ASSOCIATION OF TEMPOROMANDIBULAR DISORDER SYMPTOMS WITH PARAFUNCTIONAL BEHAVIORS, SLEEP QUALITY, STRESS, AND ANXIETY AMONG DENTAL EDUCATORS AND STUDENTS

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by
FNU Amal Fatima
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Thesis Approvals:

Shabnam Seyedzadeh Sabounchi, Thesis Advisor,Oral and Maxillofacial Pathology
Shraddha Kamat, Oral and Maxillofacial Pathology
Mehran Hossaini, Oral and Maxillofacial Pathology

ABSTRACT

Temporomandibular disorders (TMDs) are a collection of pain problems that affect the orofacial region. TMD is regarded as the second most widespread musculoskeletal disorder that causes disability and pain with a major impact on the patient's quality of life. Its etiology is considered multifactorial and significantly related to genotype and phenotype; however, several risk factors predispose, precipitate, or prolong TMD . These are biological factors (e.g., sex hormones), age, endogenous opioid function, anatomical genotype differences, trauma, occlusal changes, systemic illness, parafunctions and psychosocial factors (e.g., exposure to stress, coping with pain, disasters, and emotions). Lifestyle habits and lifestyle choices have an undeniable impact on an individual's health. A study by Lei J. et al.(2021) showed a moderate to strong cross-age relationship between stress, depression and anxiety and TMD. Also, in patients with painful TMD, a greater amount of stress and reduced quality of life have been reported precisely because of the symptoms of the disorder itself.

Objective: In this cross-sectional study, a survey was conducted to collect primary data on oral parafunctional behaviors, sleep quality, anxiety and stress, and its association with symptoms of temporomandibular disorders in dental educators and students. *Methods*: The study population included all the dental graduates, undergraduates and active faculty at the Temple University, Kornberg School of Dentistry. The survey included three sections: a demographic section including questions on age, gender, race/ethnicity and current position at the dental school; the TMD symptom questionnaire, Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) was used to screen for the presence of TMD symptoms in the study participants; Oral behavioral checklist, PatientReported Outcomes Measurement Information Systems (PROMIS), General Anxiety Disorder-7(GAD-7) and Perceived Stress Scale (PSS)questionnaires was used to assess oral parafunctional behaviors, sleep quality, anxiety and stress among the study population. Mean, standard deviation (SD), and percentage (%) were computed for descriptive analysis. Chi-square and one-way ANOVA tests were conducted to determine whether there is a significant difference in sleep quality, stress, anxiety, and parafunctional behavior with the TMD symptom assessment status. Multivariable analyses were conducted to assess the association between positive temporomandibular disorder status and various individual characteristics, such as age, gender, year at dental school, sleep quality, stress, anxiety, and oral parafunctional behaviors. SPSS version 28.0 was used to analyze the data and a p-value equal to or less than 0.05 was considered statistically significant.

Results: In total 62 completed online surveys were submitted. Participants with positive TMD symptoms were younger than those without positive symptoms ($P<0.05$). Dental students/residents (n=18) reported positive TMD symptoms more than the dental faculty (n=6) in the school ($P<0.05$). There were no statistically significant differences between means of the two groups of Dental Students/Residents and Dental Faculty among their total OBC, PROMIS, GAD-7, and PSS scores ($P>0.05$). According to the multiple logistic regression, oral parafunctional behavior could significantly predict the presence of positive TMD symptoms. Participants with one unit increase in their parafunctional behavior were 1.2 times more likely to show positive TMD symptoms in this study ($P<0.05$).

Conclusions: Higher parafunctional behavior was the only significant predictor for exhibiting positive TMD symptoms among dental students/residents and faculty participating in this study while controlling for demographic variables.

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CHAPTER 1

INTRODUCTION

The orofacial region is affected by a collection of pain problems known as temporomandibular disorders (TMDs), which are primarily characterized by discomfort, a restriction in jaw opening, and sounds coming from the temporomandibular joint (TMJ) [1]. According to the most widely accepted diagnostic methods and criteria, TMDs, are the second most commonly occurring musculoskeletal condition in the USA after chronic low back pain [1].

Temporomandibular Disorders (TMDs) are a significant public health concern, with patients often spending thousands of dollars out of pocket for tests, appliances, and care not covered by insurance [2]. These costs can be quantified using objective measures of treatment costs, such as visits to healthcare professionals, or indirect costs like time lost from work [2]. Quality of life is also crucial, as TMDs can lead to alterations in daily activities, disruption of work and social life, and poor sleep [2]. However, the costs of care associated with TMDs are not well captured in insurance claims data in the United States due to the split in cost information and limited opportunity to capture costs [2].

The temporomandibular joint (TMJ) is formed by the articulation of the mandible and the temporal bone of the cranium [3]. The condylar process along with the condylar neck form the mandibular component and the squamous part of the temporal bone (glenoid fossa and the articular tubercle) form the cranial part of TMJ [3]. The TMJ has a unique range of motion; it is frequently referred to as a ginglymo-arthroidal joint because it is capable of both translation and hinge movements [3].

