



## Original Research Article

## The influence of oral health behavior and caries status of mothers on their children caries status

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## ABSTRACT

**Background:** Dental caries is a multifactorial disease affects large segment of population worldwide. This study aimed at evaluate the relationship between oral health behaviors including the consumption of sugar/acid diet of both mothers and their children on the caries status of the children. The relationship between the caries status of mothers and children was also evaluated.

**Materials and Methods:** This cross-sectional study was performed in rural villages near the capital of our country (Syria). The dentition status of 57 mother-child pairs was evaluated using World Health Organization (WHO) criteria for oral health surveys. Oral health behaviors and diet assessment of both mothers and children were investigated through WHO suggested questionnaires. Pearson and Spearman correlations, independent sample t-test, and linear regression analysis were used for the statistical analysis. The Significance level was set at 0.05.

**Results:** Mean DMFT values were 16.6 and 1.6 for mothers and children, respectively, whereas children dmft mean value was 4.3. Children of mothers who consumed diet with high sugar and acid content had worse caries status ( $0.010 \leq P\text{-value} \leq 0.013$ ). Caries status of children had weak correlation coefficients (0.2-0.4) with mothers' caries status though statistically significant ( $0.008 \leq P\text{-value} \leq 0.048$ ). Linear regression analysis revealed statistically significant models ( $P < 0.05$ ) with  $R^2$  values  $\leq 0.2$ .

**Conclusion:** Although some oral health behaviors and sugar/acid-rich diet of both mothers and their children correlated with the caries status of the children, these correlations were generally weak to intermediate. The current study suggested that oral health behaviors enhancement of both mothers and children could be one of these activities.

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## 1. Introduction

Oral health is an integral part of the general health. Oral hygiene maintenance prevents many diseases as well.<sup>1</sup> Many analyses of children's dental caries focused on individual-level caries risk and protective factors. However, family factors can play an important role in the child's

diet, oral health behaviors, and dental utilization,<sup>2-5</sup> as can possible genetic and other biologic factors.<sup>4,6,7</sup> Oral diseases pose large economic impact besides its personal and public implications.<sup>8</sup> Despite the fact that preventive strategies are largely adopted by many countries, dental caries is still a dental public health problem especially in developing countries.<sup>9</sup> Carious lesions in deciduous teeth are considered the 10<sup>th</sup> most prevalent health condition.<sup>10</sup> Good oral health status at a young age is of the utmost

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importance for children's development, overall health and well-being.<sup>11</sup>

Mothers are usually the main caregivers during early childhood and are the key persons in their family for the determination of dental health behavior of young children.<sup>12</sup> Recent research reported that mothers' oral health status is a strong predictor of the oral health status of their young children.<sup>13</sup> Furthermore, Li and Caufield found that transmission of cariogenic bacteria from mothers to their young children has been documented.<sup>14</sup>

Previous studies showed the importance of parents' role, especially mothers, in teaching their children health behaviors.<sup>15,16</sup> On the other hand, parental supervision on tooth brushing had a positive effect on their oral health. Sistani et al. found that children of parents with poor oral hygiene had higher caries and less fillings in comparison to children of parents with good oral hygiene.<sup>17</sup> Other essential strategies for preventing dental caries include healthy behaviors of limiting the frequency and amount of sugary foods and drinks, and brushing teeth with fluoridated toothpaste twice a day.<sup>18,19</sup> Considering the fact that children spend most of their time with parents, especially their mothers, dietary habits and healthy behaviors are acquired from them.<sup>20</sup> If these behaviors are established at an early age, this supports maintenance throughout the life course, supporting lifelong protection against caries.

