Original Article

Oral and Dental Status of Lebanese and Syrian Refugees Living in Proximity to Deir Kanoun Ras El Ain Dump in Lebanon

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ABSTRACT

Aims: In this study, we aimed at investigating the oral and dental health conditions of Lebanese and Syrian refugees living in proximity to Deir Kanoun Ras El Ain dump whereby its leachates influx into a canal used for irrigation and drinking purposes. **Materials and Methods:** This observational study involved oral and dental examinations of 589 Lebanese and Syrian Refugees participants living in the three villages: Deir Kanoun Ras El Ain, Klayleh, and Smaiyeh. Differences in oral and dental examination results were analyzed between different villages, sexes, nationalities, and age groups. Correlation tests were conducted between dental fluorosis, staining, papilla swelling, and several sociodemographic factors. **Results:** Dental fluorosis, staining, and papilla swelling were the most prominent problems among total participants. The highest percentages of individuals with the studied diseases were shown to be in Klayleh village, among females, and individuals aged between 21 and 40 years. Significant associations were observed between dental fluorosis and nationality; between dental staining and gender, nationality, age, and smoking; as well as between papilla swelling and age, smoking, and diabetes. **Conclusions:** Our study investigated and highlighted the prevalence of several oral and dental diseases among Lebanese and Syrian inhabitants that are related to environmental, social, and economic determinants and not just by individual behaviors. It also showed gaps of oral and dental health knowledge that recommend implementing health systems that focus on preventing oral diseases.

Keywords: *Dump, fluorosis, papilla swelling, pollution, staining*

Introduction

Globally, there is an increased burden of oral and dental diseases in spite of the immense enhancements in the oral health of many populations. The burden of these diseases is influenced by various sociobehavioral risk factors in both developing and developed countries.[1] Oral and dental diseases such as dental fluorosis, staining, pigmentation, erosion, and papilla swelling are common public health problems that have profound effects on the quality of life of individuals in most populations.[2,3]

Dental fluorosis is a well-documented enamel defect that results from prolonged intake of fluoride during enamel formation.[4] The excessive uptake of fluoride hypomineralizes the tooth, decolorizes it into shades that vary from white to brownish opaque areas, and alters the structure of the tooth enamel, rendering it more susceptible to fracture and wear.[5] The prevalence of mild-to-moderate degrees of dental fluorosis is dependent on the amount of fluoride intake, duration, and age of the exposed individual.[6] Fluorosis occurs when fluoride is ingested in amounts that surpass the

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permissible level of 0.05–0.07 mg/kg/day.[7] As drinking water is a major source of fluoride, the World Health Organization (WHO) recommended a permissible reference value of 1.5 mg/L of fluoride in drinking water.[8]

Dental staining or discoloration is an abnormal change in tooth color due to the external accumulation of stains on its surface or to the internal absorption of pigments into its structure.[9] Extrinsic dental staining is commonly caused by dental plaque, foods and beverages, tobacco smoking, bacteria, metals, and some medications, whereas intrinsic dental staining is mainly caused by medications, genetics, diseases, trauma, dental caries, and aging.[10,11]

Dental erosion is also a form of tooth wear defined as the irreversible loss of tooth substance rendering the enamel thin and giving a dull yellow color to the tooth. This chemical dissolution is caused by acids of nonbacterial sources.[12] The acid that leads to erosive wear could be of intrinsic sources such as stomach acid in gastroesophageal reflux disease, anorexia, and bulimia nervosa, or extrinsic sources such as the consumption of acidic foods and beverages and exposure to chlorinated swimming pool water or to acid fumes/droplets in the work place.[13,14] Dental erosion is the most prevalent chronic disease that affects children aged between 5 and 17 years.[3]

Papilla swelling or lingual papillitis is the state of inflamed taste buds that line the tongue.[15] There are several causes of inflamed papilla including acid or gastroesophageal reflux, allergies and food sensitivities, mouth burns, bacterial or viral infections possibly due to the lack of oral hygiene, oral cancer, smoking, stress, and iron and vitamin B deficiencies.[15,16]