The TMJ exhibits significant mobility, with the mandibular condyle freely rotating on the inferior surface of the disc [4]. The disc-condyle complex moves within the fossa and translates unimpeded along the posterior aspect of the articular eminence [4]. Limited lateral movements are possible. The interarticular disc is always positioned between the fossa/eminence and the condyle by the superior lateral pterygoid muscle and the uppermost elastic properties of the posterior attachment known as the posterior, superior retrodiscal lamina of the retrodiscal tissue [4].

The maxillary and mandibular dentition's occlusal relationship and muscle anatomy limit the TMJ's range of motion [3]. Unlike discs in other joints that are made of fibrous tissue, the articulating disc of the TMJ is extremely strong and resilient because it is lined by fibrous cartilage on the outside and composed of hyaline cartilage inside [5]. The disk separates the joint into two synovial joint chambers on either side [3]. Four joints work as a single unit because the disc facilitates movement of each TMJ as two separate joints and each cavity has its own synovial membrane coating [5].

The temporomandibular joint is a complex synovial joint with two compartments and four articular surfaces. It functions within the glenoid of the temporal hone, located in the temporal bone bilaterally [4].

Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) is currently the most widely used and standardized instrument for TMD assessment and categorization [6]. In order to account for the clinical and biopsychosocial components of TMD, the DC/TMD assessment uses two axes [6]. Axis-I includes a methodology for a recommended physical examination to determine specific physical diagnoses of TMD related to the muscles and joints, whereas Axis-II includes a number of tools to screen for psychosocial factors in the patients [6]. The sensitivity and specificity for the most common TMD diagnoses have been demonstrated in the DC/TMD studies [7].

The Temporomandibular Disorder (TMD) screening questionnaire, as developed by Gonzalez et al. (2011), serves as a valuable tool in the assessment of TMD pain and symptoms [6]. The questionnaire, designed by a team of experienced dental professionals, demonstrates both reliability and validity in its ability to efficiently screen for TMD-related pain. Its brevity enhances its practicality for routine clinical use, making it a valuable asset for dental practitioners aiming to identify and address temporomandibular disorders in a timely manner [6]. The rigorous development process, as outlined in the referenced study, lends credibility to the questionnaire's effectiveness, providing clinicians with a reliable means of identifying and addressing TMD pain in their patients [6]. TMD screening examination among different study populations have demonstrated good reliability and high validity for the self-reported pain questions related to TMD [6,9,17-18].

Although the exact cause of TMD is unknown, it is believed to have a complex origin that can be caused by inappropriate interference from hereditary disorders, psychological, physiological, structural (such as occlusion and trauma), and postural (such as parafunctional habits) conditions [8]. These disorders have the potential to operate as initiating, predisposing, and perpetuating factors for the development of TMD signs and symptoms, which could jeopardize the homeostasis state of the stomatognathic system [8].

Recent studies have demonstrated that the pathophysiology of common painful TMD is biopsychosocial and multifactorial, where no one factor is responsible for its development [9]. The biopsychosocial model emphasizes how emotional factors affect TMD. It does this by showing how anxiety, stress, and depression are linked to muscular hyperactivity, parafunctional habits, and microtraumas in the TMJ [10].

The symptoms and signs of TMD include pain or soreness in the facial muscles while chewing, speaking, or opening wide, pain in the jaw joint area, neck, shoulders, and in or around the ears. Additional symptoms include jaws that get "locked" or become "stuck" in the open or closed mouth, and popping, or clicking noises produced in the jaw joint while moving the jaw [8]. Some individuals also report headaches, neck aches, dizziness, earaches, hearing problems, and ringing in the ears (tinnitus). Upper shoulder soreness is another common symptom [8,11]. The condition also involves a range of symptoms, including facial and neck pain, limited mandibular movement, which can be exacerbated by various factors such as parafunctional behaviors, sleep quality, stress, and anxiety.

In a prospective cohort study, the Pittsburgh Sleep Quality Index showed that a 40% decrease in sleep quality increased the rate of first-onset TMD [12]. According to Slade et al.,(2016) clinical TMD is influenced by comorbid health conditions, nonpainful orofacial symptoms, self-reported jaw parafunction, and frequency of somatic symptoms, with somatic reactivity being the strongest psychosocial predictor [12,14]. Understanding the interplay between these factors is crucial for developing effective prevention and management strategies, ultimately improving the well-being and productivity of dental practitioners and students.

One notable comorbidity that is commonly linked to TMJ issues is anxiety, which has the ability to alter pain perception and produce neurotransmitters linked to parafunctional habits [11]. According to Rener et al., (2022), sleep bruxism is often identified in TMD patients when polysomnography (PSG) sleep studies are performed, but the associations for these two sleep-associated disorders with TMD are still poorly understood [11]. Currently, there is also insufficient scientific evidence that sleep bruxism and sleepdisordered breathing are correlated [11]. PSG recordings have shown that nearly 36% of TMD patients meet diagnostic criteria for insomnia, and more than 28% meet criteria for obstructive sleep apnea [11]. Poor sleep quality is a common complaint reported by up to 90% of patients with temporomandibular dysfunction (TMD) [12, 13].

