Impact of awake bruxism, temporomandibular joint tenderness and stress perception on tension type headache: a cross-sectional study

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Running Title: Impact of Bruxism, TMJ tenderness & stress on TTH

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Abstract:

Objective: To evaluate the association of awake bruxism (self-reported), temporomandibular joint (TMJ) tenderness and stress perception with tension type headache (TTH).

Background: The precise cause of TTH remains ambiguous, despite numerous clinical and neurophysiological studies. Not many studies have explored the relationships of awake bruxism, stress and TMJ pain with TTH.

Methods: Patients attending the Oral Medicine clinic and who sought dental treatment of any nature were recruited as the study population by systematic random sampling in this *cross-sectional, observational study*. History of self-reported awake bruxism (both clenching and repeated tapping of teeth) was obtained. Headache history was obtained and classified using the International Classification of Headache Disorders (ICHD) -3. Stress was evaluated with the aid of the short 4 item scale of Perceived Stress Scale (PSS). Chi-Square Test was performed to assess the relationship between TTH and other categorical variables. Logistic regression analysis was done. $P < .05$ was considered to be statistically significant for all analyses.

Results: Age (p=0.006), awake bruxism(p <0.001), TMJ tenderness (p= 0.002) and stress perception (p <0.001) were all significantly associated with the occurrence of TTH while gender (p=0.247) appeared to have no influence. Logistic regression analysis revealed an adjusted odds ratio of 4.946 (p <0.001) for awake bruxism, 2.391 (p=.016) for TMJ tenderness and 1.686 (p <0.001) for stress perception.

Conclusion: Presence of awake bruxism (self-reported), stress and TMJ tenderness significantly influence the occurrence of TTH.

Introduction

Headaches are often reported by adults and chronic and recurrent headaches have a profound influence on an individual's functional ability[1] causing a decline in the quality of life. This neurological disorder ranks among the top 10 most disabling conditions worldwide for both men and women[2].Tension type Headache (TTH) and Migraine have an extremely high socio-economic impact as they are the most commonly encountered and also the costliest diseases in the world[3]. TTH, the most common primary headache has a lifetime prevalence rate of about 26.1% to 45% and a 1-year prevalence rate of about 38.2% to 59.4%[4]. The precise cause of TTH remains ambiguous, despite numerous clinical and neurophysiological studies[5]. The current consensus is that there is an intertwining of central and peripheral mechanisms[4]. Furthermore, the aetiology, intensity, frequency and chronicity of headache have been suspected and shown to be influenced by disorders of the temporomandibular joint (TMJ) region[6]. The symptomatology of TTH is also likely to be influenced by age and gender dependent changes in general pain perception[7].

Bruxism is a behaviour that can be a risk factor for certain negative oral health consequences (e.g.: severe masticatory muscle pain or temporomandibular joint pain) [8]. There have been studies that have found an association between bruxism and TTH. The same studies have also found an association between anxiety and TTH[9, 10,]

Maladaptive coping, personality disorders and affective distress may explain the routinely observed psychiatric co- morbidities in patients with TTH[2]. Stress is postulated to be a significant contributing factor in the etiology of TTH[11].Evaluation of stress perception is therefore critical to determine its impact on TTH.

The recent theories on occurrences of TTH suggest that pain signals arise from the periphery to the central nervous system (CNS) due to a myofascial component, through trigger points

(TP). This nociception could be responsible for sensitization of the CNS and headaches[12]. There are only 2 studies which explored the relation of TTH and bruxism in firefightersand literature on the same is especially scarce. Therefore, we hypothesized thattheir may be an association of awake bruxism (self-reported), TMJ tenderness and stress perception with tension type headache among patients visiting a tertiary care dental hospital.

Materials & methods:

This cross- sectional study was conducted in the Department of Oral Medicine & Radiology (OMR) of a Tertiary Dental Hospital in Mumbai, India. Institutional Ethics Committee clearance was obtained from Nair Hospital Dental College, Mumbai (EC/PG-02/DOMR/2014). Verbal informed consentwas taken from all study subjects. Patients attending the Oral Medicine clinic in the year 2016-17 aged 12 and above andwho sought dental treatment of any nature (restorations, endodontic interventions, prosthetic crowns, oral prophylaxis etc.) were recruited as the study population by systematic random sampling (every 5th person reporting to the Out Patient Department [OPD]).Our study population was from the lower socio-economic group(though no formal evaluation was done) and draining from the city and its suburban areas. Patients showing less than five teeth per quadrant, who had undergone prosthetic rehabilitation of their teeth, who had history of maxillofacial trauma, those with swellings or clinical diagnosis of malignancies and the ones who had any systemic disorder were excluded from the study. The global age standardized prevalence found through the Global Burden of Diseases, Injuries, and Risk Factors (GBD) studies 2016 was 26.1% (23.6–29.0) overall: 30.8% (28.0–34.0) for women and 21.4% (19.2–23.9) for men[13]. Based on the upper limit of 34% prevalence of TTH found in women, keeping 95% confidence limit (z=1.96)and 5% margin of error, sample size was calculated and the final number of the study participants was 345; 350 participants were therefore chosen. Stress was evaluated with the aid of the short 4 item scale of Perceived Stress Scale (PSS). Each answer

