

The impact of dental environment stress on caries experience, salivary flow rate and uric acid

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ABSTRACT

Background: Several pathologies of the oral cavity have been associated with stress. Dental students need to gain assorted proficiencies as theoretical knowledge, clinical proficiencies, and interpersonal dexterity which is accompanied with high level of stress. Uric acid is the major antioxidant in saliva. The aim of this study is to assess the dental caries experience among dental students with different levels of dental environment stress in relation to physicochemical characteristics of whole unstimulated saliva.

Materials and Methods: the total sample is composed of 300 dental students (73 males, 227 female) aged 22-23 years old, from collage of dentistry / university of Baghdad, from the 4th and 5th grade. The total sample was classified into three categories (mild stress, moderate stress and severe stress) according to Dental environment stress questionnaire (DESQ); Diagnosis and recording of dental caries were assessed according to Decay, Missed, Filled surface and teeth index (DMFS, DMFT) of WHO criteria in 1987. Unstimulated salivary samples were collected from the 95 dental students from the mild stress group (27 male, 28 female) and from the severe stress group (11 male, 29 female). Then, salivary flow rate was measured and chemically analyzed to determine salivary uric acid concentration. All data were analyzed using statistical package for social science (SPSS) version 21.

Results: The mean value of the DMFT and DS fraction was higher among severe stress group of dental environment stress scale with no significant differences ($P \geq 0.05$), while DMFS, FS and MS fractions were higher among moderate stress group of dental environment stress scale with no significant differences ($P \geq 0.05$). The data from salivary analysis showed that the mean value of salivary flow rate was lower among severe dental environment stress category than mild dental environment stress category but the difference was statistically not significant, while the mean value of uric acid was higher among students with severe dental environment stress than students with mild dental environment stress with statistically significant difference. The flow rate was negatively correlated with caries experience among both mild and severe stress groups except for the DS was positively correlated with flow rate among students with mild stress. The correlation of uric acid with DMFT was negative among students with mild stress while among severe stress group was positive; however all these correlations were not statistically significant.

Conclusion: Dental environment stress appears to affect oral health, shown by higher caries prevalence among dental students with moderate and severe dental environment stress level by affecting the normal level of salivary flow rate and uric acid.

Keywords: Dental environment stress, stress, dental caries, flow rate, uric acid. (Received: 15/12/2019; Accepted: 23/1/2020)

INTRODUCTION

Most of the stress definitions emphasize stress as any factor that menaces the wellbeing of an individual or cause adverse effects on the body functions.⁽¹⁾ The central nervous system (CNS) reacts to stress; this reaction involves different morphological and neurochemical alterations, among them, oxidative stress.⁽²⁾ Oxidative stress consists of an imbalance between the amounts of reactive oxygen species (ROS) and the capability of antioxidant systems to equalize them.⁽³⁾ Stressors are known as the causes of stress, they could be emotional or physical, in addition, they could be internally or externally generated.

The stressors are categorized as: A) Exogenous or outer stressors. B) Endogenous or inner stressors. C) The formation of stress is also caused by the combination of exogenous and endogenous influences.⁽⁴⁾ D) System induced stress is a kind of stress that is distinguished by psychologists. System is related to association such as schools, family, offices, and any other social structures, in which a person is dealt with.⁽⁵⁾

Dentistry is known as a very stressful occupation and dental education is involved as being a stressful education environment because the dental occupation demands interpersonal dexterity and clinical competencies as well as theoretical knowledge.⁽⁶⁾ This stress can result in physical and psychological distress, which in turn can affect the health and performance of the student.⁽⁷⁻⁸⁾ The main sources of stress among dental students include the education environment, apprehension of fail, hardness in dealing with patients, clinical requirements, hardness in dealing with transitions in curriculum and difficult relationships with academic staff.⁽⁹⁾

