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Association between orthodontic treatment need and caries experience

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Abstract

Objective. To investigate the association between orthodontic treatment need (OTN) and caries experience (CE). ***Subjects and methods.*** Using a stratified sampling method, 748 subjects (355 females, 393 males; mean ± standard deviation age 15.11 ± 2.23 years) were examined. The Dental Aesthetic Index (DAI), DMFT, simple (DMFT > 0) and severe CE (DMFT > 8) were recorded. Socio-economic status (SES) was assessed by recording parental education, mother's employment status, and household size. ***Results.*** Higher (but not statistically significant) CE was observed in subjects with OTN (DAI > 30). The association between DAI and DMFT scores was not significant (rho = 0.05). Mean DMFT score did not vary significantly between the SES and OTN subgroups. In children with a household size >6 persons ($n = 85$), OTN was associated with higher CE and a higher prevalence of severe CE compared with those without OTN. In this group, when DAI treatment need grade increased, severe CE prevalence also increased from 10.8% to 50%. Similarly, in those with OTN and household size >6 persons, the odds of observing subjects with severe CE was 4.6 times higher (95% confidence interval 1.45–14.55) compared to those without OTN. ***Conclusions.*** Associations were observed between OTN and CE and also between the prevalence of severe CE and the severity of malocclusion in children with a household size >6 persons. The current findings suggest that the relationship between caries experience and malocclusion should be assessed in a wider context of SES and background factors.

Key Words: *Caries experience, Dental Aesthetic Index, DMFT, socio-economic status, orthodontic treatment need*

Introduction

Dental caries remains the most common childhood chronic disease and certain features of malocclusion, such as crowding, are believed to be associated with the caries experience.

Previous studies investigating the possible association between malocclusion and dental caries reached conflicting results. Some authors reported a positive association between malocclusion and dental caries [1,2]. Some studies even reported a significantly higher mean caries experience (DMFT) in subjects with malocclusions [1]. In contrast, other authors could not establish any significant relationship between malocclusion and dental caries [3–6].

It is believed that orthodontic treatment removes stagnation areas and results in a reduced incidence of dental caries. However, a review of previous studies did not reveal an association between crowding and dental caries [7]. Palin-Palokas and Ruokokoski-Pirkkanen [7] reviewed previous studies and concluded that, wherever there was any association, it was tooth caries that led to tooth loss, thereby resulting in malocclusion, and not vice versa. Similarly, according to Stahl and Grabowski [6], dental caries and premature loss of primary teeth are predisposing factors for occlusal and space anomalies in the mixed and permanent dentition. Therefore, crowding does not seem to increase susceptibility to caries. Within this context, Hunt et al. [8] evaluated clinicians' professional perceptions of the benefits of orthodontic treatment. Younger practitioners were more likely to consider the benefits in terms of reduced susceptibility to periodontal disease, whereas older practitioners placed a greater emphasis on a reduced susceptibility to caries. Any oral health benefits of orthodontic treatment in terms of reducing the caries experience were not supported by longitudinal studies [9]. Helm

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and Petersen [5], in a longitudinal study involving a 22-year follow-up of 176 subjects with malocclusion, concluded that they were unable to find any relationship between the dental caries experience of the subjects and the presence of malocclusion. Thomson [10] examined the long-term outcomes of orthodontic treatment among participants in a longstanding cohort study of young New Zealanders. He compared the oral health status of orthodontically treated and untreated individuals and did not find any significant difference between them in terms of dental caries. Therefore, orthodontists today do not claim to prevent caries by orthodontic intervention [11].

Socio-economic status (SES) can however play a significant role in oral health. To our knowledge, the interrelationship between caries experience (DMFT), SES and orthodontic treatment need has yet to be investigated. Therefore, the main aim of this cross-sectional study was to assess the relationship between orthodontic treatment need, as assessed by the Dental Aesthetic Index (DAI) [12], caries experience (DMFT index) and SES. The secondary aim of the study was to assess the prevalence of severe caries experience in the population and to evaluate whether there is any relationship between severe caries experience and orthodontic treatment need within different SES categories.

