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Effect of Adolescent Pregnancy on Dental Caries Experience and Selected Salivary Physicochemical Characteristics

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Abstract

Background: Adolescent pregnancy is associated with major health consequences for adolescent pregnant women including medications and oral health problems such as dental caries and periodontal disease. Pregnancy is a unique state of physical, hormonal, and metabolic changes that can result in an oral cavity imbalance. Changes in salivary components and a decrease in salivary flow rate caused by an increase in progesterone may compromise saliva's protective effects, resulting in dental caries.

Objectives: To evaluate dental caries experience in adolescent pregnancy.

Method: A sample including 80 pregnant ladies were recruited in this study and categorized into a study group involving 40 primigravida adolescent females aged (15-19)years old and a control group involving 40 primigravida women (20-32) years old who married at age 20 years or more, all of them in the second trimester of pregnancy. Unstimulated salivary samples were collected, salivary flow rate, pH, and dental caries experience were assessed. Saliva samples were analyzed to estimate salivary lactoferrin concentration.

Results: The mean (±sd) of decayed surface of the study group was (11.850±0.669) compared to (9.425±1.015) of the control group (p=0.049) and the level of salivary lactoferrin of the study group was (8.071± 0.558) compared to (6.610±0.447) of the control group (p=0.044), while the mean (±sd) of salivary flow rate of the study group was (0.349±0.020) compared to (0.540±0.157) of the control group (p=0.231) and the mean (±sd) salivary pH was (5.935±0.053)) compared to (5.995±0.153) of the control group (p=0.712).

Conclusion: Adolescent pregnancy is linked to increased dental caries experience by altering salivary characteristics, including lactoferrin levels.

Keywords: Adolescent pregnancy, dental caries, salivary lactoferrin, salivary flow rate, salivary pH.

Introduction:

Adolescent pregnancy can cause serious health and social problems, with particular medical impacts for the adolescents and society (1). Pregnancy is a stressful condition that greatly affects several physiological and metabolic processes (2). Oral health is a crucial aspect of overall health. Pregnant adolescents are at greater risk for medical issues that may impact their standards of life (3). Dental caries is one of the most common infectious diseases worldwide. It is widely believed that some species of lactic acid-producing bacteria, especially *Streptococcus mutans* and *Lactobacillus*, settle on the tooth surface and cause tooth caries(4). Pregnancy is a unique state of physical, hormonal, and metabolic changes thatcan result in an oral cavity imbalance(5).

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Changes in salivary components and a decrease in salivary flow rate caused by an increase in progesterone may compromise saliva's protective effects, resulting in dental caries and mucosal inflammation (6) (7). Lactoferrin (LF) is an iron-binding glycoprotein with antimicrobial properties against *Streptococcus mutans*, fungi, parasites, and viruses (8). Lactoferrin is produced endogenously by mucosal epithelial cells and neutrophils, but it also appears in other exocrine fluids (9). Because LF is also found in other exocrine fluids, such as saliva, its antimicrobial properties can also be observed in the buccal cavity. LF is secreted by both minor and major salivary glands in the oral mucosa, primarily by serous cells. The protein's protective function in the oral environment derives from its high affinity for iron and its ability to keep iron inaccessible to iron-requiring microbes,rendering it bacteriostatic (10). As far as there is no previous Iraqi study available concerning the impact of adolesecent pregnancy on oral health status, as the pregnancy at this developmental stage

may aggravate the negative effects of physiological changes during pregnancy on oral health and salivary characteristics, this study was conducted.

Methods

The study was performed at Baghdad City/Iraq during the period from the end of January to the end of March 2022. Within this time, the saliva samples were collected, the participating women were examined for dental caries experience and the salivary samples were analyzed for biochemical constituents. The Ethics Committee of the College of Dentistry at University of Baghdad has authorized the protocol for this cross-sectional study (number 483322/date 19-1-2022). The study samples consisted of a study group involving 40 primigravida adolescent females aged (15-19) in the second trimester of pregnancy. In addition to, control group involved 40 primigravida women (20-30) years who married at age 20 years or more, also in the second trimester of pregnancy.

In this study, the following exclusion criteria were applied in both group:-

- Medical problems or systemic diseases such as diabetes, cardiovascular disease, and hypertension that can impact oral health.
-Medications at study time that can affect the state of oral health.
-Anti-inflammatory drugs or antibiotics during the last month before the study.
- Abortion history.
-Risk of abortion.
-Smokers.
- Wearing a dental replacement or orthodontic device, whether fixed or removable.

In both groups, demographic criteria about name, age, history of medical illness, smoking, medication, and trimester of pregnancy were taken from each woman before starting the study. A special format was prepared for the data recording. Also, Verbal consent was obtained from the participants.

