e-ISSN: 2637-0611

Available online at
https://myjms.mohe.gov.my/index.php/corals

Compendium of Oral Science 11(1) 2024, 89 – 102

Compendium of Oral Science

Academic Stress contributes to Temporomandibular Joint Disorders (TMDs) among Dental Students of the Universiti Teknologi MARA Malaysia, not the Social Stress: An Institutional Study

Nik Mohd Mazuan Nik Mohd Rosdy[1], Farlyana Alia Azizan[2], Halimah Mohd Nasaruddin[1], Khairil Anuar Md. Isa[2], Jamil Ahsan Kazi[1*]

[1]*Faculty of Dentistry, Universiti Teknologi MARA Sungai Buloh Campus, Jalan Hospital, 47000 Sungai Buloh, Selangor*
[2]*Faculty of Health Sciences, Universiti Tekonologi MARA Puncak Alam Campus, 42300 Bandar Puncak Alam, Selangor*

ARTICLE INFO

Article history:
Received 12 February 2023
Revised 22 May 2023
Accepted 25 July 2023
Online first
Published 01 March 2024

Keywords:
Temporomandibular disorders
Social stress
Academic Stress
Dental students

DOI:
10.24191/cos.v11i1.26042

ABSTRACT

Objectives: The objectives of this study were to determine the prevalence of TMD in dental students in Universiti Teknologi MARA, and to identify risk factors that may contribute (social vs academic) to TMD in dental students.

Methods: In a cross-sectional study, 202 dental undergraduate students, aged 19 to 25 years from year 1 to year 5 were recruited in our study. The respondents have undergone an assessment using a Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) and Dental Environment Stress (DES) questionnaires. TMD was diagnosed by using RDC/TMD axis I and II. The DES questionnaire was based on five-point Likert scale, from a range of not pertinent to very stressful. Stress scores were measured from seven stressor domains. Statistical analysis was performed using Fisher-exact test using SPSS 20.0. Significance level was set at $P \leq 0.05$.

Result: 13.3% of the students were diagnosed with TMD, The higher prevalence of TMD was detected among female students. Present study demonstrated that academic stress is significantly higher than social stress among all dental students. Among the domains in the academic stress, performance pressure found to be the highest to effect the students.

Conclusion: The significant association between TMD and academic stress observed in our present study warrants further investigation to examine the underlying molecular mechanism of academic stress in TMD initiation and progression.

[1*] Corresponding author. *E-mail address*: *kazi@uitm.edu.my*

INTRODUCTION

Temporomandibular disorders (TMD)

Temporomandibular disorders (TMD) comprise of a group of musculoskeletal disorders that affect alterations in the structure and/or function of one or more of the following: temporomandibular joints (TMJ), masticatory muscles, the dentition and its supporting structures, and the complex neuromuscular system related to TMJ can coexist with other musculoskeletal disorders within the head and neck area (Cooper et al., 2011).

Temporomandibular disorders generally divided into three groups, representing muscle diagnoses/myofascial pain (also known as myofascial pain syndrome); disc displacements; and arthralgia, arthritis and arthrosis. The pathophysiology of temporomandibular disorders is unknown (Wheeler, 1998). The aetiology of TMD is considered multifactorial and may be viewed in the light of contributing factors. These factors can be divided into predisposing, initiating, and perpetuating factors. Predisposing factors may increase the risk of developing a condition; initiating factors may cause the onset or incidence of the condition; while perpetuating factors may contribute to the maintenance or persistence of the condition in focus (DeBoever et al., 1994; Okeson et al., 1996). As a complementary hypothesis, pain and dysfunction in TMJ and jaw muscles may be regarded as an outcome of the load subjected to these structures in relation to the tissues' capacity to adapt to or restrain the load (Stegenga et al., 2006; Wänman et al., 1991).

Stress

Stress is defined as ''pressure or worry caused by problems in somebody's life'' (Hornby et al., 2010). Stress is also a subjective sensation with a varied degree of perception (Lefcourt et al., 1989). Stress includes a wide range of strong external stimuli, both physiological and psychological, which can cause a physiological response called the general adaptation syndrome, first described in 1936 by Hans Selye in the Nature Journal.

The transition from Eustress (curative stress or positive form of stress) to distress (having negative implications) occurs when the demands exceed the personal and social resources the individual can mobilize (Selye et al., 1956).

