual impairment, educational level of the parents, self-reported dental health

Table 2. Clinical characteristics among 7-11-year-old visually impaired school children (n=47)

Variable	Number	%
Bleeding on probing		
Yes	37	78.7
No	10	21.3
Caries free	11	23.4
	Mean (SD)	**Range**
OHI-S	2.09 (0.58)	1-3.5
Debris index	2.06 (0.54)	1-3
Calculus index	0.03 (0.15)	0-1
DMFT	0.81 (1.15)	0-4
Decayed teeth	0.51 (0.80)	0-3
Missing teeth	0	0
Filled teeth	0.30-0.72	0-3
dmft	2.85 (3.21)	0-12
decayed teeth	2.51 (3.15)	0-12
missing teeth	0	0
filled teeth	0.34 (1.03)	0-6
DMFT+dmft	3.66 (3.50)	0-15

OHI-S: Oral Hygiene Index-Simplified; DMFT: Decayed, missing and filled permanent teeth; dmft: decayed; missing and filled primary teeth

status, self-reported gingival health status, brushing frequency, dental visits, and the reason for them in the past 12 months, toothache in the past 12 months, and dietary habits). The results showed that toothache in the past 12 months was positively associated with dmft (P=0.003) and dt (P=0.002) in children with visual impairment. An inverse correlation was observed between the frequency of tooth brushing and OHI-S. Moreover, children who brushed at least once a day had lower OHI-S than others (P=0.02). Children of mothers who had educational level lower than high-school diploma had a higher dt (P=0.01). The observed power is reported in Tables 3 and 4.

DISCUSSION

The present study showed high rate of unrestored dental caries in primary dentition and high prevalence of gingival bleeding in children with visual impairment. In addition, dmft and oral hygiene were associated with toothache in the past 12 months and brushing frequency, respectively.

Most children reported that they used toothbrush and toothpaste; however, using dental floss was rare, which was in line with the results of previous studies [12,29-31]. In addition, daily brushing was reported in 70.2% of the participants, which was consistent with most other studies on children with visual impairment [12,30,31]. However, most of the children had no idea whether their toothpaste contained fluoride or not, which indicates the lack of knowledge about this topic. The high rate of decayed teeth observed in the present study was in line with similar previous studies [10,12,14,16,30]. However, most of such studies were done on a wide age range (usually all grades in schools), and limited number of studies reported dmft separately. The mean DMFT+ dmft score in the present study was in line with a study conducted on 4-12-year-old children in Isfahan with visual impairment [20]. In the present study, both dmft and DMFT+ dmft were higher than the rates reported in Chinese children [17]. Our results showed that toothache had the greatest association with dmft/dt, which was in line with similar previous studies [14,17]. We found that more than half of the dental visits in the past 12 months were because of toothache. High rate of unrestored caries was consistent with the findings of a study that showed that the D component had the greatest share in the final score; however, the F component was negligible [31]. This can be associated with difficulty in access to dental care centers and not affording the care services. Thus, special prevention programs for these children especially in primary dentition period is an urgent need. In the current study, an inverse correlation was found between daily toothbrushing with oral hygiene. Although most children had an acceptable oral hygiene status in our study, gingival bleeding was observed frequently which was in line with previous studies in other countries [8,12,17] and also in Isfahan [20] in children with visual impairment. The high rate of gingival bleeding in such children could be caused by inappropriate toothbrushing and insufficient cleaning of teeth.

Table 3. Association of DMFT/dmft, OHI-S, and bleeding on probing with demographic information in 7-11-year-old visually impaired school children (n=47)

Variables	N(%)	DMFT M(SD)	P	Pw	DT M(SD)	P	Pw	Dmft M(SD)	P	Pw	dt M(SD)	P	Pw	OHI-S M(SD)	P	Pw	BOP+ OR	95% CI	P	Pw
Gender																				
Male[a]	29(61.7)	0.76(1.06)	0.84	<0.8	0.52(0.87)	0.77	<0.8	2.38(2.66)	0.32	<0.8	1.93 2.49)	0.19	0.95	2(0.64)	0.13	<0.8	3.05	0.57-16.36	0.28	<0.8
Female	18(38.3)	0.89(1.32)			0.50(0.71)			3.61 (3.90)			3.44 3.88)			2.24(0.45)						
Visual status																				
Blind	18(38.3)	0.72(1.13)	0.66	<0.8	0.61(0.98)	0.80	<0.8	2.89(2.89)	0.78	0.96	2.33(2.68)	0.98	<0.8	1.98(0.51)	0.31	<0.8	0.54	0.13-2.22	0.47	<0.8
Low vision[a]	29(61.7)	0.86(1.19)			0.45(0.69)			2.83(3.44)			2.62(3.45)			2.16(0.62)						
Father's education																				
<12	13(27.7)	0.54(0.88)	0.51	<0.8	0.46(0.78)	0.82	<0.8	3.23(2.95)	0.38	1	3.15(2.94)	0.14	1	2.10(0.38)	0.99	<0.8	0.43	0.09-1.97	0.41	<0.8
≥12[a]	31(66)	0.84(1.21)			0.52(0.81)			2.77(3.48)			2.29(3.38)			2.07(0.66)						
Missing	3(6.4)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	
Mother's education																				
<12	17(36.2)	0.76(0.97)	0.79	<0.8	0.65(0.86)	0.41	<0.8	3.82(3)	0.06	1	3.65(3)	0.01	1	2.20(0.42)	0.44	<0.8	0.38	0.09-1.69	0.26	<0.8
≥12[a]	29(61.7)	0.76(1.21)			0.45(0.78)			2.34(3.29)			1.90(3.14)			2.04(0.66)						
Missing	1(2.1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			-	

M: Mean; SD: Standard Deviation; P: P-value, Pw: Power (observed power); DMFT: Decayed, missing, and filled permanent teeth; DT: Decayed permanent teeth: dmft: Decayed, missing, and filled primary teeth; dt: Decayed primary teeth; OHI-S: Oral Hygiene Index-Simplified; BOP: Bleeding on Probing; OR: Odds Ratio; CI: Confidence Interval using the Chi-square test.
[a] Reference category

Table 4. Association of DMFT/dmft, OHI-S, and bleeding on probing with oral health related information in 7-11-year-old visually impaired school children (n=47).

