ORIGINAL ARTICLE

Correlation of cheek biting with stress and salivary cortisol in final-year dentistry students: a cross-sectional study

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Received: 02 October 2024
Revised: 30 October 2024
Accepted: 20 November 2024
Published: 30 November 2024
DOI: 10.24198/pjd.vol36no3.58218

p-ISSN 1979-0201
e-ISSN 2549-6212

Citation:
Sabirin, IPR;. Safira, R; Mentari,DG, Sulaksana, SD. Correlation of cheek biting with stress and salivary cortisol in final year dentistry students of Universitas Jenderal Achmad Yani: a cross-sectional study. Padj J Dent, November. 2024; 36(3): 363-371.

ABSTRACT

Introduction: Stress is a situation that can feel self-threatening, arising from stressors that exceed the body's ability to cope. Final-year students are particularly vulnerable to stress as they face the pressure of completing their theses. Cheek biting is recognized as a coping mechanism for psychological stress, which is why it is often associated with stress. The purpose of this study is to analyze the correlation between stress levels and the occurrence of cheek biting in final-year students. **Methods:** This research was an observational study with a cross-sectional approach. The research subjects were final-year students who were completing their theses. The sample size was determined using the correlation sample size formula and employed total sampling, including 40 respondents based on the inclusion criteria. A perceived stress score (PSS-10) questionnaire, salivary cortisol examination, and cheek biting assessment were conducted for all respondents. **Results:** PSS-10 examination results revealed that five students had a low stress level, 29 students had a moderate stress level, and six students had high levels of psychological stress. The Spearman correlation coefficient between stress perception and cheek biting incidents was 0.638, which indicated a strong relationship and was statistically significant (p-value=0.001). However, salivary cortisol examination of ten respondents with cheek biting showed only slightly higher levels than the control group, and the Mann-Whitney test showed no significant differences. **Conclusion:** There was a moderate correlation between perceived stress levels and the occurrence of cheek biting in the final-year dentistry students in the Faculty of Dentistry, Jendral Ahmad Yani University, Indonesia. However, there was no difference in salivary cortisol level when compared to students without cheek biting.

KEYWORDS

Cheek biting, PSS-10 questionnaire, salivary cortisol, stress

INTRODUCTION

Psychological stress is how the body responds to any real or perceived threat that increases physiological and psychological activity to cope with the stressor. according to McEwen and Akil. Stress response basically has an adaptive function that can help to overcome and reduce the negative effects of stressors, but it can

cause imbalances in the body. This situation can be experienced by students who are completing their final projects or theses.[1,2]

Previous research.[2,3] has stated that final-year students are more stressed compared to first-year students because of the long syllabus, tight schedules, and final project load, which is a requirement for graduation. They are also more prone to anxiety and depression.[4] Psychological stress has a great impact on physical and emotional conditions such as fatigue, weakness, headaches, eating disorders, aches, irritability, crying, moodiness, and frustration.[5] Additionally, stress can also affect the stomatognathic system, one of which is the habit of biting their inner cheek as a way to reduce stress unconsciously.[6-8]

Cheek biting is an irritation or injury to the buccal mucosa. Cheek biting can be caused by temporomandibular joint (TMJ) abnormalities, tooth fractures, eruptions of wisdom teeth, and the use of ortho instruments, but it is often found also in individuals who are stressed and anxious. High stress levels can cause various problems that occur in the oral cavity, one of which is cheek biting. Behaviors such as biting nails, clenching teeth, and chewing on objects, as well as cheek biting, are seen as ways to relieve emotional stress.[9-12]

The prevalence of cheek biting for stress and mental disorders has been reported to increase from year to year, with a male-to-female ratio of 1:3.[13] Final-year students at the Faculty of Dentistry, Jendral Ahmad Yani University (Unjani), Indonesia, represent a group particularly vulnerable to stress due to the academic demands and pressure of completing their final projects. As a result of this obligation, those students often experience high levels of stress and, consequently, elevated cortisol levels. One measurable biomarker of stress is the cortisol hormone, which is secreted from the adrenal glands into saliva through diffusion.[14,15]

The combination of cheek biting as a stress biomarker and the focus on final-year dentistry students has not been previously assessed, so there is potential for practical stress management in this group. Thus, this study aimed to analyze the correlation between stress levels with the occurrence of cheek biting and salivary cortisol in these students.