Symptoms of distress include anxiety, depression, phobia, hostility, fear and tension, as well as physical complaints such as sleeplessness, fatigue, dizziness tachycardia, and gastrointestinal system distress (Rajab et al., 2011). This stress can result in which in turn can affect the well-being and performance of the student (Cecchini et al.,1987); (Westerman et al., 1986). In general, anxiety is reported to be predictive of reduced performance (Sanders et al., 2002). Further, stress is influenced by the person's system of beliefs and attitudes (Kumar et al., 2009). These self-cognitions mediate the perceived stressors and consequent behavior, resulting in either positive or negative consequences (Rajab et al., 2011).

https://doi.org/10.24191/cos.v11i1.26042

Undergraduate Dental Students

The stressful nature of dental education or curriculum starts early as dental students are expected to acquire a sound of knowledge and a variety of skills to help them succeed in their studies, and also in their future careers (Polychronopoulou et al., 2009).

The practice of dentistry has long been associated with high levels of occupational stress. In Malaysia, the prevalence of stress among dentists was reported as 89.7% (Khalid et al., 2000). A high level of stress is associated with dental practice; it appears to begin during dental school and is manifested differently during different years of study (Peker et al, 2009); (Polychronopoulou et al., 2010). Stress has detrimental effects on dental students and is associated with physical symptoms, psychological distress, emotional exhaustion and burnout (Humphris et al., 2002); (Pohlmann et al., 2005); (Gorter et al., 2008). Symptoms of distress include anxiety, depression, phobia, hostility, fear and tension, as well as physical complaints such as sleeplessness, fatigue, dizziness tachycardia, and gastrointestinal system distress (Rajab et al., 2011). This stress in turn can affect the well-being and performance of the student (Cecchini et al,1987); (Westerman et al,1986). A longitudinal study of first-year dental students attending several US dental schools showed that, stress is related to detrimental effects on performance and health and that the amount and sources of stress change over time (Silverstein et al., 2010). Existing evidence in the literature indicates that high levels of perceived stress subsequently result in psychological morbidity and emotional exhaustion among dental students. This may predispose them to professional burnout and decreased productivity (Humphris et al., 2002).

In the United States, these levels of depression, anxiety, and hostility in dental students have been reported as close to the norms for psychiatric outpatients (Naidu et al., 2002). A multi-country study, reported self-efficacy beliefs, assigned workload, and performance pressure as the main perceived stressors in six European dental schools (Polychronopoulos et al., 2009). The study investigated sources of stress and psychological disturbance among dental students and found the fear of failing and examinations to be the only two stressors that appeared across all five study years (Naidu et al., 2002).

This study aimed to identify risk factors that may contribute (social vs academic) to TMD among undergraduate dental students at Universiti Teknologi MARA (UiTM).

METHODOLOGY

Participants

This study is a cross-sectional study that comprised 202 undergraduate dental students from the first to fifth years enrolled in the Bachelor of Dental Surgery (BDS) program in UiTM Shah Alam, Selangor. The undergraduate course comprises 5 years: years 1 and 2 courses mainly medical and preclinical curricula, while the clinical training courses are distributed in the three subsequent years. All students gave their written informed consent to the clinical diagnostic procedures undertaken during the investigation and to the use of the so-gathered data for statistical purposes. The exclusion criteria will be the student who has a history of trauma at the head and neck region, psychosis, and dementia, undergoing psychological treatment. All patients were assessed by the same two examiners. Ethical approval for performing this study was obtained from the UiTM ethics committee, with reference number 600-FPG (PT.1/5).

https://doi.org/10.24191/cos.v11i1.26042

Questionnaire and Examination

Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD)

Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) is a tool that is widely accepted internationally for diagnosis of Temporomandibular disorder. Examination for chronic orofacial pain was performed according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD), the dual-axis diagnostic procedure developed by Dworkin and LeResche in 1992. The examination was performed by two calibrated examiners. The RDC/TMD contains two different parts which are axis I and axis II. Axis I involves the clinical TMD conditions and patients were given 1 or more of the following group diagnoses: muscle disorders (group I); disk displacement (group II); and arthralgia, osteoarthritis, and osteoarthritis (group III). Axis II involves pain-related disability and psychological status. Both axis was done according to the guidelines available since 2002 from the RDC/TMD consortium Web site (http://www.rdc-tmdinternational.org). The scoring and diagnostic details were described in the original 1992 RDC/TMD publication.

Dental Environment Stress Questionnaire

Dental Environment Stress (DES) questionnaire was used to determine the stress level of dental students in UiTM. The questionnaire used in this research was relevant to undergraduate dental student populations. The DES questionnaire was used for this research according to the published article (Al-Sowygh et al., 2012) due to its suitability to our study and environment and modified into 34 stress-related items. The modified-34 stress-related items of the Dental Environment Stress questionnaire were used in this study. Five-point Likert scale was used, and the students were asked to scale the questionnaire as 1=not pertinent, 2=not stressful, 3= slightly stressful, 4=moderately stressful, and 5= very stressful. The questionnaire items were grouped into seven main categories comprised of several items that induce stress in a dental environment which are self-efficacy beliefs, performance pressure, clinical training, workload, patient treatment, and social stressors. However, the categories were not shown in the questionnaire.

