Dental caries severity in relation to selected salivary variables among a group of pregnant women in Baghdad city/Iraq.

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ABSTRACT

Background: During pregnancy many physiological, anatomical and biochemical changes take place that affect almost all body systems. In the oral pregnant women have serious changes such as more severe dental caries. This study was conducted to measure dental caries severity and selected salivary variables [salivary flow rate, pH and viscosity] and to find the relation of dental caries with these salivary variables.

Subjects, materials and methods: The study group consisted of 60 pregnant women that were divided into three equal groups according to trimester (20 pregnant women in each trimester). They were selected randomly from the Maternal and Child Health Care Centers in Baghdad city, the age range was 20-25 years. In addition to 20 unmarried women as a control group and matched with age. Stimulated salivary samples were collected. Then salivary flow rate, pH and viscosity were measured. Dental caries severity was recorded by using Decay, Missing and Filled index (DMFT) using the criteria described by Manjie et al. (1989). Plaque index system by Silness and Löe, (1964) was used for measuring dental plaque thickness. For measuring dental calculus the calculus index component of the periodontal diseases index (PDI) by Ramfjord (1959) was used.

Results: Results of the current study revealed that dental caries parameter represented by (DMFT, DMFS, DS and MS) were higher among pregnant than non-pregnant women with significant differences (p<0.05) for DMFT, DMFS and DS also all grades of lesion severity (D1-4) were higher among pregnant than non-pregnant women with nonsignificant differences (p>0.05). Almost all dental caries parameter were higher in the 2nd trimesters with highly significant difference (p<0.01) for D1, DS, DMFS and DMFT among four groups.

Concerning oral cleanliness both plaque and calculus indices recorded higher values among pregnant than non-pregnant with highly significant difference for both (p<0.01). Values were higher during 2nd trimester with highly significant and non-significant differences among four groups. Regarding the relations of dental caries with oral cleanliness, it was found that all dental caries parameters recorded positive correlations with both plaque and calculus indices with significant and highly significant relations. Regarding salivary variables, results revealed that salivary flow rate was higher among pregnant (especially in the 2nd trimester) than non-pregnant women but with non-significant difference (p>0.05). On the other hand salivary pH value was lower among pregnant than non-pregnant women with highly significant difference (p<0.01) among them. Salivary pH was lowest in the 2nd trimester with highly significant difference (p<0.01) among four groups. Also Salivary viscosity was higher among pregnant than non-pregnant women with highly significant difference (p<0.01) and it recorded higher mean value in the 3rd trimester with highly significant difference among four groups (p<0.01). Salivary pH recorded inverse relation with almost all dental caries parameters with significant relations with D1, MS and highly significant relations with DS, DMFS and DMFT. while salivary flow rate and salivary viscosity revealed non-significant relations with dental caries parameters (p>0.05).

Conclusion: Dental caries severity was higher among pregnant women probably due to the effect of pregnancy itself on oral hygiene (higher plaque and calculus indices) and salivary variables (increased salivary acidity and viscosity). Therefore, intensive education and preventive programs should be directed for pregnant women.

Key words: dental caries, pregnancy, salivary viscosity.

INTRODUCTION

Pregnancy is a physiological process that affects even healthy women and involves many physiological, biochemical and anatomical changes (1, 2).

In addition to noticeable oral changes among them is an increase in dental caries severity (3-5). Dental caries is an infectious transmissible bacterial diseases caused by acid from bacterial metabolism diffusing into enamel and dentine and dissolving the mineral (6). Several studies recorded an increase in dental caries severity among pregnant women (7-9).

In Iraq comparison studies had been carried out and recorded an increase in dental caries among pregnant in comparison to non-pregnant (10-13). A longitudinal study was found that recorded an increase in DMFT and DMFS during pregnancy but a decrease in decay severity DS from initial 2.58 to 1.54 before labor by Papp et al. (14).

