Dental Caries Prevalence among Schoolchildren in Urban and Rural Areas of Qom Province, Central Part of Iran

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Abstract: Dental caries among 12 years old schoolchildren and some caries-related risk factors in Qom province, central part of Iran, were investigated. 440 students from urban and rural areas were visited to indicate the DMFT index. Caries-associated factors such as routine toothbrushing, tea drinking, fluoride in drinking water and socioeconomically status were considered. DMFT values were determined 2.19 ± 0.26 and 2.69 ± 0.17 for urban and rural areas, respectively. In urban community, DMFT values reported 2.43 ± 0.21 and 1.95 ± 0.12 for male and female, respectively. Also for rural communities, DMFT values were calculated 2.79 ± 0.3 and 2.60 ± 0.18 for male and female, respectively. Results revealed the routine toothbrushing has the most significant effect on decreasing dental caries (R^2=0.98, p<0.01). For all communities, weak relationships were obtained between fluoride concentration of drinking water sources and DMFT values (p>0.05). Toothbrushing should be considered as a routine educational program in primary schools especially in rural regions. Also, a supporting program enforced by government comprises the financial aspects, may be helpful to decrease the DMFT index of schoolchildren in urban and rural areas.

Key words: DMFT Index · Toothbrushing · Fluoride · Schoolchildren

INTRODUCTION

Based on global overview of oral health published by WHO, dental problems are still among the most important concerns of public health [1, 2]. Dental caries affects 60-90% of schoolchildren and also majority of adults [2].

Various studies established that controlled concentrations of fluoride; almost less than 1 mg/L are useful to decrease dental caries during childhood period [3-5]. Concentrations more than 1 mg/L in drinking water sources may cause to fluorosis [6-8] and even some reports revealed intelligence decrease in children and retard of birth rates after consume water and food with rich contents of fluoride [9-11].

During past 20 years, the increase of seafood and bottled water consumption which contains fluoride, other media for fluoride delivery like toothpaste and mouth rinse has been used widely [12-15]. Also, studies showed noticeable contents of Fluoride in other drinkable sources like tea liquor [16]. So, concerns have risen about

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population over-intake of fluoride and increase doubtfulness about healthy efficacy of drinking water fluoridation in modern communities [2, 3, 6, 17].

Zhu *et al*. reported tooth brushing in China cities among children and adolescents more than rural residents [18, 19]. A cohort study in Malaysia which lasted for 5 years, reported 74% and 62% caries free in urban and rural 12 years old schoolchildren respectively. However, Apart from water fluoridation and fluoridated toothpaste, parental educational level and monthly household income had significant effect on oral health circumstance [20, 21]. This study aimed to determine dental caries of 12 years old schoolchildren of Qom province comprised of urban and rural residents. Beside this, the measurement of waterborne fluoride concentration in drinking water sources was considered. Socioeconomic status of students is also surveyed through questionnaire.

MATERIALS AND METHODS

Study Area: Qom is the smallest province of Iran and as shown in Figure 1, has been located in the central part of Iran. Qom province is laid between 36° to 37° geographical latitude. *Qom* is the name of province and also the name of single and capital city of this province.

We are classified Qom province to Urban and rural regions which the urban area was consisted of municipality districts of city. Based on municipality classification, river and railway cross each other and divide the city to four districts (Figure 1). Rural areas comprise all main rural regions regarding to the national geographical classifications. These regions are eight areas as can be shown in Figure 1.

Like the other cities, Qom districts have not the equal levels of socioeconomic levels. It can be inferred from obvious evidences that, people who live in district number four (Known as Zanbilabad) are ranked in higher levels of socioeconomic criteria as district number one (Known as Niroogah). Nevertheless, Districts two and three (Known as Haram and Emam respectively) can be classified between districts one and four.

Low precipitation and geological structures in the central part of Iran plateau engaged the Qom province with both low quantity and poor quality of water resources. Two raw water sources which supply the municipal water needs are Qomroud River and deep wells dug mainly alongshore the river path through the city. Dissolved solids (TDS) concentration of surface water and deep wells is 1800 and 4500 mg/L, respectively. Some alternatives have been developed to improve Qom drinking water quality such as installing Public Desalinated Distribution System (PDDS), Private Desalinated Water Suppliers (PDWS) and Household Desalinated Water Units (HDWU). All of these desalination options are base on reverse osmosis technology and completely satisfy the drinking water needs of city population from almost past ten years ago. The Public Salty Distribution System (PSDS) has been assigned only to non-drinking demands in the urban districts. But in rural areas, public water distribution systems have drinkable quality because of relatively low salt contents.

