

Depression Levels in Relation to Oral Hygiene, Gingival Health Status, and Salivary Constituents in a Group of Dental Students: A Cross-Sectional Study

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ABSTRACT

Aim: In this study, the effects of depression on oral hygiene, gingival health conditions, and some salivary components (total protein, magnesium, and calcium) were explored. **Materials and Methods:** A total of 207 dental students aged 20–21 years (third grade) in a College of Dentistry, University of Baghdad, Baghdad, Iraq, were examined. They were distributed into four groups (normal, mild depression, moderate depression, and severe and very severe depression) according to the Patient Health Questionnaire for Depression Scoring. Oral examinations include oral hygiene (dental plaque and calculus) and gingival health status; samples were collected from 90 participants to serve as a sub-sample of the total sample and classified as follows: normal (22), mild depression (24), moderate depression (22), and moderately severe and severe depression (22) groups. Then, saliva samples were analyzed to determine the total protein, magnesium, and calcium. Statistical Package for Social Sciences version 21 was used to analyze the data. **Results:** The mean value of oral hygiene and gingival indices increased significantly with increasing severity of depression. For salivary calcium and magnesium, their values decreased with increasing severity of depression, whereas total protein values increased. Salivary calcium and magnesium were negatively correlated with oral hygiene and the gingival indices, and the highest correlations of total proteins with plaque index, calculus index, and gingival index were positive. **Conclusions:** Depressive feelings were observed in dental students. In reality, depression has a close link with oral hygiene and gingival health status, and normal constituents of saliva could be affected.

KEYWORDS: Dental student, depression, mental health, oral hygiene, salivary variables

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INTRODUCTION

Depression and oral health are complicated in Iraq, like many countries around the world. Bad oral hygiene and bad oral health can lead to low self-esteem and social isolation, common symptoms of depression. On the contrary, in people with depression, oral hygiene can be ignored, leading to oral problems.^[1] Depression has become an important factor in human health, and

a significant increase in young people with depression has occurred in the last decade.^[2,3] Young people can hardly deal with these stress sources,^[4] and depression

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may affect oral health because depressed people do not want to maintain oral hygiene.^[5]

The professional stress experienced by dentists begins during college, and their personal and professional lives are negatively affected.^[6-8] Furthermore, dental students are often exposed to high levels of stress due to their academic curriculum, clinical requirements, and pressure to perform well. Depression influences oral hygiene and access to dental health services, and the relationship between dental students and depression is becoming increasingly concerning.^[9,10]

Psychological disorders through noradrenergic α - and β -adrenoceptors (sympathetic) and muscarinic cholinergic receptors (parasympathetic) can affect the salivary gland that contains their nerve endings, and in response to this produce an organic chemical that can later be found in saliva.^[11] Furthermore, any change that occurs in the components of saliva like protein, electrolyte concentration, flow rate, and pH is related to oral disease (dental caries and periodontal disease).^[12] Magnesium plays an important role in ionic regulation; it regulates calcium ion surge in the calcium neuronal canals. Magnesium levels decrease in many mental disorders, such as depression, and neuronal magnesium requirements cannot be met due to magnesium deficiency.^[13]

Typically, magnesium reduces the inflammation caused by bacterial toxins and prevents periodontal disease. The reduction in magnesium concentrations can be linked to an increase in inflammation responses to the challenges of bacterial bacteria.^[14]

Dentistry is considered a source of stress for dental students and requires a great deal of adoption because it is a mixture of knowledge, skills, and persistence that can harm student's mental and physical health, as university students are young adults who will become an important part of society and should, therefore, monitor their mental state.^[15] Many studies have addressed depression in the population, but their relationship to oral health is lacking. Therefore, this study was conducted to estimate the effect of the level of depression on oral hygiene, gingival health status, and some salivary components (total protein, magnesium, and calcium) in dental students experiencing different levels of depression and to identify the relationship between these variables.

MATERIALS AND METHODS

This is a cross-sectional study (observational study). Dental students of both sexes were from the third class and aged 20–21 years (age was determined according to the last birthday^[16] at the College of Dentistry,

University of Baghdad, Baghdad, Iraq, participated in this study. All dental students were examined at the Department of Paediatric and Preventive Dentistry of the same university. An ethical approval (reference no. 655; project no: 655322; date, September 13, 2022) was obtained before the study from the scientific institutional ethics committee of Dentistry, University of Baghdad (Chairman, Prof. Dr. Salwan Y. Bede). The study project protocol was approved by the scientific committee of the Pedodontic and Preventive Department of the university.