METHODS

This study employed a cross-sectional correlational approach to determine the association between cheek biting, perceived stress, and salivary cortisol level. The research quantitatively analyzed the association between cheek biting and stress levels among dentistry students at Unjani. A total sampling method was employed, including final-year students who met the inclusion and exclusion criteria, resulting in a sample of 40 respondents.

In this study, the instrument employed was the PSS-10 questionnaire. The questionnaire has been validated according to Indira et al. with a reliability coefficient or α value of 0.822.[16] The PSS-10 questionnaire consists of 10 items designed to evaluate individuals' perceptions of their level of difficulty, pressure, and ability to manage stress. Each item on this questionnaire relates to emotional and physical experiences related to stress, such as feelings of depression or anxiety.

The use of PSS-10 is particularly beneficial in the context of dentistry in public health or assessing individual well-being related to their dental health, as it provides insight into a person's response to challenges in their life. The scores obtained from this questionnaire can help in identifying individuals who are at risk of experiencing excessive stress so that appropriate psychological follow-up can then be carried out.[16-18]

Other instruments used in the study include informed consent sheets, mouth glasses, trays, mouth cups, containers for saliva, pencils, erasers, mobile phones with cameras, gloves, masks, microtiter plates, micropipettes, incubators, washing stations, plate readers, and pipette tips. The research materials were 70% alcohol, tissues, drinking water for gargling, sterile gauze, aquadest, an ELISA cortisol kit, and antiseptic liquid hand soap.

Respondents who used orthodontic devices, wore dentures, experienced tooth fractures, had third molar eruptions to buccal, had TMJ abnormalities, had smoking habits, had systemic diseases, or had a history of long-term medications were excluded from this study. During the examination, participants were seated according to the established criteria and were first instructed to complete the informed consent form, followed by the PSS-10 questionnaire.[17]. Subsequently, the right and left buccal mucosa were examined to observe for any signs of cheek biting. The condition of the buccal mucosa was documented using a smartphone camera. Respondents with a diagnosis of cheek biting were selected for subsequent saliva tests.

Saliva was collected using the passive drooling method without stimulation on the following day between 9:00 and 11:00 a.m. Respondents were instructed to sit comfortably with their backs upright, their heads lowered, and one hand holding the saliva container. During saliva collection, respondents were not allowed to speak, move their tongues, or make swallowing movements. When collected, the saliva must be in a clear state, and if there was any leftover food, blood, or mucus, the saliva was collected once more until clear saliva was obtained. Saliva collection was carried out until the saliva was gathered in the measuring cup, approximately as much as 5 ml.[17] The collected saliva was analyzed using a cortisol saliva kit from ELK Biotechnology and tested using the ELISA method at the Microbiology Laboratory of the Unjani Medical Faculty.

Statistical tests were carried out to assess the association between stress and cheek biting, as well as between cheek biting and salivary cortisol levels. The Spearman rank correlation test was carried out to analyze the correlation between stress and cheek biting, whilst the Mann-Whitney test was used to analyze if there was a relationship between cortisol levels and cheek biting in research subjects with a diagnosis of cheek biting. Ethical approval for the study was granted by the local ethical committee, and informed consent was obtained from all respondents.

RESULTS

The PSS-10 questionnaire was distributed to 40 final-year students at the Faculty of Dentistry, Unjani, which consisted of 15 males and 25 females in the age group of 21, 22, and 23 years old (Table 1).

Table 1. Characteristics of respondents

Characteristics	Amount	Percent
Sex		
Male	15	37.5
Female	25	62.5
Age (year)		
21	28	70
22	11	27.5
23	1	2.5
Total	**40**	**100**

The results show that among all respondents, 29 individuals (72.5%) exhibited moderate stress levels, 5 individuals (12.5%) had low stress levels, and 6 students (15.0%) experienced high stress levels. The results of the PSS-10 questionnaire (Table 2) conducted on 40 students revealed that the most frequently answered questions by respondents about the state of stress were at least three things, including "Over the past month, how often have you been upset because of something unexpected?" which was answered very often by 22.5% of respondents. Additionally, 37.5% of respondents answered "quite often" to the question "Over the past month, how often have you felt like you have lost control of the important

things in your life?" and 42.5% of students reported rarely being able to control "irritability in your life." In conclusion, moderate stress levels were more common among students than low or high stress levels.