These dental and oral problems may be related to the chemical quality of the water consumed by humans.[17] Water is one of the resources affected by human actions and environmental pollution that leave hazardous microorganisms and chemical elements in the body.[18] For example, the exposure to high amounts of iron or iodine can cause substantial black tooth. On the other hand, exposure to sulfide, silver nitrate, or manganese may be associated with gray-yellow or brown-black stains, copper or nickel can cause green stains, and cadmium can produce yellow-brown pigmentations.[17,19]

The environmental, demographic, and epidemiological transitions that many countries, including Lebanon, have been going through impose an urgent need to search for oral and dental health aspect.[1,20] In Lebanon, the epidemiological studies that refer to oral and dental health conditions are rare on the national level. According to the WHO, epidemiological, oral, and dental health studies aid in the determination of oral health preventive, curative, and restoring services as well as in treatments in relation to the demands. They also help in determining the needed resources for establishing, maintaining, expanding, or reducing dental care plans and policies.[21]

Lebanon is a Mediterranean country that has been suffering from environmental pollution, particularly water pollution in its many resources.[22,23] Deir Kanoun harbors one of the worst country dumps of wastes. Leachates from this dump influx into a canal that is used for the irrigation of surrounding agricultural lands and for drinking purposes.[24] Therefore, this study aimed to investigate the oral and dental health conditions of Lebanese and Syrian refugees living in proximity to Deir Kanoun Ras El Ain dump in Lebanon.

Materials and Methods

Study area

This study area is located in south Lebanon along the Mediterranean coast, specifically in Deir Kanoun Ras El Ain (geographic coordinates 33.222°N, 35.246°E), Klayleh (geographic coordinates 33.198°N, 35.228°E) and Smaiyeh (geographic coordinates 33.221°N, 35.235°E) villages. Deir Kanoun Ras El Ain village has a total number of 3800 Lebanese inhabitants and 451 registered Syrian refugees. Klayleh has a total number of 6000 Lebanese inhabitants and 1300 registered Syrians. Smaiyeh, the smallest village, has a total number of 2000 Lebanese inhabitants and 70 registered Syrians (data obtained from the head of each municipality).

Ethical considerations

This retrospective observational study was conducted in three Lebanese Southern villages: Deir Kanoun Ras El Ain, Klayleh, and Smaiyeh. This study was approved by the institutional review board at Beirut Arab University (Code number 2017H-0026-S-R-0188).

Each subject involved in the study signed an informed consent about her/his approval for enrolling in the study, for undertaking any study-related activities, and for the publication of the results without specifically identifying the subject. Consent of guardians was taken for under-aged participants.

Study subjects

Healthy male and female candidates between 10 and 80 years of age were enrolled representing the three studied villages. The study involved Lebanese participants who were inhabitants of the villages as well as Syrian refugees. At enrolment, personal, demographic, medical history, and further required information were

collected in a well-studied questionnaire (available in Supplementary Materials). In addition, each volunteer underwent oral and dental examinations under natural light by a dentist who was properly protected with complete personal protective equipment.

Potentially ineligible subjects were excluded if they (1) resided in one of these villages for less than a year and (2) were edentulous. From February 2016 to April 2016, 589 participants met the inclusion criteria and were identified for study enrolment and final analysis.

Statistical analysis

Data analysis was performed with the Statistical Package for Social Sciences (SPSS, version 23.0, SPSS Inc., Chicago, IL) and Microsoft Excel 2010. Study sample characteristics were summarized using simple descriptive statistics (i.e., mean, standard deviation, and percentages). Bivariate correlation test using the Pearson correlation coefficient was performed with $P < 0.05$ considered significant.

Results

Demographic data

Five hundred eighty-nine participants were enrolled in this study. Table 1 shows their distribution according to village, sex, nationality, and age group distribution.

Dental health status of all participants

The percentage of total participants with dental fluorosis, staining, pigmentation, papilla swelling, and erosion were 27.85%, 44.15%, 6.5%, 24.8%, and 5.1% respectively [Figure 1].