Salivary Samples:-For each pregnant woman involved in the research, saliva collection was carried out between 9 and 11 a.m. Unstimulated salivary samples were collected under similar circumstances and fixed time (5 minutes). It was carried out following the instructions developed via Navazesh and Kumar (2008)(11). After collecting the salivary sample and the disappearance of salivary foam, the salivary flow rate was determined as millilitre per minute (ml\min) by dividing the amount of saliva collected in millilitres by how long it was collected in minutes. Flow rate (ml/min) = Volume/ minute(12).

A digital pH meter was used to measure the pH of saliva, after calculating the salivary flow rate and pH, The saliva sample was stored in a cooler box and taken to the laboratory for centrifugation at 3000rpm for 10 minutes. Then using a micropipette, the supernatant was separated and stored in deep freezing (-20C)(13). For the subsequent analysis of salivary lactoferrin.

Oral examination:-Each pregnant woman was seated in a suitable position on the dental chair. after that, clinical examination was done by using chair light according to the criteria of the oral health surveys of the WHO (2013) (14).The decayed, missing, and filling surface index (DMFS index for permanent teeth) as described by WHO (2013), was used to diagnose and record dental caries experience (14).

Biochemical analysis of saliva:-The measurement of salivary LF concentration was achieved using the sandwich enzyme-linked immunosorbent assay (ELISA) method by a ready kit (Elabscience, USA).

Statistical Analysis:- Statistical Package for Social Science (SPSS version -22, Chicago, Illinois, USA) was utilized for the data description, analysis, and presentation.

Results:-

Table (1) demonstrated the mean and statistical differences of the DMFS index for the study and control groups. The DS was significantly higher ($p<0.05$) in the study group than in the control group. The MS and DMFS were shown to be greater in the control group than in the study group, although the difference was not significant ($p>0.05$). The FS in the control group was shown to be higher than in the study group, with a statistically highly significant difference ($p<0.01$).

Table 1: Mean values and statistical differences of dental caries experience (DS, MS, FS and DMFS), among study and control groups

Variable	Group	Mean	SE	*t*- test	*P* value
DS	Study	11.850	0.669	1.995	0.049*
	Control	9.425	1.015		
MS	Study	0.375	0.211	1.931	0.059
	Control	1.500	0.543		
FS	Study	0.725	0.226	3.475	0.001**
	Control	3.650	0.811		
DMFS	Study	12.950	0.686	1.275	0.206
	Control	14.575	1.075		

*=statistically significant when $p<0.05$
**=statistically highly significant when $p<0.01$

Table (2) explains the flow rate and pH mean values in the study and control groups. The pH and flow rate of the study group were found to be lower than that of the control group, with a statistically none significant difference ($p>0.05$).

Table 2: Mean value and statistical difference of pH and salivary flow rate (ml/min) among study and control groups

Variable	Group	Mean	SE	*t*-test	*P* value
pH	Study	5.935	0.053	0.371	0.712
	Control	5.995	0.153		
SFR	Study	0.349	0.020	1.208	0.231
	Control	0.540	0.157		

Table (3) showed the mean values of LF in the study and control groups. The study group's LF was significantly greater ($p<0.05$) than that of the control group.

Table3: Concentrations of salivary lactoferrin (ng/ml) in study and control groups

Variable	Group	Mean	SE	*t*-test	*P* value
Lactoferrin	Study	8.071	0.558	2.044	0.044*
	Control	6.610	0.447		

*=statistically significant when $p<0.05$

Table (4) showed the correlation between dental caries experience and salivary flow rate and pH. The pH positively correlated with MS and negatively correlated with DS, FS and DMFS in the study group, however, both correlations were statistically non-significant ($P>0.05$; Table 4).Regarding the control group, The pH positively correlated with DS, MS and DMFS and negatively correlated with FS however, both correlations were statistically non-significant ($P>0.05$; Table 4).

The salivary flow rate correlated with MS and FS in the study group with a positive none significant correlation and with DS and DMFS with negative, none significant correlation ($p>0.05$). In the control group, salivary flow rate correlated with DS, MS and FS in a negative none significant correlation ($p>0.05$) and with DMFS in a negative significant correlation ($p<0.05$).