Subjects and methods

A cross-sectional study was carried out. The study population consisted of Iranian schoolchildren aged 11–20 years from the city of Isfahan. Overall, 748 subjects (355 females, 393 males; mean age 15.11 years) participated in the study. Permission to undertake the survey was obtained from the Iranian Ministries of Health and Education. Ethical approval was given by the Research Ethics Committee and Faculty of Community Dentistry, School of Dentistry, Isfahan University of Medical Sciences. Isfahan is the capital city of Isfahan province and Iran's third largest city. It is located in the central part of Iran and is home to 3% of the country's population. According to the 2006 census it had a population of 1,986,542 and the Isfahan metropolitan area had a population of 3,430,353, making it the second most populous metropolitan area in Iran after the capital.

The exclusion criteria for this study were: subjects with craniofacial anomalies (clefts and syndromes) and non-Iranian nationals. To ensure random selection from the schools, a stratified sampling method within different clusters was used in a population comprising 11–20-year-old subjects. Forty public and private schools were randomly selected from different geographic locations in the city of Isfahan and 15–20 subjects of different age groups were randomly examined in each school. The process of randomization was carried out using random tables. DMFT and DAI scores were recorded. DAI scores were recorded in those without a history of orthodontic treatment (n = 728). The calibration process was conducted before the study in order to guarantee reliable data collection [13]. To assess the examiner's reliability, the examination was repeated in 5% of cases (38 subjects) 1 week later. The results showed a substantial level of agreement (Kappa statistic >0.80) between the two assessments of the different variables investigated. The examination chairs were placed in the rooms in such a way as to ensure an adequate source of natural light, while at the same time avoiding direct sunlight. A mouth mirror, a ruler and a disposable dental probe were used during the examination and data collection.

Assessment of oral health

Assessment of caries experience (DMFT). The DMFT, the sum of decayed (DT), missing (MT) and filled teeth (FT) indices, was recorded and used to assess the oral health outcomes. The DMFT index includes a record of the presence/absence of all teeth, including presumptive cause of tooth loss, and is a cumulative measure of caries experience. Apart from using a dental explorer to detect cavities in proximal surfaces, the following was sufficient to record proximal decay: if the marginal ridge showed darkening/shadowing as evidence of caries of dentine or if caries in dentine was visualized as a loss of translucency producing a shadow in a calculus- and stain-free proximal surface. A tooth that had been extracted for orthodontic or trauma reasons did not signify a missing tooth in the DMFT index. Filled due to decay (FT) was recorded when a tooth contained one or more permanent restorations placed to treat caries, whilst missing (MT) was recorded when a tooth had been extracted due to pathology (verified by interview). To perform certain analyses we created the following two-level categorical variables: simple (DMFT > 0) and severe caries experience (DMFT > 8). We selected nine as our cut-off point because children with a DMFT > 8 were above the 75th percentile for our study sample.

Assessment of orthodontic treatment need and SES

Malocclusion was assessed using the DAI [12]. The SES of the population was also assessed during the face-to-face interview. The following SES variables were recorded: parental education (lower than or greater than or equal to high school diploma), mother's employment status (employed or housewife) and household size. The sample was divided into two groups on the basis of household sizes of ≤6 and >6 persons. We selected seven as our cut-off

point because children with a household size >6 persons were above the 75th percentile for our sample.

Statistical analysis

Data were collected and entered into the SPSS 17 program for statistical analysis (SPSS Inc., Chicago, IL). Histograms and box plots were used to show the distributions of DAI and DMFT scores in the study sample. Descriptive statistics such as means and standard deviations were calculated in the data analysis. Confidence intervals (CIs) were calculated for average DAI and DMFT scores for both genders and for the different categories investigated (orthodontic treatment need and SES). The number of subjects in each DAI treatment need category (no treatment, treatment elective, treatment desirable and treatment mandatory) was compared according to gender using the Chi-square test. A Student's *t*-test was used to assess any differences in mean DMFT between groups defined by gender, orthodontic treatment need (DAI > 30), parental education (lower than or greater than or equal to high school diploma) and mother's employment status (housewife or employed). A one-way ANOVA test was used to assess any differences in mean DMFT between different DAI treatment need categories. All groups were tested with the Levene statistic for equality of variances before performing the *t*-test or ANOVA test.