Some pregnant women might experience excessive salivation (i.e. ptyalism) (15, 16) on the other hand xerostomia or hypo-salivation was reported to be a frequent complaint among pregnant women. Al Taie (17) found the flow rate of resting and stimulated saliva were significantly higher in pregnant than control group. While Sulaiman (18) showed that stimulated salivary flow rate was significantly reduced among pregnant women and Al-Zaidi (12) reported no statistically

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significant difference between pregnant and control group also salivary pH is affected during pregnancy. Kivela et al.\(^{15}\) reported a decrease in salivary PH during pregnancy followed by rapid and significant increase after delivery. While in pregnancy, Kivela control group also salivary pH is affected during pregnancy. Laine and Pienihakkinen,\(^{19}\) reported a decrease in salivary pH during pregnancy. Regarding salivary viscosity fresh mixed human saliva is viscoelastic fluid with distinct surface activity.\(^{20}\) During pregnancy, however, study in blood viscosity during pregnancy could be found.\(^{21}\) These changes in salivary flow rate, pH and salivary viscosity during pregnancy might increase dental caries severity among them.\(^{16,22,24}\) However limited studies could be found regarding changes in salivary flow rate and PH during pregnancy while no studies could be found that measure salivary viscosity among pregnant women. Therefore it was decided to carry out this study to assess dental caries severity in addition to salivary flow rate, pH and viscosity among pregnant women in comparison to un-married women and to evaluate the relation of salivary flow rate, PH and viscosity with dental caries severity.

**SUBJECTS, MATERIALS AND METHODS**

The study group consisted of (60) pregnant women that were divided according to trimester into three equal groups (20 pregnant women in each trimester). The age range was 20-25 years. In addition to 20 un-married women as a control group, these women should be matched with age. Both pregnant and control women were selected randomly from the Maternal and Child Health Care centers in Baghdad city.

Stimulated salivary samples were collected according to Tenovuo and Lagerlof\(^{25}\) instructions. After saliva collection the PH was measured by using digital PH meter. Salivary volume was measured by using measuring cylinder and the rate of secretion was expressed in milliliter per minute (ml/min). Salivary viscosity was determined by using the Ostwald viscometer (U-type viscometer).\(^{26}\) Then salivary samples were centrifuged and stored at \(-20^\circ\text{C}\) for subsequent chemical analysis. Plaque index by Silness and Løe,\(^{27}\) was used for measuring dental plaque thickness. For measuring the amount of dental calculus, calculus index (Cal I) component of the periodontal diseases index (PDI) by Ramfjord,\(^{28}\) was used, and all teeth was diagnoses. Dental caries experience was recorded by lesion severity according to Decay, Missing and Filled index (D\(_{1-4}\) MFS) Index according to criteria described by Manjie et al.,\(^{29}\) Statistical analyses were done by using IBM SPSS version 23 computer software (Statistical Package for Social Sciences) in association with Microsoft Excel 2016.

**RESULTS**

Table (1) showed that dental caries parameters (DMFS), (DS) were higher among pregnant than non-pregnant women (mean 17± 9.5; mean 9± 5.5) respectively with significant differences (p<0.05) in the 2nd trimester. While missing surfaces (MS) recorded higher mean rank value among pregnant than non-pregnant with significant difference (p<0.05) (MS) was higher in the 1st trimester of pregnancy.

Data showed that all grades of caries severity (D\(_1\) - 4) were higher among pregnant than non-pregnant but with non-significant differences (p>0.05). According to trimester all grades (D\(_1\),D\(_2\),D\(_3\)) of severity were higher in the 2nd trimester except for D\(_3\) that was higher in the 3rd trimester with highly significant difference among the four groups for D\(_1\) only(p<0.01). Statistical difference in MS between pregnant and non-pregnant (U test=414.0, Z value=-2.93, P value =0.022*) Statistical difference in DS between pregnant and non-pregnant (t test=2.26, d.f=78, P value =0.027). Statistical difference in DMFS between pregnant and non-pregnant (t test=2.46, d.f =78, P value=0.016).