Table 4: Correlation coefficient between dental caries experience (DS, MS, FS and DMFS) and selected salivary physical parameters (flow rate and pH) in study and control groups

Group		pH		SFR	
		r	p	r	p
Study	DS	-0.212	0.188	-0.157	0.332
	MS	0.199	0.219	0.114	0.485
	FS	-0.102	0.531	0.122	0.455
	DMFS	-0.180	0.267	-0.079	0.630
Control	DS	0.238	0.139	-0.206	0.202
	MS	0.037	0.820	-0.037	0.821
	FS	-0.022	0.892	-0.142	0.382
	DMFS	0.227	0.159	-0.320	**0.044***

*=statistically significant when $p<0.05$

Table (5) showed the correlation between dental caries experience and LF. In the study group, LF correlated with DS in a positive significant correlation ($p<0.05$) and with MS, FS and DMFS in a positive, none significant correlation ($p>0.05$). In the control group LF was correlated with MS and FS in a negative none significant correlation ($p>0.05$) and with DS and DMFS in a positive, none significant correlation ($p>0.05$).

Table (5) Correlation coefficient between dental caries experience (DS, MS, FS and DMFS) and selected salivary chemical parameter (lactoferrin) in study and control groups.

Group		LF	
		r	p
Study	DS	0.313	**0.049***
	MS	0.182	0.261
	FS	0.095	0.559
	DMFS	0.031	0.851
Control	DS	0.219	0.175
	MS	-0.126	0.437
	FS	-0.097	0.552
	DMFS	0.070	0.670

*=statistically significant when $p<0.05$

Discussion

Pregnancy has numerous negative effects, including immune suppression, cravings for sugar, fluctuations in hormones, salivary changes, and other physiologic alterations that influence the oral cavity environment and are anticipated to have a detrimental effect on the host's resistance to caries(15). Women having their first pregnancy are subjected to risk more than other pregnant women who passed a second or more pregnancies that can be influenced by inadequate health literacy and so have poor health awareness (16).

The result of the current study revealed that adolescent pregnant females had higher DS mean value than the control group. This outcome is consistent with the findings of a previous study which proved that adolescents pregnant females had high caries experience(17) . The increase in dental caries in pregnant women is caused by local cariogenic variables such as changes in saliva composition and oral flora, vomiting from acid reflux, poor oral hygiene, and dietary changes. These factors enhance the likelihood of developing dental caries (18, 19). Despite the increased risk of dental caries during pregnancy, women do not appear to seek routine dental care. Pregnant women are less physically active, eat more, consume daily sugars, and prefer food that's fast than non-pregnants(20) .

In addition to mentioned reasons which increase dental caries risk during pregnancy, it was found in the current study: -

1-Lower salivary flow rate in adolescent pregnant and as salivary flow rate decreases, the caries risk increase (21, 22) , due to a decrease in salivary washing action and protective factors. This was supported in the current study result by the negative correlation between salivary flow rate and the DS component of DMFS in the study group.

1- Lower salivary pH in the study group than control. Acidic salivary pH increases dental caries experience (23, 24). This was proved in the present study by the negative correlation between salivary pH and the mean of DS in the study group.

2- Hormonal changes during pregnancy specifically, estrogen level, increase dental caries experience (25).

All of the previous reasons in addition to low oral hygiene awareness and behavior during adolescence, dental caries experience (DS) was higher among adolescent pregnant females. FS was significantly lower in the study group compared to the control group. This was explained by the fact that adolescent pregnant had limited appointments with the dentist and little awareness of oral health and pregnancy outcomes (25) Salivary physiological changes during pregnancy may contribute to the pathophysiology of pregnancy-related oral conditions (26). The hormonal changes during pregnancy, specifically estrogen levels, cause a reduction in salivary flow(25). In our research, the study group had a lower salivary flow rate than the control group. Other studies by Karnik et al.(2015) and Migliario et al.(2021) also reported a decrease in flow rate in pregnancy (7, 27).

The decline in the rate of salivary flow during pregnancy is due to hormonal changes. Progesterone and estrogen levels gradually rise as a result of placental production of these hormones, causing physiological changes in women that result in both systemic and oral adaptations. Human chorionic gonadotropin (HCG) levels rise throughout the second trimester and cause a decrease in salivary flow. Human chorionic somatomammotropin (HCS) and progesterone levels rise markedly during pregnancy, which causes a decrease in the salivary flow rate(28, 29).