Nevertheless, the relationship between maternal oral health knowledge, attitudes, and early childhood caries do not seem to have a simple cause-and-effect relationship.<sup>21</sup> It is believed that parents who have a good oral health knowledge tend to have a good attitude that may lead to following recommended oral health behavior on behalf of their children.<sup>21</sup> However, when early childhood caries are considered, parental oral health behaviors and feeding were found to be the key risk factors.<sup>22</sup> On the other hand, mothers' health behaviors are associated with their practices towards their children's consumption of various sugar-sweetened products.<sup>23</sup> Their greater understanding of oral hygiene and dietary habits also contributes to their children's oral health.<sup>24</sup>

Few studies had evaluated the relationship between oral health behaviors of children with that of their parents, and many of them were restricted on the primary dentition.<sup>25,26</sup> Shearer et al. compared the oral health behaviors between parents and children without evaluating the carious status of them.<sup>27</sup> Previous studies have investigated parental factors associated with caries in children.<sup>26,28-30</sup> focusing on the social determinants of the parents,<sup>28</sup> their behaviors and practices,<sup>26</sup> and their dental caries status.<sup>31</sup> In Harris et al review, parental oral health behavior was suggested as an important role in determining the oral health of their children.<sup>32</sup> This is why oral health education targeting mothers may positively impact oral the health status of children. However, before educating mothers, it is important

to assess their oral health behaviors and its effect on the oral health status of their children. Additionally, more research on family characteristics and parent-child relations to find factors promoting children's oral health behavior has been suggested.<sup>24,33</sup>

Accordingly, the current study aimed at evaluating the relationship between caries status of children and oral health behaviors and caries status of their mothers in rural areas in our country, after ongoing internal circumstances since 2011, which negatively affected the whole life of its citizens including their general health as well as their oral health.

## 2. Materials and Methods

### 2.1. Ethical approval and informed consent

Ethical approval was obtained from the University of Kalamoon Faculty of Dentistry Research Ethics Committee (41109/2020). Written informed consents were obtained from the parents of all children who participated in the study, before conducting interviews and collecting specimens. The study conforms to Declaration of Helsinki regarding the recognized standards for human subjects.

### 2.2. The sample

Fifty-seven children aged between 6 and 12 years old in addition to their mothers (45 mothers) were included in this current cross-sectional study. The children and their mothers belong to Kalamoon a rural area north to the capital of our country. Thirty-eight mothers had only one child included in the study. Of the other seven mothers, three mothers had two children, three had three children and one had four children who took part in the study. The sample were collected from three schools from the three villages of this rural area. One school, out of two, was chosen randomly from each village.

There were six 6-year-olds, seven, 7-year-olds, six 8-year-olds, eleven 9-year-olds, seven 10-year-olds, nine 11-year-olds, eight 12-year-olds and two 13-year-olds children in this study.

### 2.3. Oral health behaviors evaluation

Two questionnaires were completed by parents of each child to provide information on oral health behaviors and diet for both the mothers and their children, using the World Health Organization (WHO) recommended questionnaires (version 2013).<sup>34</sup>

### 2.4. Caries examination

Three calibrated dentists examined the dentition status of children and their mothers using WHO criteria (2013) for the oral health survey.<sup>34</sup> The supervisor of this study asked the three dentists to examine 10 children (after having training on the WHO criteria), and they were re-examined two weeks later by them. Intra-observer agreement ranged

from 0.85 to 0.92, whereas inter-observer agreement ranged from 0.71 to 0.81 using Kappa test.

Clinical examination for children was carried out at schools using intraoral mirror and WHO probe under sun light with an additional lightening source, whereas the examination for mothers was performed at their homes or at schools when coming to accompany their children back home, under the same conditions. The tooth status was assessed through visual inspection, aided by tactile inspection if necessary. The WHO criteria for the diagnosing and coding of dental caries were used.

Caries experience was reported using DMFT/dmft indices for permanent/primary dentition of both mothers and their children; the sum of decayed, missing (due to caries for less than 30-year-old individuals, and for any reason for individuals  $\geq 30$  years old) and filled teeth, and the sum of decayed, missing due to caries, and filled teeth (dmft) for primary teeth of the children.

### 2.5. Statistical analysis

Data were analyzed using SPSS version 23 (IBM Corp. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY).

