A Cross-Sectional Study of Prevalence and Etiology of Signs and Symptoms of Temporomandibular Disorders in High School and University Students

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The aim of this study was to evaluate the prevalence and need for treatment of temporomandibular disorders (TMD) in students living in Bauru, Brazil. The role of occlusal and emotional factors was also addressed. The presence and severity of TMD was determined by using a self-reported anamnestic questionnaire composed of 10 questions regarding common TMD symptoms. The symptoms were transposed into a severity classification according to the number and frequency of positive responses. Occlusal evaluation included an analysis of retruded contact position, intercuspal position, anterolateral guidance, and nonworking side contacts during mandibular movements. Palpation of the muscles and temporomandibular joints were performed to detect clinical signs of TMD. A chi square test was used to compare clinical and occlusal data with the presence and severity of TMD. A total of 0.65% of the subjects had severe TMD symptoms, 5.81% had moderate symptoms, and 34.84% had mild symptoms. Those with severe and moderate symptom levels were interpreted to be in need of treatment. Symptoms were found significantly more frequently in females than in males ($P < .01$). Self-reported emotional tension and parafunctional habits demonstrated strong associations with TMD ($P < .01$). Occlusion did not seem to influence the presence or severity of TMD. Based on these results, the efficacy of some traditional TMD treatments should be reconsidered, and reversible and conservative procedures should be the first choice for managing TMD patients.

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The term *temporomandibular disorders* (TMD) is defined as a "collective term embracing a number of clinical problems that involve the masticatory musculature, the temporomandibular joint (TMJ) and associated structures, or both."[1] Its study has been of interest to dentistry and medicine since 1934, when Costen[2] first described a series of symptoms that came to be named *Costen's syndrome*. The most common symptoms associated with TMD today are masticatory and cervical muscle pain, TMJ pain and/or sounds, and limitation and incoordination of mandibular movements. More recent studies[3–5] demonstrate that although the prevalence of such problems is high, the true need for treatment is still unclear because symptoms are episodic and self-limiting in most cases.

To better understand the prevalence of TMD among a nonpatient population, many epidemiologic studies[6–10] have been conducted utilizing a variety of assessment and measurement methods. Different methodologies are believed to be one of the reasons for the frequent disagreement among researchers, forcing vague and uncertain conclusions in most cases. To standardize the methodologic approaches, various proposals for TMD research have been developed over the years.[11–13] Among these, the Anamnestic and Clinical Dysfunction indexes proposed by Helkimo[7,14–16] have been the most utilized by researchers for epidemiologic surveys.

Anamnestic questionnaires have been used to assess the problems of the masticatory system for the last 20 years.[14,17] Studies[18] have reported that as much as 75% of a general population may have some type of functional alteration. Such high prevalence questions whether the epidemiologic methods are applied correctly and whether the data are correctly interpreted. Answering these questions is an important step toward better defining treatment goals and minimizing overtreatment of "episodic" patients.

The etiology of TMD is another topic that still remains unclear. Among various hypotheses proposed to explain the onset and maintenance of symptoms, those advocating occlusal factors and psychologic disturbances are among the most common. Loss of posterior support, occlusal interference, and lack of anterolateral guidance during mandibular movements are proposed by some to play an important role in initiating and perpetuating TMD.[19,20] Conversely, some studies[4,21–25] refute these hypotheses, stating that there is no scientific evidence supporting such a relationship.

Psychologic factors including individual, interpersonal, and situational variables influence the patient's capacity to function adaptively.[1] It has been hypothesized that some emotional conditions such as anxiety, depression, and individual personality characteristics can predispose, initiate, and perpetuate TMD.[26,27] It has also been proposed that parafunctional habits such as teeth clenching and grinding can create excessive forces, overload the muscles and the TMJ, and lead to generalized damage of the entire masticatory system.[28,29]

Prevalence and etiology of TMD thus remain challenging topics, although they have been studied for more than 50 years. The aim of the present study was to contribute information regarding the prevalence and possible causes of TMD in teenagers and young adults. The goals of this investigation were to determine *(1)* the prevalence of TMD symptoms and signs among a selected group of students, using a self-reported anamnestic questionnaire; *(2)* the difference in prevalence for TMD symptoms and signs between males and females; and *(3)* the association of occlusal and psychologic factors with TMD signs and symptoms.