Dental students and educators face heightened risks due to the inherently stressful nature of the dental profession and the demanding academic environment [5]. Prashant and Dodamani (2012) found that between 50% and 75% of TMJ patients experienced stressful life circumstances prior to the onset of symptoms [15]. The COVID-19 pandemic has further exacerbated these challenges, leading to increased reports of myofascial pain and other temporomandibular disorder symptoms [16]. Students and faculty attending dental school face intense pressure in this demanding atmosphere, which is commonly linked to elevated stress levels [17].

It is further estimated that 17,800,000 workdays are lost each year for every 100,000,000 full-time working adults in the United States due to disabling TMDs [18]. The high prevalence of TMD, coupled with its significant impact on daily functioning, underscores the need for a comprehensive understanding of the factors contributing to this condition, particularly among dental professionals and students [18]. Dental students who experience physical illness, emotional distress, or interpersonal difficulties may be at greater risk of negative academic consequences, potentially further aggravating their overall well-being [5].

In this study, the dental graduates and undergraduates and faculty of the Kornberg School of Dentistry at Temple University, were assessed for TMD symptoms and related psychosocial factors. Self-administered questionnaires were distributed that consisted of three parts: demographic which also include a brief medical/dental history; screening for psychosocial factors through assessing oral parafunctional behaviors, anxiety and stress levels as well as sleep quality; and TMD symptoms.

The specific aims of this study are:

1. To explore prevalence of TMD symptoms among dental graduates and undergraduates and educators in Kornberg School of Dentistry.

2. To explore prevalence of oral parafunctional behaviors among dental graduates and undergraduates and educators in the Kornberg School of Dentistry, Temple University

3. To explore prevalence of sleep quality among dental graduates and undergraduates and educators in Kornberg School of Dentistry, Temple University

4. To explore prevalence of stress among dental graduates and undergraduates and educators in Kornberg School of Dentistry, Temple University

5. To explore prevalence of anxiety among dental graduates and undergraduates and educators in Kornberg School of Dentistry, Temple University

6. To explore the association between temporomandibular disorder symptom screening in dental graduates and undergraduates and educators with their sleep quality, stress, anxiety, and parafunctional behavior status

7. To explore the likelihood of students and educators presenting with positive temporomandibular disorder symptoms and their sleep quality, stress, anxiety, and parafunctional behavior status.

CHAPTER 2

METHODS

This study employed a cross-sectional design. It was conducted among undergraduate and graduate dental students currently enrolled and all active faculty (full-time or parttime) in the Kornberg School of Dentistry at Temple University. All participants received an invitation email to participate in the study through an official email from the university in Summer 2024. Three follow-up emails were sent out in 2 weeks intervals. The emails were not sent out at exam periods.

The survey comprised three sections: a demographic questionnaire, a TMD screening questionnaire, and a section incorporating four standardized assessment tools— the Oral Behaviors Checklist (OBC), the Patient-Reported Outcomes Measurement Information System (PROMIS™), the Perceived Stress Scale (PSS), and the Generalized Anxiety Disorder-7 (GAD-7).

The demographic variables were consisted of position at the dental school, gender (male/female), age in years (intervals in decades) and race/ethnicity.

Participants were asked to respond to questions in the symptom questionnaire, as a suitable protocol to screen individuals who may have simple to complex TMD. This questionnaire was used to effectively screen for temporomandibular disorder pain, parafunctional behaviors, sleep quality, stress, and anxiety [11]. Participants with positive TMD symptoms were invited to contact the primary investigator to receive further evaluation at the oral surgery department.

All participants regardless of having or not having positive TMD symptoms were asked to respond to the Oral Behavioral Checklist (OBC) which assesses oral parafunctional behaviors [19]. The Patient-Reported Outcomes Measurement Information System (PROMIS™) Sleep Disturbance (SD) [20] were used to assess the sleep quality, Perceived Stress Scale (PSS) for assessing stress [21] and the GAD-7 (General Anxiety Disorder) screening questionnaire [22] for anxiety assessment.

The OBC is a 21-item self-reported questionnaire designed to measure how frequently oral behavior parafunctions were used in the month before [19]. The analysis included items evaluating activities during sleep and options were none of the time, to <1 night month, 1-3 nights month, 1-3 nights week, 4-7 nights/week [19]. The remaining items' response options for assessing waking oral behaviors range from 0 (none of the time) to 4 (all of the time). The mean score of OBC was calculated by adding up the scores and dividing by the total number of items in the analysis (21 items) [19].

The PROMIS SD is comprised of 8 questions [20]. Participants rated different aspects of their sleep in the past 7 days on 5-point Likert scales [14]. The responses are intensity scale and were consisted of: not at all, a little bit, somewhat, quite a bit, very much, with a smaller number of questions using a frequency scale (never, rarely, sometimes, often, always), and one question as overall sleep quality assessment using a scale of very poor, poor, fair, good, very good [20].

The 10 items on the Perceived Stress Scale were straightforward to comprehend, and the response options were easy to grasp [21]. Additionally, as previously said, the questions were generic in nature, meaning they did not contain much substance unique to any particular demographic group. The process of obtaining PSS scores involved flipping the results of the seven positive items, such as 0 for 4, 1 for 3, 2 for 2, and so on, and then adding the results for all 10 things [21]. The positively mentioned items were items 1, 5, 6, 7, 9 and 10 [21].