Village-related findings

According to village distribution, the highest percentages of individuals with dental fluorosis, staining, pigmentation, papilla swelling, and erosion were shown to be in Klayleh village followed by Deir Kanoun whereas the least were in Smaiyeh [Figure 2A]. As shown in Figure 2A, 39.6% of all cases of fluorosis, 42% of all cases of staining, 63.1% of all cases of pigmentation, 37% of all cases of papilla swelling, and 50% of all cases of erosion were shown to be among Klayleh inhabitants. Deir Kanoun village had 39.6% of all cases of fluorosis, 29.6% of all cases of staining, 18.4% of all cases of pigmentation, 34.2% of all cases of papilla swelling, and 50% of all cases of erosion. Smaiyeh village had 20.7% of all cases of fluorosis, 28.4% of all cases of staining, 18.4% of all cases of pigmentation, and 28.7% of all cases of papilla swelling whereas no cases of erosion were recorded.

Gender-related findings

The highest percentages of cases with dental fluorosis, staining, pigmentation, papilla swelling, and erosion were shown to be among females compared to males. Results indicated that 59.8% of all cases of fluorosis, 52.7% of all cases of staining, 57.9% of all cases of pigmentation, 52.7% of all cases of papilla swelling, and 73.3% of all cases of erosion were females. In contrast, 40.2% of all cases of fluorosis, 47.3% of all cases of staining, 42.1% of all cases of pigmentation, 47.3% of all cases of papilla swelling, and 26.7% of all cases of erosion were males [Figure 2B].

Nationality-related findings

The highest percentages of cases with dental fluorosis, staining, and pigmentation were shown to be among Syrian participants, whereas the highest percentages of cases with papilla swelling and erosion were shown to be among Lebanese participants. Findings revealed that Syrian participants comprised 64.6% of all cases of fluorosis, 56.2% of all cases of staining, and 63.2% of all cases of pigmentation. On the other hand, Lebanese participants comprised 57.5% of all cases of papilla swelling and 66.6% of all cases of erosion [Figure 2C].

Age-related findings

Figure 2D shows the percentages of individuals with dental fluorosis, staining, pigmentation, papilla swelling, and erosion among different age groups. It is shown that the highest percentages of cases with dental fluorosis (44%), staining (41.5%), and pigmentation (60.5%) were shown to be among individuals aged between 21 and 40 years. Moreover, the highest percentages of cases with papilla swelling (39%) and

Table 1: Distribution of subjects according to village, sex, nationality, and age group

Village	Overall number	Sex		Nationality		Age			
		F	M	L	S	10–20 years	21–40 years	41–60 years	Above 60 years
Klayleh	245	154	91	102	143	68	98	67	12
Deir Kanoun	208	129	79	104	104	73	71	55	9
Smaiyeh	136	67	69	127	9	38	52	34	12
Total frequency	589	350	239	333	256	179	221	156	33
Total (%)	100	59.4	40.6	56.5	43.5	30.4	37.52	26.48	5.6

F = female, M = male, L= Lebanese, S= Syrian

erosion (63.3%) were shown to be among individuals aged between 41 and 60 years.

Correlation between dental fluorosis and some sociodemographic factors

The correlations between dental staining and some sociodemographic factors were assessed in a correlation matrix using the Pearson correlation coefficient. The correlation matrix that assesses the variance of dental staining, village, sex, nationality, and age is illustrated in Table 2. Results show a significant positive correlation between dental fluorosis and nationality ($r = 0.269$, $P < 0.01$) only.

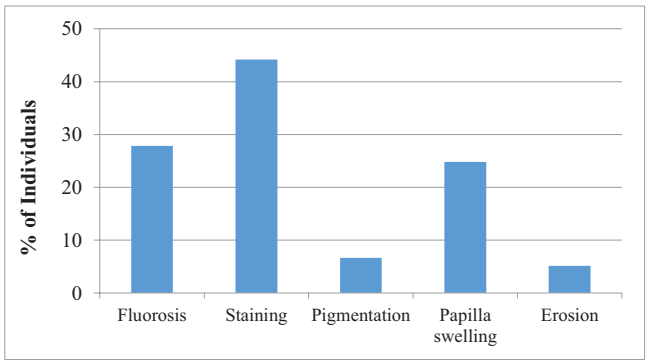

Figure 1: Percentage of individuals with dental fluorosis, staining, pigmentation, papilla swelling, and erosion among total individuals involved in the study

