

Dental health by age, gender, and residence place in 6- to 12-year-old children living in Shahroud, Iran

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Original Article

Abstract

BACKGROUND AND AIM: This study aims to determine dental health indices and their associated factors in 6-12-year-old Iranian school children.

METHODS: In this cross-sectional study, a total of 5620 students, living in Shahroud, northeast of Iran, participated as the participants of Shahroud School Children Eye Cohort Study (SSCECS). Children were selected through cluster sampling in urban areas and by census in rural areas. The children were examined by two trained dentists, using disposable dental mirrors and dental explorers on a dental unit. The indices of decayed, missing, and filled teeth (DMFT), decayed filled teeth (dft), and Significant Caries Index (SiC Index) as well as decay percentage were estimated by age, gender, and place of residence, with 95% confidence intervals (CIs). The differences in mean value were investigated by independent t-test or analysis of variance (ANOVA).

RESULTS: Dental examinations were performed for 5577 students, 3005 (53.9%) of whom were boys and 4434 (79.5%) were urban residents. The mean age of the participants was 9.7 ± 1.7 years. The overall DMFT, dft, and SiC indices were 0.97, 2.84, and 2.48, respectively. At the age of 12, DMFT and SiC indices were 1.80 and 4.07, respectively. Moreover, the mean DMFT was higher in girls and in rural areas, increasing with age. Overall, 36.2% and 38.9% of the male and female students had at least one decayed permanent tooth, respectively.

CONCLUSION: Dental health status in 6-12-year-old Iranian children was not favorable in Shahroud, especially in girls and in rural areas. Therefore, preventive and therapeutic programs and access to health care services need to be expanded.

KEYWORDS: Dental Caries; DMF Index; Dental Health Surveys; Oral Health; Iran

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Dental caries affect 60%-90% of the school children worldwide.¹ However, this high burden of disease can be prevented by controlling risk factors and using fluoride.² Worldwide, 621 million children are affected by untreated caries in deciduous teeth, which was 10th most prevalent condition in 2010.³

World Health Organization (WHO) believes that "oral health means more than good teeth" and implies any diseases and

disorders that affect craniofacial complex.¹ A person with good oral health, can speak, smile, kiss, touch, smell, taste, chew, swallow, and cry without pain.¹

The decayed, missing, and filled teeth (DMFT) index, which refers to the number of decayed (D), filled (F), and missing (M) teeth, is used to assess severity of dental caries. Accordingly, WHO and World Dental Federation (FDI) specified six goals in 1981 to be achieved by 2000.¹ In school children the

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goal was to achieve an average DMFT of no more than 3 at 12 years of age.¹ A number of countries achieved the specified goals while others were not very successful in doing so. Therefore, WHO added a new strategy for managing prevention and control of oral diseases to the common risk factor approach in prevention and control of non-communicable diseases (NCDs) strategy.¹ The International Association for Dental Research (IADR), WHO, and FDI specified new goals to be obtained by 2020. These goals are not numerical because public health status is different in each country. Based on these goals, all countries, under any economic, social, political, and cultural conditions, should make the maximum effort to improve oral health status in various aspects.⁴ The results of a systematic analysis carried out in 195 countries between 1990 and 2015 showed that oral health had not improved over the past 25 years, remaining as a serious challenge by 2015. In fact, population growth and aging have led to a dramatic increase in the burden of untreated oral conditions throughout the world.⁵

Various national⁶ and regional^{7,8} studies on oral health status have been conducted in Iran. Most of these studies have either lacked sufficiently large sample sizes or standard dental examinations. Given the importance of oral and dental health as a determinant of quality of life, increased DMFT index values in Iran and throughout the world, and specified goals to be achieved by 2020, the dental health status of 6-12-year-old children should be monitored consistently and the effectiveness of the existing interventions should be assessed. The present population-based study aims to assess dental health by age, gender, and residence place in 6 to 12-year-old children living in Shahroud, Iran.

