

# Temporomandibular disorders and bullying: The mediating role of anxiety in young adults

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**Background:** Bullying is a major social issue. Individuals who experience bullying victimization may develop stress-related health disorders, such as anxiety and temporomandibular disorders (TMDs). As school bullying can enhance or trigger stress and anxiety, individuals who experience bullying victimization are prone to develop TMD. However, it is still unclear whether this relationship is mediated by anxiety. **Objective:** The aim of this study was to investigate the role of anxiety in the relationship between bullying victimization and TMD among young adults. **Methods:** A cross-sectional study among 578 students aged 18 to 25 years in Yucatan, Mexico. A mediation model was used to identify whether anxiety mediated the relationship between bullying victimization and the development of TMD. **Results:** Our results showed that 14.2% of the students self-identified as victims of bullying, and 43.7% reported having a type of TMD. The indirect effect of the pathway “victimization → anxiety → TMD” was significant ( $\beta = 0.660$ ;  $p < 0.001$ ). There was also an effect, not mediated by anxiety ( $\beta = 0.31$ ;  $p = 0.026$ ). This means that the relationship between victimization caused by bullying and TMD is mostly mediated by anxiety. **Conclusion:** This study presents the first evidence of the role of anxiety as a mediator of the relationship between bullying victimization and TMD among young adults in Mexico.

**Keywords:** Mexico, Anxiety, Temporomandibular disorders, Bullying victimization

## Introduction

Bullying has become one of the most important social issues around the world. Bullying can be defined as a repeatedly aggressive behavior that includes physical, verbal and social abuse by a perpetrator (Gladden *et al.*, 2014). Bullying victimization is the most common type, characterized by a power imbalance between the perpetrator(s) and the victim (Moore *et al.*, 2017). Studies on bullying victimization are mostly focused on mental health problems, including drug abuse, or the effects on academic achievement (Nakamoto and Schwartz, 2010; Ttofi *et al.*, 2016). Nevertheless, some studies have explored the impact on stress-related health disorders (Smokowski and Kopasz, 2005).

Temporomandibular disorders (TMDs) have been reported among young adults (Bertoli *et al.*, 2018). TMD is a musculoskeletal disorder of the masseter muscles, temporomandibular joint (TMJ) and other structures associated with the oral cavity (Maini and Dua, 2019). The etiology of TMD is multifactorial; with emotional factors, such as anxiety, playing an important role (Fulgencio *et al.*, 2017). Individuals who experience different types of violence, such as bullying victimization, may develop stress-related health disorders, such as anxiety and TMD. Previous reviews have associated bullying with anxiety, social phobia and post-traumatic stress disorder (PTSD) (Moore *et al.*, 2017). Moreover, the relationship between anxiety and TMD has been described. Patients with anxiety reported greater hyperactivity and muscle fatigue (Micco *et al.*, 2009). In this regard, the association between bullying and TMD might be mediated by anxiety (Fulgencio *et al.*, 2017).

In Mexico, only one study has addressed the relationship between bullying victimization and anxiety (Mendoza González *et al.*, 2017). The Organization for Economic Cooperation and Development (OECD) revealed that Mexico had higher rates of intimidation or verbal bullying among students than the other evaluated countries (Backhoff and Pérez-Morán, 2015). Although Yucatan is one of the states in Mexico with the highest prevalence of depression and anxiety (Castillo León *et al.*, 2019), no data could be found regarding the relationships between bullying victimization, anxiety and TMD.

As school bullying can enhance or trigger stress and anxiety, we hypothesized that young adults who experience bullying victimization are prone to develop TMD, and this relationship is mediated by anxiety. Therefore, the aim of this study was to investigate the possible role of anxiety in the relationship between bullying victimization and suspected TMD among young adults in Yucatan, Mexico.

## Methods

A cross-sectional study was performed among university students aged 18 to 25 years in Yucatan, Mexico from February to May 2020. The inclusion criteria included students who were currently enrolled at the university and 18 years of age and older. No exclusion criteria were applied. The power calculation assumed a 97.5% confidence interval, a 5% margin of error, a 50% unknown prevalence of bullying victimization and a 10% adjustment for nonresponse. From this calculation, the minimum required sample size was 559 participants. A

total of 578 students participated. After explaining the purpose of the study, participants who agreed to take part were briefed on the correct way to fill out instruments. Data were collected using paper-based self-administered surveys. All participants signed a consent form. This study was approved by the Ethics Committee of Regional High Speciality Hospital (Identification code: 2020-027).