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Dental caries is a complex, chronic, multifactorial disease and one of the most prevalent diseases in industrialized and developing countries.⁽¹⁰⁾ When the individual is exposed to stressful event, the psychological reaction to this event activates the sympathetic nervous system and the hypothalamic-pituitary-adrenocortical (HPA) axis, causing the secretion of elevated amount of stress hormones, primarily cortisol and catecholamine, which causes decrease in salivary flow and in this manner changes salivary capability with regards to oxidation reduction.⁽¹¹⁻¹²⁾ The reduction in salivary flow decreases the defensive actions created by saliva and, as a result, raising the hazard for dental caries.⁽¹³⁻¹⁴⁾ It was proposed that persons with psychological disturbance were more susceptible to bad caries state, which is because of a variety of causes such as self-negligence.⁽¹⁵⁾ The severity of the psychological stress diminishes in the capability to understand the complications of poor oral health, poor attention of oral hygiene, and illogical fear from dental therapy.⁽¹⁶⁻¹⁸⁾ Another study found that there is no relation between stress and salivary flow rate.⁽¹⁹⁻²⁰⁾ The major anti-oxidant of the saliva is the uric acid. The first defense mechanism against oxidative stress due to free radicals is the anti-oxidants present in the saliva.⁽²¹⁻²³⁾ The disequilibrium in concentrations of free radicals (reactive oxygen species) and antioxidants in saliva may have an important action in the initiation and progression of dental caries.⁽²⁴⁾ Several studies found that the adherence capacity of some bacteria may be modulated via the antioxidant capacity of their environment.⁽²⁵⁻²⁶⁾ Therefore, the increase in the total antioxidant capacity (TAC) of saliva could cause changes in the Streptococcus adherence to the dental plaque, leading to maximal cariogenic action.⁽²⁷⁾ Results of studies on the relation between uric acid concentration and caries experience were controversial. Therefore the main goal of this study was to determine the dental caries experience among different stress levels of dental students and to conduct an evaluation of its relation with salivary uric acid and flow rate. The null hypothesis was that there is no relation between salivary uric acid and flow rate with the development of dental caries experience among different stress levels of dental students.

MATERIALS AND METHODS

The total sample is composed of 300 dental students (73 males, 227 female) aged 22-23 years old, from College of Dentistry/ University of Baghdad, from the 4th and 5th grad. Dental environment stress was recorded for all dental students by means of self-

recorded questionnaire using dental environment stress questionnaire (DESQ).⁽²⁸⁾ This is a specific scale designed to measure the stress of dental students which consisted of (24) items, for each event 5 alternatives (very stressful, stressful, moderately stressful, not stressful, and not stressful at all), so the students have to answer for each event by choosing one of these alternatives. This questionnaire was adopted from other studies. The scale validity and reliability were checked. Caries experience was diagnosed according to Decay, Missed, Filled surface and teeth index DMFS/DMFT of WHO.⁽²⁹⁾ For salivary analysis, a sub-sample of 95 students was taken. The collections of unstimulated saliva were performed under standard condition according to the University of Southern California School of Dentistry guidelines for saliva collection.⁽³⁰⁾ The collected saliva sample was poured directly after being collected in a graduated test tube to determine the volume collected through the 5 minutes period. The salivary flow rate was calculated by dividing the volume of collected saliva in milliliter (ml) by the time required for collection in minute (min), Flow rate (ml/min) = Volume (ml)/ Time (min).⁽³¹⁾ After the collection of saliva, each salivary sample was centrifuged (at 2000-3000 rpm) for approximately 20 minutes. Salivary uric acid was determined colorimetrically by using the spectrophotometer and ready kit (Agappe kit /Switzerland). This method allows the determination of uric acid by reaction with uricase. Uricase transforms uric acid into allantoin, with formation of hydrogen peroxide, and produces a violet colored complex whose color intensity is directly proportional to the uric acid concentration in the sample. Data processing; analysis and description were performed by the use of (Statistical Package for Social Science SPSS version 21), Frequency and percentage were used for qualitative variable, while mean and standard error were used for quantitative variable.