Scatter plots and Spearman rank correlation coefficients (ρ) were used to explore the relationships between the DMFT and DAI scores in the whole sample and in different DAI treatment categories. Pearson's Chi-square tests were used to assess any relationship between severe caries experience (DMFT > 8) and orthodontic treatment need (according to DAI) within the different socio-economic subgroups. Whenever a Chi-square test revealed any significant difference between socio-economic subgroups (e.g. household size ≤6 and >6 persons), a binary logistic regression test was performed in that subgroup to estimate the predictive value of orthodontic treatment need for the presence/absence of severe caries experience (DMFT > 8) dichotomized into yes or no. $P < 0.05$ was considered statistically significant.

Results

Assessment of orthodontic treatment need (DAI)

The mean ± standard deviation (SD) age of the participants was 15.11 ± 2.23 years. Figure 1 shows the histogram of DAI scores. Overall, 2.7% of the study subjects (n = 748) had either a history of previous orthodontic treatment or were wearing orthodontic appliances at the time of the survey.

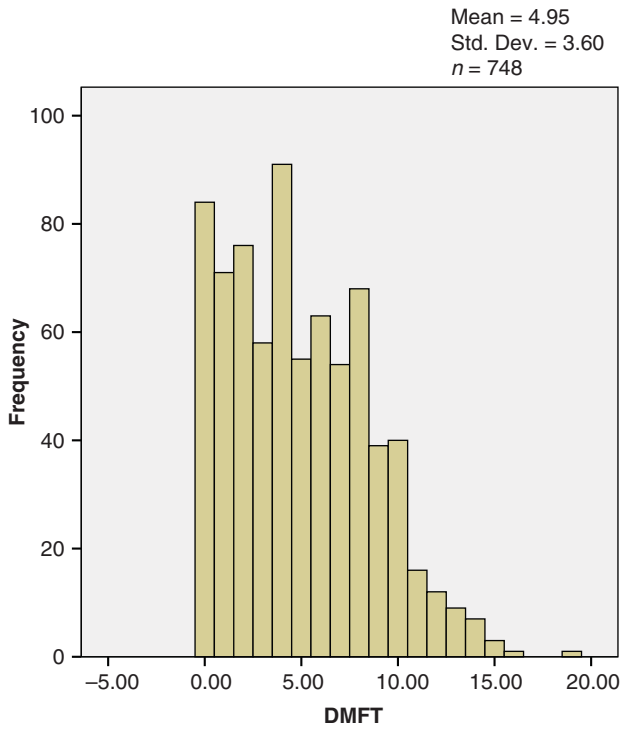

Figure 1. Distribution of DMFT scores in the study sample (n = 748).

The mean DAI score for those without a history of orthodontic treatment was 26.14 points (n = 728; 95% CI 25.60–26.72). The mean ± SD DAI scores for male and female subjects were 26.90 ± 8.28 and 25.28 ± 6.75, respectively. In the present sample (n = 728), boys had a significantly higher mean DAI score compared to girls (95% CI of the mean DAI difference 0.50–2.72). According to the DAI, 24.0% of boys needed orthodontic treatment, compared with 19.4% of girls, and the need for treatment did not vary significantly between genders (χ^2 = 2.20, df = 1, $P > 0.05$). Overall, 54.5% of the study subjects showed no need or a slight need for treatment (DAI ≤ 25). In 23.6% of the sample the need for treatment was elective (25 < DAI ≤ 30). However, in 11.0%, treatment was highly desirable (30 < DAI ≤ 35) and 10.9% showed very severe malocclusions and treatment was considered mandatory (DAI > 35). There were statistically significant differences between the genders with regard to the DAI treatment need categories (χ^2 = 10.10, df = 3, $P < 0.05$). Of the evaluated Iranian schoolchildren, 21.8% had a DAI score of ≥31 points, suggesting highly desirable or mandatory orthodontic treatment need (Table I).

Assessment of caries experience (DMFT)

Figure 2 shows the histogram of DMFT scores. The mean ± SD DMFT score for the study sample

Table I. Gender distribution [*n* (%)] of household size, DMFT and different DAI treatment need categories in the study sample.