Determining of DMFT Index: Based on WHO criteria, 12 years old is an appropriate age for reporting the DMFT Index which is because of full removal of infant tooth and
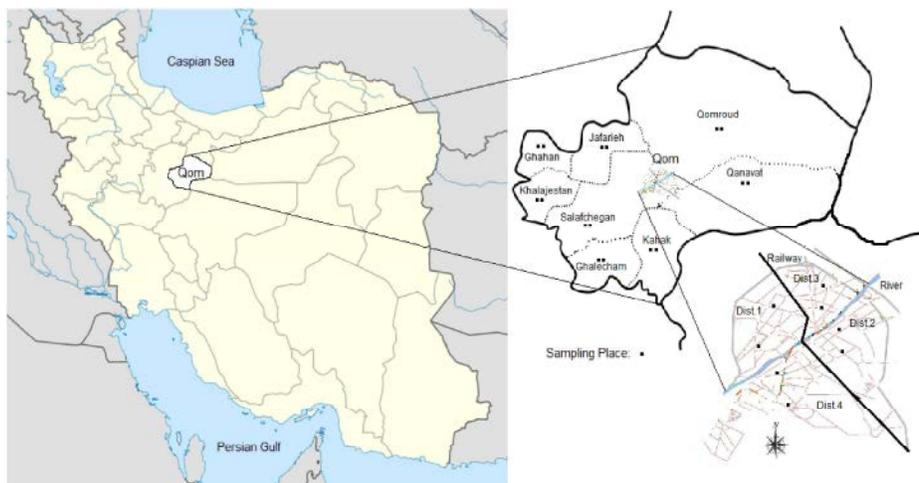

Fig. 1: Qom province location in administrative divisions of Iran, urban districts and rural regions of Qom and schools which was sampling places

no interference with dmft Index [22]. Also, availability of 12 years old students who stay together in school and diversity of their social levels regarded to select them as the target population.

Iranian educational system is based on gender-separated schools. So, from each city district or rural region, two schools were selected randomly to comprise females and males. The first 20 students of class-names list were selected as participants.160 cases in urban and 281 cases in rural areas were investigated. If each of top 20 individuals did not have entering criteria (For instance: at least 5 years residence in that rural area), he/she would be replaced with successive student. A monitoring team consists of dentist, dentist assistant and environmental health expert were gone to all schools to visit the students. A standard questionnaire which was covered demographic circumstances and specific questions like mother educational status and tooth brushing behavior was completed by asking to each student. Then, the student's teeth were examined by dentist and results were recorded as Dt (Number of decayed tooth), Mt (Number of missed tooth) and Ft (Number of filled tooth). The surveying program was performed from January 2012 through March 2012.

Fluoride Concentration Measurement: Schoolchildren in urban districts were selected among those who relied on household reverse osmosis systems as drinking water source. But, rural students entered to the study, consumed public drinking water source. Both the urban and rural participants have consumed from the respective water sources since 5 past years, continuously. The locations of water sampling were determined from addresses recorded in each student questionnaire. Then, the water samples were transferred to the laboratory to indicate the fluoride concentration.

Analysis was performed based on SPADNS method according to standard methods for water and wastewater examinations (Code: 4500-F) [23].

The optimal fluoride content of water was measured by Galagon and Vermillion [24] as follows:

$$\textit{Optained Fluoride Concentration}\left(\frac{mg}{L}\right)=\frac{0.022}{0.0104 \div (0.000724 * AMMT)}$$

Eq.1

where, AMMT is the Annual Mean Maximum Temperature (°C).

Data related to temperature were obtained from Qom Meteorological Center.

Data Analysis: Variables were compared with a one-way ANOVA and are presented as means $\square\pm\square$ standard deviations. The linear regression and Paired Sample-T test were also used. All statistical analyses were performed using SPPS version 18.5 (SPSS Inc., Chicago, IL, USA).