Dental Environment Stress (DES)

Domain	Stressor items
Self-efficacy	
	Fear of failing a course
	Fear of unable to keep up with workload
	Lack of confidence to be professional student
	Insecurity concerning your professional future
	Lack of confidence in career decision
Faculty and administration	
	Amount of cheating in professional (dental) school
	Learning environment created by Faculty
	Receiving criticism about work
	Rules and regulations of dental school

https://doi.org/10.24191/cos.v11i1.26042

	Attitudes of faculty toward professional students
	Inconsistency of feedback among instructors
	Discrimination race, class status, ethnic group, or sexual orientation
	expectations of professional school versus reality
Workload	
	Amount of assigned work
	Difficulty of the course work
	Lack of time to do assigned schoolwork
	Lack of time for relaxation
Patient treatment	
	Patients inability to complete the prescribed care plan
	Responsibilities for patient care
	Patients not available
	Working on patients with poor personal hygiene
Clinical training	
	Difficulty in learning clinical proceduress
	Difficulty in learning precision manual skills
Performance pressure	
	Competition with classmates
	Examinations and grades
	Completing graduation requirements
Social Stressors	
	Relationships with other members
	Lack of home atmosphere in living quarters
	Having children at home
	Marital/relationship adjustment problems
	Financial responsibilities
	Forced postponement of marriage
	Personal physical health
	Having a dual role

https://doi.org/10.24191/cos.v11i1.26042

Statistical analysis

Statistical analysis was performed using Fisher-exact test using SPSS 20.0 to associate TMD development to stress with a significance level set at $P \leq 0.05$. Internal consistency of the questionnaire was already verified from a published report in Saudi Arabia in 2012 (Al-Sowygh et al., 2012) using Cronbach's alpha. Fisher-exact test was used to establish and determine the significant differences associated with stress and temporomandibular disorder among dental students.

RESULT

From 213 participants, 11 students were excluded due to incomplete information obtained from the questionnaires that needed to be scored. Thus, a total of 202 samples (95%) were included in this study. Out of 203 students, 27 students (13.3%) were diagnosed with TMD, 5 of them are male, and 22 for female. The third-year dental student was the most diagnosed with TMD (Table 1).

Table 1. Number of TMD students based on the year of studies.

	Total number of student	Total Respondent	Number of students with TMD
Year 1	51	50 (98%)	7
Year 2	52	50 (96%)	6
Year 3	50	48 (96%)	11
Year 4	30	28 (93%)	2
Year 5	31	27 (87%)	5

Results showed that academic stress was higher compared to social stress in TMD (Fig.1).

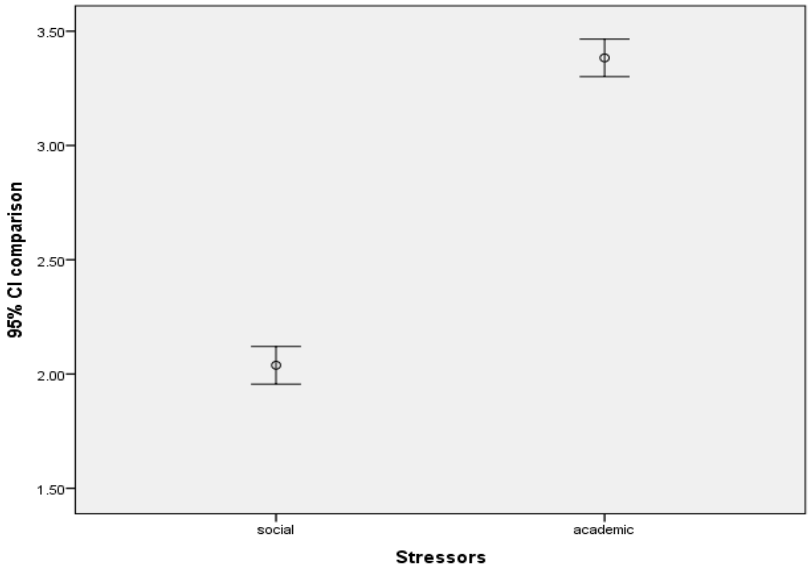

Fig. 1. Comparison between Social and Academic Stress

The " Performances Pressure " domain scored the highest DES scores among stressors with a listed item such as "Completing graduation requirement", "Examination and Grades" and " Competition with classmates" were the most stressful item, followed by the Workload domain with listed items such as "amounts of assigned work, the difficulty of the course, Lack of time to do schoolwork, lack of the relaxation" and "Self-efficacy "domain with listed items such as "Fear of failing the dental course, Fear of unable to keep up with the workload, Lack of confidence to be professional students, Insecurity concerning in career decision".