Table (2) show that Both PI I and Cal I values were higher in the second trimester with highly significant difference among four groups for plaque (p<0.01) and for calculus index the p-value was close to the confidence limit. Statistical difference in Plaque index between pregnant and non-pregnant (U test=238.5, Z value =-4.017, P value<0.001; Statistical difference in Calculus index between pregnant and non-pregnant (U test=414, Z value =-2.076, P value<0.001) In Table (3) Salivary flow rate was higher in pregnant than non-pregnant in the 2nd trimester but with non-significant difference among four groups (p>0.05). Salivary PH was lower (more acidic) among pregnant than non-pregnant with highly significant difference (p<0.01). Salivary PH was lower in the 2nd trimester with highest significant difference among four groups. Salivary viscosity was higher among pregnant women than non-pregnant with high significant differences (p<0.01). It was higher in the 3rd trimester with highly significant difference among four groups (Statistical difference in PH between pregnant and non-pregnant women (F=5.464, d.f
The relation of dental caries parameters with salivary physico-chemical characteristic are shown in Table (5). It was found that the relation of salivary flow rate with dental caries parameters were weak non-significant correlations (p>0.05). Salivary pH revealed weak inverse relations with dental caries parameters except for (FS) that was weak positive relations statistical significance were significant (p<0.05) for (DS) and highly significant (p<0.01) for (DS, MS, DMFS, DMFT). Salivary viscosity revealed weak non-significant (p=0.05) correlations with dental caries parameters. The effect of pregnancy on oral variables analyzed by using (ROC test) is shown in Table (6) also adverted in Fig. (1,2). Results showed that the most affected oral variables by pregnancy was salivary (PH) with highly significant difference (p<0.05). Followed by Pl I GI (salivary viscosity).

Table 1: Dental caries experience among non-pregnant and pregnant women according to trimester.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Non pregnant women</th>
<th>1st trimester</th>
<th>2nd trimester</th>
<th>3rd trimester</th>
<th>Total (Pregnant women)</th>
<th>Statistical differences among four groups (ANOVARAs test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Median</td>
<td>Mean rank</td>
<td>Mean</td>
<td>No.</td>
<td>Median</td>
</tr>
<tr>
<td>D1</td>
<td>20</td>
<td>3.5</td>
<td>40.3</td>
<td></td>
<td>20</td>
<td>1.5</td>
</tr>
<tr>
<td>D2</td>
<td>20</td>
<td>1.5</td>
<td>33.9</td>
<td></td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>D3</td>
<td>20</td>
<td>0.3</td>
<td>36</td>
<td></td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>D4</td>
<td>20</td>
<td>0.3</td>
<td>38</td>
<td></td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>MS</td>
<td>20</td>
<td>0.3</td>
<td>31.2</td>
<td></td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>FS</td>
<td>20</td>
<td>3</td>
<td>45.4</td>
<td></td>
<td>20</td>
<td>3</td>
</tr>
</tbody>
</table>

*significant p<0.05; **Highly significant p<0.01.

Table 2: Oral cleanliness among pregnant and non-pregnant women according to trimesters.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Non-pregnant</th>
<th>1st trimester</th>
<th>2nd trimester</th>
<th>3rd trimester</th>
<th>Total pregnant</th>
<th>Statistical differences between trimester and non-pregnant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Median</td>
<td>Mean rank</td>
<td>Mean</td>
<td>No.</td>
<td>Median</td>
</tr>
<tr>
<td>Plaque index</td>
<td>20</td>
<td>0.142</td>
<td>22.4</td>
<td></td>
<td>20</td>
<td>0.321</td>
</tr>
<tr>
<td>Calculus index</td>
<td>20</td>
<td>0.0089</td>
<td>31.2</td>
<td></td>
<td>20</td>
<td>0.0187</td>
</tr>
</tbody>
</table>

*significant p<0.05; Highly significant p<0.01.