	Gender		
	Male	Female	Total
Household size			
≤6	337 (86.6)	313 (90.2)	650 (88.3)
>6	52 (13.4)	34 (9.8)	86 (11.7)
DMFT (simple prevalence)			
0	51 (13.0)	33 (9.3)	84 (11.2)
>0	342 (87.0)	322 (90.7)	664 (88.8)
DMFT (severe caries prevalence)			
≤8	325 (82.7)	295 (83.1)	620 (82.9)
>8	68 (17.3)	60 (16.9)	128 (17.1)
Total	393	355	748
DAI treatment need category[a]			
≤25 (no treatment need/slight need)	196 (50.5)	201 (59.1)	397 (54.5)
26–30 (treatment elective)	99 (25.5)	73 (21.5)	172 (23.6)
31–35 (treatment highly desirable)	40 (10.3)	40 (11.8)	80 (11.0)
≥36 (treatment mandatory)	53 (13.7)	26 (7.6)	79 (10.9)
Total	388	340	728

[a]$\chi^2 = 10.10$, $df = 3$, $P < 0.05$.

($n = 748$) was 4.94 ± 3.59 points (95% CI 4.69–5.20). The mean ± SD DMFT scores for boys and girls were 4.89 ± 3.67 and 5.01 ± 3.51, respectively. The difference in mean DMFT score between boys and girls did not reach significance ($P > 0.05$).

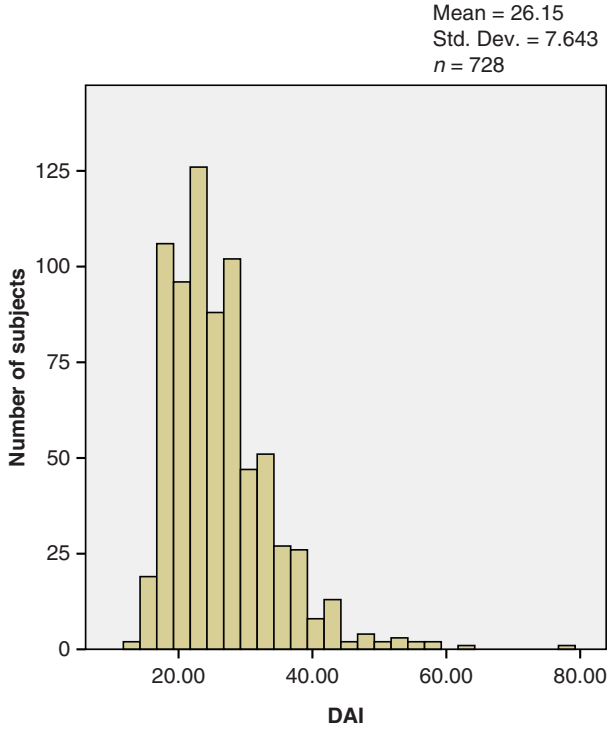

Figure 2. Distribution of DAI scores in the study sample ($n = 728$).

Simple (DMFT > 0) and severe caries experience (DMFT > 8) were seen in 88.8% and 17.1% of cases, respectively.

Relationship between orthodontic treatment need (DAI) and caries experience (DMFT)

Figure 3 shows a box plot of DAI and DMFT scores. Table I summarizes the distribution of the DAI treatment need categories and shows the basic characteristics of the study sample in terms of DMFT

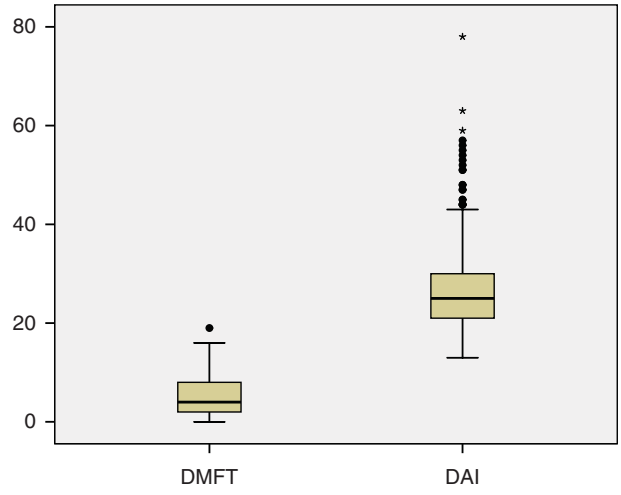

Figure 3. Box plot of DMFT and DAI scores.