The GAD-7 questionnaire for assessing anxiety consisted of 7 questions rated on a 4point scale as not at all, several days, more than half of the days and nearly every day [16]. The individuals recorded their answers for the past 2 weeks which at the end a total score was calculated [16].

The completed questionnaire was sent out as Google Forms for the students and faculty to complete. Follow-up emails were sent by the dentistry school's information technology department. A total of 62 surveys were successfully completed and submitted for analysis. Following data cleaning, the responses were saved in a Microsoft Excel file.

SPSS version 28 statistical package was used to analyze the data exported to excel sheets. According to the questionnaire, the participants who were suspected of having a TMD, were requested to contact the principal investigator and were further examined. In accordance, instructions and recommendations were provided.

The mean, standard deviation (SD), and percentage (%) was computed for descriptive analysis. The Kolmogorov-Smirnov test was used to test the null hypothesis to assess the parameters' applicability to a normal distribution.

One-way ANOVA was used to compare associations between temporomandibular disorder symptom screening in dental students and educators with their sleep quality, stress, anxiety, and parafunctional behavior status. The Kruskal-Wallis test was employed if the data did not exhibit a normal distribution. Chi-square test was used to compare differences in various categories of anxiety, sleep disorder, OBC and stress level between those participants with and without TMD symptoms.

Multiple Logistic regression model was employed to assess the association between temporomandibular disorder and various individual characteristics, such as age, gender, year at dental school, sleep quality, stress, anxiety, and parafunctional behaviors. Odds ratios and confidence intervals were calculated.

We employed Nagelkerke R-squared test which provides an estimate of the proportion of variability in the outcome variable that is explained by the predictor variables.

To assess potential multicollinearity among the independent variables, a variance inflation factor (VIF) analysis was conducted. The results indicated that all VIF values were below 4, suggesting no significant multicollinearity and confirming the independence of the predictor variables.

CHAPTER-3

RESULTS

In total, 62 surveys were successfully completed and submitted. Among the respondents, 28 (45.2%) had positive TMD symptoms and 34 (54.8%) were without symptoms. Results showed that individuals without positive TMD symptoms had a significantly higher average age (38.79) compared to those with positive TMD symptoms (30.59) which the difference was statistically significant (Table 1). The majority of respondents were Caucasian (58.8%) [Table 2]. The difference in number of respondents with and without positive TMD symptoms seems to be relatively balanced across different race/ethnic groups as it was not statistically significant p.value = 0.72 [Table 2].

Table-1 - Distribution of mean age of the participants with and without positive TMD symptoms

Variable	**Mean (SD)**	
	With TMD Symptoms	Without TMD Symptoms
Age	30.59 (10.7)	38.79 (14.34)

df= 1; T (1) = 2.55, p= 0.01

Table-2- Distribution of number of the participants with and without TMD symptoms based on race/ethnicity

Race/ethnicity	With TMD Symptoms N (%)	Without TMD Symptoms N (%)
Caucasian	16 (59.3)	20 (58.8)
African American	1 (3.7)	0
Hispanic	8(29.6)	11 (32.4)
Asian	2(7.4)	3 (8.8)

Fisher's exact test (3, n=62) =3.34, p= 0.72

The study also found that number of females who reported positive TMD symptoms (70.4%) was higher compared to the males (29.6%) but the difference was not statistically significant [Table 3].

Table-3- Distribution of mean score of the participants with and without TMD symptoms based on gender

Gender	With TMD Symptoms N (%)	Without TMD Symptoms N (%)	P.value
Female	19 (70.4)	16 (47.1)	0.06
Male	8 (29.6)	18 (52.9)	

df=1; $X^2_{(1)} = 3.34$

Positive TMD symptoms was reported more frequently among resident and undergraduate students compared to faculty members, and the difference was statistically significant (P<0.05).

Table-4- Distribution of number of participants with and without positive TMD symptoms based on group

Group	With TMD Symptoms N (%)	Without TMD Symptoms N (%)	p-value
Faculty	6 (21.4)	16 (47.1)	0.03*
Resident/Student	22 (78.6)	18 (52.9)	

*significance value; $X^2_{(1)} = 4.40$

Results showed that faculty taking part in the study had a significantly higher average age 48.14 (SD=13.22) compared to residents and undergraduate students 27.85 (SD=5.88) which the difference was statistically significant p.value = [Figure 1]. The majority of respondents among faculty were Caucasian (90.9%) and among resident/students both white (41.0%) and Asian (46.2%) race/ethnicity were high (41%) [Figure 2]. The differences between different groups in regard to race/ethnicity was significant (p.value= 0.002).