Pearson (for continuous) and Spearman correlation (for categorical variables) tests were used to evaluate the correlation between children' and their mothers' oral health behaviors and sugar/acid-rich diet, with the DMFT and dmft of the children. Correlation strength was classified into weak, medium or high when correlations coefficient was  $0.2 < r < 0.4$ ,  $0.4 \leq r < 0.7$ , and  $r \geq 0.7$ ; respectively.<sup>35</sup> Then, linear regression analysis was used for variables that showed medium or high correlations ( $r \geq 0.4$ ), where the dependent variables were the carious status of the children, and the independent variables were the oral health behaviours, carious status, and sugar/acid-rich diet of both mothers and their children.

In addition, t-test was used to examine the difference in DMFT/dmft of children based on their mothers' oral health behaviors/ sugar/acid-rich diet.

Inter-and intraobserver agreement were tested via Kappa test.

## 3. Results

### 3.1. Descriptive statistics

The mean (SD) ages of children and mothers were 9.3 (2) and 34.8 (7.2) years respectively. The carious status of children and their mothers are shown in Table 1. Only four children (7%) were caries-free. Both D-component and d-component comprised the major fraction of DMFT and dmft, respectively.

About 85.7% and 98.2% of the children and their mothers used the toothbrush for cleaning their teeth, respectively; however, the use of residual oral hygiene aids was scare among the children in this study (<7%).

Wooden toothpicks, dental floss and miswak were the most commonly additional methods for oral care (24.6%, 22.8% and 7%; respectively) among mothers.

The majority of children and their mothers used toothpaste to clean their teeth (86% and 98.2%; respectively); nevertheless, 22.4% of children and 16.4% of mothers were not aware whether the toothpaste contained fluoride or not.

### 3.2. The relationship between mothers' oral health behaviors and the carious status of their children

Because the majority of mothers in this study used the toothbrush (98.2%), the comparison between oral health status of their children considering this habit for grouping was not possible. When DMFT, dmft, and each component separately of children of mothers who used wooden toothpicks and dental floss were compared to children of residual mothers, p-values ranged from 0.165 to 0.840, and from 0.063 to 0.935; respectively, i.e., there were no statistical differences between these two groups of children.

There were only four mothers who used miswak, thus, the comparison with children of non-miswak user mothers might be inappropriate. Nevertheless, DMFT and D-component were statistically less among children of miswak used mothers (P-value=0.001).

### 3.3. The relationship between children' oral health behaviors and their carious status

There were no statistical differences in the carious status between the children who regularly brushed their teeth, or used any other cleaning tool and those who rarely clean their teeth (p-value ranged from 0.093 to 0.693). On the other hand, Spearman correlation coefficients were -0.320 (p-value=0.020) and -0.4 (p-value=0.009) between frequency of teeth cleaning and d-component, and dmft; respectively. This indicated that the more the child cleaned his/her teeth per day, the less the carious lesions in his/her primary teeth.

### 3.4. The relationship between children' DMFT/dmft and sugar/acid-rich diet of their mothers

Spearman correlation revealed statistically significant correlations between two variables of the sugar/acid-rich diet of the mothers and their children' carious status. "The use of sweetened chewing gum" by mothers correlated weakly with D-component and DMFT of their children [ $r=0.35$  (P-value=0.011) and 0.34 (0.013); respectively]. Also, "drinking sweetened coffee" by mothers correlated with the F-component of their children ( $r=-0.36$ , p-value=0.01).

### 3.5. The relationship between children' DMFT/dmft and their sugar/acid-rich diet

The frequency of "drinking lemonade, cola and juice" was correlated with dmft and d-component ( $r=0.368$  P-value=0.010, and  $r=0.336$  P-value=0.018; respectively). The higher the frequency of drinking these beverages, the higher the d-component (and hence dmft) of the children. Nevertheless, the correlations were of moderate strength.

Similarly, both the frequency of "eating sweetened gum" and "eating candies" positively correlated with dmft and d-component significantly ( $r=0.423$  P-value=0.002 and  $r=0.436$  P-value=0.002; and  $r=0.280$  P-value= 0.050 and  $r=0.359$  P=0.012; respectively). These correlations were also of moderate strength.

However, DMFT of children and its component separately had no significant correlations with any variable of the sugar/acid-rich diet of them.