The domains that were considered moderately to severely stressful were the "Clinical training "domain with listed items "Difficulty in learning clinical procedures, Difficulty in learning precision manual skills followed by the "Patient treatment" domain with listed items "Patients inability to complete the prescribed care plan, responsibilities for patients care, patients not available and followed by "Faculty and administration" domain.

On the other hand, the majority of students felt only minimally stressed when faced with social domain with the following items: "The necessity to postpone having children and Marital /Relationship adjustment problems, Relationships with other members, Lack of home atmosphere in the living hostel, etc". (Fig.2).

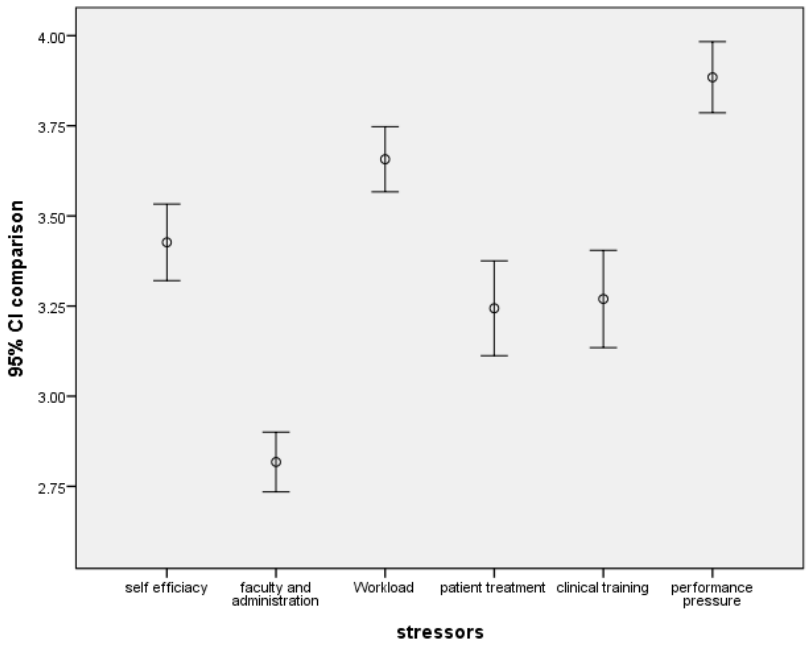

Fig.2. Comparison between Domains of the Academic Stress.

DISCUSSION

In our study, out of 202 students, 27 students (13.4%) were diagnosed with TMD. It is noteworthy to mention that the prevalence of TMD varies considerably among different populations. Studies documented that the prevalence of TMD ranged from 2.6% to 11.4%. A study in Saudi Arabia showed that 49.7% of university students complained of at least one sign or symptom of TMD (American Society of

Temporomandibular Joint Surgeons 2023); (Zwiri et al., 2016). In this study, Out of 27 diagnosed students, 81.5% were female, and 18.5% were male. Our study supported previous studies on the fact that females are more prone to TMD than males (Garcia et al., 1997).

According to our result, academic stress was higher compared to social stress in TMD-diagnosed students. The "Performances Pressure" domain scored the highest DES among stressors with listed items such as "Completing graduation requirement", "Examination and Grades" and "Competition with classmates" were the most stressful items. This can be explained by the fact that finishing clinical requirements is an integral part of each clinical course that should be fulfilled for the students to pass to the next level and sit for professional examinations. A study conducted in Malaysia reported that the requirement system of dental procedures received the highest stress scores for final students (Rosli et al., 2005).

The "Self-efficacy" domain with listed items such as "Fear of failing the dental course, Fear of being unable to keep up with the workload, Lack of confidence to be professional students, and Insecurity concerning in career decision". Most dental schools put a heavy requirements emphasis on clinical sciences and focus on producing graduates with competent clinical skills (Divaris et al., 2008). However, some students fear they will not be able to catch up if they fall behind or fail a course or the year. This might be the reason that put the "Self-efficacy" category which has "Fear of failing a professional dental course "items as number one in the overall class of the year. Studies reported stress encountered during dental education was more pronounced than during medical education (Gotter et al., 2008); (Schmitter et al., 2008); (Murphy et al., 2009).

A previous study among undergraduate students of the University Malaya Malaysia showed that the prevalence of stress was 100% in all years of study (Ahmad et al., 2011). The most common cause of stress among preclinical students was academic concerns and among clinical students was patient management and clinical performance. Students in all years rated social and gender problems as the least stressful.