The California Bullying Victimization Scale (CBVS) was used to assess bullying across three key components: (1) intention to cause harm, (2) aggression for a long period of time and (3) the existence of a power imbalance between victim and perpetrator (Felix *et al.*, 2011). The CBVS determines bullying by identifying cases that have experienced some type of aggression at least 2 or 3 times in the last month (Solberg and Olweus, 2003) and who experience the power imbalance between the victim and the perpetrator. In previous studies, the CBVS reported a test-retest reliability of 0.71 (Felix *et al.*, 2011) with an internal consistency ranging from 0.72 to 0.83 (Atik and Guneri, 2012). The intention to cause harm was determined using the words “mean or hurtful way” in each item. The CBVS includes eight items that are presented in both ways (victimization and perpetrator). The items are ranked using a five-point ordinal scale (0 = never; 1 = once last month; 2 = 2- or 3-times last month; 3 = once a week; 4 = several times in a week). To assess power imbalances, the CBVS asks students “how popular, smart and physically strong” they are compared with the aggressor.

The Beck Anxiety Inventory (Beck *et al.*, 1988) was used to measure anxiety using 21 Likert-type scale items that measure a one-dimensional construct. Previous studies indicate a reliability of 0.75 and an internal consistency of 0.92. Furthermore, this instrument can discriminate between clinical patients with anxiety disorders and nonclinical samples. The instrument has been previously validated and adapted among Mexican populations (Robles *et al.*, 2001).

The Fonseca anamnestic index was used to measure temporomandibular disorders (Fonseca *et al.*, 1994). The instrument includes 10 items with precoded responses ranked as follows: No (0), Sometimes (5) and Yes (10). Each participant was classified into four categories: without (0-15), mild (20-40), moderate (45-60) and severe (70-100) TMD. Previous studies indicate a reliability of 0.745 for this scale (Bonini *et al.*, 2014). The Fonseca anamnestic index has been used and validated in Latin America, including Mexico. The data used in the present study had a Cronbach’s alpha reliability coefficient of 0.754 and a McDonald’s omega coefficient of 0.758.

A descriptive analysis of variables created mean values, standard deviations and frequencies. Associations were estimated using the Pearson correlations. Gender differences were estimated using the Mann–Whitney U test, and comparisons of the effect size were obtained using Cohen’s d. A mediation model was performed to identify whether anxiety (M) mediated the possible relationship between bullying victimization (X) and the development of TMD (Y). In addition, adjusted analysis was carried out to control the effect of age, sex and type of school. Anxiety and TMD data were skewed, therefore a bootstrap bias-corrected mediation model was used. A bootstrap method with 1000 samples estimated the

unstandardized effects through the maximum likelihood method. For all analyses, an alpha of 0.05 was used. Statistical analyses were performed using JAMOVI software version 1.1.9.0 and R statistical software. Variables did not present collinearity ( $VIF < 5$ ). A minimum of 462 participants were used to obtain a statistical power of 0.80. Thus, the final sample size can be considered sufficient. Listwise exclusion of missing values was used (anxiety = 9, TMD = 2, bullying victimization = 0). Moreover, the sensitivity analyses did not show outliers (z value greater than 1.96).

## Results

A total of 578 students were enrolled, with a mean age of  $19.4 \pm 1.68$  years. Slightly fewer were female (42.6%), than male (57.4%). More were from public (54.7%) than private schools (45.3%). Indirect bullying was the most frequent type of victimization, such as spreading rumors, gossiping and teasing (insulting). Threats and physical violence, such as hitting and shoving, were less frequent (Table 1).

Eighty-two participants (14.2%) self-identified as experiencing bullying and reported some type of violence during the last month at least 2 or 3 times per week. They

**Table 1.** Characteristics of the sample and descriptive of bullying victimization, TDM and anxiety among 578 students.

Variable	%	
Gender		
Male		42.6
Female		57.4
School type		
Public		54.7
Private		45.3
Bullying victimization		
Victim		14.2
No victim		85.8
Victimization type		
Teased or called names		6.4
Spreading rumors or gossip		7.6
Social exclusion		3.7
Physical violence		2.1
Threatening		1.9
Sexual comments or jokes		4.7
Things stolen or damaged		3.5
Cyberbullying		3.5
	Mean (SD)	Min-Max
Age	19.37 (1.68)	18-25
Bullying (CBVS)	11.86 (3.99)	10-50
TMD (Fonseca anamnestic index)	17.91 (15.80)	0-100
Anxiety (Beck anxiety inventory)	9.80 (9.75)	0-63

TMD: Temporomandibular disorders;  
SD: standard deviation.

also perceived a *power imbalance* between them and the *aggressor*. As shown in Table 2, 88.8% of participants experienced low levels of anxiety. Almost half (43.7%) reported mild, moderate or severe TMD. Higher levels of TMD and anxiety were found in those experiencing bullying both ( $p < 0.001$ , Mann-Whitney U).