INTERVIEWING OF STUDENTS

The purpose of the study was explained by the researcher to the students, who were then invited to participate in the present study. A total of 207 dental students (the dental students of the third grade) agreed to participate and, then, signed their consent forms. The inclusion criteria include all students who agreed to participate and met the criteria in this study. Students who were suffering from any systemic disease, pregnant, lactating, taking hormonal supplements, wearing orthodontic appliances, and smokers were not included in this study and represented the exclusion criteria. Then, each participant was asked to complete the Patient Health Questionnaire for Depression Scoring (PHQ-9) to evaluate their level of depression.

SAMPLING, METHODS, AND CRITERIA

A total of 207 dental students represented the total sample. Only 90 students met the study requirements. The 90 dental students were classified according to their levels of depression in PHQ-9 into the following groups: the normal (22), mild depression group (24), moderate depression group (22), and severe and very severe depression group (22). After that, the students were orally examined to estimate oral hygiene^[17] for plaque index (PLI), Ramfjord index,^[18] and calculus component of periodontal disease index) for calculus (CaI). The gingival index (GI)^[19] was used to evaluate gingival health status and saliva sample collection. No pilot study was conducted because of the time limitations.

SAMPLE SIZE

G power 3.0.10 (a program written by Franz-Faul, Universitat Kiel, Germany) was used, and the study power was 85%, the alpha error of probability was 0.05 (two-sided), and the effect size of F was 0.4 (large effect size). Four groups were studied. All these conditions required a sample size of 84, and thus 90 subjects were enough for this study and more calculated than the G power. The effect sizes were as follows: small = 0.1, medium = 0.25, and large = 0.4.^[20]

QUESTIONNAIRE METHOD

PHQ-9 is a 9-item tool used as a depression assessment tool for the past 2 weeks^[21] and it was recorded for all participants and students utilizing a self-recorded questionnaire, which was allocated for this purpose. It is a validated tool with an average sensitivity of 0.77 and a specificity of 0.94. The questionnaire assesses how often a subject is disturbed by any of the nine items 2 weeks before he or she answers the questionnaire. The total score ranges from 0 to 27 (scores 5–9 are classified as mild depression; 10–14 as moderate depression; 15–19 as moderately severe depression; and ≥ 20 as severe depression).^[22]

METHOD OF SALIVA COLLECTION

Saliva samples were collected in the morning (9:30–11:30 AM). Unstimulated salivary samples were collected according to the standard guidelines of Navazesh and Kumar.^[23] Each student sits on the dental chair of the teaching clinic. First, the mouth was rinsed with a cup of distilled water. After 5 min of relaxation with small movements, an unstimulated salivary sample was collected. The head slid forward and the mouth remained open to allow drooling to the numbered and sterilized graduated tube. A serial number for the questionnaire identification was provided to each student. The students were asked to rapidly collect saliva with the tubes. It was stored in a cooler box; then, sent to the laboratory; and centrifuged for 10 min at 3000 rpm (revolution per minute); thereafter, a micropipette was used to separate the obtained supernatant and then deep freeze (-20°C) for biochemical analysis. Total protein determination (mg/dL) was performed using a colorimetric method; a kit was used (Lab Kit, Nau J, Spain). A colored complex formed by the reaction of protein in an acid solution containing pyrogallol red and molybdate. The intensity of the color was proportionate to the protein concentration in the

study sample.^[24] Biochemical analysis was performed on magnesium (Mg) and calcium (Ca) with a flame atomic absorption spectrophotometer (Buck Scientific, 210VGP, USA) and standard procedures.

The author followed the exclusion criteria to compensate for the effects of confounding factors on depression level and saliva. No bias in the sample was observed.

STATISTICAL ANALYSIS

Statistical Package for the Social Sciences (version 22, Chicago, IL, USA) was used. Frequency, percentage, mean, and standard error (SE), cluster graph bar, and inferential statistics were determined using the Shapiro–Wilk test, Fisher’s exact test, one-way analysis of variance, Levene test, Games–Howell, Hochberg GT2 *post hoc* tests, and Pearson correlation test. The *P* value was set at 0.05.