Materials and Methods

Subjects

The subjects comprised 310 students (51.61% females and 48.39% males) living in Bauru, São Paulo, Brazil, with a mean age of 19.79 years. The subjects were placed into two groups: group 1, composed of 152 high school students (51.32% females and 48.68% males), with a mean age of 18.47 years; and group 2, the comparison group, composed of university students (51.90% females and 48.10% males), with a mean age of 21.05 years. For both groups, the selection was randomized, and students were not informed of the research goals before the data collection so as to avoid any increased number of "possible patients."

Questionnaire

The questionnaire contained information about personal and medical history as well as questions about symptoms that make up an anamnestic index developed from previous investigations.[14,17,30] This questionnaire has been previously tested with 100 patients with TMD complaints and has shown a strong statistical association to a modified Helkimo's Clinical Dysfunction Index at a 95% level of confidence.[17] Questionnaires with accompanying clinical examinations for group 1 were given during the time of the students' final school exams. This time period was selected to study the influence of emotional components (stress, emotional tension) on this group because competing for a place in a university is often stressful.

The questionnaire was composed of 10 questions inquiring about the presence of the most common TMD symptoms. For every response indicating the presence of the dysfunction, a grade of 2 was given. A score of 0 signified the absence of symptoms, while 1 was given for a report of an occasional occurrence. A score of 3 was used to indicate severe pain and/or bilateral symptoms. The sum of the scores from all 10 responses were used to classify the students into four categories:

Table 1 Results (%) of the Anamnestic Questionnaire

Question	Response		
	No	Sometimes	Yes
Do you have difficulty in opening your mouth?	91.61	6.45	1.94
Do you have difficulty in moving or using your jaw?	90.32	6.77	2.90
Do you have tenderness or muscular pain when chewing?	70.97	21.61	7.42
Do you have frequent headaches?	61.29	22.58	10.32//5.81*
Do you have neckaches and/or shoulder pain?	65.16	20.97	13.87
Do you have pain in or about the ears?	81.95	10.00	2.58//5.48†
Are you aware of noises in the jaw joints?	64.52	14.52	10.32//10.65†
Do you consider your bite "normal"?	10.65	4.52	84.84
Do you use only one side of your mouth when chewing?	61.61	16.13	22.26
Do you have morning facial pain?	89.35	8.06	2.58

*Headache//weekly and/or long-lasting headache.
†Unilateral//bilateral.

(1) from 0 to 3 points, TMD free; *(2)* from 4 to 8 points, mild TMD; *(3)* from 9 to 14 points, moderate TMD; and *(4)* from 15 to 21 points, severe TMD. To avoid any examiner bias during the occlusal analysis and muscle palpation, results of anamnestic scoring were not available to the examiner before the clinical examination. Questions about awareness of parafunctional habits (clenching, bruxing, nail biting, chewing gum, etc) and emotional tension were also answered.

Occlusal Evaluation

The occlusal analysis consisted of evaluation of the following: retruded contact position (RCP), intercuspal position (IP), overbite and overjet, excursive movements of the mandible (protrusive and lateral), and supracontacts on the nonworking (balancing) side. Centric relation was recorded with slight pressure on the chin, according to a technique proposed in previous epidemiologic studies.[9,31,32]

Muscle and TMJ Palpation

Head and neck muscle palpation was performed following the technique proposed by Okeson,[29] and TMJ palpation was carried out with the mandible in both the closed (lateral wall) and open (posterior wall) positions. Palpation was performed with a standardized pressure and was completed by the same examiner, using the middle finger. A soft but firm pressure was maintained for 2 seconds. No differentiation between levels of pain was done. Muscles palpated were the superficial and deep masseter; anterior, medial, and posterior temporalis; suboccipital; sternocleidomastoid; digastric; and medial pterygoid.

Statistical Analysis

The prevalence of joint sounds and headaches was calculated by percentage. A chi square test with a 95% level of confidence assessed the association between the variables studied and the presence and severity of TMD signs and symptoms.

Results

Prevalence and Need of Treatment

The results of the anamnestic questionnaire for all subjects are shown in Table 1. Constant joint sounds (20.97%) and frequent headaches (16.13%) were the most frequent symptoms reported. Results of the anamnestic questionnaire also revealed that 58.71% of the subjects were asymptomatic, 34.84% had mild TMD signs and symptoms, 5.81% had moderate TMD signs and symptoms, and only 0.65% had severe TMD signs and symptoms. When sex differences were analyzed, females presented with significantly more symptoms than did males ($P < .01$); 10.0% of the females had moderate or severe TMD, and only 2.6% of the males had moderate or severe TMD.