RESULTS

DMFT Index and Living Area: DMFT index of schoolchildren of urban area was 2.19. Principal portion (1.73) of urban DMFT was attributed to Dt (Decayed teeth) and less portion (0.08) was assigned to Mt (Missed teeth). Among four urban districts, the highest DMFT Index was belonged to district number two (2.43) and lowest DMFT Index was for the district number four (1.96). Ft (Filled teeth) in district number four is more than other districts (0.43) and Dt (Decayed teeth) of district number three (1.82) was more than others.

DMFT index of rural regions was 2.74 which was significantly more than those obtained for urban districts (P<0.05).

Dt (Decayed teeth) had the principal impact on DMFT index and so, its value had significant different with the other partial indexes (P<0.05). Ghahan region has more amount of DMFT index (4.26) among all rural and urban regions (P<0.05). Jafarieh and Ghalecham have fewer amounts of DMFT values (2.02) (Figure 1).

The Ft (Filled teeth) of schoolchildren in Qom (City) was significantly more than those of rural areas. But, the Dt of schoolchildren inhabited in rural areas were significantly more than those of city (Qom) (p<0.05).

Fluoride in Drinking Water: The fluoride concentration was determined in urban and rural water distribution systems. As revealed in Table 1, the average fluoride concentrations were 0.14 and 0.66 mg/L for urban and rural drinking water systems, respectively.

Table 1: Optimal and measured Fluoride concentrations of Qom urban and rural areas during annual survey

Season	SMMT[†] (°C)	Fluoride (mg/L)		
		OFC[?]	Urban	Rural
Winter	12	1.15	0.11±0.02	0.81±0.51
Spring	32.2	0.65	0.14±0.04	0.71±0.34
Summer	39.5	0.56	0.15±0.05	0.58±0.26
Fall	19.7	0.89	0.17±0.06	0.55±0.20
Average	26.5 (AAMT)[‡]	0.74	0.14±0.03	0.66±0.12

[†]SMMT: Seasonal Maximum Mean Temperature

[‡]AAMT: Annual Maximum Mean Temperature

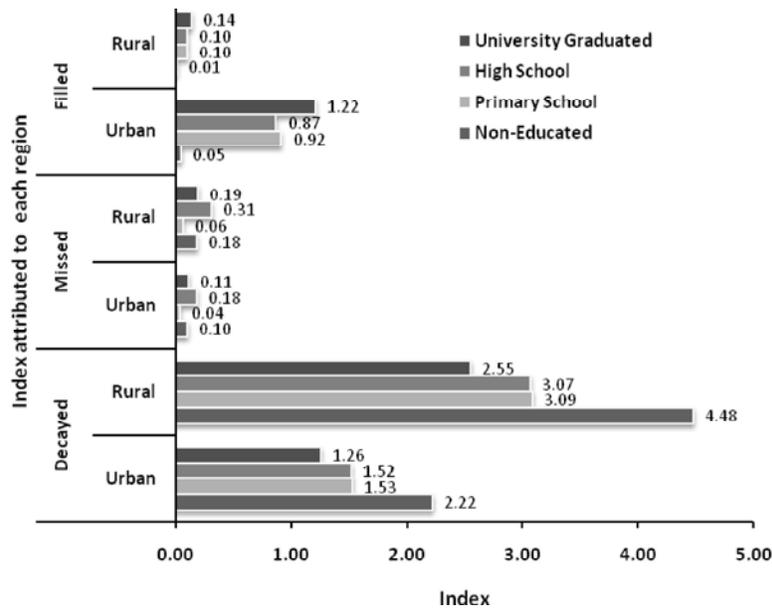[?]OFC: Optimal Fluoride Concentration[From Eq. 1].

Fig. 2: Decayed, Missed and Filled teeth in relation with Mother educational status and habitation.

The optimal fluoride concentration (OFC) of water measured by Calagon and Wermillion equation (Equation 1) revealed that, regarding to AMMT and SMMT, optimal fluoride concentration is ranged from 0.56mq/L to 1.15mg/L for summer and winter respectively. It seems that for rural regions in fall and winter and also for urban districts in all seasons the average measured fluoride concentrations are less than the optimal levels (Table 1).

Results of regression analysis showed a weak relationship between fluoride concentration in water distribution systems and DMFT index of those respective populations. Regarding to this model, the regression coefficients (R^2) around 0.08 and 0.6 were estimated for urban and rural areas, respectively.