RESULTS

Tables (1 and 2) illustrate the caries experience (DMFT, DMFS and its components DS, MS and FS) among dental students according to dental environment stress levels for the total sample. The mean value of DMFT and DS fraction was higher among severe stress level with statistically non-significant difference ($P \geq 0.05$), while DMFS, FS and MS fractions were higher among moderate stress level with statistically non-significant difference ($P \geq 0.05$). Table (3) demonstrates the mean value of salivary flow rate and uric acid. The mean value of

flow rate was lower among severe dental environment stress category than mild dental environment stress category, statistically the difference was not significant ($P \geq 0.05$), while the mean value of salivary uric acid was higher among severe dental environment stress category than mild dental environment stress category with statistically significant difference ($P < 0.05$). Table (4) demonstrates the correlation between salivary physicochemical characteristics and dental caries. The caries experience caries (DMFT, DMFS and its components DS, MS and FS) were negatively correlated with flow rate among students with mild dental environment stress except for the DS and

positively correlated with flow rate; while among the student with severe dental environment stress there was negative correlation between the caries experience and flow rate. There were negative correlations between uric acid and caries experience except for the MS and FS which were positively correlated with uric acid among students with mild dental environment stress; while among students with severe dental environment stress the caries experience were positively correlated with uric acid except for DS and MS which were negatively correlated with uric acid, however all these correlations were statistically not-significant ($P \geq 0.05$).

Table 1: Caries experience (DMFT, DMFS) of dental students according to dental environment stress levels

| Variable | Stress level | N | Mean | SE | F | P-value |
|----------|--------------|-----|------|-------|-------|---------|
| DMFS | Mild | 83 | 9.37 | 0.899 | 0.087 | 0.916 |
| | Moderate | 141 | 9.84 | 0.753 | | |
| | Severe | 76 | 9.72 | 0.756 | | |
| DMFT | Mild | 83 | 5.30 | 0.438 | 0.461 | 0.631 |
| | Moderate | 141 | 5.46 | 0.347 | | |
| | Severe | 76 | 5.88 | 0.412 | | |

Table 2: Caries experience (DMFs and its components DS, MS and FS) of dental students according to dental environment stress levels

| Variable | Stress level | N | Mean | SE | F | P-value |
|----------|--------------|-----|------|-------|-------|---------|
| DS | Mild | 83 | 3.33 | 0.390 | 0.748 | 0.474 |
| | Moderate | 141 | 2.89 | 0.253 | | |
| | Severe | 76 | 3.38 | 0.411 | | |
| MS | Mild | 83 | 1.02 | 0.268 | 1.079 | 0.341 |
| | Moderate | 141 | 1.24 | 0.226 | | |
| | Severe | 76 | 0.72 | 0.243 | | |
| FS | Mild | 83 | 5.02 | 0.685 | 0.308 | 0.735 |
| | Moderate | 141 | 5.72 | 0.626 | | |
| | Severe | 76 | 5.63 | 0.612 | | |

Table 3: Salivary physicochemical characteristics among dental students of mild and severe dental environment stress

| Variable | Stress level | | | | | | Statistical test | | |
|------------------|--------------|-------|-------|--------|-------|-------|------------------|----|---------|
| | Mild | | | Severe | | | T-test | df | P-value |
| | N | Mean | SD | N | Mean | SD | | | |
| Flow rate ml/min | 55 | 0.804 | 0.358 | 40 | 0.715 | 0.282 | 1.299 | 93 | 0.197 |
| Uric acid mg/dL | 55 | 5.142 | 1.706 | 40 | 6.059 | 2.485 | 2.134 | 93 | 0.035 |

Table 4: Correlation coefficient of caries experience (DMFT, DMFS and its components DS, MS and FS) with salivary physicochemical characteristics according to dental environment stress levels

| | | | Correlations | | | | |
|--------------|---------------------|---|--------------|--------|--------|--------|--------|
| Stress level | | | DS | MS | FS | DMFS | DMFT |
| Mild | Flow rate ml/min | r | 0.002 | -0.179 | -0.056 | -0.110 | -0.076 |
| | | P | 0.989 | 0.191 | 0.684 | 0.424 | 0.583 |
| | Uric acid mg/dL | r | -0.111 | 0.000 | 0.035 | -0.035 | -0.075 |
| | | P | 0.418 | 0.999 | 0.798 | 0.799 | 0.586 |
| Severe | Flow rate ml/min | r | -0.049 | -0.074 | -0.011 | -0.003 | -0.018 |
| | | P | 0.764 | 0.650 | 0.948 | 0.983 | 0.913 |
| | Uric acid mg/dL | r | -0.147 | -0.088 | 0.001 | 0.004 | 0.018 |
| | | P | 0.365 | 0.588 | 0.996 | 0.978 | 0.914 |