Methods

This cross-sectional study was a part of Shahroud School Children Eye Cohort Study (SSCECS) which was conducted on 6-12-year-old children in Shahroud. The first phase of

the study was carried out in 2015 on primary school children (first to sixth grade), studying in Shahroud School District (urban and rural areas).⁹ All primary school students living in 15 villages, located in south of Shahroud District (1214 students) were invited to participate in the study. In urban schools, 200 out of 483 classrooms were selected using cluster sampling. Finally, among 6624 invited children, 5620 (84.8%) students participated. All children underwent comprehensive optometric examinations and corrected and uncorrected visual acuity tests. Other examinations such as blood pressure measurement, anthropometry, and complete dental examination were also carried out. The students' age, gender, economic status, place of residence, and body mass index (BMI) were assessed. All participants of cohort study were included in this study and the only exclusion criterion was unwillingness for dental examination.

Oral and dental examinations were carried out by two trained dentists. Before beginning the study, the procedures for examination and recording results were explained to the dentists and the significance of an identical performance was stressed. All examinations were conducted using disposable dental mirrors, dental explorers, on a dental chair with standard halogen dental light for illumination. The data were collected directly by the dentists into the special software for examinations.

Dental examinations were carried out separately by measuring the decayed filled teeth (dft) index for deciduous teeth (proposed by Gruebbel) and the DMFT index for permanent teeth (proposed by Klein, Palmer, Knutson). Visible evidence of a cavity in tooth, including untreated and recurrent caries, was considered decayed (D-component). M-component represented a tooth that had been extracted due to caries. F-component included filled teeth. The Significant Caries Index (SiC Index) was also measured by classifying the students according to the DMFT value. The mean DMFT of the upper third (students with

higher DMFT) was then reported. A 95% confidence interval (CI) was calculated for all mean values.

The dft, SiC, and DMFT indices were calculated for different age and gender groups. Independent t-test or analysis of variance (ANOVA) was used to assess the difference in mean values. Bonferroni test was used for pairwise comparison after ANOVA. The adjusted associations of independent variables with outcomes were investigated by multiple linear regression. A significance level of 0.05 was assumed for all tests. The design effect of cluster sampling was taken into account to arrive at a better estimate of the CIs. Considering different sampling weights in urban and rural areas, poststratification was also carried out.

This study was carried out based on the declaration of Helsinki. All examinations were approved by Ethics Committee of Shahroud University of Medical Sciences (ethics code: 100/108054). Written informed consents were obtained from the children's parents and students participated in the study willingly.

Results

Out of 5620 students participating in the cohort study, 5577 students underwent dental examinations; therefore, total number of missing data for this study was 43 (0.8%). Among the participants in this study, 3005

students (53.9%) were male and 4434 (79.5%) lived in urban areas. The mean age of the participants was 9.7 ± 1.7 years.

The overall DMFT, dft, and SiC indices were 0.97, 2.84, and 2.48, respectively. Table 1 describes most of these indices by gender, place of residence, and age groups. At the age of 12 years, the DMFT index was 1.80 and the mean DMFT for permanent teeth in boys (1.70), girls (1.92), urban areas (1.80), and rural areas (1.76) was not significantly different. At the age of 12, the SiC Index was 4.07 (95% CI: 3.86-4.27) and was not significantly different in terms of age and place of residence.

The DMFT index in girls and rural areas was higher and increased with age. The dft index in boys was higher and decreased with age. The SiC Index was not different in terms of gender and place of residence; however, it increased with age, reaching 4.07 at the age of 12 (Table 1). Multiple comparisons of outcomes in different age groups showed that except for age groups of 6 and 7 years old, all mean differences in age categories were significant for DMFT, dft, and SiC indices ($P < 0.001$).

The results of multiple linear regression showed that DMFT and SiC indices increased with increasing in age, SiC Index increased by 0.29 in rural area and DMFT increased by 0.19 in girls (Table 2).