### 3.6. The relationship between carious status of children and their mothers

ummarizes the correlation coefficients and the statistical significance of the correlations between carious status of children with their mothers' counterparts. The correlation strength between these variables were weak ( $r<0.4$ ) in general.

### 3.7. The relationship between children carious status and parental educational level

Spearman correlation test revealed that D-component of children correlated with educational level of the mothers ( $r= 0.218$  P-value=0.05), whereas other correlations were insignificant (Table 3). The correlations were of weak strength ( $r<0.4$ ).

### 3.8. The result of the linear regression analysis

resents the results of the linear regression models. According to this table, eating sweetened gum by children could explained about 20% of d-components among children ( $R^2=0.202$ ). Other models provided in general less  $R^2$  values; i.e., the independent variables (which are health behavioral of mothers and children and carious status of mothers) give less explanation as causal factors to the dependent variable (carious status of children).

## 4. Discussion

The findings of the current study have important implications, especially in countries with internal conflicts. The results of this study suggested that mothers' oral health behaviors influenced their children oral health status. This is consistent with the determinants of the conceptual model previously suggested by Fisher-Owens

et al; there are five key factors affecting children's oral health, including genetic and biological, social environment, physical environment, health-influencing behavioral and dental and medical care factors at the individual, family and community levels.<sup>2</sup>

Untreated caries compromised nearly all the fraction of both the DMFT and dmft indices in the current study, although the majority of individuals in the study brushed their teeth. This may be attributed to the rural nature of the area where the sample was collected. Many of those thought that treating primary teeth was unnecessary. This is similar to many other developing countries, and what found previously in our country.<sup>36</sup> The parents of these high-risk children often wait until caries in primary teeth is advanced and becomes symptomatic before bringing their children to the dentist.<sup>37</sup> Unfortunately, the treatment at that time is invasive, and parents tend to avoid subsequent treatment until their children's needs again become extreme.<sup>38</sup>

### 4.1. The effect of oral health behaviors of mothers and their children on the carious status of the children

In the current study, nearly all mothers brushed their teeth twice daily, thus the comparison with children of mothers who did not brush their teeth would be inapplicable. Petrauskiene et al found that mothers who brushed their teeth were more likely to clean their children' teeth likewise.<sup>39</sup> Also, Sherar et al. found that poor maternal oral health increased the risk of developing dental caries of their children.<sup>27</sup> Notwithstanding, Peterson et al found that very few children had practical support from their parents to brush their teeth daily.<sup>40</sup>

Despite the fact that only four women used miswak in this study, children of mothers who used miswak, which is an old Islamic habit for cleaning the teeth, had less caries than those of mothers not using miswak. Notwithstanding, it is just an indicator that requires further studies to be confirmed. Oral hygiene habits are established in stages of development and are influenced by parental behaviors, predominantly of mothers, as they are often the primary caregivers of their children.<sup>41</sup> Miswak was found to have anti-bacterial properties including streptococcus mutans.<sup>42,43</sup> Thus, the transmission of bacteria from mothers to their children might be reduced among those children. Also, those children might be motivated to clean their teeth following the example of their mothers.<sup>32</sup>

Anyhow, most mothers' oral health behaviors did not show correlations with the dental status of their children in our study; similar to Husain et al. study, where no relationship between the oral health behaviors of the mothers and their children was found.<sup>44</sup>

In respect to children' oral health behaviors, the frequency of brushing teeth of children was correlated with their oral health status in the current study. It might be attributed to the fact that children' ability to clean their teeth

**Table 1:** Mean (SD) DMFT and dmft and each component for children and their mothers.

DMFT/dmft	DMFT	Dmft	D-component	M-component	F-component	d-component	m-component	f-component
Children	1.6 (1.8)	4.3 (2.8)	1.5 (1.8)	0	0.09 (0.34)	3.7 (2.6)	0.09 (0.39)	0.4 (0.7)
Mothers	16.6 (7.6)	-	6.8 (5)	3.6 (2.8)	6.2 (6.4)	-	-	-