Table 2. Stress questions and answers distribution (% of answers)

Questions	Never (0)	Almost never (1)	Sometimes (2)	Fairly often (3)	Very often (4)
In the past month, how often have you been upset because of something that happened unexpectedly?	7.5	37.5	12.5	20	22.5
In the past month, how often have you felt that you were unable to control the important things in your life?	12.5	35	12.5	37.5	2.5
In the past month, how often have you felt nervous and "stressed"?	5	17.5	35	25	17.5
In the past month, how often have you felt confident about your ability to handle your personal problems?	12.5	32.5	37.5	15	2.5
In the past month, how often have you felt that things were going your way?	12.5	30	42.5	12.5	2.5
In the past month, how often have you found that you could not cope with all the things that you had to do?	5	27.5	27.5	30	10
In the past month, how often have you been able to control irritations in your life?	20	42.5	17.5	17.5	2.5
In the past month, how often have you felt that you were on top of things?	20	40	27.5	12.5	0
In the past month, how often have you been angered because of things that were outside of your control?	7.5	30	40	12.5	10
In the past month, how often have you felt difficulties were piling up so high that you could not overcome them?	7.5	45	30	12.5	5

Of the 40 respondents who were examined for their buccal mucosa clinical condition, 10 people experienced cheek biting (Table 3). Among these 10, six reported high stress levels, while four perceived moderate stress. None of the students with cheek biting reported mild stress.

Table 3. Correlation between cheek biting and stress level

		Stress level			Cheek biting			
Sex		**Low**	**Moderate**	**High**	**Yes**	**No**	**p-value**	**r**
Male	15	3	10	2	2	13	0.001**	0.638
Female	25	2	19	4	8	17		
Total	40	5	29	6	10	30		

**significant with Spearman rank correlation test ($p<0.05$)

The results of saliva cortisol examination using the ELISA method followed by the Mann-Whitney test, from 10 students who experienced cheek biting, showed no significant difference compared to the saliva of students without cheek biting. This may be due to the fact that the control group, although not diagnosed with cheek biting, consisted of student respondents who all reported stress according to the questionnaire.

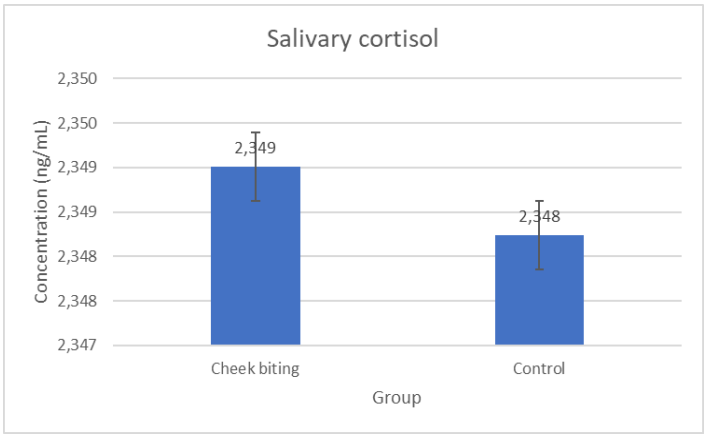

Figure 1. Mean salivary cortisol levels in the cheek biting and control groups. *Denotes that the Mann-Whitney test showed the result was not significant, with p=0.242 (p<0.05 is considered significant)

DISCUSSION

Stress can be described as a feeling of pressure or tension that weighs heavily on an individual. Psychological stress refers to a state of mental strain caused by challenging and harmful situations. When the body responds to psychological stress, it undergoes physical changes triggered by hormones. One key hormone produced during stress is cortisol, which is released by the adrenal medulla. Cortisol is linked to various physical effects of stress, including muscle tension and heart palpitations. If stress becomes chronic, it can lead to immunosuppression. The release of cortisol is initiated by the hypothalamic-pituitary-adrenal (HPA) axis. This process starts with the hypothalamus secreting corticotropin-releasing hormone (CRH), which stimulates the anterior pituitary gland to produce adrenocorticotropic hormone (ACTH). In turn, ACTH prompts the adrenal glands to release cortisol.[6,21,22]

The Perceived Stress Scale (PSS-10) is a questionnaire developed by Sheldon Cohen et al. in 1983 for measuring psychological stress. It was designed to measure the circumstances in an individual's life that were considered stressful. The scale comprises ten general questions, each rated on a five-point scale ranging from 0 to 4, with response options of never, almost never, sometimes, fairly often, and very often.