More than half of the subjects (59.76%) attended or applied for a place in a highly regarded university. A total of 46.45% of the subjects answered that they had some type of orthodontic treatment, and 3.23% had some type of dental prosthesis (fixed or removable).

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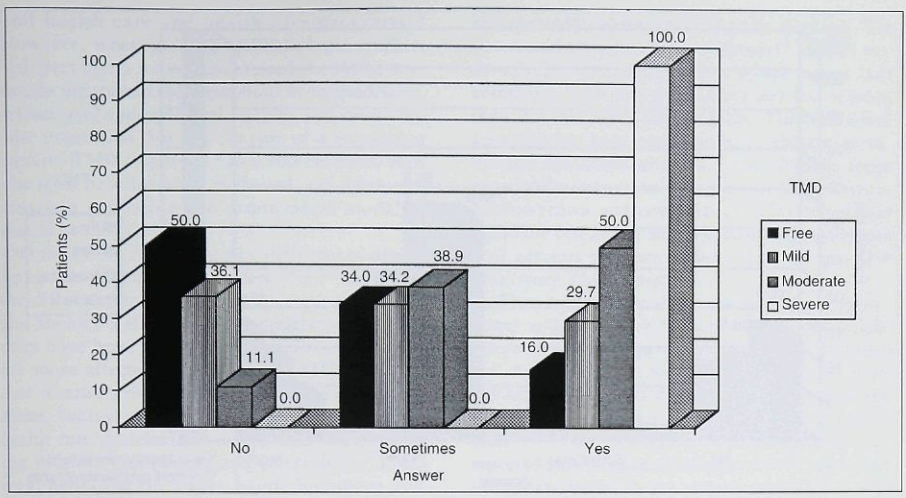

Fig 1 Association between TMD signs and symptoms and self-reported emotional tension ($P < .01$).

Stress and Parafunctional Habits

There was no difference in the severity of TMD between groups (1 and 2) ($P = .128$). High school students (competing for a spot in a university and assumed to be more tense) did not demonstrate a higher degree of TMD signs and symptoms severity than did university students. When the two groups were combined, however, and TMD presence and severity were correlated with the results of the question about emotional tension, a significant association was found ($P < .01$), ie, students who considered themselves to be tense were more frequently classified as having moderate or severe TMD (Fig 1).

Only 23.23% of the subjects did not report any parafunctional habit. On the other hand, 5.81% answered "sometimes," 54.84% were aware of having up to two habits, and 16.13% had three or more habits. When these figures were compared with the TMD anamnestic score, a significant association was found ($P < .01$) between the number of parafunctional habits and the severity of TMD (Fig 2). Among those considered in need of treatment, 35.0% reported up to two parafunctional habits, 35.0% had three or more habits, 15.0% answered "sometimes," and 15.0% reported no parafunctional activities.

Occlusal Factors and Muscle Palpation

Maxillomandibular position showed a 20.65% coincidence between RCP and ICP; the others (79.35%) showed some slide from RCP to ICP. Anterior guidance, considered normal when it allowed immediate and complete displacement of posterior teeth during mandibular movements, was judged to be normal in 76.13%, nonefficient in 12.90%, and absent in 10.97% of the subjects. During lateral movements, 41.20% had bilateral canine guidance, 18.06% presented with unilateral canine guidance, and 40.65% were considered to be group function subjects. Supracontacts on the nonworking (balancing) side were detected in 22.58% of the subjects.

When individual items from the clinical examination were analyzed, no relationship between the occlusal factors and the presence and severity of TMD signs and symptoms was found ($P = .719$, .893, and .836 for maxillomandibular position, anterolateral guidance during excursion movements, and nonworking side supracontacts, respectively).

Of the subjects, 68.71% were free of any muscle tenderness. There was a statistically significant association between the presence of at least one tender muscle spot (31.28%) and the severity of