Table 1. Description of dental indices according to the age, gender, and residence place, Shahroud, Iran, 2015

Independent variables	n	DMFT		dft		SiC		
		Mean (95% CI)	P	Mean (95% CI)	P	Mean (95% CI)	P	
Gender	Male	3005	0.90 (0.81-0.99)	< 0.001*	2.91 (2.60-3.21)	0.018*	2.41 (2.19-2.63)	0.362*
	Female	2572	1.05 (0.93-1.18)		2.75 (2.42-3.09)		2.55 (2.34-2.75)	
Residence place	Urban	4434	0.96 (0.88-1.04)	0.048*	2.82 (2.75-2.90)	0.172*	2.47 (2.30-2.64)	0.683*
	Rural	1143	1.06 (0.87-1.25)		2.94 (2.79-3.10)		2.54 (2.24-2.82)	
Age (year)	6	220	0.18 (0.11-0.26)	< 0.001**	5.03 (4.69-5.38)	< 0.001**	0.61 (0.36-0.86)	< 0.001**
	7	839	0.28 (0.21-0.34)		4.97 (4.74-5.19)		0.84 (0.68-0.99)	
	8	1004	0.64 (0.57-0.71)		4.36 (4.20-4.52)		1.94 (1.83-2.04)	
	9	1058	0.91 (0.82-1.00)		3.31 (3.13-3.49)		2.42 (2.29-2.55)	
	10	887	1.11 (1.00-1.23)		1.94 (1.78-2.10)		2.90 (2.77-3.04)	
	11	932	1.46 (1.34-1.59)		0.91 (0.79-1.03)		3.40 (3.21-3.60)	
12	637	1.80 (1.64-1.95)		0.33 (0.26-0.40)		4.07 (3.86-4.27)		
Total	6-12	5577	0.97 (0.89-1.05)	-	2.84 (2.61-3.07)	-	2.48 (2.32-2.63)	-

*Independent sample t-test; **Analysis of variance (ANOVA)

DMFT: Decayed, missing, and filled teeth; dft: Decayed filled teeth; SiC: Significant caries; CI: Confidence interval

Table 2. The association of dental indices with age, gender, and residence place in multiple linear regression, Shahroud, Iran, 2015

Independent variables	DMFT		dft		SiC	
	Coefficient (95% CI)	P	Coefficient (95% CI)	P	Coefficient (95% CI)	P
Gender (Female/male)	0.190 (0.100, 0.270)	< 0.001	-0.260 (-0.410, -0.120)	< 0.0010	0.060 (-0.060, 0.180)	0.3150
Residence place (Rural/urban)	0.160 (-0.003, 0.320)	< 0.055	-0.100 (-0.330, 0.130)	0.3800	0.290 (0.110, 0.460)	0.0010
Age (year)	0.300 (0.270, 0.320)	< 0.001	-0.990 (-1.030, -0.950)	< 0.0010	0.600 (0.570, 0.640)	< 0.001

DMFT: Decayed, missing, and filled teeth; dft: Decayed filled teeth; SiC: Significant caries; CI: Confidence interval

In this study, 36.2% of the boys (95% CI: 33.2-39.2) and 38.9% of the girls (95% CI: 35.2-42.7) had at least one decayed permanent tooth. This difference was statistically significant ($P = 0.017$). Tooth decay in permanent teeth was not different in urban and rural areas. Overall, 9.0% (95% CI: 5.2-12.7) of the 6-year-old students and 56.8% (95% CI: 52.5-61.1) of the 12-year-old students had at least one decayed permanent tooth. At the age of 12, 55.5% of the boys, 58.4% of the girls, 55.8% of urban students,

and 66.7% of rural students had at least one decayed permanent tooth.

Table 3 summarizes the status of the filled, decayed, and extracted teeth by tooth type (deciduous or permanent). As seen, the mean number of decayed deciduous teeth was 2.55 in the studied population and it was higher in boys and in rural areas than in girls ($P = 0.007$) and urban areas ($P < 0.001$) (Table 3).

The mean number of filled deciduous teeth was 0.28, which increased between the ages of 6 and 8 and then decreased until the age of 12.