The results of this questionnaire were considered valid for four to eight weeks after respondents completed the survey (Table 2). Initially, the PSS-10 was developed in English, but because it has been proven valid in measuring stress levels, this questionnaire was developed and translated into foreign languages, including Indonesian. The translation was carried out carefully to maintain the meaning of each item and remain relevant to the local stress context. To maintain accuracy and representativeness, both direct translation and back-translation methods were employed. This study employed the Indonesian version of the PSS-10, based on research conducted by Indira at Immanuel in 2021.[16,18,19]

Final-year students working on a minor thesis face various challenges that can eventually cause stress. These include difficulty managing important aspects of their lives, lack of motivation, frequent distractions that lead to prioritizing leisure activities over studying, and spending more time on social media than on reading journals or textbooks necessary for thesis preparation. According to Owczarek et al. in 2020, dental students experience significantly higher stress levels than students in other fields, including medicine.[7,8,21] During the thesis completion process, students encounter several perceived obstacles, such as difficulties in selecting research ideas or topics, insufficient funding for research, excessive manuscript revisions, delays in research ethics approval, limited availability of supervisors, and slow feedback from advisors. These factors, particularly when combined with a lack

of motivation to learn, can leave students feeling burdened, anxious, and stressed.[23,24]

The increase in stress levels can vary from person to person depending on factors such as their coping mechanisms, gender, family background, extracurricular activities, financial situation, leisure habits, self-esteem, study motivation, coping style, and social skills.[7,25] Previous study by James[26] states that individuals respond to stimuli in varied ways, and not all tension-inducing situations are perceived as stress due to differences in coping mechanisms. The stress experienced by students, especially those who respond to life events negatively, can lead to a decrease in quality of life, such as depression, insomnia, or anxiety.[7,27]

Among the 40 students, 10 were diagnosed with cheek biting. There were no differences between the salivary cortisol levels of students diagnosed with cheek biting and those without cheek biting (Table 3). A prior study by Kadhim et al. in 2021 on cortisol levels of patients with cheek biting showed a highly significant difference between the case group of cheek biting with stress and the control group of volunteers without stress.[28] The difference with this study was that both groups had a perception of stress, whether they suffered from cheek biting or not. This was likely because during the saliva examination, the control group consisted of final-year students who, despite not exhibiting cheek biting, acknowledged experiencing stress according to the questionnaire. These findings suggest that cortisol levels are more closely associated with stress[22], although not all young adults experiencing stress develop clinically observable habits such as cheek biting.

This result aligns partially with research by Artika, Ossa, and Chang on the relationship between stress, anxiety, and chronic habitual biting of the oral mucosa.[13,24,29] According to a study by Graves in 2021, females experience stress more often than men and are considered more susceptible to constant stress.[30] Conversely, in another study conducted by Gao in 2020[31] using the DASS-21 questionnaire, it was found that there was no difference between stress levels in male and female students. However, the study revealed that males were more prone to depression, while females experienced higher levels of anxiety.

The difference in perceived stress in males and females is also inextricable from the role of sex hormones, where the initiation of HPA in females is related to the estrogen and progesterone hormones. During the luteal phase of the menstrual cycle, an increase in estrogen is associated with a decrease in basal cortisol levels, while stress-induced cortisol levels are elevated.[21,32] Another difference is that the coping mechanism in females leads to emotional ones while males do problem-focused coping.[30,31]

The average age of final-year students is 21 years, which also affects the level of stress (Table 1). Final-year students working on their theses are typically between 18 and 25 years old, a period marking the transition from adolescence to early adulthood. This transition requires them to take responsibility for their own lives, presenting challenges that make them more susceptible to stress.[31] Previous research states that the age range of undergraduate students, in general, is prone to age-related stress, often feeling dissatisfied with how they manage their time and financial resources. They also experience pressure from the responsibility of making decisions about their future lives and careers and are more likely to adopt ineffective coping mechanisms, such as consuming alcohol or isolating themselves.[33,34]