was rated between 0-4 [0 (Never), 1 (Almost Never), 2 (Sometimes), 3 (Fairly Often) & 4 (Very Often)] and an average was obtained. The final value obtained was classified into categories of mild (0-1), moderate (1-2), severe (2-3) and very severe (3-4). History of awake bruxism (self-reported, including both clenching and repeated tapping of teeth) was obtained using the non-instrumental approach as per the *international consensus on the assessment of bruxism*. Headache history was obtained and classified using the International Classification of Headache Disorders (ICHD) -3. Patients with no history of headache or with characteristics not fulfilling the criteria of TTH were recorded as TTH absent. The minimum frequency criteria for infrequent episodic variety of TTH alongside criteria B to E of the episodic and chronic subtypes were used to qualify patients into the TTH presentgroup[14]. Palpation of the lateral side of both the joints as well as palpation through external auditory meatus was done in rest position to elicit TMJ tenderness. TMJ tenderness was noted as either absent (0) or present (1).

Data Analysis:

The data was entered into the Statistical Package for Social Sciences (SPSS) version 28. Descriptive statistics (percentage) were done. Achi-square test of independence was performed to assess the relationship between TTH and other categorical variables. Logistic regression analysis was done to ascertain the effects of awake bruxism, TMJ tenderness and stress perception on the likelihood that participants have TTH$P < .05$ was considered to be statistically significant for all analyses.

Results:

The prevalence of TTH in the study population was 29.14% (102 of 350 participants).

A greater percentage of women subjects (32%) had TTH compared to the male subjects (26.5%) (Table 1), although no significant association between TTH and gender was found.

Amongst the TTH subjects, 52% were women, 44.1% had awake bruxism (Table 2) and 26.5% had TMJ tenderness (Table 2). More than 50% of the study population who reported with severe stress also suffered from TTH. Awake bruxism, TMJ tenderness and stress perception were all significantly associated with the occurrence of TTH.

Table 1: Descriptive analysis of the response variable tension type headache (TTH) and the predictors of gender & age.

		TTH		p value
		Absent	Present	
GENDER	Male	136	49	0.247
	Female	112	53	
AGE	Adolescents (<19 Years)	41	3	0.006
	Young Adults (20-39 Years)	121	56	
	Middle Aged (40-59 Years)	71	37	
	Elderly (>60 Years)	15	6	

Table 2: Distribution of the response variable tension type headache (TTH) and predictors of awake bruxism, temporomandibular joint (TMJ) tenderness and stress

		TTH		p value
		Absent	Present	
AWAKE BRUXISM	Absent	219	57	<0.001
	Present	29	45	
TMJ TENDERNESS	Absent	216	75	0.002
	Present	32	27	
STRESS LEVEL ON PSS-4	Mild(0-1)	108	10	<0.001
	Moderate(1-2)	72	33	
	Severe(2-3)	46	51	
	Very Severe(3-4)	22	8	
CONCOMITANT BRUXISM and JOINT TENDERNESS	Absent	245	92	<0.001
	Present	3	10	

Binary logistic regression analysis revealed a statistically significant model, $\chi2(4) = 65.692$, $p < .001$(Table 3). The model explained 24.4% (Nagelkerke R2) of the variance in TTH and correctly classified 75.4% of cases. People with awake bruxism were 4.95 times more likely to exhibit TTH than those without it. TMJ Tenderness was associated with 2.39 timesincrease in the likelihood of exhibiting TTH. Greater stress perceived by patients increased the possibility of having TTH by 1.68 times.

Table 3: Logistic Regression Analysis demonstrating the relationship of various variables to TTH.

		p	**Exp(B) - Odds Ratio**	**95% C.I. for EXP(B)**	
				Lower	**Upper**
Step 1[a]	**Age**	.648	.995	.976	1.015
	Gender	.547	1.175	.695	1.987
	Bruxism	**<.001**	**4.946**	2.592	9.438
	Temporomandibular joint (TMJ) tenderness	**.016**	**2.391**	1.173	4.870
	Stress level on perceived stress scale (PSS)-4	**<.001**	**1.686**	1.267	2.244
	Concomitant Awake Bruxism and TMJ tenderness	.912	.915	.187	4.466
	Constant	<.001	.079		

a. Variable(s) entered on step 1: age, gender, awake bruxism, TMJ tenderness, stress level on PSS-4, concomitant awake bruxism and TMJ tenderness.