**Table 2:** Correlation coefficients between children carious status and their mothers' carious status.

Carious status of mothers		D-component	M-component	DMFT
Carious status of Children	d-component	<b>0.266</b> (P-value=0.046)	<b>0.298</b> (P-value=0.012)	<b>0.305</b> (P-value=0.010)
	D-component	0.202 (P-value=0.132)	0.254 (P-value=0.057)	0.259 (P-value=0.052)
	(d+D) component	<b>0.279</b> (P-value=0.036)	<b>0.313</b> (P-value=0.018)	<b>0.310</b> (P-value=0.019)
	dmft	0.199 (P-value=0.142)	0.101 (P-value=0.458)	<b>0.239</b> (P-value=0.048)
	DMFT	0.151 (P-value=0.261)	0.231 (P-value=0.083)	0.232 (P-value=0.083)
	DMFT+dmft	0.203 (P-value=0.133)	0.297 (P-value=0.013)	<b>0.316</b> (P-value=0.008)

**Table 3:** Spearman correlation coefficients between maternal educational level and the indices of children.

Carious status of children	Father's educational level	Mother's educational level
DMFT of children	r=-0.118, P-value=0.359	r=-0.193, P-value=0.127
Dmft	r=-0.055, P-value=0.673	r=-0.141, P-value=0.272
D-component	r=0.119, P-value=0.358	r=-0.218, P-value=0.05
M-component	-	-
F-component	r=-0.043, P-value=0.738	r=0.040, P-value=0.753
d-component	r=-0.059, P-value=0.648	r=-0.171, P-value=0.177
m-component	r=-0.157, P-value=0.224	r=-0.078, P-value=0.538
f-component	r=0.042, P-value=0.750	r=138, P-value=0.282

**Table 4:** The results of linear regression analysis.

Dependent variable	Independent variable	Adjusted R <sup>2</sup>	P-value of the model
Children' D-component	Using miswak by mothers	0.112	0.006
Children' dmft	Frequency of teeth brushing by children	0.067	0.036
DMFT+dmft	Frequency of teeth brushing by children	0.077	0.026
Children' D-component	Eating sugar sweetened gum by mothers	0.116	0.007
Children DMFT	Eating sugar sweetened gum by mothers	0.108	0.009
Dmft	Drinking lemonade, cola and juice by children	0.105	0.014
d-component	Drinking lemonade, cola and juice by children	0.082	0.026
d-component	Eating sweetened gum by children	0.175	0.001
Dmft	Eating sweetened gum by children	0.202	0.001
d-component	Eating candies by children	0.150	0.004
Dmft	Eating candies by children	0.106	0.015
d-component	Mothers' D-component	0.060	0.042
d-component	Mothers' M-component	0.089	0.012
d-component	Mothers' DMFT	0.093	0.010
D+d component	Mothers' D-component	0.076	0.021
D+d component	Mothers' M-component	0.113	0.002
D+d components	Mothers' DMFT	0.143	0.001

is limited, and the increased frequency might overcome this limitation. This is in contrast to Husain et al. findings; where no correlation between children oral health behaviors and their dental caries experience,<sup>44</sup> but was consistent with the findings of others.<sup>45,46</sup> Improving children's oral health behaviors is an important target, because children who are introduced to good health habits in early childhood, this good behavioral approach tends to continue later into adulthood.<sup>47</sup>

Accordingly, this study suggests that individual behaviors have more effect on the carious status than the indirect effect from their parents.

#### *4.2. The effect of sugar/acid-rich diet of mothers and their children on the carious status of the children*

Children of mothers who used to eat sweetened chewing gum had slightly more caries than other children. The correlation was weak, however. It was reported that mothers' health behaviors are associated with their practices towards their children's consumption of various sugar-sweetened products.<sup>23</sup> This is similar to Husain et al. who found also a significant association in the sugar intake between the children and their mothers.<sup>44</sup> The relationship between drinking coffee by mothers and f-component might be considered just a false relationship.