**Table 2.** TMD and anxiety levels by victimization condition among 578 students.

Variable	Not experiencing	Experiencing
	(n = 496) %	(n = 82) %
Temporomandibular disorder		
Non TMD	58.9	39.0
Mild	35.0	42.7
Moderate	5.3	14.6
Severe	0.8	3.7
Anxiety		
Low	91.0	75.3
Moderate	7.2	17.3
Severe	1.8	7.4

TMD: Temporomandibular disorders.

The relationship between TMD, anxiety and bullying victimization is shown in Figure 1. Victimization had a significant and direct relationship with TMD ( $r = 0.245$ ;  $p = < 0.001$ ), meaning that an increase in victimization was associated with an increase in TMD (Figure 1A). Bullying victimization was also positively associated with anxiety ( $r = 0.318$ ;  $p = < 0.001$ ) (Figure 1B). Finally, there was a strong correlation between TMD and anxiety ( $r = 0.550$ ;  $p = < 0.001$ ) (Figure 1C).

Scores for bullying victimization were similar between female and male students (means and SDs = 12.07, 4.35 and 11.7, 3.71 respectively). However, TMD scores were lower among female than male students (15.12, 14.86 and 20.00, 16.19 respectively,  $p < 0.001$ , Mann-Whitney U) as were scores for anxiety (8.59, 8.32 and 10.7, 10.61 respectively,  $p < 0.026$ , Mann-Whitney U).

The role of anxiety in the relationship between bullying victimization and TMD is depicted in the model

presented in Figure 2. The model demonstrated a significant effect of having TMD ( $\beta = 0.967$ ;  $SE = 0.160$ ;  $p = < 0.001$ ), and  $R^2$ s of 0.307 for TMD and 0.101 for anxiety. The indirect effect of the pathway “victimization  $\rightarrow$  anxiety  $\rightarrow$  TMD” was significant ( $\beta = 0.660$ ;  $SE = 0.095$ ;  $p = < 0.001$ ) at both stages, from bullying victimization to anxiety and anxiety to TMD. Finally, there was a direct effect of bullying victimization on having TMD ( $\beta = 0.31$ ;  $SE = 0.145$ ;  $p = 0.034$ ). This suggests that although there is a direct association between victimization and TMD, the relationship is mostly mediated by anxiety.

In model analysis adjusting for confounders, such as sex, age and type of university (private or public school), the direct effect of “bullying victimization  $\rightarrow$  anxiety” and the effect of “anxiety  $\rightarrow$  TMD” were significant. However, the direct effect of “bullying victimization  $\rightarrow$  TMD”, was not significant suggesting that the positive effect identified in Figure 1 might be mediated by other factors.

## Discussion

This study aimed to investigate the possible role of anxiety in the relationship between bullying victimization and suspected TMD in young adults in Yucatan, Mexico. Higher levels of anxiety and TMD were found among males. Positive associations between bullying victimization and suspected TMD and anxiety were established. Anxiety mediated between bullying victimization and suspected TMD.

Our results showed that 14.2% of university students self-identified as experiencing bullying. A meta-analysis on the prevalence of bullying in Mexico (cyber-victimization, face-to-face victimization and face-to-face aggression) reported higher rates, varying from 19% to 21% (Vega-Cauich, 2019). A cross-sectional study (Álvarez *et al.*, 2017) among adolescents between 12 and 18 years showed a prevalence of bullying of 37.7%. Another study among 210 10 and 19 year olds of Mayan descent between reported a higher prevalence (74.3%) (Mendiburu-Zavala *et al.*, 2020).

The relationship between anxiety and TMD has been more widely explored than the relationship between bullying and TMD. Individuals with TMD have been documented to be more anxious and usually express feelings by bracing or thrusting of the jaw, leading to effects on the TMJ or other oral structures. Castillo-Gamboa *et al.* (2019) concluded that adolescents with higher levels of