Educational Status of Mothers: As shown in Figure 2, educational status of schoolchildren mothers was classified in four levels from non-educated to university graduated. Both in urban and rural areas, there was significant difference of Dt index (Decayed teeth) between children with university graduated mothers and others with lower educational levels ($p<0.05$). The difference between Dt values of children belonging to mothers with middle educational status (Primary and high school) was not significant ($P>0.05$) both in urban and rural areas.

The non educated mothers had children with higher number of Dt (Decayed teeth) ($P<0.001$). Beside this, children with non educated mothers in rural areas had Dt value more than 4 which was meaningfully more than urban children with non educated mothers ($P<0.001$).

The number of filled teeth (Ft) had direct relationship with educational status of mothers in urban districts ($R^2=0.78$). There were reverse relationship between Dt and mothers educational status in urban ($R^2=0.83$) and rural ($R^2=0.82$) areas.

Toothbrushing Behavior: There was an obvious reverse relationship between the number of toothbrushing per day and DMFT value among 12 years old students. Especially, as shown in Figure 3, the reverse relationships between toothbrushing (Numbers per day) and Dt (Number of Decayed teeth) are noticeable, both in urban and rural areas.

Apart from urban and rural area, DMFT values of students who brush their teeth more than three times per day is less than 2 and for those no brushing their teeth, are more than 3. The strong relationship between dental brushing behavior and decayed teeth ($R^2=0.98$) also can be served as a model to predict the decreasing of decayed teeth by developing the brushing behavior in schoolchildren as follows:

$$D_t \ Value = -0.34 \times [Number \ of \ teeth \ brushing \ per \ day(n/d)] + 2.69 \ \text{Eq.2}$$

According to Eq. 2, dental brushing three times per day can be tending to decrease almost one decayed tooth.

The Effect of Schoolchildren Gender: Table 2 showed the values of DMFT index in urban and rural areas based on the gender of schoolchildren. Minimum and maximum
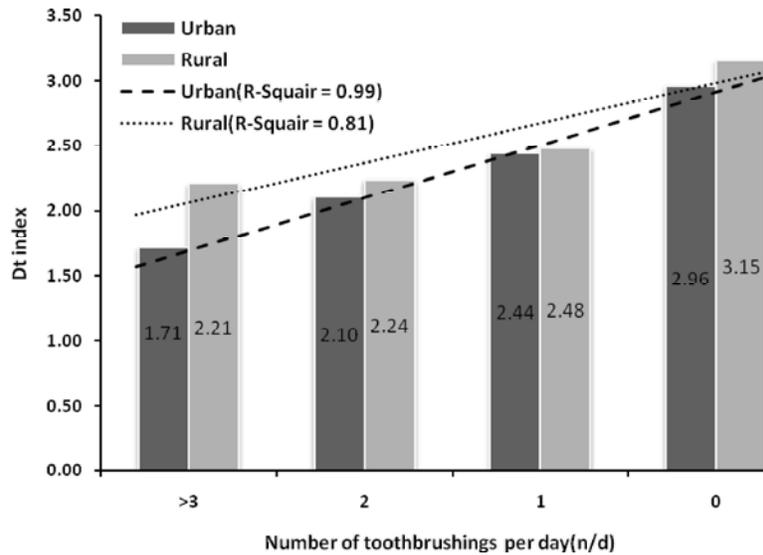
Fig. 3: DMFT index regarding to students dental brushing. Comparison between urban and rural populations.

Table 2: DMFT index of schoolchildren in Qom province attributed to habitation and gender

Region	Gender	D	M	F	DMFT
Urban	Male	1.81±0.20	0.08±0.02	0.53±0.10	2.43±0.21
	Female	1.65±0.19	0.06±0.01	0.23±0.09	1.95±0.12
Rural	Male	2.61±0.14	0.12±0.03	0.05±0.01	2.79±0.30
	Female	2.31±0.31	0.10±0.04	0.18±0.07	2.60±0.18
Total	Male	2.21±0.28	0.10±0.01	0.29±0.06	2.61±0.25
	Female	1.98±0.17	0.08±0.01	0.20±0.04	2.27±0.39
All participants					2.44±0.29

values of DMFT Index were belonged to urban females (1.95) and rural male (2.79), respectively. Also, as can be inferred from Table 2, DMFT index among males in rural regions was more than females (p<0.05).