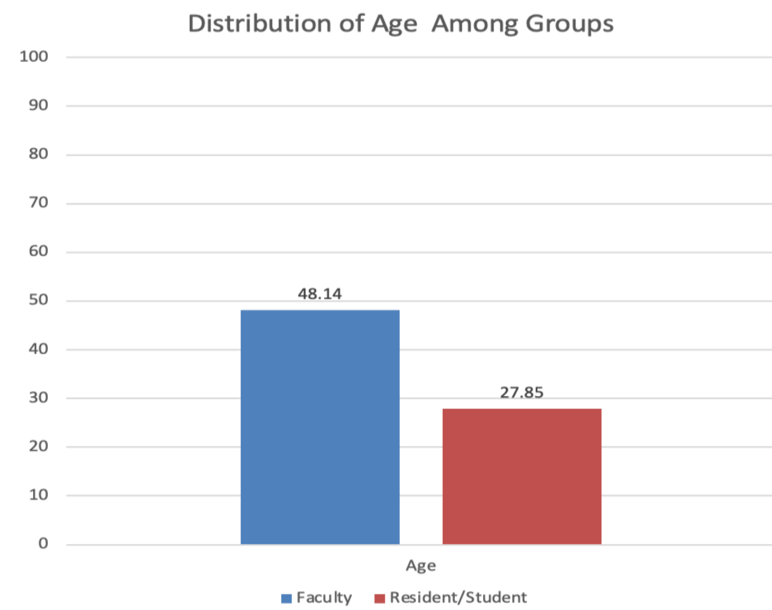

Figure 1-Distribution of age among groups, * significant <0.05.

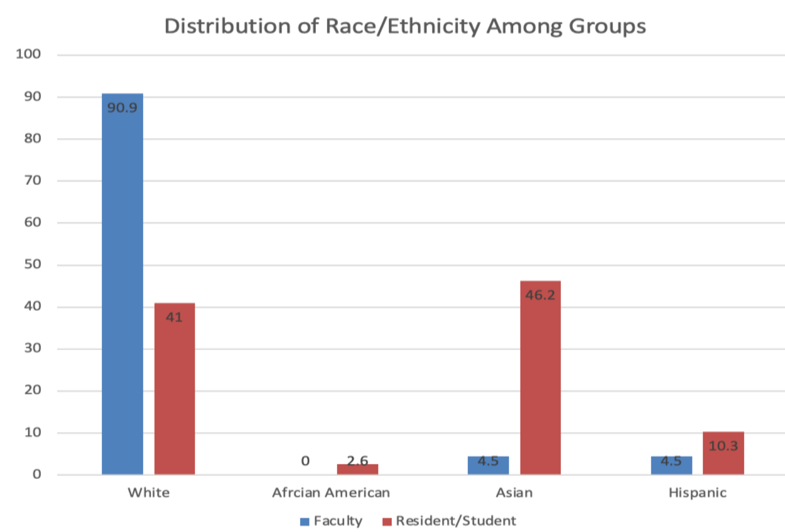

Figure 2-Distribution of race/ethnicity among groups, *significant<0.05

The number of females were higher in the resident/students group (64.1%) compared to the higher number of males in the faculty group (54.5 %) but the differences were not statistically significant.

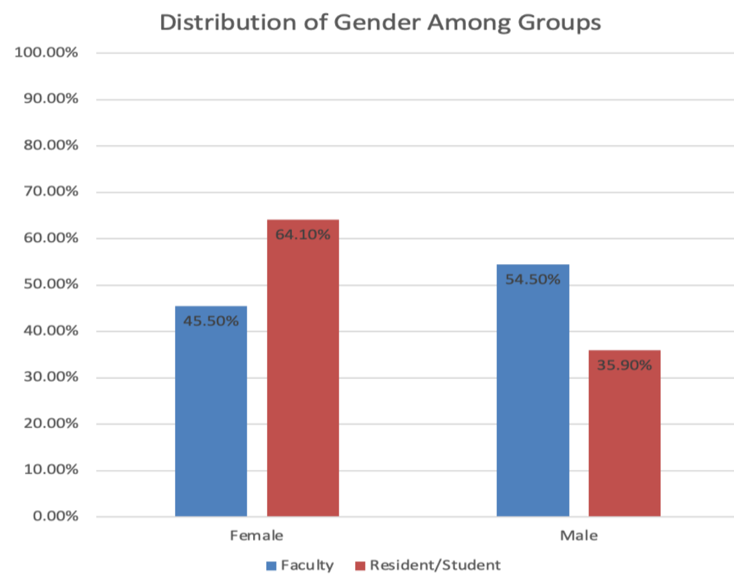

Figure 3- Distribution of gender among groups

Faculty with positive TMD symptoms were younger than those without TMD symptoms and the difference was not statistically significant (P<0.05) [Table 5].

Table-5- Distribution of age among faculty with and without TMD symptoms

Variable	**Mean (SD)**		**P.value**
	With TMD Symptoms	Without TMD Symptoms	
Age	4.5 (14.93)	49.5 (12.78)	0.44

F = 0.61, df = 1 (Anova test)

The number of faculty with positive TMD symptoms was equal among male and female respondents and the differences were not statistically significant (P<0.05) [Table 6].

Table-6- Distribution of faculty with and without TMD symptoms based on gender

Gender	With TMD Symptoms N (%)	Without TMD Symptoms N (%)	p-value
Female	3 (50)	7(43.8)	
Male	3 (50)	9 (56.3)	0.99

Fisher's exact test

All the faculty respondents with positive TMD symptoms were white and the differences were not statistically significant (P<0.05) [Table 7].