DISCUSSION

The defensive elements of saliva and the relationship between oral diseases and psychological components were taken into consideration. It is surprising how minimal psychological stress can adjust the safeguard element in saliva. In this study the dental caries was higher among severe dental environment stress category than other categories, the increase of dental caries occurrence with increased stressful situation agrees with other studies.⁽³²⁻³³⁾ This might be because of affecting the immunity and weakening the host defense to cariogenic bacteria⁽³⁴⁾, by the increase of the secretion of catecholamines and corticosteroids in serum and saliva. The cortisol level of the body increases during stress producing acid creating a favourable environment for bacteria,⁽³⁵⁾ by unhealthy meals eating prompting frequent snacking and increase the intake of sugar rich diet,⁽³⁶⁻³⁵⁾ by weakening the execution of self-care behavior (flossing teeth, brushing teeth) prompting poor oral cleanliness making great condition for microbes,⁽³⁷⁾ by diminishing salivary flow prompting diminished removal of cariogenic bacteria subjective oral dryness and unstimulated salivary flow were connected with stress to decrease the protective functions of saliva, increasing the vulnerability to dental caries.^(20,38-39) Although a lower unstimulated salivary flow rate was found in the severe stress group, this difference did not reach statistical significance; the same result was found by other studies.^(20,40-41) This is because anxiety and fear may influence salivary flow through pathways in the amygdala, the hypothalamus, and the brainstem.⁽⁴²⁾ The salivary flow rate was negatively correlated with caries experience among students with severe stress level and this agrees with other studies.⁽⁴³⁻⁴⁵⁾ This may be because of the important action of salivary flow rate as washing action and the defensive components of saliva increase with increasing salivary flow rate,⁽⁴⁴⁾ while among mild stress category the flow

rate was positively correlated with DS; this agree with other studies.⁽²⁰⁾ This may be due to higher flow rate; the flow rate may have little effect on the activity of caries at a specific point in time and determination of salivary flow rate at one-time may not be thorough estimation of salivary flow actions.⁽⁴⁶⁾ In this study the uric acid was significantly higher among students with severe dental environment stress than those with mild dental environment stress; the same result was found by other studies.⁽³⁹⁾ Antioxidant one of the protection components against oxidative stress is available in all body liquids and tissues, Uric acid is the major anti-oxidant of the saliva which comprises more than 85% of saliva total antioxidant capacity (TAC) which may be increased as a protection mechanism during stress,^(23,46-47) or maybe the adaptive response to a long dated expanded oxidative stress can result in high antioxidant of saliva,⁽⁴⁸⁾ or might be because of a significant number of the constituents of saliva changes with flow rate and as the flow rate declines during stress so the antioxidant may be increased for this cause.⁽⁴⁹⁾ Goodman found that with activation of hippocampal during stress uric acid level increased.⁽⁵⁰⁾ The data of present current study found that uric acid was weak and negatively correlated with dental caries; the same result was found by other studies.^(23,51-52) This may be due to enhanced production of reactive oxygen species (ROS) in the presence of bacteria by increased activity of neutrophils and monocytes in the oral cavity during phagocytosis.⁽²³⁾ In contrast, other studies⁽⁵³⁾ found positive correlation between TAC and dental caries and explained that a raise in total antioxidant capability of saliva could create alterations in the adherence of Streptococcus to the dental plaque and lead to more cariogenic action. In evaluating caries risk the determining of single salivary antibacterial component is not significant.⁽⁵⁴⁾ Therefore, further experimental and

clinical studies are required for progress to estimate the anticariogenic activity of uric acid.

CONCLUSION

The results of this study maintain that the salivary flow rate and uric acid may serve as a biomarker of stress, which affects the oral health as showed by the higher dental caries among dental students with severe dental environment stress.