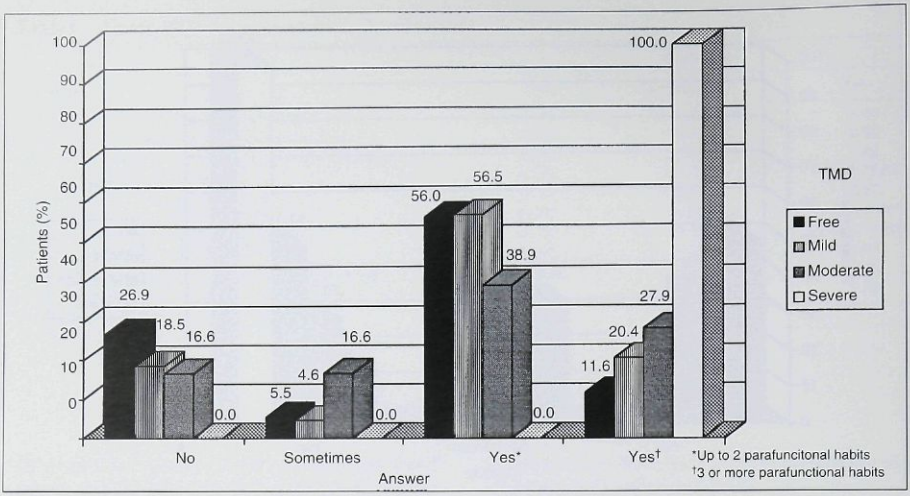

Fig 2 Association between TMD signs and symptoms and parafunctional habits ($P < .01$).

the TMD score ($P < .05$). The role of occlusal interferences in producing muscular pain is also controversial. In the present study, no association between both variables was found, confirming previous results[22,23,25,33] about the lack of association between TMD signs and symptom severity (obtained from an anamnestic questionnaire) and occlusion.

Discussion

The prevalence of joint sounds and headaches is in agreement with most of the previous studies.[9,22,32,34,35] When asked about general health, 74.84% of the subjects in the present study responded that they were not undergoing any medical or psychologic treatment. Wänman and Agerberg[9] found 95% of the subjects in their study in such conditions; Agerberg and Carlsson[6] reported that 86% of the subjects in their study considered themselves in good health.

The application of an anamnestic questionnaire for detecting TMD signs and symptoms has the advantage of being easily used either by general practitioners or epidemiologists. Although it has been proven to be a useful tool, a complete clinical examination is always mandatory to confirm subjective findings.

Regarding the prevalence of TMD signs and symptoms, Wigdorowicz-Makowerowa and coworkers[10] found a prevalence of 10.5% of "pure" TMD, and in 0.3% of all subjects, pain was associated with dysfunction. Their results, obtained from medical students, are a little higher than those reported in the present study when moderate and severe TMD (6.46%) are considered. Similar results were described by Wänman and Agerberg,[9] who found 13% and 7% with moderate and severe TMD, respectively, and by Rieder et al,[35] who found 10.3% with advanced and severe TMD. Such agreement is indicative of an acceptable validity of the method used in the present study, which has also met the criteria previously suggested for epidemiologic studies.[11]

There has been agreement in the literature[3,35,36] that although the prevalence is relatively high, the need of treatment is low, and most of the time, the required procedure is rapid and simple. Some studies report a broader range of those in need of treatment, from 5% to 6%[3,4] to 25% to 30%.[7,36] The authors of the present study agree with De Kanter et al[5] that "treatment need and demand data are essential in qualifying TMD in terms of planning

oral health care and health care programs." However, when judging epidemiologic studies, high prevalence for treatment need should be cautiously interpreted. Manipulation of methodology, subject age, and statistical analysis can create the false impression that a great part of a population requires TMD treatment. On a routine basis, each case must be individually evaluated, and when necessary, a reversible and noninvasive modality should be the first choice.

Our results regarding sex differences are in agreement with previous studies.[6,33,37,38] Although the difference in TMD prevalence between males and females is still not well understood, some theories have been proposed to explain why females are more affected than males. Smith[39] suggested that females seek treatment more frequently than males, because they maintain a closer contact with health care professionals during their lives, resulting in more complaints and referrals for TMD treatment. On the other hand, Weinberg and Sändstrom[40] believe that this difference is because of the fact that males can more easily handle their stress, which is reflected in lower levels of functional disorders. More recently, Levitt and McKinney[41] found that females with TMD compared to males with TMD reported a higher level of severity of all physical and psychologic symptoms, which could help to explain the high female-male ratio in patients seeking treatment. Differences between females and males in the presence of estrogen receptors in the TMJ[42] and the possible role of exogenous hormones[43] have been suggested to be important for gender differences. Despite these theories, the true reason or set of reasons why females present more frequently for treatment remain unknown and warrant additional studies.