RESULTS

Table 1 reveals that oral hygiene (plaque and calculus) and gingival health indices increased significantly with the severity of depression. The results also revealed that salivary calcium and magnesium levels decreased with increasing severity of depression, whereas salivary total protein values increased with increasing severity of depression. Significant differences were found among the levels of severity of depression, as shown in Table 2. The correlation between salivary calcium and magnesium levels in each depression level was positively weak and not significant, except in moderate severity, which had a positive significant correlation. The correlations of salivary calcium and magnesium levels were negatively weak and not significant, except in mild cases with salivary calcium and the last grade of depression with salivary magnesium. Calcium at a mild level and magnesium at a moderately severe and severe level indicated negative weak and significant correlations when correlated with salivary total protein [Table 3].

Table 1: Descriptive and statistical test of PLI, CaII, and GI in depression severity

	Severity	Mean	\pm SE	<i>F</i>	<i>P</i> value
PLI	Normal	0.65	0.14	11.94	0.0000*
	Mild	0.66	0.05		
	Moderate	1.06	0.08		
	Moderately severe and severe	1.25	0.09		
CaII	Normal	0.11	0.06	6.93	0.0003*
	Mild	0.14	0.03		
	Moderate	0.29	0.05		
	Moderately severe and severe	0.41	0.07		
GI	Normal	0.51	0.11	4.45	0.006*
	Mild	0.52	0.06		
	Moderate	0.78	0.09		
	Moderately severe and severe	0.94	0.14		

SE = standard error, *F* = Fisher’s exact test.

*Significant at $P < 0.05$

Table 2: Descriptive and statistical test of salivary calcium, salivary magnesium, and salivary total protein among depression severity

		Mean	±SE	F	P value
Ca (mmol/L)	Normal	3.78	0.15	15.16	0.000*
	Mild	2.75	0.08		
	Moderate	2.45	0.18		
	Moderately severe and severe	2.27	0.16		
Mg (mmol/L)	Normal	0.97	0.09	32.53	0.000*
	Mild	0.59	0.01		
	Moderate	0.56	0.02		
	Moderately severe and severe	0.54	0.02		
Total protein	Normal	0.16	0.06	8.62	0.000*
	Mild	0.24	0.02		
	Moderate	0.33	0.03		
	Moderately severe and severe	0.39	0.04		

SE = standard error, F = Fisher's exact test,

*P ≤ 0.05 (significant)

Table 3: Correlation between salivary calcium, salivary magnesium, and salivary total protein among depression severity

Depression		Mg		Total protein	
		r	P value	r	P value
Normal	Ca	0.10	0.771	-0.03	0.929
	Mg			-0.51	0.112
Mild	Ca	0.11	0.485	-0.40	0.009
	Mg			-0.04	0.785
Moderate	Ca	0.61	0.048	-0.05	0.896
	Mg			-0.03	0.934
Moderately Severe & severe	Ca	0.24	0.232	-0.18	0.371
	Mg			-0.40	0.044

r = coefficient correlation spearman; *P ≤ 0.05 (significant)

No significant and weakly negative correlations were found among salivary calcium, salivary magnesium, PLI, CaII, and GI at different levels of severity of depression, except in last grade, salivary magnesium level had a negative and significant correlation with GI, whereas most of the correlations of salivary total protein with PLI, CaII, and GI were positively weak and not significant, except in the moderate grade, which showed a positive and significant correlation [Table 4].

DISCUSSION

One of the most important psychological disorders observed among university students is depression, which is not uncommon among dental students, although it appears later in their lives.^[10] The relationship between psychological conditions and oral health must be taken into account. Minimum psychological depression and stress can affect the defensive components of saliva and oral health. Data from the study show that oral hygiene and gingival inflammation increase significantly with the severity of depression ($P = 0.05$). These results are consistent with many studies.^[25,26] Depression can affect normal life to some extent, and oral health

harms self-care behavior. Therefore, depression may affect oral health.^[27] The correlation between oral health and depression can be interpreted with several behavioral and biological mechanisms (neglect of oral hygiene, cariogenic nutrition, and avoidance of necessary dental care). The increase in severity of depression is associated with oral hygiene, which is affected by a decrease in salivary secretion and an increase in bacterial counts, such as the *Lactobacillus* spp.^[28] The results of this study revealed that salivary calcium and magnesium levels decreased significantly with increasing depression severity ($P < 0.05$), whereas the salivary total protein increased significantly with increasing severity of depression severity ($P < 0.05$), these results were in agreement with Al-Nuaimy *et al.*^[29] they expressed that salivary total protein level increased with increased stress level, another study proposed that parasympathetic stimulation produces abundant saliva with a low concentration of protein while sympathetic stimulation produces little saliva but a high concentration of protein and this confirmed our results.^[30] In addition, calcium is one of the most important inorganic components of salivary saliva, and magnesium is involved in pathology in some psychological disorders including affective