thresholds and household size categories. The level of association between DAI and DMFT scores was not significant (rho = 0.05; $n = 728$; $P = 0.11$). When we split the data according to orthodontic treatment need, the level of association was stronger (but not significant) in those with (rho = 0.105, $P > 0.05$) compared to those without orthodontic treatment need (rho = 0.06, $P > 0.05$). Higher caries experience was found for subjects in need of orthodontic treatment (DAI > 30); however, the difference did not reach significance ($P > 0.05$) (Table II). Analysis of variance showed that the mean DMFT score did not vary significantly between the orthodontic treatment need categories tested ($P = 0.29$).

Relationship between caries experience (DMFT), orthodontic treatment need (DAI) and socio-economic variables

The level of association between DAI and DMFT was stronger in the group with a household size >6 persons (Figure 4). Table III shows the mean and 95% CI for the DMFT scores within different orthodontic treatment need and socio-economic categories. Table II summarizes the results of the *t*-test and ANOVA tests for the mean DMFT scores between different orthodontic treatment need and socio-demographic categories, respectively. Analysis of variance showed that the mean DMFT score did not vary significantly between the socio-economic subgroups tested ($P = 0.3$). Table IV summarizes the findings of Pearson Chi-square tests between different DMFT thresholds (≤8, >8) and orthodontic treatment need categories (DAI >30, ≤30) according to socio-economic variables. Household size was the only SES variable that affected the relationship between the DMFT thresholds and orthodontic treatment need categories (Table IV).

Table V shows contingency tables of different caries experience thresholds (DMFT ≤8, >8) and orthodontic treatment need categories according to household size (≤6, >6 persons). It can be seen that for children living in a household with >6 persons ($n = 85$), there was an association between the prevalence of severe caries experience and the severity of malocclusion (as assessed by DAI). In this group, the mean DMFT score in subjects with orthodontic treatment need (DAI > 30) was 6.47 (95% CI 5.46–7.48). However, the corresponding figure in children without orthodontic treatment need was 4.65 (95% CI 4.18–5.12), which is significantly lower. In fact for children living in a household with >6 persons, the odds of observing subjects with severe caries experience in addition to orthodontic treatment need (DAI > 30) was 4.6 times higher (95% CI 1.45–14.55) compared to those without orthodontic treatment need. Reviewing the DAI treatment need categories for children living in a household with >6 persons, it can be seen that when the DAI treatment need grade increased, the prevalence of severe caries experience (DMFT > 8) also increased, from 10.8% to 50% (Table V). However, for children living in a household with ≤6 persons, there was no statistically significant association between a severe caries experience and orthodontic treatment need ($P > 0.05$). Table VI summarizes the

Table II. Summary of Student *t*-test and ANOVA test results for mean DMFT in different orthodontic treatment need and socio-demographic categories.

Variable (statistical test)	DAI group	*P*	95% CI of the mean difference (DMFT)
DAI treatment need (*t*-test)	>30/≤30	0.57	−0.81–0.45
DAI treatment need category (ANOVA)	≤25/26–30	0.49	−1.30–0.38
	≤25/≥36	0.43	−1.80–0.47
	26–30/31–35	0.76	−0.77–1.73
	26–30/≥36	0.97	−1.46–1.05
	31–35/≤25	1.00	−1.14–1.11
	31–35/≥36	0.63	−2.14–0.78

Variable	DMFT group	*P*	95% CI of the mean difference (DMFT)
Gender	Male/female	0.65	−0.63–0.39
No. of persons in household	≤6/>6	0.80	−0.91–0.70
Mother's educational level	<High school diploma/≥High school diploma	0.21	−1.47–0.33
Father's educational level	<High school diploma/≥High school diploma	0.15	−1.16–0.19
Mother's employment	Housewife/employed	0.09	−1.58–0.12