The result of the present study revealed that salivary pH in the study group was slightly lower than the control group. Other studies by Issa and El-Samarrai (2012), Mutlak and Yas (2017) and Migliario et al. (2021) reported low salivary pH in pregnant women (27, 30, 31). The decrease in salivary pH during pregnancy can be explained as plasma bicarbonate and salivary gland CO2 are thought to be the sources of salivary bicarbonate. During pregnancy, the composition of salivary proteins changes, and progesterone causes a decrease in plasma bicarbonate, resulting in a decrease in pH and buffering capacity. Increasing estrogen levels during pregnancy are accompanied by a decrease in pH and buffering capacity (6). The reduction in salivary pH may also be due to an increase in carbohydrate consumption during pregnancy because bacteria ferment carbohydrates, which leads to increased production of organic acids that decrease the pH of saliva and plaque, resulting in dental caries. (5). The study group in the current study also had higher DS value, resulting in lower salivary pH as the presence of dental caries affects carbohydrate clearance, resulting in extended contact with dental plaque and a persistent drop in salivary pH value (32). In addition to hormonal and metabolic changes related to the period of adolescence which modify the buffer capacity and secretion rate of saliva(33). The concentration of salivary LF in this research was significantly greater in the study group than in the control group. This result is in accordance with the result of the research by Lomova et al.(2010) that found that LF content of the saliva in a group of pregnant women with dental caries was higher than that in the group of pregnant women without dental caries, successively raised from the first to second and third trimesters, which characterizes the increase of the oral cavity antimicrobial protection(34). In the present

research, a higher concentration of salivary LF was detected in the group with higher DS score (adolescent pregnant); this agreed with other studies by Hao and Lin(2009) and Felizardo et al.(2010) (35, 36).

In this research, a significant positive correlation was observed between LF and DS in the study group, and this agreed with the results of research that found a significant correlation between DS and the levels of LF(37). This increase in salivary LF level in association with higher dental caries experience could be explained as a result of a compensating mechanism. It appears that in particular circumstances, such as the existence of dental caries or elevated levels of Streptococcus mutans , the secretion of this protein which represents a defensive strategy, could be triggered (38) .

Conclusion:

The study reported that adolescent pregnancy increases the risk of dental caries. Thus, proper awareness programs must be spread on adolescent pregnancy regarding its negative impacts on general and oral health and the direction of dental practitioners to provide dental motivation and services for this community sector.

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Author contributions:

Balsam Adnan Al-jabari:collection of data, Acquisition of data analysi,Interpretation of data, Drafting of manuscript,Critical revision.

Nibal Mohammed Hoobi: Study design and supervision)

Authors' Declaration:

We hereby confirm that all the Tables in the manuscript are mine/ ours.The project was approved by the college's in-house ethics committee of Dentistry, University of Baghdad.according to the code number (project No. 483322).

Conflicts of Interest: None

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تاثير حمل المراهقات على تسوس الاسنان والخصائص الفيزيائية والكيميائية اللعابية المختارة

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الخلاصة
المقدمة : حمل المراهقات يرتبط بتأيرات صحية كبيرة على المراهقات الحوامل بما في ذلك المضاعفات الطبية ومشاكل صحة الفم التي تتضمن تسوس الاسنان وامراض اللثة.
هدف الدراسة: تقييم تجربة تسوس الاسنان في حمل المراهقات.
الطريقة: تضمنت العينات 80 حبلى حمل اول تم تصنيفها في مجموعة دراسة ضمت 40 من المراهقات الحوامل للمرة الاولى تتراوح أعمارهن بين (15-19) سنة ومجموعة ضابطة تضم 40 امراة حامل للمرة الاولى تتراوح أعمارهن بين 20 و 32 عامًا تزوجن في سن 20 عامًا أو أكثر ، وجميعهم في الثلث الثاني من الحمل. تم جمع عينات اللعاب غير المحفزة ، وتقييم معدل تدفق اللعاب ، ودرجة الحموضة ، و تسوس الأسنان ، كما تم تحليل عينات اللعاب لتقدير تركيز اللاكتوفيرين اللعابي.
النتائج: وجد ان مؤشر تسوس الاسنان ومستوى اللاكتوفيرين اللعابي في مجموعة الدراسة أعلى من المجموعة الضابطة ، مع وجود فرق معنوي ، حيث وجد أن معدل تدفق اللعاب ودرجة الحموضة اللعابية لمجموعة الدراسة أقل من تلك الموجودة في المجموعة الضابطة مع عدم وجود فرق معنوي.
الاستنتاج: الحوامل المراهقات معرضات بنسبة عالية لتسوس الأسنان. وبالتالي يجب نشر برامج توعية مناسبة حول حمل المراهقات وتاثيراته الجانبية على الصحة العامة وصحة الفم وتوجيه ممارسي طب الأسنان لتوفيرمحفزات للاهتمام بصحة الفم وخدمات طب الأسنان لهذه الفئة من المجتمع..
الكلمات المفتاحية: حمل المراهقات ، تسوس الأسنان ، اللاكتوفيرين اللعابي ،معدل تدفق اللعاب ،درجة الحموضة اللعابية.