Fear of failure item from the "Self-Efficacy" domain was the most stressful item across all classes (Pradeep et al., 2011). In our study, the overall mean stress scores were observed to increase through the year of study. This is consistent with the findings of other studies (Naidu et al., 2002); (Sanders et.al., 1996); (Yap et al., 1996). Examinations, fear of failing, workload and completing course requirements ranked highest among stressors related to dental student training and the academic environment (Rajab et al., 2011); (Heath et al., 1999); (Polychronopoulos et.al., 2005).

The study reported that quality of life was associated with group II of RDC/TMD and demonstrated a higher association between disc displacement with reduction (Resende et al). It is noteworthy to mention that, pain and stress associated with TMD represent a negative influence on systemic health and quality of life, which can compromise daily social activities at school or work, social functions, affective and cognitive equilibrium, sleep, and also physical activities (Oliviera et al., 2003).

Studies documented that compared to the post-graduate students undergraduate students aged between 21 to 25 years suffered more commonly from TMD. Symptoms and signs of TMD demonstrated significantly higher on scales of depression/anxiety and pain connected with emotional stress and anxiety. Even in healthy individuals, acute stress causes a shift in neural networks by suppressing executive control and causes stress vulnerability due to the result of maladaptive changes in these neural networks (Paulino et al., 2018); (Staniszewski et al., 2018); (Sojka et al., 2019); (Ahuja et al., 2018).

https://doi.org/10.24191/cos.v11i1.26042

Recently, research on academic stress and depression among students has gained increasing attention. The World Health Organization indicated that "depression is one of the leading causes of disability worldwide and is projected to significantly contribute to the overall global burden of disease by 2030". Further, a recent report on university students showed that academic stress could affect depressive symptoms via direct and indirect pathways. Academic stress may cause severe depressive symptoms through the mediating effect of anxiety and hopelessness. through the mediating role of anxiety symptoms, the role of hopelessness and through the mediating role of both anxiety symptoms and hopelessness. Also leads to several negative consequences, some of which may even be fatal (James et al., 2018); (Mathers et al., 2002); (Zhang et al., 2018).

The Orofacial Pain Prospective Evaluation and Risk Assessment (OPPERA) study found that psychosocial factors (e.g., somatic awareness, distress, catastrophizing, pain amplification, and psychosocial stress) had a significantly higher prevalence in subjects with a TMD compared to healthy individuals. Our results are consistent with previous reports that a high prevalence of TMDs among university students was due to increased distress (Slade et al., 2016); (Fillingim et al., 2011).

Reports observed that the prevalence of TMD to 30–50% among dental students compared to the prevalence in the general population (10%) (Rocha et al., 2017); (Smiljic et al., 2016); (Paulino et al., 2018). More importantly, studies documented epigenetic mechanisms (DNA methylation, histone modification, and microRNA) in chondrocyte of TMD patients. It is noteworthy to mention that, as an epigenetic factor stress causes various epigenetic changes and induces long-term phenotypic adaptations that contribute to neuropsychiatric disorders (Rahman et al., 2022); (Garrett et al., 2018).

CONCLUSION

Results of this study showed academic stress perceived by dental students at UiTM was higher compared to social stress diagnosed with TMD. Understanding the molecular mechanisms that drive academic stress in brain activity during the stress response, might give insight into the development of academic stress-induced TMD disorders that were observed in our present study.

ACKNOWLEDGMENT

None.

CONFLICT OF INTEREST STATEMEN

The authors declare that they have no conflicts of interest related to the contents of this article.

ABOUT THE AUTHORS

Nik Mohd Mazuan Nik Mohd Rosdy
Associate Professor at Faculty of Dentistry, Universiti Teknologi MARA (UiTM) Sg Buloh Campus, Malaysia.
Head, Centre of OMF Diagnostics & Medicine Studies, Project Manager,
Integrated Dental Information & Record Management System (iDeRMS).
nikmohd@uitm.edu.my

Farlyana Alia Azizan
Involved as a student of this Elective Research Project (ERP). Faculty of Dentistry, Universiti Teknologi MARA (UiTM) Sg Buloh Campus, Malaysia.

Halimah Mohd Nasaruddin
Involved as a student of this Elective Research Project (ERP). Faculty of Dentistry, Universiti Teknologi MARA (UiTM) Sg Buloh Campus, Malaysia.

Khairil Anuar Md. Isa, Senior Lecturer,
Senior lecturer at the Department of Basic Sciences, Faculty of Health Sciences, Universiti Teknologi MARA Puncak Alam Campus, 42300 Puncak Alam, Selangor, Malaysia.

Jamil Ahsan Kazi
Associate Professor at Centre of Preclinical Sciences Studies, Faculty of Dentistry, Universiti Teknologi MARA (UiTM) Sg Buloh Campus. Malaysia.