Table-7- Distribution of faculty with and without TMD symptoms based on race/ethnicity

Race/Ethnicity	With TMD Symptoms N (%)	Without TMD Symptoms N (%)	p-value
Caucasian	6 (100)	14 (87.5)	
African American	-	-	
Hispanic	-	1 (6.3)	0.66
Asian	-	1 (6.3)	

Fisher's exact test

Resident/students with positive TMD symptoms were younger than those without TMD symptoms and the difference was not statistically significant (P=0.16) [Table 8].

Table-8- Distribution of residents/students with and without TMD symptoms based on age

Variable	**Mean (SD)**		**P.val**
	With TMD Symptoms	With TMD Symptoms	
Age	21 (26.62)	18 (29.28)	0.16

The number of resident/students with positive TMD symptoms was higher among female respondents and the differences were not statistically significant (P=0.08) [Table 9].

Table-9- Distribution of residents/students with and without TMD symptoms based on gender

Gender	**With TMD Symptoms N (%)**	**Without TMD Symptoms N (%)**	**p-value**
Female	16 (76.2)	9 (50)	
Male	5 (23.8)	9 (50)	0.08

$X^2_{(1)} = 2.88$

Majority of the resident/students respondents with positive TMD symptoms were white and the differences were not statistically significant (P=0.57) [Table 10].

Table-10- Distribution of residents/students with and without TMD symptoms based on race/ethnicity

Race/Ethnicity	With TMD Symptoms N (%)	Without TMD Symptoms N (%)	p-value
Caucasian	10 (47.6)	6 (33.3)	
African American	1 (4.8)	0	
Hispanic	10 (38.1)	1 (55.6)	0.57
Asian	2 (9.5)	2 (6.3)	

Fisher's exact test

The average Total Perceived Stress Scale was similar among those with and without TMD symptoms 18.8 (6.06) and 18.52 (5.80) respectively, but no significant difference was found p= 0.87 (Table 11). The parafunctional behavior scores were significantly higher in individuals with pain by function, suggesting greater impairment in functioning. However, there was no significant difference in sleep scores, suggesting that pain by function does not significantly impact overall sleep quality concluding that pain by function does not substantially impact overall sleep quality. Further studies are needed to confirm these findings.

This study also examines the relationship between sleep quality and daily function in students. It found that faculty members experience less pain by function (21.4%), while graduate/resident and undergraduate students report higher percentages (39.3% each). The relationship between group members (Faculty, Graduate/Resident, Undergraduate) and pain by function is not statistically significant (p-value greater than 0.05).

Table 11- Distribution of psychosocial characteristics among respondents with and without TMD symptoms

Variables	**Mean (SD)**		**P. Value**
	With TMD Symptoms	Without TMD Symptoms	
GAD-7[1]	7.35 (5.46)	5.23 (4.88)	0.112
Oral Behavior Checklist	18.25 (10.67)	8.58 (8.96)	0.001*
Perceived Stress Scale	18.80 (6.06)	18.52 (5.80)	0.872
Sleep	21.47 (2.88)	22.30 (2.93)	0.325

1 General Anxiety Disorder-7; * significant <0.05

The only statistically significant difference between the two groups is in oral behaviors (p=0.001), suggesting a strong association between parafunctional habits and TMD symptoms. Other factors like anxiety, stress, and sleep showed differences, but these were not statistically significant.

Table 12- Distribution of psychosocial characteristics among faculty with and without TMD symptoms

Variables	Mean (SD)		P. Value
	With TMD Symptoms	Without TMD Symptoms	
GAD-7[1]	4.16 (3.25)	5.06 (3.10)	0.55
Oral Behavior Checklist	14.00 (13.17)	9.37 (7.68)	0.31
Perceived Stress Scale	17.80 (7.98)	16.41 (4.05)	0.63
Sleep	23.00 (2.91)	21.80 (2.70)	0.41

1 General Anxiety Disorder-7;

Among faculty, none of the psychosocial variables showed a statistically significant difference between those with and without TMD symptoms. The trends suggest higher oral behaviors and stress in the TMD group.

Table 13- Distribution of psychosocial characteristics among resident/students with and without TMD symptoms

Variables	Mean (SD)		P. Value
	With TMD Symptoms	Without TMD Symptoms	
GAD-7[1]	8.22 (5.67)	5.38 (6.13)	0.13
Oral Behavior Checklist	19.40 (9.92)	7.88 (10.14)	<0.001*
Perceived Stress Scale	19.05 (5.71)	20.81 (6.70)	0.44
Sleep	21.05 (2.81)	23.00 (3.22)	0.09

[1] General Anxiety Disorder-7; * significant <0.05

Among students, oral behaviors are significantly associated with TMD symptoms, suggesting parafunctional habits are a key factor. Other variables (anxiety, stress, and sleep) showed trends like higher anxiety and poorer sleep in the TMD group—but these were not statistically significant.

The logistic regression model was used to examine the relationship between pain by function and several predictors, including age, race, gender, functioning based on Oral Behavior Checklist (OBC), and group. The most significant predictor in the model was functioning based on OBC (FTotOBC) which suggests that individuals with higher parafunctional behavior are more likely to report pain by function. Age, race, gender, and group did not show significant associations with pain by function, with age and group having p-values well above 0.05.