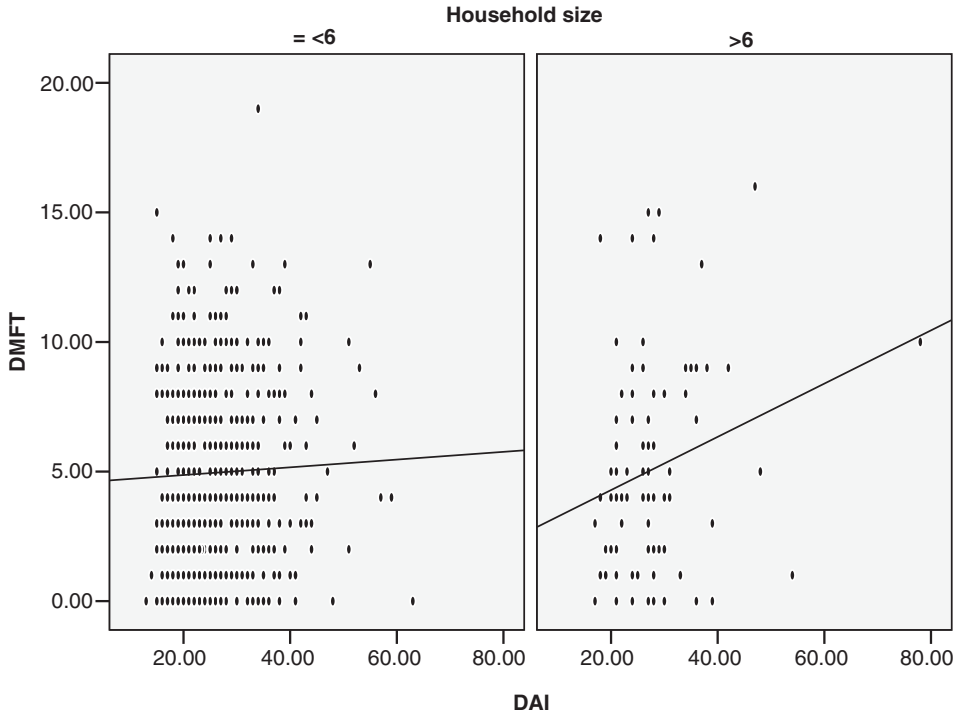

Figure 4. Scatter plot of DAI versus DMFT scores. Solid lines show the regression lines.

average DT and FT components of the DMFT index according to different socio-economic variables. The mean FT score was higher for those with a higher SES.

Discussion

Chronic demineralization of the tooth enamel leads to dental caries which begin after consuming sugars and

Table III. Mean (SD) DMFT and corresponding 95% CIs within different orthodontic treatment needs and socio-economic categories.

Orthodontic treatment need		*N*	Mean (SD) DMFT	95% CI
	Whole sample	748	4.94 (3.59)	4.69–5.20
	Male	393	4.89 (3.67)	4.52–5.25
	Female	355	5.01 (3.51)	4.64–5.37
DAI treatment need	DAI ≤ 30	569	4.91 (3.56)	4.62–5.21
	DAI > 30	159	5.10 (3.69)	4.52–5.67
DAI treatment need category	≤25	397	4.77 (3.54)	4.42–5.12
	26–30	172	5.23 (3.61)	4.69–5.78
	31–35	80	4.76 (3.49)	3.98–5.54
	≥36	79	5.44 (3.88)	4.57–6.31
Socio-economic variables	**DMFT groups**	***N***	**Mean (SD)**	**95% CI**
Mother's educational level (*N* = 697)	<High school diploma	629	4.85 (3.53)	4.57–5.13
	≥High school diploma	68	5.42 (4.11)	4.43–6.42
Father's educational level (*N* = 703)	<High school diploma	570	4.85 (3.51)	4.56–5.14
	≥High school diploma	133	5.34 (3.87)	4.68–6.01
Mother's employment (*N* = 734)	Housewife	657	4.86 (3.58)	4.59–5.14
	Employed	77	5.59 (3.77)	4.74–6.45
Household size (*N* = 736)	≤6	650	4.94 (3.54)	4.66–5.21
	>6	86	5.04 (4.03)	4.18–5.91

Table IV. Summary of Pearson Chi-square test results between different DMFT thresholds (≤8, >8) and orthodontic treatment need categories (DAI > 30, ≤30) according to different socio-economic variables.