When analyzing different student groups, we found no statistically significant differences regarding TMD score. The relationship between TMD and psychologic disturbances has been extensively studied. However, methods to measure anxiety and depression levels are controversial, causing confusion about the exact role of those factors in TMD etiology. Some authors[44,45] believe that high levels of stress can induce muscle hyperactivity and consequent pain. Conversely, it has been hypothesized that consecutive unsuccessful treatments can cause depression, with consequent initiation of a self-perpetuating cycle between pain and suffering.[46] Although there was no higher TMD score for the "tense," competing high school students, our findings supported a direct and significant relationship between self-reported emotional tension and TMD. Unexpectedly, when answering the question "Do you consider yourself a tense person?" control students reported more tension, which means that competing high school students felt less tension than did the university students. This simplified approach has been proven to be as efficient as traditional assessment methods.[47] Our findings about group differences agree with those of Wigdorowicz-Makowerowa and coworkers,[10] who stated that social life conditions and job/school responsibilities lead patients who are under stress to report 1.4 times more TMD symptoms.

When considering the awareness of parafunctional activities (70.97% with at least one habit), the present study supports the findings of Wänman and Agerberg,[9] who found 68% of their 17-year-old subjects aware of at least one parafunction; the present study is also supported by other studies.[6,48,49] The strong association between self-reported parafunctional habits and TMD signs and symptoms found in the present study ($P < .01$) agrees with those of Moss and colleagues,[50] who found a strong association between teeth clenching and dysfunction symptoms. These authors concluded that in the absence of teeth clenching, there is much less likelihood of having facial pain. In the present study, 100% of those considered as having severe TMD signs and symptoms reported three or more parafunctional habits. This fact stresses the importance of a detailed explanation of the problems for the patient. Thus, the detection and control of deleterious activities is an important goal in the management of TMD patients.

The role of occlusion in TMD has been extensively studied for a long time. Although occlusion factors have been considered an important predisposing and initiating factor in the past, recent publications[4,10,16,21,25,27,51,52] suggest no scientific evidence for a positive relationship between occlusion factors and TMD, which is in agreement with our findings.

Although recent studies have shown a lack of evidence to support the occlusion theory, most of the articles published in the 1960s emphasized such association. Some authors[20,53] believed that differences between RCP and ICP were deleterious enough to cause muscle isometric contractions and fatigue with consequent muscular pain. More recently, Lipp[51] pointed out that one problem in relating TMD and occlusion is the high prevalence of occlusal interferences in a general population (85% to 90%), which does not permit one to establish an adequate control group. Laskin[28] wrote that occlusion represents a self-perpetuating factor for TMD and that chronic parafunctional

habits may be the cause of muscular pain. As can be seen, there is no agreement about such a relationship. According to Seligman,[54] problems related to study designs are responsible for this finding. Design problems include considering symptoms as disease states, the lack of differential diagnosis, unrepresentative subjects, lack of factor definition, failure to use multifactorial analysis, and inappropriate grouping of data.

Considering slides from RCP to ICP, our data (79.35%) agree with those of Wänman and Agerberg,[9] who reported 77% of a young population with unilateral ICP contact. Pullinger and colleagues[55] described 71% of their subjects who had this condition. It has been hypothesized[56] that an occlusal discrepancy may be the consequence of an articular disorder rather than an initiating factor.

As suggested above, occlusal interferences are a common finding in a nonpatient population as well as in TMD patients. We agree with Seligman and Pullinger[57] that bilateral RCP contacts may be an important feature when considering extensive restorative dental procedures. However, establishing bilateral RCP contacts through occlusal adjustment is not advisable as prophylactic therapy because it is an invasive and irreversible procedure and shows no association with TMD.[56] As for excursive movements, nonworking-side supracontacts were found in 22.58% of the subjects in our study. As for the type of lateral guidance (41.20% with bilateral canine guidance), this factor did not show any association with TMD signs or symptom severity. Manns et al[58] have suggested that canine guidance might be associated with reduction in elevator muscle activity, but it does not necessarily contribute to a reduction of symptoms, which is in agreement with our data. McNamara and colleagues[56] stated that "there is little evidence to suggest that a given guidance pattern can provoke TMD symptomatology."

Thus, we must reconsider classic procedures to manage TMD symptoms. Based on the available data, invasive occlusal procedures (occlusal adjustment, orthodontics, complete-mouth rehabilitation, etc) should be avoided as first-phase management. Reversible procedures such as occlusal appliances and physical therapy should constitute the dentist's first choice of treatment direction.

In our opinion, the effectiveness of occlusal appliances goes much beyond a simple reestablishment of a "functional occlusion," but a discussion of this topic is not within the scope of this article.