Table-14- Summary of multiple logistic regression for different demographic and individual characteristics and positive TMD as outcome variable

Variables	Odds Ratio	p-value	95% C.I. for Exp(B)	
			Lower	Upper
Age	0.97	0.58	0.9	1.05
Race/Ethnicity	-		-	-
Caucasian[1]	0.6	0.68	0.05	-
African-American	44115751.3	1.00	0.000	-
Hispanic	8047557.340	1.00	0 .000	-
Asian	0.4	0.44	0.04	-
Gender				
Male[1]	0.49	0.3	0.13	1.88
OBC [2]	1.08	0.01*	1.01	1.16
Group				
Faculty[1]	1.55	0.67	0.19	12.38
	0.84	0.94		
Constant				

[1]Reference category; [2] Oral Behavior Checklist; Nagelkerke = 0.38; * significant <0.05

Table-15- Summary of multiple logistic regression for different demographic and psychosocial characteristics and positive TMD as outcome variable

Variables	Odds Ratio	p-value	95% C.I. for Exp(B)	
			Lower	Upper
Age	0.99	0.97	0.91	1.08
Race/Ethnicity Caucasian[1]	0.77	0.87	0.03	18.02
African-American	0.33	0.32	0.03	2.91
Gender Male[1]	0.49	0.3	0.13	1.88
OBC [2]	1.11	0.05*	0.99	1.25
PSS[3]	1.01	0.9	0.85	1.19
Sleep	0.83	0.2	0.62	1.1
GAD-7[4]	0.86	0.27	0.66	1.12
Group Faculty[1]	6.60	0.16	0.46	95.00
Constant			13.16	0.54

[1]Reference category; [2] Oral Behavior Checklist; * significant <0.05; [3]Perceived Stress Scale; [4]General Anxiety Disorder

The Hosmer and Lemeshow Test showed no significant impact of the predictors on the model, suggesting that the model fits the data well. The Nagelkerke R-squared test was utilized to estimate the proportion of variability in the outcome variable explained by the predictor variables. The resulting value of 0.37 indicates a moderate goodness of fit for the model. Significant Predictors were that no variables show strong significance in predicting pain by function in this model. However, the Graduate group comes close to significance ($p = 0.068$), suggesting that graduate students might have a higher likelihood of experiencing pain by function compared to undergraduates.

CHAPTER 4

DISCUSSION

Temporomandibular Joint Dysfunction (TMD) is an umbrella term that includes musculoskeletal and neuromuscular conditions affecting the temporomandibular joint [23]. The etiology of TMD is complex and multifactorial [24]. About 60–70% of the general population has at least one sign of temporomandibular joint dysfunction (TMD), but only one out of four individuals is aware of these symptoms and reports them to a specialist [24]. Furthermore, TMD is regarded as the second most widespread musculoskeletal disorder that causes disability and pain with a major impact on the patient’s quality of life [25]. Previous findings from the OPPERA (Orofacial Pain: Prospective Evaluation and Risk Assessment) study reveals that clinical and psychological factors including somatic symptoms, perceived stress, and negative mood independently contribute to the risk of developing first-onset TMD [26]. According to Fale et al.,parafunctional habits should be considered as risk factor for TMD as they act as triggering point for appearance of TMD due to its effect on stomatognathic system [27].

This study explores the association between various psychosocial factors including oral parafunctional behaviors, stress, anxiety and sleep quality among the dental educators and students at Temple university, Kornberg School of Dentistry, United States.

The study surveyed dental students and faculty at Temple University's Kornberg School of Dentistry using a cross-sectional design. Participants were invited to participate via email in Summer 2024 and followed up with follow-up emails. The survey included a demographic questionnaire, a TMD screening questionnaire, and four standardized assessment tools: the Oral Behaviors Checklist, PROMIS™, Perceived Stress Scale, and GAD-7. The questionnaire assessed pain, parafunctional behaviors, sleep quality, stress, and anxiety. Participants with positive symptoms were invited for further evaluation.

The mean age of individuals experiencing TMD positive symptoms was significantly lower than those without TMD symptoms ($p = 0.01$), indicating that younger individuals may be more susceptible to developing TMD-related pain consistent with the study by Isong et al., 2008 [28]. Gender differences were also observed, with females showing a higher prevalence of positive TMD symptoms compared to males. However, this difference did not reach statistical significance ($p = 0.06$). This trend aligns with findings from previous studies by Moreira et al. (2018) [29] and Srivastava et al. (2021) [30]. Racial disparities were observed, but no significant association was found ($p = 0.72$), suggesting that race may not be a primary determinant of TMD susceptibility in this cohort.

All the faculty respondents and residents/students with positive TMD symptoms were Caucasians but the differences were not statistically significant. However in the study by Isong et al (2008) [28], Caucasians experienced higher rates compared to Black and Hispanic individuals in the U.S. adult population.

In this study, a greater number of residents/students reported positive TMD symptoms compared to the faculty which is in alignment with the study by Larkin et al.,2024 [31] where 90.1% of dental students reported TMD symptoms compared to 75.7% of faculty, a statistically significant difference.

According to Slade et al., 2016 [14] and his evaluation on the OPPERA study, the key predictors for developing TMD included jaw parafunctional activities, frequent somatic symptoms and deteriorating sleep quality.