Socio-economic variable	Pearson Chi-square	*P*
Gender		
Male	2.41	0.12
Female	0.59	0.44
No. of persons in household		
≤6	0.09	0.76
>6	7.47	0.006
Age group (years)		
11–14	3.46	0.06
14–17	1.25	0.26
17–20	1.15	0.28
Mother's employment		
Housewife	0.78	0.37
Employed	0.06	0.80
Mother's education level		
<High school diploma	0.53	0.46
≥High school diploma	0.02	0.88
Father's education level		
<High school diploma	1.98	0.15
≥High school diploma	1.21	0.27

carbohydrates that are metabolized by cariogenic bacteria present in oral plaque [14]. This bacterial metabolism of sugar produces an acidic environment and consequently lowers the pH of the oral cavity, and creates an environment in which demineralization of the tooth enamel can occur. This process can be reversed if the pH is restored within ≈20 min [14]. If the remineralization process does not occur either naturally or with the application of fluoride, prolonged acidic pH in the oral cavity will cause a substantial amount of demineralization of the tooth enamel [14]. This demineralization starts as a white spot on a tooth, and then progresses to actual tooth cavitation. The present study revealed that dental caries are highly prevalent in Iranian schoolchildren. A comparison of the current finding with that of similar studies has been provided elsewhere [15].

The SES of the children plays a significant role in their oral health and is believed to be in complex interplay with other oral health determinants, such as knowledge and beliefs, behaviours and biomedical factors. One example of such a group includes individuals in remote and deprived communities who have limited access to fresh food and nutrients. Limited family incomes, large family sizes, lack of nutritional knowledge and lack of culturally appropriate information on healthy food may contribute to dietary choices that do not promote or maintain oral health. Many diseases demonstrate a strong association with SES, i.e. those of higher social status experience better health [16,17].

The aetiology of dental caries is a complex one and is associated with factors such as tooth-brushing frequency [18], fluoride exposure [19,20] and receipt of sealants [21]. Compared with children without

Table V. Contingency table [*n* (%)] of different DMFT thresholds (≤8, >8) and orthodontic treatment need categories according to household size (*n* = 716).

		Orthodontic treatment need		
No. of persons in household		DAI < 31	DAI ≥ 31	Total
≤6	DMFT ≤8	409 (83.0)	116 (84.1)	525 (83.2)
	DMFT > 8	84 (17.0)	22 (15.9)	106 (16.8)
	Total	493	138	631
>6	DMFT ≤ 8	57 (86.4)	11 (57.9)	68 (80.0)
	DMFT > 8	9 (13.6)	8 (42.1)	17 (20.0)
	Total	66	19	85

		DAI treatment need category				
No. of persons in household		≤25	26–30	31–36	≥36	Total
≤6	DMFT ≤ 8	298 (83.7)	111 (81.0)	62 (86.1)	54 (81.8)	525 (83.2)
	DMFT > 8	58 (16.3)	26 (19.0)	10 (13.9)	12 (18.2)	106 (16.8)
	Total	356	137	72	66	631
>6	DMFT ≤ 8	33 (89.2)	24 (82.8)	5 (71.4)	6 (50.0)	68 (80.0)
	DMFT > 8	4 (10.8)	5 (17.2)	2 (28.6)	6 (50.0)	17 (20.0)
	Total	37	29	7	12	85

Table VI. Average DT and FT components of the DMFT index according to different socio-economic variables.

Socio-economic variable	DMFT groups	*N*	Mean DT	Mean FT
Mother's educational level	<High school diploma	629	3.62	1.10
	≥High school diploma	68	3.44	1.70
Father's educational level	<High school diploma	570	3.62	1.03
	≥High school diploma	133	3.48	1.72
Mother's employment	Housewife	657	3.59	1.08
	Employed	78	3.63	1.77
No. of persons in household	≤6	650	3.54	1.2
	>6	86	4.13	0.69

untreated caries, children with untreated caries are less likely to obtain regular dental treatment [22]. The measurement of SES varies according to the culture and can include factors such as individual/household income, residential location, occupation, education, household size, access to health care, language group and mobility [23,24]. Controversies surround the effect of SES on dental caries experience. Reisine and Psoter [25], in a review of previous studies, concluded that there was limited information to demonstrate whether SES is a risk factor for caries experience. The evidence from the few studies in which this question was investigated was also mixed [25]. Although subsequent studies from several countries have found evidence of an SES disparity in caries experience in adolescents [26–29], some have not [30].