Correlation between dental staining and some sociodemographic factors

The correlations between dental staining and some sociodemographic factors were assessed in a correlation matrix using the Pearson correlation coefficient. Table 3 shows the correlation matrix that evaluates the variance of dental staining, village, sex, nationality, age, pregnancy, and smoking in relationship with each others. The association between dental staining and sociodemographic factors such as sex ($r = 0.121$, $P < 0.01$), nationality ($r = 0.23$, $P < 0.01$), age ($r = 0.212$, $P < 0.01$), and smoking ($r = 0.087$, $P < 0.05$) indicates a significant positive correlation between these factors.

Correlation between papilla swelling and some sociodemographic factors

The associations between papilla swelling and some sociodemographic factors were evaluated a correlation

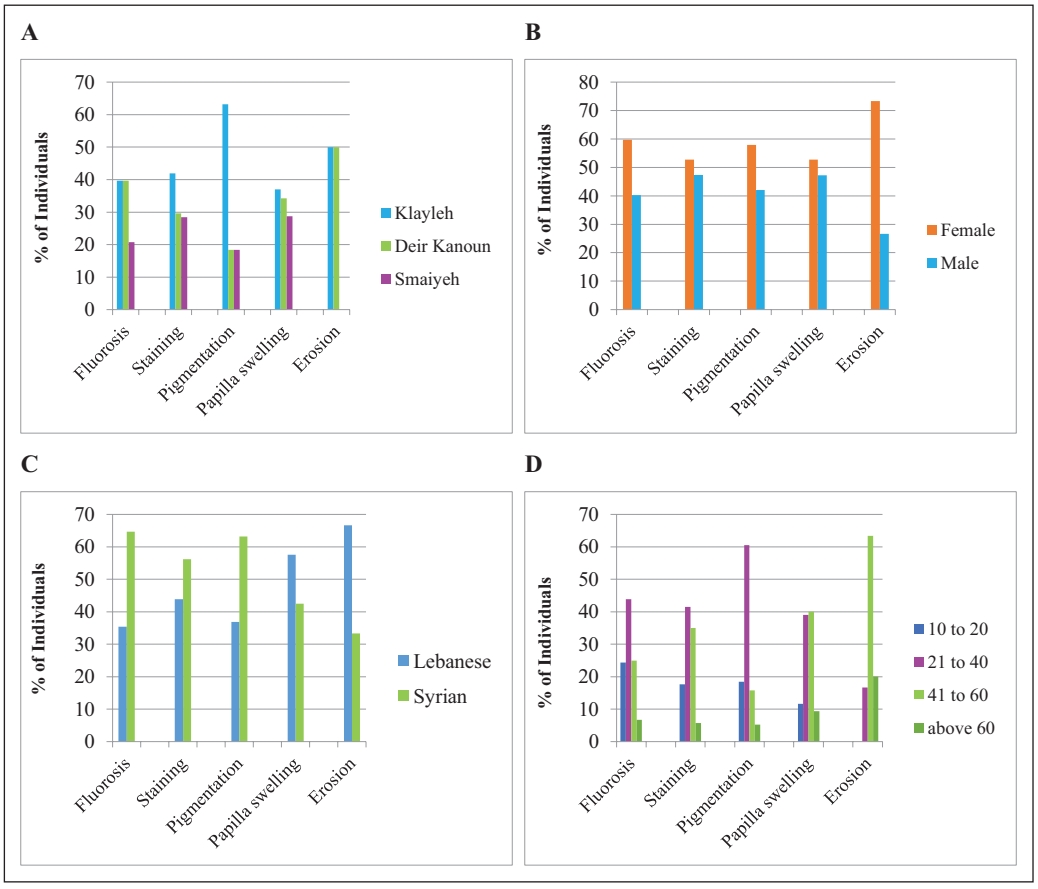

Figure 2: Percentage of individuals with dental fluorosis, staining, pigmentation, papilla swelling, and erosion in accordance of village (A), sex (B), nationality (C), and different age groups (D)

Table 2: Correlation matrix between dental fluorosis and some sociodemographic factors

	Fluorosis	Village	Sex	Nationality	Age
Fluorosis	1				
Village	−0.004	1			
Sex	−0.001	0.098*	1		
Nationality	0.269**	0.379**	0.043	1	
Age	0.047	0.003	0.183**	−0.021	1

*Correlation is significant at the 0.05 level.