Table 3. Comparison of mean decayed filled teeth (dft) in primary and decayed, missing, and filled teeth (DMFT) in permanent dentition, Shahroud, Iran, 2015

Independent variables	Primary dentition		Permanent dentition			
	Mean decayed (95% CI)	Mean filled (95% CI)	Mean decayed (95% CI)	Mean missed (95% CI)	Mean filled (95% CI)	
Gender	Male	2.63 (2.35-2.92)	0.27 (0.21-0.34)	0.77 (0.68-0.85)	0.04 (0.03-0.05)	0.10 (0.08-0.13)
	Female	2.46 (2.16-2.76)	0.29 (0.22-0.36)	0.84 (0.73-0.93)*	0.04 (0.03-0.05)	0.18 (0.13-0.22)*
Residence place	Urban	2.51 (2.29-2.74)	0.31 (0.26-0.36)*	0.790 (0.73-0.86)	0.03 (0.02-0.03)	0.140 (0.11-0.17)*
	Rural	2.93 (2.47-3.39)	0.02 (0.004-0.03)	0.84 (0.69-1.00)	0.14 (0.09-0.20)*	0.07 (0.04-0.10)
Age (year)	6	4.72 (4.35-5.11)	0.31 (0.15-0.46)	0.12 (0.07-0.18)	0.04 (0.02-0.07)	0.03 (0.01-0.06)
	7	4.44 (4.17-4.71)	0.52 (0.38-0.67)	0.22 (0.17-0.27)	0.02 (0.01-0.03)	0.04 (0.02-0.07)
	8	3.84 (3.65-4.03)	0.52 (0.40-0.63)	0.54 (0.48-0.61)	0.02 (0.01-0.04)	0.07 (0.05-0.09)
	9	2.98 (2.81-3.16)	0.33 (0.23-0.42)	0.78 (0.69-0.86)	0.04 (0.02-0.06)	0.09 (0.06-0.13)
	10	1.81 (1.64-1.98)	0.13 (0.09-0.17)	0.92 (0.81-1.02)	0.05 (0.03-0.07)	0.15 (0.11-0.19)
	11	0.83 (0.72-0.95)	0.08 (0.05-0.10)	1.19 (1.09-1.29)	0.05 (0.03-0.07)	0.23 (0.16-0.29)
	12	0.30 (0.23-0.36)	0.04 (0.01-0.06)	1.46 (1.33-1.59)	0.06 (0.03-0.09)	0.28 (0.18-0.38)
Total	6-12	2.55 (2.35-2.76)	0.28 (0.24-0.33)	0.80 (0.74-0.86)	0.04 (0.03-0.05)	0.13 (0.11-0.16)

*P-value < 0.05

CI: Confidence interval

Table 4. The comparison and summary results of different studies on oral health

Authors	Study place	Study year	n	Age (year)	dft	DMFT	Caries prevalence (%)
Current study	Iran, Shahroud	2015	5577	6-12	3.12	0.97	56.8*
Babaei Hatkehlouei et al. ⁸	Iran, Mazandaran	2016	3000	6-7	4.08		
Dehghani et al. ⁷	Iran, Shiraz	2010	760	7-11		0.93	
Seyedein ⁶	Iran	1993-1994	43772	12		1.67	
Momeni et al. ¹⁰	Iran, Tehran/Isfahan	1999	1102	12		0.77	58.7
Meyer-Lueckel et al. ¹¹	Iran, Tehran	2003	103	6	3.30		
Hamissi and Hamissi ¹²	Iran, Qazvin		792	6-9	6: 3.83 7: 3.57 8: 3.04 9: 2.80	0.31	
Hamissi ¹³	Iran, Qazvin	2012-2013	4701	6	3.17	0.06	68.1
Ajami and Ebrahimi ¹⁴	Iran, Mashhad	2001	1938	6-7	4.72		
Ramezani et al. ¹⁵	Iran, Dayer		506	13		1.80	
Rezaei et al. ¹⁶	Iran, Sanandaj	2014	400	6-11	3.63		
Sajadi et al. ¹⁷	Iran, Sirjan	2009	700 (boys)	12		3.56	
Faezi et al. ¹⁸	Iran, Tehran	2009	820	6-12	2.90		
Sadeghi and Bagherian ¹⁹	Iran, Rafsanjan	2008	353	12		2.46	75.7
Hiremath et al. ²⁰	India		13200	6-11	2.97	0.17	78.9
Al-Haddad et al. ²¹	Yemen, Sana'a	2002-2003	1489	6-14	4.16	2.25	
Srisilapanan et al. ²²	Thailand	2012	2312	12		0.70	52.3
Srisilapanan et al. ²²	Thailand	2012	2456	5-6	4.40		78.5
Kim et al. ²³	Korea	2012	4379	12		1.84	