Discussion:

Primary headache disorders are underrated and underdiagnosed in many developing nations[3]. They constitute a significant public health problem with up to 75% of adults experiencing headache in the year 2021 worldwide[15]. Most patients resort to over-the-counter (OTC)

medications to self-manage symptoms and are never professionally diagnosed[13]. The fundamental symptoms of TTH are bilateral pressing or tightening (non-pulsating) pain, mild or moderate intensity, not aggravated by routine physical activity such as walking or climbing stairs, no nausea (mild nausea may be present in chronic forms) or vomiting and no more than one of photophobia or phonophobia[14]. There may be accompanying pericranial tenderness. In general, even though TTHs are eased by rest, relaxation, or OTC medications, sufferers often continue their usual routine. Two studies have confirmed the global increase in negative effect in patients with TTH[16]. Their results have indicated that people with TTH were more easily distracted, had greater psychomotor slowing and showed impairment in logical reasoning and semantic processing tasks. TTH is reported to have caused 7·2 million years of life lived with disability globally in 2016[13]. The exact cause of TTH is not fully understood. However, there are links to various factors, including nutritional (vitamin B12 & D deficiencies) muscular and environmental such as stress and forward posture[17]. A study done by Troeltzsch et. al[6] concluded that female gender, middle age (30 to 60 years), and muscular pathology (myogenic pain, trigger points, or combinations) influence the prevalence, frequency, and intensity of headache. Since the trigeminal nuclei for mechanoreceptive, proprioceptive, and pain sensations are present in close proximity, continuous strong mechanoreceptive input from inflamed TMJ structures, tense muscles or bruxism may explain the incidence and prolongation of headache in patients whose stomatognathic system is upset in any way[6].

This study is the first to assess the association of TMJ tenderness, awake bruxism and stress perception with TTH. The global age standardised prevalence of TTH is reported to be 26.1% overall, 30.8% for women and 21.4%for men[13]. We found a prevalence of 29.14% of TTH in the overall population studied. The female population had a greater prevalence of TTH (n =53 of 165, 32.1%) compared to the male population (n=49 of 185, 26.5%), although the

association between gender and TTH was not found to be statistically significant. Our results show that overall TTH prevalence and female prevalence is marginally higher in the population we studied than the global prevalence. Given the male dominated study population it could be expected that the female prevalence may actually be higher than that projected in this study. Some underrepresentation may also be possible as in a male dominated society; females do not readily seek treatment for non-emergent issues like headache, preferring to manage it themselves.

Lifetime prevalence of TTH in the general population ranging between 30 to 78% has been reported[14]. Stovner et al. reported the percentage of global adult population with an active TTH disorder to be about 42%[18]. A study of the adult population between 18 and 65 years revealed a 33.3% prevalence of TTH[19]. In our study, 32.35 % of the adult population (20 and above) was found to be affected by TTH. Among the entire adult population, young adults (between ages 20 and 39 years) constituted the maximum percentage of TTH afflicted patients (n = 56, 54.9%) followed by middle aged adults (age: 40 to 59 years; n=37, 36.3%). TTH prevalence in the elderly patients (above 60 years of age) was found to drop to 28.6%. Studies have reported that in the very old age group (> 70 years) the headache frequency seems to decrease again[15]. The results of this study are in concurrence with earlier studies. None of our over 70 years' subjects had TTH.

The prevalence of TTH in children is found to be significantly less (31% in global studies, range: 10–72%) with chronic forms of TTH reported to be nearly absent in the age group below 15 years[15].Prevalence of TTH in urban Indian adolescents is reported to be 11%[20]. We found a TTH prevalence of 6.8% in adolescents of our study. This difference may be because our study cohort belonged to low socio-economic strata, who may ignore milder forms of headaches.

It was found that of the patients suffering from TTH, 44.1% had awake bruxism,26.5% manifested with TMJ tenderness while 9.8% of the patients reported with concomitant awake bruxism and TMJ tenderness. Stress perception was reported as very severe by 7.8 %, severe by 50% and moderate by 32.4% of the study population suffering from TTH (Table 2).