Variable	DMFT				DT			dmft			dt			OHI-S			BOP+			
	N(%)	M(SD)	P	Pw	M(SD)	P	Pw	M(SD)	P	Pw	M(SD)	P	Pw	M(SD)	P	Pw	OR	95% CI	P	Pw
Brushing frequency																				
≥1/day[a]	33(70.2)	0.82(1.10)	0.82	<0.8	0.54(0.87)	0.9	<0.8	2.82(3.34)	0.75	<0.8	2.45(3.28)	0.61	<0.8	1.98(0.59)	0.02	<0.8	4.87	0.55-42.84	0.24	<0.8
<1/day	14(29.8)	0.79(1.31)			0.43(0.65)			2.93(3)			2.64(2.92)			2.35(0.47)						
Self-reported dental health																				
Satisfied[a]	33(70.2)	0.79(1.19)	0.75	<0.8	0.54(0.87)	0.9	<0.8	2.73(2.94)	0.98	<0.8	2.30(2.78)	0.9	<0.8	2.13(0.53)	0.36	<0.8	0.99	0.21-4.54	1	<0.8
Not satisfied	14(29.8)	0.86(1.10)			0.43(0.65)			3.14(3.88)			3(3.96)			2(0.70)						
Self-reported gingival health																				
Satisfied[a]	34(72.3)	0.85(1.10)	0.54	<0.8	0.56(0.86)	0.64	<0.8	2.68(2.87)	0.95	<0.8	2.21(2.73)	0.59	<0.8	2.11(0.6)	0.75	<0.8	4.32	0.49-38.13	0.24	<0.8
Not satisfied	13(27.7)	0.69(1.31)			0.38(0.65)			3.31(4.07)			3.31(4.07)			2.04(0.53)						
Toothache in the past 12 months																				
Often, occasionally	12(25.5)	0.67(1.07)	0.65	<0.8	0.25(0.45)	0.29	<0.8	5.75(4.16)	0.003	1	5.5(4.25)	0.002	1	2.29(0.52)	0.16	<0.8	3.81	0.43-33.78	0.41	<0.8
Rarely, never, don't know[a]	35(74.5)	0.86(1.19)			0.60(0.88)			1.86(2.09)			1.49(1.82)			2.02(0.59)						
Dental visit in the past 12 months																				
Yes[a]	20(42.6)	0.70(1.03)	0.64	<0.8	0.35(0.59)	0.4	<0.8	3.05(3.47)	0.85	<0.8	2.85(3.53)	0.7	<0.8	2.03(0.64)	0.36	<0.8	0.50	0.11-2.26	0.48	<0.8
No	27(57.4)	0.89(1.25)			0.63(0.93)			2.70(3.06)			2.26(2.88)			2.14(0.54)						
Reason of visit in the past 12 months																				
Pain/trouble	11(55)	0.64(0.92)	0.89	<0.8	0.36(0.67)	0.89	<0.8	2.82(2.44)	0.72	<0.8	2.64(2.42)	0.63	1	1.91(0.48)	0.32	<0.8	0.56	0.04-7.44	1	<0.8
No pain[a]	9(45)	0.78(1.20)			0.33(0.50)			3.33(4.58)			3.11(4.70)			2.17(0.80)						
Dietary habits																				
Low Sugar consumption[a]	22(46.8)	0.86(1.25)	0.78	<0.8	0.54(0.86)	0.80	<0.80	2.95(2.85)	0.53	0.97	2.50(2.74)	0.68	<0.8	2.19(0.48)	0.19	<0.8	0.70	0.17-2.91	0.73	<0.8
High Sugar consumption	25(53.2)	0.76(1.09)			0.48(0.77)			2.76(3.55)			2.52(3.52)			2(0.65)						

M: Mean; SD: Standard Deviation; P: P-value, Pw: Power (observed power); DMFT: Decayed, missing, and filled permanent teeth; DT: Decayed permanent teeth: dmft: Decayed, missing, and filled primary teeth; dt: Decayed primary teeth; OHI-S: Oral Hygiene Index-Simplified; BOP: Bleeding on Probing; OR: Odds Ratio; CI: Confidence Interval using the Chi-square test.[a] Reference category

A significant association was observed between primary dental caries experience and mothers' educational level (P=0.01). This finding was consistent with a study in China which emphasized on an inverse correlation between the mothers' educational level and caries in children with visual impairment [17]. There are limited studies about dietary habits in children with visual impairment. Contrary to our findings, an exploratory cross-sectional study showed an association between caries and consumption of solid or sticky sugars [10]. A potential reason for this inconsistency can be related to the method of scoring and grouping of the dietary items in our study.

CONCLUSION

The frequency of unrestored caries which was strongly associated with toothache indicated an urgent need to provide a good access to oral care services and effective caries prevention programs for children with visual impairment. The findings of the present study can be useful for implementation of oral health programs for such children. Oral health programs for caries prevention especially in primary dentition and for gingival bleeding should be considered.

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CONFLICT OF INTEREST STATEMENT
None declared.

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