AUTHORS' CONTRIBUTIONS

Nik Mohd Mazuan Nik Mohd Rosdy
Conceptualization, data analysis, review and editing of the manuscript. Co-supervisor of this ERP project.

Farlyana Alia Azizan
Involved as a student in this Elective Research Project (ERP). Faculty of Dentistry, Universiti Teknologi MARA (UiTM) Sg Buloh Campus, Malaysia.

Halimah Mohd Nasaruddin
Involved as a student in this Elective Research Project (ERP). Faculty of Dentistry, Universiti Teknologi MARA (UiTM) Sg Buloh Campus, Malaysia.

Khairil Anuar Md. Isa,
Performed the Statistical analysis of this project.

Jamil Ahsan Kazi
Conceptualized the central research idea and provided the theoretical framework, data analysis, and manuscript write-up and revision and approved the article submission. Main supervisor of this ERP project.

REFERENCES

Acharya, S. (2003). Factors affecting stress among Indian dental students. *Journal of Dental Education, 67*(10), 1140-1148.

Bhole, S., Razak, I. A., Teo, C. S., & Yap, A. (1995). Malaysian dental students' perception of course and socio-cultural stressors. *Journal of Dental Research, 74*, 496.

American Society of Temporomandibular Joint Surgeons. (2003). Guidelines for diagnosis and management of disorders involving the temporomandibular joint and related musculoskeletal structures. *Cranio, 21*(1):68-76.

Da Silva Andrade, A., Gamero, G. H., Pereira, L. J., Junqueira Zanin, I. C., & Gavião, M.B. (2008) Salivary cortisol levels in young adults with temporomandibular disorders. *Minerva Stomatologica. 57*(3):109-16.

Manfredini, D., Guarda-Nardini, L., Winocur, E., Piccotti, F., Ahlberg, J., & Lobbezoo, F. (2011) Research

diagnostic criteria for temporomandibular disorders: a systematic review of axis I epidemiologic findings. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology, 112*(4), 453-462. https://doi.org/10.1016/j.tripleo.2011.04.021.

Divaris, K., Barlow, P. J., Chendea, S. A., Cheong, W. S., Dounis, A., Dragan, I. F., Hamlin, J., Hosseinzadeh, L., Kuin, D., Mitrirattanakul, S., Mo'nes, M., Molnar, N., Perryer, G., Pickup, J., Raval, N., Shanahan, D., Songpaisan, Y., Taneva, E., Yaghoub-Zadeh, S., West, K., & Vrazic, D. (2008). The academic environment: the students' perspective. *European Journal Dental Education,* 12(1), 120-130. https://doi.org/10.1111/j.1600-0579.2007.00494.x.

Jones, D. A., Rollman, G. B., & Brooke, R. I. (1997). The cortisol response to psychological stress in temporomandibular dysfunction. *Pain, 72*(Issues 1-2), 171–182. https://doi.org/10.1016/s0304-3959(97)00035-3.

Garcia, A. R., Lacerda Jr, N., & Pereira, S. L. S. (1997). Evaluation of the degree of dysfunction of the temporomandibular joint and of mandibular movements in young adults. Revista da Associacao Paulista de Cirurgioes Dentistas, 51, 46–51.

Goel, N., & Bale, T. L. (2010). Sex differences in the serotonergic influence on the hypothalamic-pituitary-adrenal stress axis. *Endocrinology.151*(4), 1784-1794. https://doi.org/10.1210/en.2009-1180.

Gorter, R., Freeman, R., Hammen, S., Murtomaa, H., Blinkhorn, A., & Humphris, G. (2008). Psychological stress and health in undergraduate dental students: fifth year outcomes compared with first year baseline results from five European dental schools. *European Journal of Dental Education, 12*(2), 61-68. https://doi.org/10.1111/j.1600-0579.2008.00468.x.

Heath, J. R., Macfarlane, T. V., & Umar, M. S. (1999). Perceived sources of stress in dental students. *Dental Update, 26*(3), 94-100. https://doi.org/10.12968/denu.1999.26.3.94.

Hendricks, S. J., Joshi, A., Crombie, K., & Moola, M. H. (1994). Perceived source of stress among black dental students in South Africa. *Journal of Dental Education, 58*(6), 406-410.

Humphris, G., Blinkhorn, A., Freeman, R., Gorter, R., Hoad-Reddick, G., Murtomaa, H., O'Sullivan, R., & Splienth, C. (2002). Psychological stress in undergraduates: baseline results from seven European dental schools. *European Journal of Dental Education, 6*(1), 22-29. https://doi.org/10.1034/j.1600-0579.2002.060105.x.