**Correlation is significant at the 0.01 level

Table 3: Correlation matrix between dental staining and some sociodemographic factors

	Staining	Village	Sex	Nationality	Age	Pregnant	Smoking
Staining	1						
Village	0.056	1					
Sex	0.121**	0.098*	1				
Nationality	0.23**	−0.379**	0.043	1			
Age	0.212**	0.003	−0.183**	−0.021	1		
Pregnant	0.05	−0.006	−0.172**	0.101*	0.03	1	
Smoking	0.087*	0.073	0.229**	−0.114**	0.08	−0.054	1

*Correlation is significant at the 0.05 level.

**Correlation is significant at the 0.01 level

matrix as shown in Table 4. This correlation matrix showed a significant positive correlation between papilla swelling and sociodemographic factors including age ($r = 0.252$, $P < 0.01$), smoking ($r = 0.139$, $P < 0.01$), and diabetes ($r = 0.106$, $P < 0.05$).

Discussion

This study provided knowledge of the oral and dental health profiles among Lebanese inhabitants and Syrian refugees residing in Deir Kanoun Ras El Ain, Klayleh, and Smaiyeh villages. To the best of our knowledge, this is the first study in Lebanon that uses a randomized sample of subjects with different nationalities, age groups, and sexes. In fact, randomized samples represent an important contribution for the comprehension of the oral health–disease process among populations rather than other national studies that focus on specific groups and restrict to convenience samples such as health center and institutionalized subjects.[25] In Lebanon, very few regional studies were held using convenience samples: Diab *et al.*[26] assessed the oral health status of institutionalized individuals with intellectual disabilities living in Mount Lebanon, whereas Doumit *et al.*[27] assessed the prevalence of dental caries and fluorosis among Lebanese children in 18 towns.

This study focused on few oral and dental problems namely dental fluorosis, staining, pigmentation, papilla swelling, and erosion. Results showed that dental fluorosis, staining, and papilla swelling were the most prominent problems among total participants. However, few participants showed dental pigmentation and erosion. According to village distribution, Klayleh village had the highest percentages of individuals with dental fluorosis, staining, pigmentation, papilla swelling, and erosion.

Dental fluorosis, staining, pigmentation, papilla swelling, and erosion are well-documented oral problems that occur in different populations. Fluorosis is caused by excess intake of fluoride that could be from different sources including drinking water,[28] vegetables and fruits grown in soils irrigated with fluorinated water or supplied with fertilizer and pesticides, fish, and dental products.[29,30] Our findings are consistent with several studies where human populations in countries such as China,[31] India,[32] Iran,[33] Libya,[34] Turkey,[35] Saudi Arabia,[36] Algeria,[37] and Jordan[38] have been reported to be suffering from dental fluorosis due to the consumption of fluoride-enriched water and food.

In addition, a study that could be considered similar in relation to the prevalence of extrinsic stains was conducted by Rebelo de Sousa *et al.*[17] in Brazil. This study showed that there was low prevalence of extrinsic stains, being found mainly in children and adolescents.[17] Another study by Alkhatib *et al.*[39] assessing the prevalence of tooth discoloration in the United Kingdom showed that half the population had mild tooth discoloration whereas only 6% had severe discoloration.[39] Similarly, a study by Xiao *et al.*[40] assessed the prevalence of tooth discoloration among

Table 4: Correlation matrix between papilla swelling and some sociodemographic factors

	Papilla swelling	Village	Sex	Nationality	Age	Smoking	Diabetes	Cardiovascular diseases
Papilla swelling	1							
Village	0.075	1						
Sex	0.078	0.098*	1					
Nationality	−0.021	−0.379**	0.043	1				
Age	**0.252****	0.003	−0.183	−0.021	1			
Smoking	**0.139****	0.073	0.229**	−0.114**	0.08	1		
Diabetes	**0.106***	0.039	−0.031	−0.059	0.314**	0.108**	1	
Cardiovascular diseases	0.081	−0.059	−0.019	0.004	0.138**	0.074	0.164**	1

*Correlation is significant at the 0.05 level.