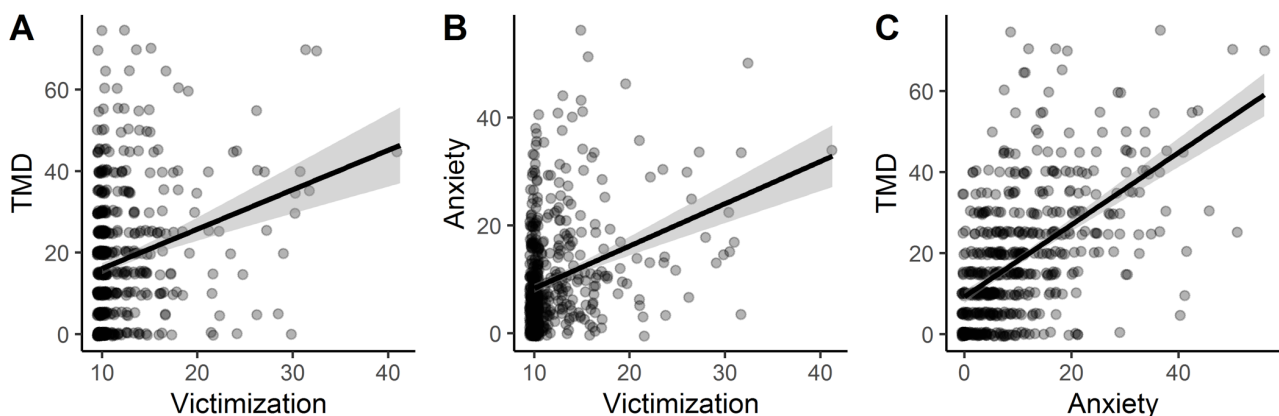


Figure 1. Relationship between A) bullying victimization and TMD; B) bullying victimization and anxiety and C) Anxiety and TMD.

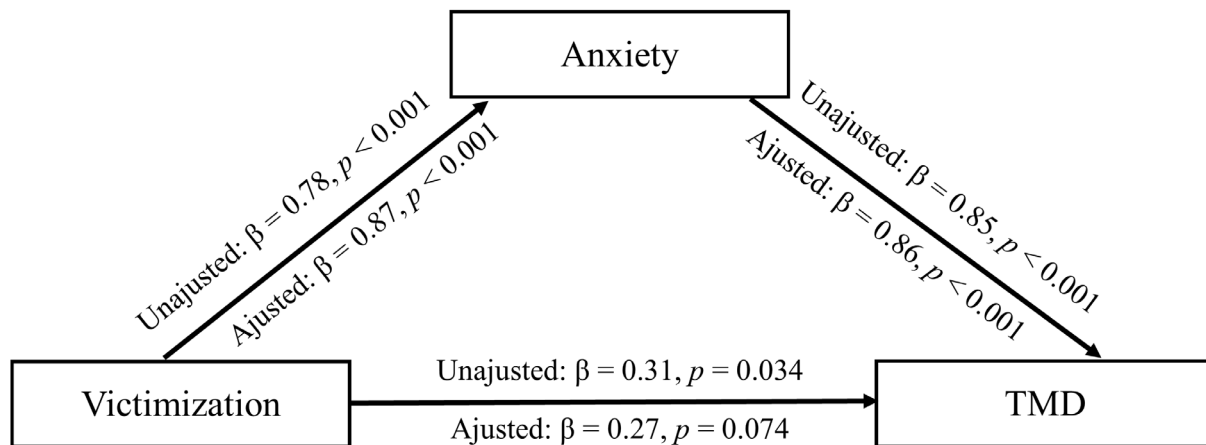


Figure 2. The mediation model of “victimization → anxiety → TMD”.

anxiety presented a greater degree of TMD. However, the component of bullying victimization has not been included or found in the literature. In our study, the model of “bullying victimization → anxiety → TMD” had a strong association among variables ( $\beta = 0.660$ ;  $p < 0.001$ ). Bullying victimization predicted TMD, with the indirect relationship mediated by anxiety having a stronger effect. After controlling age, sex, and type of school, only the anxiety-mediated relationship remained significant.

The apparent effect of anxiety might be due to anxiety being associated with muscle hyperactivity. Thus, students who experience bullying victimization may develop TMD as an expression of muscle tension (*tightness*). Hence, bullying might lead to oral damage, such as a TMD (Alonso *et al.*, 2021, Fulgencio *et al.*, 2017).

However, it is important to consider that higher education students are exposed to different types of environments, such as work, family, and friends, that could also play a role in anxiety levels (Gómez-Galán *et al.*, 2021). Moreover, the impact of bullying in university students is under-researched. Therefore, this study presents the first evidence of the role of anxiety as a mediator of the relationship between bullying victimization and suspected TMD among university students in Mexico.

The associations reported here could be further validated in future studies. Limitations in our study include using self-report data, which may lead to a lack of reporting some symptoms, or some participants could be experiencing bullying but do not realize or mention it. In addition, university students are in a different environment than other students, with different levels of anxiety and stress. Further studies should control confounders, such as workload and academic demands. Our cross-sectional design also restricts causal inference.

### Conclusion

Early detection of bullying could lead to reduced anxiety symptoms and may prevent the development of TMD. Mental health professionals could consider the development of TMD symptoms among patients who experience bullying and anxiety. Although TMD and bullying were related, the mechanism for this relationship is not clear.

Therefore, long-term studies may help to comprehend the association between TMD, bullying victimization and anxiety.

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