In the subset of population suffering from awake bruxism (n=74), 60.8% were suffering from TTH while in the subset of population suffering from TMJ tenderness (n=57), 45.8% had TTH. Logistic regression analysis revealed an adjusted odds ratio of 4.946 ($p < 0.001$) for awake bruxism and 2.391 ($p = .016$) for TMJ tenderness (Table 3). In people reporting very severe, severe and moderate stress, 26.66%, 52.57% and 31.42% respectively suffered from TTH while of those who reported mild stress levels, only 8.4% were found to be suffering from TTH. It is interesting to note that 76.92% of patients who reported concomitant awake bruxism and TMJ tenderness also had TTH.

There are only two studies assessing bruxism and solely TTH among primary headaches[9, 10.] A study was done among military firefighters of Rio de Janeiro who had frequent episodic tension-type headache (FETTH) and painful TMDs[10]. The results indicated that awake bruxism was a risk factor for FETTH with non-painful TMDs while anxiety and awake bruxism were found to be independent risk factors for developing FETTH associated with painful TMDs. A similar study revealed that TMDs and anxiety among firefighters were associated with FETTH[9]. Comparing the logistic regression results; earlier studies demonstrated an Odd's Ratio(OR) of 2.11 and 3.14 for awake bruxism with painful and non-painful TMD respectively and 0.7 & 1.6 for sleep bruxism [9, 10, 21](Table 3). Surprisingly our results revealed a OR of 4.9 for awake bruxism, which was higher than the earlier studies. While a significant association of concomitant awake bruxism and TMJ tenderness was noted with TTH, logistic regression analysis revealed an odds ratio of 0.915. However, it is important to note that 76.92 % (n=10/13) patients with concomitant awake bruxism and TMJ

tenderness had TTH. It needs mention here that the earlier studies were on firefighter population while ours was on patients visiting the dental hospital. This difference in results could be because probably firefighters are better trained to handle stressful situations than the general population. Interestingly, a systematic review (SR) ascertaining any association between primary headaches and bruxism in adults among observational studies concluded that patients with awake bruxism have 5 to 17 times greater chances of having TTH while no association was found between sleep bruxism and TTH[22]. Surprisingly the OR for developing TTH in awake bruxism patients from this SR was higher than that of the individual study included in the SR. This could be because the data was divided into subsets with concomitant awake bruxism and TMD (OR=5.23) and with awake bruxism without TMD (OR=17.29), as opposed to the categories of the original study i.e., awake bruxism with painful TMDS and awake bruxism with non-painful TMDS. Also, this SR pooled data from only studies for assessing the association of primary headaches to bruxism.

We evaluated patients who presented with concomitant awake bruxism and TMJ tenderness (n=13). Although chi square test revealed a significant association ($p<0.001$), logistic regression analysis revealed it to be statistically insignificant.

Stress and anxiety also have time and again been iterated as contributory factor in TTH[9,10,11.] A cross-sectional study done in patients suffering from TTH found that 70.6% had co- morbid generalized anxiety disorder (GAD) while 54.1% had major depressive disorders (MDD)[2]. Wittrock and Myers *et al*. found evidence to suggest that individuals with recurrent TTH were more sensitive, had a lower threshold to pain and experienced more stressful events[23].

We too found that 57.8% of the population with TTH obtained scores between 2 -4 (maximum score: 4) on the PSS-4 scale while 32.4% had scores between 1 and 2. Logistic

Regression analysis revealed that increase in stress led to 1.686 greater odds of occurrence of TTH (Table 3).

Limitations:

As with any other cross-sectional study, our study design precluded temporal assessment. TMJ tenderness is just one among the plethora of factors associated with TMD that we studied. We also did not subclassify TTH into infrequent episodic, frequent episodic, chronic and probable forms. Only one examiner (dentist) obtained the relevant history and performed clinical examination of the patients.

Conclusion:

Presence of awake bruxism (self-reported), stress and TMJ tenderness significantly influence the occurrence of TTH. Awake bruxism (self-reported) appeared to have the greatest impact, causing a near fivefold rise in the probability of TTH occurrence. Stress perception had a strong association with TTH ($p<0.001$). TMJ tenderness also had an association, with its presence constituting twice the risk of having TTH. These findings suggest that it is vital that clinicians do not ignore awake bruxism (self-reported), TMJ tenderness and stress in a patient in order to prevent future TTH development and complications. General population studies with further investigation correlating the TMDs as a whole with TTH along with detailed evaluation of psychiatric comorbidities will definitely help to understand the association of these factors better.

Highlights:

- To the best of our knowledge, this is the first study evaluating the effects of awake bruxism (self-reported), stress perception and TMJ tenderness on TTH in a *civilian* population.

- This is one of the few studies ascertaining the impact of awake bruxism, stress perception and TMJ tenderness on TTH in an *Indian* subpopulation.

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- Resources: Dr. Kaustubh Sansare, Dr. FrenyKarjodkar
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