**Correlation is significant at the 0.01 level

a Chinese urban population. Their results showed that tooth discoloration is common among the Chinese where 48.9% of the enrolled individuals with some tooth discoloration.[40]

Moreover, our erosion-related findings are consistent with other population-based studies in countries such as Norway,[41] Brazil,[42] Switzerland,[43] Finland,[44] United Kingdom,[45] Saudi Arabia,[46,47] and Turkey[48], which have been afflicted with erosion mainly due to the consumption of acidic beverages and foods.

Regarding gender, our results revealed that females had higher percentages of dental fluorosis, staining, pigmentation, papilla swelling, and erosion compared to males. Although some studies showed that females act more positively toward oral health than males,[49,50] many other studies have shown that the rates of oral and dental problems are higher in females than in males due to several factors that could explain our findings.[51,52] These factors mainly include hormonal fluctuations during events such as puberty and menstruation, diets, genetic variations, and saliva composition.[51] For example, systemic diseases associated with caries have been shown to be associated with the female gender.[53] Other female-related factors such as earlier eruption of teeth and hence longer exposure to foods and beverages, easier access to foods and frequent eating during food preparation, and pregnancy contribute to poorer oral health than males.[52]

As for nationality, the highest percentages of cases with dental fluorosis, staining, and pigmentation were shown to be among Syrian participants, whereas the highest percentages of cases with papilla swelling and erosion were shown to be among Lebanese participants. These findings could be explained by a wide range of personal, socioeconomic, and environmental factors. It should be noted that Syrian refugees enrolled in this study were of poor income, lower education, and low occupational status as most of them were living in refugee camps that lack basic hygiene. Furthermore, some of the Syrian refugees live near to a canal that runs along Deir Kanoun Ras El Ain dump of wastes and drink from its polluted water, which could be considered as a risk factor for their oral diseases. The correlation between dental health and demographic factors such as age, gender, place of residence, or unfavorable oral health care, as well as unhealthy lifestyles, are well-documented in literature.[54-57]

On the basis of age groups, our findings revealed that the highest percentages of cases with dental fluorosis, staining, and pigmentation were among individuals aged between 21 and 40 years. Our results are consistent with a study by Johansson *et al.*,[58] which showed that oral diseases are very common in children and young adults. On the other hand, our results indicated that the highest percentages of cases with erosion were shown to be among individuals aged between 41 and 60 years. Similar findings were obtained by Jaeggi and Lussi[43] who showed that erosion was observed in 29.9% of the young (26–30 years) and 42.6% of the old (46–50 years) participants.

We went further to investigate the correlations between dental fluorosis and sociodemographic factors where results showed a significant positive correlation between dental fluorosis and nationality. Similarly, results indicated that there were significant associations between dental staining and sociodemographic factors such as gender, nationality, age, and smoking. On the basis of the literature, extensive research has been conducted to correlate sociodemographic factors and smoking with dental diseases including staining.[59-61] Similarly, results showed that there were significant associations between papilla swelling and some sociodemographic factors such as age, smoking, and diabetes. Cigarettes were shown to contain chemicals that cause irritation to the taste buds and thus inflammation and swelling. Also, diabetes has been considered as a risk factor for inflamed and swollen taste buds.[61,62]

Conclusion

All in all, health and oral health are affected by environmental, social, and economic determinants, and not just by individual behavior, genetics, and a well-functioning service.[45] Although oral and dental diseases are not life threatening, they are considered as important public health problems due to their high incidence and remarkable effects on general health and high cost of treatment.[63] Our study highlighted the prevalence of several oral and dental diseases among Lebanese and Syrian inhabitants that are related to environmental, social, and economic determinants and not just by individual behaviors.[45] It also showed gaps of oral and dental health knowledge that recommend implementing health systems that focus on preventing oral diseases.

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Conflicts of interest

There are no conflicts of interest.

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