Garofalo, J. P., Richard, R. C., & Gatchel, R. J. (2006). Hypothalamic–Pituitary–Adrenocortical Axis Dysregulation in Acute Temporomandibular Disorder and Low Back Pain: A Marker for Chronicity? *Journal of Applied Biobehavioral Research, 11*(Issue 3-4), 166–178. https://doi.org/10.1111/j.1751-9861.2007.00003.x.

Kaufman, A., Klepper, D., Obenshain, S. S., Voorhees, J. D., Galey, W., Duban, S., Moore-West, M., Jackson, R., Bennett, M., & Waterman, R. (1982). Undergraduate medical education for primary care: a case study in New Mexico. *Southern Medical Journal, 75*(9), 1110–1117. https://doi.org/10.1097/00007611-198209000-00021.

Khalid, K. (2000). Work- related stress among government dentists and dental nurse. *Kuala Lumpur: University of Malaya, Dissertation*.

Kumar, S., Dagli, R. J., Mathur, A., Jain, M., Prabu, D., & Kulkarni, S. (2009). Perceived sources of stress amongst Indian dental students. *European Journal of Dental Education,* 13(1), 39-45. https://doi.org/10.1111/j.1600-0579.2008.00535.x.

Ahmad, M. S., Yusoff, M. M. M., & Razak, I. A. (2011). Stress and its relief among undergraduate dental students in Malaysia. *The Southeast Asian Journal of Tropical Medicine and Public Health, 42*(4), 996-1004.

Murphy, R. J., Gray, S. A., Sterling, G., Reeves, K., & DuCette. J. (2009). A comparative study of professional student stress. *Journal of Dental Education, 73*(3), 328-337.

Naidu, R. S., Adams. J.S., Simeon, D., & Persad, S. (2002). Sources of stress and psychological disturbance among dental students in the West Indies. *Journal of Dental Education, 66*(9), 1021-1030.

de Oliveira, A. S., Bermudez, C. C., de Souza, R. A., Souza, C. M. F., Dias, E. M., Castro, C. E. D. S., & Berzin, F. (2003). Pain impact on life of patients with temporomandibular disorder. *Journal of Applied Oral Science, 11*(2), 138-143. Portuguese. https://doi.org/10.1590/s1678-77572003000200010.

Pohlmann, K., Jonas, I., Ruf S., & Harzer, W. (2005). Stress, burnout and health in the clinical period of dental education. *European Journal of Dental Education, 9*(2), 78-84. https://doi.org/10.1111/j.1600-0579.2004.00359.x.

Polychronopoulou, A., & Divaris, K. (2009). Dental students' perceived sources of stress : a multi-country study. *Journal of Dental Education,75*(5), 631-639.

Polychronopoulou, A., Divaris, K. (2010) A longitudinal study of Greek dental student's perceived sources of stress. *Journal of Dental Education*, *74*(5), 524-530.

de Resende, C. M. B. M., Alves, A. C. de M., Coelho, L. T., Alchieri, J. C, Roncalli, A. G, & Barbosa, G. A. S. (2013). Quality of life and general health in patients with temporomandibular disorders. *Brazilian Oral Research, (São Paulo) 27*(2), 116-121. https://doi.org/10.1590/S1806-83242013005000006.

Rosli, T. I., Rahman, R. A., Rahman, S. R. A., & Ramli, R. (2005). A survey of perceived stress among undergraduate dental students in university Kebangsaan Malaysia. *Singapore Dental Journal, 27*(1), 17–22.

Sanders, A. E., & Lushington, K. (1999). Sources of stress for Australian dental students. *Journal of Dental Education, 63*(9), 688–697.

Sanders, A. E., & Lushington, K. (2002). Effect of perceived stress on student performance in dental school. *Journal of Dental Education, 66*(1), 75–81.

Schwartz, R. M., Eigenbrode, C. R., & Cantor, O. (1984). A comprehensive stress-reduction program for dental students. *Journal of Dental Education*, *48*(4), 203–207.

Schmitter, M., Liedl, M., Beck, J., & Rammelsberg, P. (2008). Chronic stress in medical and dental education. *Medical Teacher, 30*(1), 97-99. https://doi.org/10.1080/01421590701769571.

Selye, H. (1956). The stress of life. McGraw-Hill, New York.

Sugiura, G., Shinada K., & Kawaguchi, Y. (2005). Psychological well-being and perceptions of stress amongst Japanese dental students. *European Journal of Dental Education, 9*(1), 17-25. https://doi.org/10.1111/j.1600-0579.2004.00352.x.