Children who frequently consumed sugar and/or acid in their diet had more caries in their primary teeth in comparison to children with less amount of sugar/acid-rich diet. However, the permanent dentition showed no correlation with children sugar/acid-rich diet. This might be attributed to the short period of exposure to such foods in the children of this study (mean age was 9.3 years). The WHO has been concerned with high sugar consumption and the development of dental caries and has issued the WHO guidelines for free sugars consumption: to limit free sugars intake to less than 10% of total energy intake and ideally to less than 5%.<sup>48</sup>

#### *4.3. The relationship between the carious status of the mothers and their children*

Weak correlations, though significant, were observed between carious status of mothers and their children in general. This may be attributed to the multifactorial nature of the caries. The results of this study were in agreement with Dima et al findings where parents' DMFT had a direct effect on caries experience of their children.<sup>49</sup> In Bedos et al. study, those whose mothers were edentulous had a higher caries prevalence than children of dentate mothers.<sup>6</sup> Mothers' caries status was related to preschool children's caries status in Turkey,<sup>50,51</sup> and New York,<sup>52</sup> but was not significant in a Japanese study.<sup>53</sup> Dülgergil et al. found that performing preventive and operative dental care for mothers reduced mutans streptococci and lactobacilli in

plaque in their children, and subsequently the occurrence of caries among them.<sup>54</sup> It was found also that mothers' untreated caries increased by 1.76 times the probability of untreated caries in their children.<sup>30</sup> In addition, Children whose mothers visited the dentist one year before the birth were more likely to have visited the dentist during the first year of life.<sup>31</sup> Shin et al. found that the oral health status of children of mothers who had one caries or more were worse than those of mothers who had no caries.<sup>55</sup> It was found that mothers transfer the cariogenic bacteria to their children.<sup>56</sup>

#### *4.4. The relationship between children carious status and parental educational level*

Mother's educational level weakly correlated with their children d-component. Manchanda found with her colleagues that educating mothers reduced early childhood caries among their children.<sup>37</sup> Education level and stress experience of mothers may have small but significant correlation with the oral health status of their mothers.<sup>55</sup> Furthermore, the education that combined with motivation procedures resulted in much more reduction in early childhood caries.<sup>37</sup> Higher educated mothers gave their children less frequency of sugar-containing beverages,<sup>39</sup> their children had less caries, as well.<sup>57</sup>

Oral health education targeting mothers may positively impact oral health status in children,<sup>47</sup> as knowledge is one of the main risk indicators and predictors of the disease, making it possible to identify the individuals who would benefit most from early preventive measures.<sup>58</sup> Petrauskiene et al. found that significantly more mothers with a university education than mothers with a college or lower education reported not giving sweets and candies to their children.<sup>39</sup> Furthermore, in Rai and Tiwari review, the education levels of both mothers and fathers were associated with early childhood caries in most of the studies included in the review.<sup>59</sup>

#### *4.5. The results of linear regression models*

It was suggested by a systematic review that 73 factors were associated with dental caries among children. This might explain the relatively low  $R^2$  values in the linear regression models obtained in this study. In other words, in a multifactorial disease such as dental caries, a single factor is not expected to explain a large fraction of disease incidence. Nevertheless, all the models were statistically significant.

### **5. Limitation of this study**

The determination of factors that may favor the occurrence of dental caries is accomplished primarily through cross-sectional studies. However, the cross-sectional design does not allow the determination of causality among variables, and provides weaker evidence of associations. Thus, longitudinal studies are needed, because they allow cause-

and-effect relationships to be determined, and risk factors to be confirmed.<sup>60</sup> Furthermore, although the majority of mothers used to brush their teeth in this study, the evaluation of validity of their brushing was not assessed. This should be taken in consideration in future works. Seven women had more than one child participated in this study.

## 6. Conclusion

In conclusion, although some oral health behaviors and sugar/acid-rich diet of both mothers and their children correlated with the caries status of the children, these correlations were generally weak to intermediate. Because, preventive strategies of a multifactorial disease like dental caries should have multiple activities; the current study suggested that oral health behaviors enhancement of both mothers and children could be one of these activities.

## 7. Source of Funding

None.

## 8. Conflict of Interest

None


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