Our findings regarding the presence of muscle tenderness (31.28%) agree with previous investigations that reported muscle tenderness in 37.49%[34] and 34.2%[32] of subjects in a nonpatient population. The association between muscle tenderness and TMD severity also agrees with previous studies.[8,59]

Based on the above results, it was concluded that occlusion does not seem to play an important role in producing TMD signs and symptoms for the groups studied. Conversely, self-reported tension levels and awareness of parafunctional habits have shown a strong association with TMD signs and symptom severity. In the present study, however, the interpretation of such association should be done carefully because of the use of a brief questionnaire to determine TMD severity[60] and because of the cross-sectional aspect of this research. The exact role of occlusion and psychologic factors in contributing to TMD and the reason why females constitute the majority of patients are still unknown. Therefore, well-controlled longitudinal studies should constitute the choice for future research in this field.

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Resumen

Evaluación de la Prevalencia y Etiología de las Desórdenes Temporomandibulares en Jovens Estudiantes

El propósito de este artículo es evaluar la prevalencia y necesidad de tratamiento de las Desórdenes Temporomandibulares en estudiantes de Bauru, São Paulo, Brazil. La presencia y severidad fueram determinada mediante un cuestionario (anamnesis) compuesto de 10 preguntas sobre los síntomas mas frequentes de las desórdenes. El examen de la oclusión consisti en análisis en Posisión Retrusiva de Contacto, Análisis en Intercuspidación, Guía Anterior y Lateral, Interferencias en el lado de balance durante movimientos de la mandíbula. Además se realizó palpación muscular y de la ATM para detectar signos de patología. El análisis estadístico que se usó para comparar los datos obtenidos con la presencia y severidad de Desórdenes Temporomandibulares fue un "chi quadrado." Síntomas severos de Desórdenes Temporomandibulares fueron obtenidos en un 0.65% de la muestra, síntomas moderados en un 5.81%, y síntomas leves en un 34.84%. Se consideró que aquellos con patología moderada y severa necesitaban tratamiento. Síntomas de patología fueron más frequentes en mujeres que en hombres ($P < .01$). Se encontró alta correlación entre historia de tensión emocional y hábitos parafuncionales con la presencia de síntomas ($P < .01$). Sin embargo aparentemente la oclusión no pareció influenciar la presencia y severidad de Desórdenes Temporomandibulares. Basados en estas conclusiones los autores sugirieron revisar los tratamientos convencionales y recomendaron el uso de tratamientos consevardores y reversibles como primera opción en el manejo de las Desórdenes Temporomandibulares.

Zusammenfassung

Eine kreuzuntersuchung der Häufigkeit und Ätiologie von temporomandibularen krankheiten in jungen Erwachsenen

Diese Abhandlung ist darauf gesielt, das Vorhandensein und den Behandlungedarf temporomandibularer Krankheiten von Studenten in Bauru, Staat São Paulo, Brasilien, auszuwerten. Gleichfalls wurden Okklusions - und emotionelle Faktoren angesprochen. Das Vorhandensein und die Schwere der krankheit wurden von den Student selbst auf einem anamnetischen Fragebogen beantwortet, der aus 10 Fragen hinsichtlish der gewöhnlichsten Symptome temporomandibularer krankheiten bestand. Die Okklusionsauswertung beinhaltete die Analyse der retrudierten kontaktposition, der interkuspitalen Position, der anterolateralen Führung und Störungen der nitchtarbeitenden Seiten während mandibularer Bewegungen. Außerdem wurden kiefergelenk- und Muskelpalpitation bei ermittelten klinischen Anzeichen temporomandibularer krankheiten erzielt. Ein Chi-Quadrat-Test wurde durchgefürt, um temporomandibularen krankheit zu vergleichen. Schwere Symptome der krankheit in 0.65% der Stichproben gefunden wurden, 5.81% zeigten gemäßigten Symptome und 34.84% wurden als Personen mit milden Symptomen eigenstuft. Diejenigen mit schweren und gemäßigten Symptomen wurden als behandlungsbedürftig betrachtet. Die Symptome erschienen mit erheblich größerer Häufigkeit in Frauen als in Männer ($P < .01$). Von den Studenten selbst berichtete emotionelle spannung und Parafunktion weisen auf eine starke korrelation zur temporomandibularen krankheit ($P < .01$), andererseits schien die Okkusion keinen Einfluß auf ihr Vorhandensein und ihre Schwere auszuüben. Aufgrund dieser Ergebnisse haben die Autoren die Überprüfung klassischer Behandlungsmethoden angeregt und reversible und konservative Prozeduren als erste Behandlungswahl vorgeschlagen.