Table 3: Salivary physico chemical characteristic among non-pregnant and pregnant women according to trimesters.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Non-pregnant women</th>
<th>1st trimester</th>
<th>2nd trimester</th>
<th>3rd trimester</th>
<th>Total pregnant women</th>
<th>Statistical differences among four groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Mean ± SD</td>
<td>No.</td>
<td>Mean ± SD</td>
<td>No.</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Salivary flow rate</td>
<td>20</td>
<td>1.07 ± 1.21</td>
<td>20</td>
<td>1.11 ± 0.29</td>
<td>20</td>
<td>1.36 ± 0.72</td>
</tr>
<tr>
<td>Salivary PH</td>
<td>20</td>
<td>7.9 ± 0.5</td>
<td>20</td>
<td>7.5 ± 0.4</td>
<td>20</td>
<td>7.1 ± 0.3</td>
</tr>
<tr>
<td>VISCOSITY</td>
<td>20</td>
<td>0.0104 ± 0.0033</td>
<td>20</td>
<td>0.0117 ± 0.0018</td>
<td>20</td>
<td>0.0122 ± 0.0043</td>
</tr>
</tbody>
</table>

*significant p<0.05; Highly significant value<0.01.
Table 4: Relation of dental caries with oral cleanliness for pregnant women.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>PI</th>
<th>P</th>
<th>Cal</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>P</td>
<td>r</td>
<td>P</td>
</tr>
<tr>
<td>D1</td>
<td>0.062</td>
<td>0.58</td>
<td>0.201</td>
<td>0.07</td>
</tr>
<tr>
<td>D2</td>
<td>0.298</td>
<td>0.007</td>
<td>0.195</td>
<td>0.08</td>
</tr>
<tr>
<td>D3</td>
<td>0.44</td>
<td>&lt;0.001**</td>
<td>0.164</td>
<td>0.15</td>
</tr>
<tr>
<td>D4</td>
<td>0.225</td>
<td>0.045</td>
<td>0.204</td>
<td>0.07</td>
</tr>
<tr>
<td>DS</td>
<td>0.432</td>
<td>&lt;0.001**</td>
<td>0.331</td>
<td>0.003**</td>
</tr>
<tr>
<td>MS</td>
<td>0.373</td>
<td>&lt;0.001**</td>
<td>0.4</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>FS</td>
<td>-0.11</td>
<td>0.33</td>
<td>-0.086</td>
<td>0.45</td>
</tr>
<tr>
<td>DMFS</td>
<td>0.401</td>
<td>&lt;0.001**</td>
<td>0.363</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>DMFT</td>
<td>0.28</td>
<td>0.012*</td>
<td>0.25</td>
<td>0.025*</td>
</tr>
</tbody>
</table>

*significant p<0.05; highly significant value<0.01

Table 5: Relation of dental caries with salivary physicochemical characteristic for pregnant women.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>DS</th>
<th>MS</th>
<th>FS</th>
<th>DMFS</th>
<th>DMFT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>P</td>
<td>r</td>
<td>P</td>
<td>R</td>
<td>P</td>
<td>r</td>
<td>P</td>
<td>R</td>
</tr>
<tr>
<td>S.F.R</td>
<td>-0.044</td>
<td>0.7</td>
<td>0.064</td>
<td>0.58</td>
<td>-0.146</td>
<td>0.2</td>
<td>0.031</td>
<td>0.78</td>
<td>-0.053</td>
</tr>
<tr>
<td>PH</td>
<td>-0.189</td>
<td>0.09</td>
<td>-0.173</td>
<td>0.12</td>
<td>-0.198</td>
<td>0.08</td>
<td>-0.228</td>
<td>0.042</td>
<td>*-0.424</td>
</tr>
<tr>
<td>VISCOSITY</td>
<td>-0.094</td>
<td>0.41</td>
<td>-0.081</td>
<td>0.48</td>
<td>0.022</td>
<td>0.85</td>
<td>0.136</td>
<td>0.23</td>
<td>0.053</td>
</tr>
</tbody>
</table>

Table 6: Effect of pregnancy on oral variables (ROC test).