DISCUSSIONS

Results indicated that the DMFT value of 2.44 was obtained for all participants which is more than the maximum value proposed by WHO for 12 years old children in EMRO region [25].

The Dt and Mt indexes of rural regions was much more than those from urban districts (P<0.05) whereas the fluoride contents of rural drinking waters were higher than the average of urban water sources. It seems, as finding of some other studies, socioeconomic differences are more significant factor on dental carries than fluoride concentration of water sources [3, 26]. Also, Ft index (Average number of filled teeth) from urban schoolchildren was more than rural regions which can be considered as a socioeconomic criterion because of high cost level of dentistry services [27, 28].

Regarding to the gender, DMFT value of males and females was determined 2.61±0.25 and 2.27±0.39 respectively, which showed higher DMFT level among males compare to female ($P_{value} \leq 0.05$).

Mahvi *et al*. [4] had reported DMFT prevalence to be 1.48 ± 0.13 in the 12 years old students of Behshahr town and the DMFT value determined for males and females was 1.21±0.16 and 1.75± 0.19, respectively which was higher in females compare to males [5].

There were so weak relationships between fluoride concentrations and Dt (Decayed teeth) both in urban (R^2=0.14) and rural (R^2=0.08) areas. However, the results are in agreement with those of Rahmani *et al*'s study, in that, they found the weak correlation coefficient of 0.159 [26]. Although, there were noticeable difference between optimal and measured fluoride concentration in urban districts, deciding about water fluoridation should be taking to account after surveying amount of overall body intake due to toothpaste, mouth rinse, tea liquor and other media [2, 29].

Mean concentration of fluoride in Qom drinking water sources based on membrane system was reported 0.14±0.03 mg F/L which can be comparable with mean concentration of bottled waters distributed in Iranian market. Study of Dobaradaran showed fluoride concentration in bottled water in Iranian market ranged from 0 to 0.55 mg F/L [13].

Results obtained from rural regions showed 0.66 ± 0.12 mg/L of fluoride in local drinking water sources which was relied on groundwater shallow aquifers. This amount was ranged from 0.29 to 1.28 mg F/L. Other report

performed in southern region of Iran (Dashtestan, Bushehr) showed fluoride concentration ranged between 1 to 2.5 mg F/L in samples which were taken from groundwater sources [7]. Amouei *et al.* [26] reported fluoride concentration ranged from 0.15 to 3.59 mg F/L in rural regions of Khaf (Khorasan Razavi province, eastern part of Iran) [30].

Educational status of mothers both in urban and rural areas had significant effect on decayed (Dt) and missed teeth (Mt) reducing (P<0.01) and filled teeth (Ft) increasing (P<0.05). Chu *et al* reported the dmft (6 years old children) equal to 2.2, 1.3 attributed to mothers with primary and high school education respectively [31].

The most significant factor which affected the DMFT index in this study was toothbrushing. The correlation between toothbrushing frequency (Per day) and DMFT value in urban districts (R^2=0.99, P< 0.05) was more than the rural regions (R^2=0.81, P< 0.01). Results support those of Chu's and Fadaei's studies [31, 32].

It seems that, rural schoolchildren are affected by other factors which have adverse influences on dental health such as low parents educational status and lack of routine tooth brushing program. Despite the higher levels of Fluoride in rural water sources, the average values of DMFT belonging to the rural places were obtained more than the urban districts. As denoted by Colquhoun *et al.* [33], achieving to the proper dental health levels in urban areas may be due to the better nutrition and more regulated tooth brushing than rural children.

CONCLUSIONS

- Dental health condition is not obviously affected by fluoride concentration in drinking water sources.
- The main supply of the drinking water demands in Qom is obtained by the membrane technology (Reverse osmosis). So, compensation the amounts of fluoride which are eliminated during the membrane process is suggested.
- During current years, the Fluoride is supplied via various media such as toothpaste and rinse. It seems that determining the overall fluoride intake by all media is necessary. Without this, the mere emphasis on water fluoridation is not reasonable.
- Because of the significant effect of tooth brushing, it is suggested that, the tooth brushing must be done at least 2 times per day in oral health teaching programs.

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