*In 12-year-old students

DMFT: Decayed, missing, and filled teeth; dft: Decayed filled teeth

The mean number of filled deciduous teeth in urban students (0.31) was higher than that in rural students (0.02) ($P < 0.001$); however, it was not different in terms of gender ($P = 0.489$) (Table 3). The mean number of decayed, extracted, and filled permanent teeth was 0.80, 0.04, and 0.13, respectively. The number of decayed permanent teeth was higher in girls than in boys ($P = 0.024$); however, it was not different in urban and rural areas. The number of filled permanent teeth was higher in girls and urban areas than in boys and rural areas ($P < 0.001$); whereas the number of extracted permanent teeth was higher in rural areas than in urban areas ($P < 0.001$) (Table 3).

Discussion

This population-based study with a large sample size on 6-12-year-old Iranian students showed that the mean number of decayed, missing, and filled permanent teeth was 0.97 and the mean number of decayed and filled deciduous teeth was 2.8. The DMFT of

permanent teeth at the age of 12 was 1.8, and 56.7% of the students at this age had at least one decayed tooth. Table 4 compares the above results with those of studies conducted in Iran and other countries.^{6-8,10-24}

The DMFT index in the present study is similar to that of other studies conducted in Iran. The small differences can be attributed to the studied age groups and the study time. For example, although the DMFT value was higher in the study by Babaei Hatkehlouei et al.,⁸ it was conducted within an almost identical period among 6-7-year-olds, while the participants in the present study aged 6-12 years. It is not surprising that DMFT value decreases with increase in age and loss of deciduous teeth. Due to this limitation, it is better to report dft, instead of DMFT for deciduous teeth. In the present study, the mean DMFT values at ages of 6 and 7 years were 5.2 and 5.4, respectively, which were higher than the values obtained in other studies, even those conducted in Yemen²¹ and Thailand.²² Only one study conducted by

Ajami and Ebrahimi¹⁴ in Mashhad, Iran, had almost similar results, reporting DMFT of 4.72 at age of 6-7 years. Personal hygiene, nutritional conditions, and water fluoride level might be the main reasons for this difference, which should be taken into consideration.

The DMFT index in the present study was largely similar to other studies conducted in Iran. For example, the results of the present study are similar to those of Dehghani et al.,⁷ with a relatively similar age group. For the age of 12, the results of the present study are almost similar to those of Seyedein⁶ and Ramezani et al.¹⁵ The mean DMFT in the present study was lower than that in the studies by Sajadi et al.¹⁷ and Sadeghi and Bagherian¹⁹ in Iran and Al-Haddad et al.²¹ in Yemen, and higher than that in the studies by Momeni et al.¹⁰ in Iran, Hiremath et al.²⁰ in India, and Srisilapanan et al.²² in Thailand. Such discrepancies may be attributed to the study year and students' personal hygiene and nutritional levels. The study by Momeni et al.¹⁰ in which DMFT at the age of 12 was reported to be 0.77 appears to be an exception that is not representative of the status of the Iranian population at this age.