<table>
<thead>
<tr>
<th>Variables</th>
<th>ROC area</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salivary PH</td>
<td>0.907</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Plaque index</td>
<td>0.801</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>Salivary viscosity</td>
<td>0.757</td>
<td>&lt;0.001**</td>
</tr>
<tr>
<td>DMFS</td>
<td>0.673</td>
<td>0.021*</td>
</tr>
<tr>
<td>DS</td>
<td>0.668</td>
<td>0.025*</td>
</tr>
<tr>
<td>Calculus index</td>
<td>0.655</td>
<td>0.039*</td>
</tr>
<tr>
<td>Ms</td>
<td>0.655</td>
<td>0.039*</td>
</tr>
<tr>
<td>D1</td>
<td>0.610</td>
<td>0.14</td>
</tr>
<tr>
<td>D2</td>
<td>0.605</td>
<td>0.16</td>
</tr>
<tr>
<td>D3</td>
<td>0.576</td>
<td>0.31</td>
</tr>
<tr>
<td>Fs</td>
<td>0.575</td>
<td>0.32</td>
</tr>
<tr>
<td>D4</td>
<td>0.542</td>
<td>0.58</td>
</tr>
<tr>
<td>Salivary flow rate</td>
<td>0.538</td>
<td>0.61</td>
</tr>
<tr>
<td>D1</td>
<td>0.504</td>
<td>0.96</td>
</tr>
</tbody>
</table>

*significant p-value<0.05; **Highly significant p-value<0.01.

Figure 1: Roc curves for oral variables.

Figure 2: Roc curves for selected oral variables (salivary PH and FS).
DISCUSSION

Physiologic changes during pregnancy may result in noticeable changes in the oral cavity; these changes may include dental caries, pregnancy gingivitis, periodontitis, and other oral diseases. The same results found in the current study showed that pregnant women experienced an increase in dental caries severity represented by significant higher (DMFS, DS and MS values) all grades of caries lesion severity (D1, D2, D3) were higher among pregnant women than non-pregnant but with non-significant differences. This is probably due to increased consumption of carbohydrates, and reduced salivary production and/or increased acidity of saliva, increased acid in the mouth from vomiting. In addition the number of certain salivary cariogenic microorganisms as streptococcus mutants and lactobacilli found to be increased. The same result was also found by other studies. While the result reached was in opposite with Papp et al., who found a decrease in decay teeth surfaces during pregnancy. Regarding trimesters, dental caries experience (DMFT, DMFS, and DS) was higher in the second trimester, as well the grades of caries severity (D1, D2, D3) were this probably due to hormonal changes that reached to peak level in the second trimester. That was reported to affect oral health (this finding in accordance with previous Iraqi study by Al-Zaidi, who revealed the mean values of dental caries were higher in pregnant women especially in the first and second trimesters than the control group but the differences were statistically non-significant. Regarding oral cleanliness, results of the current study revealed that both plaque and calculus accumulation were higher among pregnant women than non-pregnant with significant difference for both. This finding may further explain higher caries severity during pregnancy since). Dental plaque is the main etiologic factor for dental caries. Also dental calculus act as retentive factor for dental plaque. This is further supported by the positive correlations of plaque and calculus indices with dental caries parameters that were significant and highly significant with most of the dental caries parameters for pregnant women. Also by using the ROC test it has been found that plaque index is the second oral variable after salivary PH to be affected or changed during pregnancy with highly significant differences. This is probably because pregnant women might become anxious, restless and exhausted, in addition to nausea and vomiting during pregnancy that made the routine oral hygiene practices more difficult. Poor oral hygiene was also reported by. Tilakaratne et al.
third trimester after that it declined during the last month prior to child birth (43), also by using ROC
test, it was found that salivary viscosity was the
third oral variable affected by pregnancy with
highly significant differences (ROC area = 0.757).
An increasing salivary viscosity during pregnancy
might contributed to increasing caries severity
during pregnancy since increasing salivary
viscosity means a reduction in water content and
more thick saliva in turn affect the clearance
action of saliva (44). However no studies could be
found regarding the change in salivary viscosity
during pregnancy to compare the result of the
current study with them.

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