Ter Horst, J. P., Carobrez A. P., van de Mark, M. H., de Kloet, E. R., & Oitzl, M. S. (2012). Sex differences in fear memory and extinction of mice with forebrain-specific disruption of the mineralocorticoid receptor. *European Journal of Neuroscience. 36*(8), 3096-3102. https://doi.org/10.1111/j.1460-9568.2012.08237.x.

Westerman, G. H., Grandy, T. G, Ocanto, R. A., & Erskine C. G. (1993). Perceived source of stress in the dental school environment. *Journal of Dental Education, 57*(3), 225-231.

Pedroni, C. R., De Oliveira, A. S., & Guaratini, M. I. (2003). Prevalence study of signs and symptoms of temporomandibular disorders in university students. *Journal of Oral Rehabilitation, 30*(3), 283–289. https://doi.org/10.1046/j.1365-2842.2003.01010.x.

Al-Sowygh, Z. H., Alfadley, A. A., Al-Saif, M. I., & Al-Wadei, S. H. (2013). Perceived causes of stress among Saudi dental students. *King Saud University Journal of Dental Sciences, 4*(1), 7–15. https://doi.org/10.1016/j.ksujds.2012.11.002.

Paulino, M. R., Moreira, V. G., Lemos, G. A., da Silva, P. L. P., Bonan, P. R. F., & Batista, A. U. D. (2018). Prevalence of signs and symptoms of temporomandibular disorders in college preparatory students: associations with emotional factors, parafunctional habits, and impact on quality of life. *Ciencia & Saude Coletiva, 23*(1), 173–186. https://doi.org/10.1590/1413-81232018231.18952015 .

Staniszewski, K., Lygre, H., Bifulco. E., Kvinnsland, S., Willassen, L., Helgeland, E., Berge, T., & Rosen, A. (2018). Temporomandibular disorders related to stress and HPA-axis regulation. *Pain Research & Management, 2018*, 1–7. https://doi.org/10.1155/2F2018/7020751.

Sójka, A., Stelcer, B., Roy, M., Mojs, E., & Pryliński, M. (2019). Is there a relationship between psychological factors and TMD? *Brain & Behavior, 9*(9), e01360. https://doi.org/10.1002/brb3.1360.

Ahuja, V., Ranjan, V., Passi, D., & Jaiswal, R. (2018). Study of stress-induced temporomandibular disorders among dental students: An institutional study. *National Journal of Maxillofacial Surgery, 9*(2), 147–154. https://doi.org/10.4103/njms.njms_20_18 .

James, S.L., Abate, D., Abate, K.H., Abay, S. M., Abbafati, C., Abbasi, N., Abbastabar, H., Abd-Allah, F., Abdela, J., & Alvis, G. N. (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the global burden of disease study. *Lancet*, 392(10159):1789–1858.

Mathers, C. D., & Loncar, D. (2006). Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Medicine*, 3(11), e442. https://doi.org/10.1371/journal.pmed.0030442.

Zhang, C., Shi, L., Tian, T., Zhou, Z., Peng, X., Shen, Y., Li, Y., & Ou, J. (2022). Associations Between Academic Stress and Depressive Symptoms Mediated by Anxiety Symptoms and Hopelessness Among Chinese College Students. *Psychology Research and Behavior Management, 15*, 547–556. https://doi.org/10.2147/PRBM.S353778.

Slade, G. D., Ohrbach, R., Greenspan, J. D., Fillingim, R. B., Bair, E., Sanders, A. E., Dubner, R., Diatchenko, L., Meloto, C. B., Smith, S., & Maixner, W. (2016). Painful temporomandibular disorder: decade of discovery from OPPERA studies. *Journal of Dental Research, 95*(10), 1084–1092. https://doi.org/10.1177/0022034516653743.

Fillingim, R. B., Slade, G. D., Diatchenco, L., Dubner, R., Greenspan, J. D., Knott, C., Ohrbach, R., & Maixner, W. (2011). Summary of findings from the OPPERA baseline case-control study: implications and future directions. *Journal of Pain, 12*(11 suppl), 102–107. https://doi.org/ 10.1016/j.jpain.2011.08.009.

Rahman, M. F., & McGowan, P.O. (2022). Cell-type-specific epigenetic effects of early life stress on the brain. *Translational Psychiatry 12*, 326. https://doi.org/10.1038/s41398-022-02076-9.

Dee, G., Rebecca, R., & Dee, C. (2023). Epigenetic Changes Associated with Different Types of Stressors and Suicide. *Cells,* 12(9): 1258. https://doi.org/10.3390/cells12091258.

Zwiri, A. M. A., & Al-Omiri, M. K. (2016). Prevalence of temporomandibular joint disorder among North Saudi University students. Cranio: The Journal of *Craniomandibular* Practice*, 34*(3), 176–181. https://doi.org/10.1179/2151090315y.0000000007.