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الخلاصة

الخلفية: العديد من امراض الفم تكون مصاحبة للضغط. طلاب كلية طب الاسنان يحتاجون الى اكتساب الكفاءات المتنوعة مثل: معرفة نظرية, مهارات سريرية, وخبرة في العلاقات الشخصية والتي تكون مصحوبة بمستوى عال من الضغط. حمض اليوريك هو مضاد الاكسدة الرئيسي في اللعاب. الكميات الكبيرة من مضادات الاكسدة اللعابية من الممكن ان تعادل التأثير القاتل للجراثيم للجزيئات التي تحفز الضغط التأكسدي الموجودة في اللعاب والصفحة الجرثومية, وبذلك تدعم نمو تسوس الاسنان.

الهدف من هذه الدراسة هو تقييم تسوس الاسنان لطلاب كلية طب الاسنان لديهم مستويات مختلفة من الضغط الناجم عن بيئة طب الاسنان وعلاقته بالخصائص الفيزيو-كيميائية لللعاب الغير محفز.

مواد وطرق البحث: العينة الكلية كانت 300 طالب طب اسنان (73 ذكور, 227 اناث) اعمارهم تتراوح بين (22-23) عام, الذين تم اختيارهم من كلية طب الاسنان/جامعة بغداد. حيث تم اختيارهم من المرحلة الرابعة والخامسة, تم تصنيفهم وفق مقياس الضغط لبيئة طب الاسنان الى ثلاثة اقسام (ضغوط قليلة, ضغوط متوسطة, ضغوط شديدة). تم تشخيص وتسجيل تسوس الاسنان باستخدام مؤشر الاسنان وسطوح الاسنان المفقودة والمعالجة والمتسوسة (DMFT, DMFS) وفقا لمعايير WHO. عينات اللعاب الغير محفز تم جمعها من 95 طالب من الذين لديهم مستوى ضغوط قليلة (27 ذكور, 28 اناث) والذين لديهم مستوى ضغوط شديدة (11 ذكور, 29 اناث) لتقييم نسبة تدفق العاب وتحليلها كيميائيا لتحديد تركيز حمض اليوريك اللعابي. وتم تحليل جميع البيانات باستخدام برنامج SPSS النسخة 21.

النتائج: اظهرت النتائج ان قيمة متوسط ل (DMFT) وللجزء (DS) كان لدى الذين لديهم ضغوط شديدة من مقياس الضغط لبيئة طب الاسنان مع عدم وجود اختلافات معنوية ($P \geq 0.05$). بينما (DMFS, FS, MS) كانت اعلى لدى الذين لديهم ضغط متوسط مع عدم وجود اختلافات معنوية ($P \geq 0.05$).

(0.05). أظهرت نتائج تحليل اللعاب ان تدفق اللعاب كان اعلى لدى مجموعة الضغط القليل من مجموعة الضغط الشديد مع عدم وجود اختلافات معنوية. بينما حمض اليوريك كان اعلى لدى مجموعة الضغط الشديد. تدفق اللعاب كانت علاقته سالبة مع تسوس الاسنان لدى مجموعة الطلاب الذين لديهم ضغوط قليلة والذين لديهم ضغوط شديدة ماعدا علاقة ال DS مع تدفق اللعاب كانت موجبة لدى طلاب الصغظ القليل. علاقة حمض اليوريك مع ال DMFT كانت سالبة لدى طلاب الصغظ القليل, بينما طلاب الصغظ الشديد كانت هذه العلاقة موجبة, مع ذلك كل هذه العلاقات كانت احصائيا غير معنوية.

الاستنتاج: ضغط بيئة طب الاسنان يبدو ان له تأثير على صحة الفم, شوهدت بالانتشار الاعلى لتسوس الاسنان لدى طلاب طب الاسنان الذين لديهم ضغوط متوسطة وشديدة وذلك بتأثيره على المستويات الطبيعية لتدفق اللعاب وحمض اليوريك.
الكلمات المفتاحية: ضغط بيئة طب الاسنان, الصغظ, تسوس الاسنان, تدفق اللعاب, حمض اليوريك.