In the present study there was no difference in terms of caries experience between socio-economic subgroups. This is similar to the findings of Van Nieuwenhuysen et al. [30]. However, it is contrast to the findings of other studies that found evidence of an SES disparity in caries experience in adolescents [26–29]. In interpreting our findings one should consider that, due to different cultures, the socio-economic variables and methodology we employed were not exactly the same as those used in previous studies and these differences can account for different results. The SES variables we chose may also not have been precise enough to evaluate the large number of complex and interconnected SES factors exclusive to the Iranian schoolchildren. This could have been addressed by using other SES variables, such as household income, neighbourhood, parental beliefs about dental treatment and access to the dental service. Future studies can overcome these shortcomings. Although the mean DMFT difference between SES categories was not significant, paradoxically the mean DMFT score was higher in subjects with higher SES. One of the possible explanations for this could be the higher mean FT scores (filled due to decay) in subjects with higher SES.

We did not find a significant difference in mean caries experience (DMFT) between those with and without a need for orthodontic treatment. Our findings were similar to the work of Miller and Hobson [3], Katz [31], Addy et al. [4], Helm and Petersen [5] and Stahl and Grabowski [6]. However, these results are in contrast to the findings of Gábris et al. [1], who found higher caries experience in subjects who needed orthodontic treatment. The present study used the DAI score as a measure of malocclusion. However, there are possible limitations in using the DAI to assess malocclusion. DAI does not assess traits such as buccal crossbite, centre-line discrepancy and deep overbite and therefore the final DAI score does not represent the true picture of malocclusion [32,33]. This limitation could potentially alter the result of the present study and can be overcome in future studies by using contemporary indices such as the index of complexity, outcome and need (ICON) [34].

This present study investigated the interrelationship between caries experience, malocclusion and SES. The interesting point in the subjects with orthodontic treatment need living in households with >6 people was the higher mean caries experience and higher prevalence of severe caries experience. Possible explanations for this could be lower income, less access to preventive intervention or dental service or other factors not investigated in this study. These factors may have collectively increased the prevalence of caries in this group. It is worthwhile mentioning that we only found this association between caries experience and malocclusion in a subsample of 85 subjects. To further investigate this association in children living in households with >6 persons, disproportionately stratified sampling would be required to further investigate the relationship between caries experience and orthodontic treatment need.

As described above, there are limits to the conclusions that can be drawn from our findings. The present study is cross-sectional and therefore

cannot demonstrate causality. Therefore, it is difficult to establish a cause-and-effect relationship between malocclusion and caries experience in this group (household size >6 persons). As Palin-Palokas and Ruokokoski-Pirkkanen [7] and Stahl and Grabowski [6] concluded, it may well be that tooth caries leads to tooth loss and thereby to malocclusion. At the present time it remains unclear via what means the SES inequality (e.g. household size) affects the relationship between caries experience and orthodontic treatment need. Identifying these pathways is an important step towards creating preventive interventions and prioritizing the susceptible groups. Cross-sectional studies such as the present one cannot entirely rule out or prove the relationship between caries experience and malocclusion. Future studies employing longitudinal designs can best address these issues.

Conclusions

According to the present study, there was an association between the prevalence of severe caries experience and the severity of malocclusion in families with a household size >6 persons. With an increase in the severity of malocclusion in children living in a household size >6 persons, the prevalence of severe caries also increased. The current data suggest that the relationship between caries experience and malocclusion should be assessed in a wider context of SES and background factors. To further investigate the relationship between caries experience and malocclusion in future studies, larger sample sizes and disproportionately stratified sampling would be required. The possible predictive value of orthodontic treatment need for caries experience should be investigated through longitudinal studies.

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