According to the studies by Sajadi et al.¹⁷ and Sadeghi and Bagherian,¹⁹ it seems that the DMFT index in southern provinces of Iran is lower, which calls for further investigation. Fluoride concentration in drinking water was between 0.45 and 0.75 mg/l in Shahroud.²⁵ This situation, which is below the WHO recommended limit, is similar to most of the provinces in Iran.²⁶ However, in some cities of southern Iran, more concentration of fluoride has been reported,²⁶ which could be a reason for the low level of DMFT in the southern provinces. In Iran, water and milk resources are not usually enriched with fluoride. We did not find any report about usage of fluorinated toothpaste and mouthwash in different provinces of Iran, but it seems that toothpaste use in Iranian students is not enough.

In the present study, 56.8% of the students' teeth at the age of 12 were decayed,

which was almost similar to the study by Momeni et al.,¹⁰ lower than the study by Sadeghi and Bagherian,¹⁹ and slightly higher than the study by Srisilapanan et al.²² in Thailand. In fact, studies have reported the percentage of decayed teeth using various methods and among different age groups, which should be taken into consideration when comparing the results. Such major discrepancies in examination methods and oral health reports have even rendered numerous national studies across Europe incomparable.²⁴

In the present study, the DMFT index and decay percentage in permanent teeth were higher in girls than in boys. On the other hand, the dft index was higher in boys and SiC Index was not different among the two genders. Other studies in Iran also reported a higher DMFT index in females.^{6,15} Similar to these results, a study conducted in India also reported a higher DMFT index in boys than in girls.²⁰

In the present study, the mean DMFT and extracted permanent teeth were higher in rural students than in urban students, whereas the mean filled permanent teeth was higher in urban students. However, in multiple regression model, the residence place was not significantly associated with DMFT, although SiC Index was significantly higher in rural areas. In addition to poor personal hygiene in rural areas, this is also attributed to diminished access to preventive dental care services. The study by Kim et al.²³ in Korea also showed similar results.

The results of the present study showed that the SiC Index values in the 6-12-year-old and 12-year-old age groups were 2.48 and 4.07, respectively. Very few studies have calculated this index. For example, according to a study in Korea²³ and a study by Sajadi et al.¹⁷ in Iran, SiC Index at the age of 12 was 4.51 and 6.04, respectively. Since the results of the present study are higher than the recommended value by WHO, preventive measures and health education among students need to be promoted.

The results of the present and similar

studies in Iran shows that the oral health status in Iran has not improved significantly over the past two decades, whereas the number of dentists has increased dramatically within the same period, and general education and access to dental care services in rural areas have improved. More extensive studies need to be conducted on a national scale to arrive at the specified conclusion. Lack of significant improvement in oral health status in Iran might be due to increased prevalence of obesity and changes in nutritional status, which have exacerbated in recent years. In another report on the participants of current study, the prevalence of obesity and overweight was 24.7% (unpublished paper). Unlike this conclusion, which makes it difficult to achieve the 2020 goals of the WHO, studies conducted in Korea^{23,27} between 2000 and 2012 are indicative of reduced tooth decay at the age of 12. The study by Srisilapanan et al.²² also showed that oral health indices improved in Thailand between 1997 and 2012. Moreover, in the United Arab Emirates, DMFT at the age of 12 ranged from 1.60 to 3.24, with oral health representing a serious issue both in this country and in similar Arab countries.²⁸ Studies have shown that although DMFT at the age of 12 has decreased by 90% in developed countries between the last decade of the 20th century and the first decade of the 21st century, it has not decreased in low- and middle-income countries. This status could be due to decreased use of fluoride toothpastes

and increased risk factors such as cigarette, alcohol, salt, and sugar consumption.²⁹

Large sample size, examinations by trained dentists, and proper sampling method from both urban and rural areas were the main strengths of this report. These factors led to generalization of the results to Iranian 6-12-year-old children. However, there are no data on the periodontal situation, fluoride concentration in water, the frequency of using fluorinated toothpastes and mouthwashes among students, and agreement between dentists' examinations, which can be considered as limitations of this study.

Conclusion

The DMFT index and oral health status in 6-12-year-old Iranian students, living in Shahroud were not favorable. Therefore, caries prevention programs and provision of health care services should improve, especially in rural areas.

Conflict of Interests

Authors have no conflict of interest.

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