Table 4: Correlation among salivary calcium, salivary magnesium, salivary total protein with oral hygiene, and gingival health indices at different levels of depression severity

Depression		PLI		CaII		GI	
		r	P value	r	P value	r	P value
Normal	Ca	-0.29	0.383	-0.28	0.406	-0.55	0.079
	Mg	-0.04	0.918	0.16	0.638	-0.58	0.061
	Total protein	0.11	0.752	-0.09	0.794	0.50	0.115
Mild	Ca	-0.20	0.201	-0.15	0.351	-0.01	0.945
	Mg	-0.07	0.670	-0.19	0.222	-0.23	0.153
	Total protein	0.04	0.788	0.24	0.119	0.15	0.345
Moderate	Ca	-0.41	0.211	-0.25	0.455	-0.06	0.856
	Mg	-0.01	0.968	-0.15	0.660	-0.24	0.477
	Total protein	0.33	0.328	0.13	0.701	0.62	0.041
Moderately severe and severe	Ca	-0.06	0.784	-0.16	0.450	-0.17	0.399
	Mg	-0.05	0.820	-0.14	0.501	-0.50	0.009
	Total protein	0.05	0.816	0.09	0.678	0.04	0.837

disorders, such as depression. Magnesium plays a role in many processes associated with mood control, such as protein synthesis, hormone regulation, enzyme activation, and reduction of oxidation in neurotransmitters.^[31] The *N*-methyl-D-aspartate receptor magnesium serves as a blockade in calcium channels. It must be removed for the activation of glutamatergic excitatory signaling, and a low magnesium level is a potential risk that induces glutamatergic excitation, which contributes to psychiatric symptoms and leads to depression.^[22] In addition, the results of the study showed that a negative low correlation was observed between the total protein of saliva in the last stage of depression and the total protein of saliva magnesium ($P = 0.05$), which may be due to the increase in the total protein level in response to psychological status.^[32] The results of this study found that the correlation between saliva variables (calcium and magnesium) and the dental index of severity of depression was mostly negative ($P > 0.05$), except for the final grade, the level of saliva magnesium was negative and significantly associated with GI ($P > 0.05$) and that any decrease in magnesium concentration is related to increased response to the inflammation of bacterial challenges,^[33] and the correlation between total saliva proteins and the dental index was mostly positive, stress and depression being related to high concentrations of catecholamine.^[34] This can be attributed to psychological reactions and increases in the total saliva protein level. These effects increase the viscosity and reduce the amount of saliva, thus inhibiting the action of saliva cleansing.^[35,36]

LIMITATIONS

The results of this study cannot be generalized to all dental students in all colleges of dentistry; this is because of the small sample size of this study in one college of dentistry, lack of baseline data about their mental status, and oral

health, which should be examined at the time of dental students' induction. There is a possible recall bias for the outcomes of the questionnaire (self-reported by dental students). Further articles recommended the longitudinal correlation between depression and oral health would be important in determining this association.

CONCLUSION

The findings of this research revealed that oral hygiene and gingival inflammation increase with increasing severity of depression, which has a pernicious effect on different salivary variables. Changes in saliva variables were found between mild or moderate and severe levels of depression. It is important to focus attention on these students, especially those who are more vulnerable to higher levels of depression, by providing supporting programs and implementing preventive measures.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

AUTHORS CONTRIBUTIONS

Each authors have contributed equally and finally confirmed and given approval for publication. Alhan Ahmed Qasim conceived the manuscript concept, design, collection of data, writing, interpretation, critical revision and gave final version approval.

ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT

The study project protocol was approved by the scientific committee of the Pedodontic and Preventive Department, then an ethical approval (reference 6 no. 655; project no: 655322; date, September 13, 2022)

was obtained from the scientific institutional ethics committee college of Dentistry, University of Baghdad (Chairman, Prof. Dr. Salwan Y. Bede).

PATIENT DECLARATION OF CONSENT

The author certify that informed consent were taken from each participants prior to perform the study.

DATA AVAILABILITY STATEMENT

The data of this study are available and can be obtained by contacting the Corresponding author.

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