Among students, oral behaviors are significantly associated with TMD symptoms, suggesting parafunctional habits are a key factor. Other variables (anxiety, stress, and sleep) showed trends like higher anxiety and poorer sleep in the TMD group—but these were not statistically significant as in the study by Bal et al (2022) [32].

In our study the only significant predictor for TMD symptoms was oral parafunctional behaviors which is consistent with the study by Larkin et al., 2024 [31] where students with positive TMD symptoms exhibited elevated levels of parafunctional activities.

The findings of Moreira et al. (2018) highlight the significant prevalence of temporomandibular disorders (TMDs) among college preparatory students and their strong association with emotional factors and parafunctional habits. A substantial number of students reported symptoms such as jaw pain, discomfort, and restricted jaw movement. The study establishes a clear link between stress, anxiety, depression, and the increased prevalence and severity of TMD. Parafunctional habits, such as teeth grinding and jaw clenching, were positively correlated with TMD symptoms, underscoring the role of behavioral and psychological factors in the manifestation of the disorder. Furthermore, the negative impact of TMD on students' quality of life, particularly in activities such as eating and speaking, suggests that early intervention and preventive strategies are necessary for managing at-risk individuals [29].

The statistical analysis revealed notable differences in age, gender, and racial distribution among participants with and without TMD symptoms. The mean age of individuals experiencing pain with function was significantly lower than those without pain ($p = 0.01$), indicating that younger individuals may be more susceptible to developing TMDrelated pain. Gender differences were also evident, with females experiencing a higher prevalence of pain with function compared to males, though the difference was not statistically significant ($p = 0.06$). Racial disparities were observed, but no significant association was found ($p = 0.72$), suggesting that race may not be a primary determinant of TMD susceptibility in this cohort.

Further examination of faculty members and students revealed differences in TMD prevalence. Students exhibited a higher incidence of TMD symptoms compared to faculty members ($p = 0.03$), possibly due to increased academic stress and parafunctional habits associated with intense study periods. Within the faculty subgroup, gender did not show a significant impact on TMD symptoms ($p = 0.79$), and racial distribution was similarly not significant ($p = 0.66$). These findings suggest that while TMD prevalence varies across different demographic factors, stress and behavioral habits play a critical role in symptom manifestation.

Slade et al. (2016) investigated the association between parafunctional behaviors and chronic TMD, reporting that individuals engaging in multiple parafunctional habits had significantly higher odds of developing chronic TMD. The Oral Behaviors Checklist emerged as a strong predictor of TMD, reinforcing the need for behavioral assessments in clinical practice. Additionally, the study confirmed the link between comorbid conditions, such as depression and sleep disturbances, and the development of TMD. The bidirectional relationship between sleep impairment and pain was particularly notable, with poor sleep quality increasing the risk of first-onset TMD. These findings highlight the necessity of incorporating sleep assessments into routine TMD evaluations (14).

In the study by Larkin et al. (2024), the authors examined the prevalence, risk factors, and impact of temporomandibular disorder (TMD) signs and symptoms among dental students and faculty at a predoctoral dental school. Among 145 participants (108 students and 37 faculty), 90.1% of students reported TMD symptoms compared to 75.7% of faculty, a statistically significant difference. Students also reported a higher average number of symptoms (5.3 vs. 3.0) and showed significantly elevated levels of parafunctional activities, jaw-strain episodes from prolonged mouth opening, stress, and poor sleep quality. Furthermore, clinical students were more likely than preclinical students to seek evidence-based treatment for TMD. The study concluded that TMD is highly prevalent among both students and faculty, with students experiencing a greater burden. These findings underscore the importance of integrating preventive education and strategies into dental curricula to address modifiable risk factors and improve early management of TMD (31).

One of the strengths of this study is that the questionnaires that were employes for this study which includes the Oral Behavior Checklist to assess the parafunctional behaviors while sleep and waking hours, the Patient-Reported Outcomes Measurement Information

System (PROMIS™) Sleep Disturbance (SD) were used for assessing the sleep quality, the Perceived Stress Scale for assessing stress levels among the participants and the General Anxiety Disorder (GAD-7) for assessing anxiety.

Additionally, the survey was distributed at the time when there were no examinations, hence mitigating the risk of both sampling and response bias, thus improving the external validity of the findings. This study is only the second to be conducted among dental faculty in academic and clinical setting in the United States.

There are a few limitations to this study. The total number of surveys collected (n=62) limits the generalizability of the study findings, as a larger sample size would be needed to enhance the external validity of the results. Furthermore, the distribution of faculty and students who completed the surveys was not equal, which may introduce potential bias. Additionally, the use of self-administered questionnaires may have introduced potential bias as well as self-selection bias as only respondents interested in the survey topic may have responded.

CHAPTER 5

CONCLUSION

This study provides insights into the relationship between pain by function and several demographic and psychological factors in a student population. Dental students and residents exhibited slightly elevated scores in anxiety, perceived stress, and sleep quality; however, these differences were not statistically significant between those with and without positive TMD symptoms. The only significant predictor of positive TMD symptoms was found to be oral parafunctional behavior. Moreover, the higher prevalence of positive TMD symptoms in this group highlights the need for targeted educational and preventive interventions to address stress, anxiety, and oral parafunctional behaviors.

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