Cheek biting, or morsicatio buccarum, is a condition that often occurs in individuals who experience stress. Previous studies have identified the diagnosis of cheek biting based on the presence of a history of self-inflicted chronic trauma on the superficial surface of the cheek. This trauma manifests on the buccal mucosa as an uneven, diffuse hyperkeratotic lesion accompanied by areas of erythema.[13,35] Cheek biting occurs equivalently in all genders, occurring in 3.05% of normal adults and 0.97% of normal adolescents and children,[35] and specifically among persons in the 15-19 age group (1.77%), and 20-24 age group (1.20%). In this study, subjects who experienced cheek biting were among the second highest incidence, according to Chang.[29]

Chronic trauma due to the habit of biting the lips and cheeks in cheek biting causes the superficial epithelial layer to be damaged. The histopathological findings of this condition reveal parakeratosis, hyperplastic epithelium with irregular arrangement, and ballooned epithelial cells in the upper layers. Cytological smears also detect parakeratotic cells and bacteria but no fungi.[36] As a form of keratosis, cheek biting differs from Linea Alba, which is a horizontal and white plaque within the buccal mucosa parallel to the occlusal plane. Leukoplakia, chemical keratosis, white sponge nevus, lichen planus, hairy leukoplakia, and leukoedema are also differential diagnoses of cheek biting. Ulcers caused by cheek biting must be differentiated from malignant lesions, which rarely occur symmetrically and do not cease following treatment by removal of the etiological factor-unlike cheek biting due to traumatic and habitual cheek-biting injury.[36-38]

As mentioned earlier, stress and increased cortisol hormone levels are closely related. An approach to test cortisol levels in the human body is using saliva. Salivary cortisol has become a standard biomarker in measuring stress levels in biology and psychology.[14,21,39,40] Some people who experience psychological stress may suffer from unconscious oral habits such as biting or sucking their lips or cheeks. These habits are generally not permanent, varying with an individual's psychological stress levels, and are not dangerous.

The activity of biting the lip or cheek is considered one way to divert oneself from the pressure established in the body. Because these habits are related to tense muscles and are practiced continuously, they often cause lesions in the oral mucosal tissue, which, if not treated, may interfere with oral function and occlusion. Psychological factors are the main etiology of cheek biting; therefore, initial treatment should focus on finding solutions to reduce existing stress problems through coping mechanism programs and stress management strategies. In certain circumstances, protective appliances can be given to safeguard the cheeks from trauma.[10,24,37,41]

Future research should aim to include samples from individuals who do not perceive stress to obtain salivary cortisol results with more discrepancies. The limitation of this study was the lack of differentiation in the control group compared to the case group during saliva analysis, as the control group consisted of respondents who also perceived stress, despite the absence of cheek biting on their buccal mucosa.

CONCLUSION

There is a moderate correlation between the stress experienced and cheek biting in final-year dentistry students. However, the salivary cortisol level examination showed that even though students experience varying levels of stress, not all stress conditions result in cheek biting. It implies that although stress may be a contributing factor to coping mechanisms such as cheek biting, individual responses to stress vary, and not all students with elevated stress levels develop this behavior. Therefore, interventions to manage stress in dentistry education should consider these individual differences, since not all students may exhibit physical manifestations of stress, such as cheek biting.

Acknowledgement

The writer would like to thank dr. D Widhiastuti from Biofarma, Bandung, for her assistance in the ELISA testing examination.

Author Contributions: Conceptualization, I.P.R.S. and R.S.; methodology, I.P.R.S. and D.G.M; software, I.P.R.S. and D.G.M.; validation, I.P.R.S., R.S., S.D.S.; formal analysis, I.P.R.S.; investigation, I.P.R.S., D.G.M.; resources, I.P.R.S., D.G.M.; data curation, I.P.R.S., D.G.M.; writing original draft preparation, I.P.R.S.; writing review and editing, I.P.R.S., R.S., S.D.S.; visualization, I.P.R.S.; supervision, I.P.R.S., S.D.S.; project administration, I.P.R.S., S.D.S., D.G.M.; funding acquisition, I.P.R.S. All authors have read and agreed to the published version of the manuscript.

Funding: Universitas Jenderal Achmad Yani, Cimahi

Institutional Review Board Statement: The study protocol was approved by the Ethical Committee of the Faculty of Medicine, Padjadjaran University, under reference number 1428/UN6. KEP/EC/2023.
Informed Consent Statement: Written informed consent has been obtained from the patient(s) to publish this paper
Data Availability Statement: Data are available on valid request by contacting the corresponding author.
Conflicts of Interest: The authors declare no conflict of interest.

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