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Assessment of Etiological Factors Reported in the Literature and Their Impact on TMD Incidence in Young Adults

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Abstract

Introduction:
Chronic temporomandibular disorders (TMDs) typically result from long-term exposure to factors such as occlusal dysfunction, stress, and parafunctions, and are often associated with older patients. In contrast, young adults, exposed for a shorter time, may recover fully if diagnosed early. However, there is limited data comparing TMD treatment in young adults versus older individuals.

Aim:
To assess whether the development of TMD in young adults differs from that in the general population and whether a different treatment approach may be needed.

Materials and Methods:
Eighty-nine students aged 18–26 from various universities in Poznań completed a questionnaire and underwent clinical examination.

Results:
Muscular TMD diagnoses correlated with depression, stress, and surgical extraction of wisdom teeth. TMD presence was associated with anxiety, insomnia (AIS), pain (PS), and overbite. Parafunctional behaviors (OBC scale) correlated with anxiety, depression, stress, insomnia, and pain. Latent trigger points (TrPs) were significantly more frequent in TMD patients.

Conclusions:
Psychological factors significantly contribute to TMD in young adults, despite lower pain intensity compared to older patients. Occlusal factors and orthodontic treatment showed no correlation, while a link between wisdom tooth extraction and TMD was confirmed.

Key words: temporomandibular disorder, temporomandibular joint, young adults, etiology

Introduction

The temporomandibular joint (TMJ), being one of the most complex articulations in the human body, is known to be the cause of significant ailments for patients and diagnostic difficulties for doctors. The frequency of temporomandibular disorders (TMD) occurrence is estimated to be around 50-80% in the human population [1].

TMDs are characterized by a complex and multifactorial etiology. Okeson mentions five main factors causing temporomandibular disorders: occlusal factors, injury, emotional stress, deep pain output signal [2]. Excluding the causes of acute conditions, most chronic TMDs arise as a result of long-term exposure to the above-mentioned factors [3]. For this reason, we decided to analyze the impact of these factors on the incidence of TMD in the group of young adults, because this group is exposed to them for a shorter time than patients who most often report symptoms of TMD. At the same time, the group of young adults, being a group with high regenerative potential and high adaptability, is a group of high interest to us researchers due to the possibility of implementing prevention and more effective treatment.

The aim of this study was to investigate the correlations between the occurrence of temporomandibular disorders (TMD), emotional distress, pain, occlusal factors, and parafunctional habits among young adults. We hypothesized that there is a significant co-occurrence of psychological disorders, pain, parafunctions, and a history of third molar

extraction with TMD in this age group, while recent literature suggests no strong association between TMD and occlusal factors or previous orthodontic treatment [4]. This investigation was designed to assess young adults as a distinct cohort, given the limited data available to determine whether they should be managed according to standard protocols applied to the general population or require a modified therapeutic approach.

Materials and methods

Study participants

This study was conducted at the Department of Prosthodontics and Gerostomatology, Poznan University of Medical Sciences. A total of 89 students participated in the survey. Inclusion criteria comprised age between 18 and 26 years, student status, good general health, completion of the questionnaire, and informed consent to participate. Exclusion criteria included failure to meet any of the inclusion criteria.

Patient health questionnaire

Before qualifying for the clinical trial, students were asked to complete a health questionnaire that consisted of two parts. The first part was psychological. The purpose was to obtain information on stress intensity, general psychological well-being and other factors, correlating with the occurrence of stomatognathic complaints. It consisted of the following parts, with a corresponding scoring scale.

Generalized Anxiety Disorder Assessment, (GAD-7) - 0-3

Patient Helath Questionnaire-9, (PHQ-9) - 0-4

Perceived Stress Scale (PSS-10) - 0-2

Athens Insomnia Scale (AIS) - 0-2

The second part of the survey included questions to assess the patient's health status, current temporomandibular joint symptoms and their characteristics, presence of parafunctions Axis II questionnaire (DC/TMD)

Pain Scale (PS) - 0-2

The Graded Chronic Pain Scale (GCPS) - 0-4

Pain drawing (PD)

In addition, the questionnaire included questions about past orthodontic treatment, surgical extraction of third molars, and history of facial trauma.

Clinical trials

The study was conducted between November 21 2017 and November 8 2019. It received approval from the Bioethics Committee of the Poznan University of Medical Sciences, No. 357/19. The study was based on the axis II DC/TMD form. The physical examination procedure took an average of 10 minutes, during which patients sat with their heads supported. The DC/TMD classification is based on the determination of stomatognathic abnormalities in two planes: 1. muscular abnormalities, 2. abnormalities of osteoarticular structures and disc displacement.

Palpation of the joint was carried out using index and middle fingers with a force of about 0.5 kg. The patient was then asked to perform mandibular inversion and adduction movements three times and laterotrusion movements three times in both directions. Acoustic symptoms from the joint were then auditorily controlled, and discomfort and pain sensations reported by the patient were noted, taking into account the patient's previous history of such pain.

Palpation examination of the stomatognathic system muscles included the temporalis muscle, masseter muscle, submandibular region, mandibular region, tendon of the temporalis muscle on the beak process of the mandible and lateral pterygoid muscle bilaterally. This test was performed with uniform pressure with a force of about 1 kg. It was important for the study to determine whether the type of pain experienced at that moment was familiar, whether it had occurred before, but whether this was the first time it had been provoked.

Part of the study also involved taking measurements of horizontal bite, vertical bite, midline shift, as well as the maximum ranges reached during mandibular movements. For this purpose, a dental ruler, graduated in 0.5 mm increments, was used. While measuring the maximum opening, the distance between the incisal edges of the central upper and lower incisors was determined, while controlling for deviations from the mandibular movement path and patient-reported pain. Laterotrusive movements of the mandible were measured by determining the distance by which the tangent point of the lower medial incisors moved relative to the medial line of the jaw. This value was corrected by the value of the medial line shift when the dental arches were compact.

The study also verified intraoral symptoms of bruxism - the presence of linea alba, enamel

cracks, pathological tooth wear or impressions on the tongue. Based on the results, the diagnosis was classified into 1 of 3 types of dysfunction: muscular, articular, related to structures not involved in chewing.

Results

The sample consisted of 89 young adults aged 18-26 years (22,11 ± 1,74 years), of which 60 (67,4%) were female and 29 (32,6%) were male.

As many as 25 students (28,09 %) had been diagnosed with TMD, and 34 students (38,2%) had been diagnosed with TMJ-related muscular disorders.

Presence of a muscular diagnosis correlated with depression, stress, as reported above, and additionally surgical extraction of wisdom teeth ($r=0,34$; 0,25; and 0,31 respectively; $P<0.05$).

Presence of TMD correlated with anxiety, ASB, PS and overbite (respectively; $P<0.05$)

OBC score correlated with anxiety (Table 2), depression, stress, as reported above, and additionally insomnia and pain ($r=0,36$; 0,38; 0,32; 0,25 and 0,28 respectively; $P<0.05$).

For the purpose of analysis, we separated the diagnosis group in which the inclusion criterion was the presence of at least one disorder. The diagnosis group correlated with anxiety and PS ($r=0,3$ and 0,25 respectively; $P<0.05$), (Table 3).

Results showed that latent TrP occurrences in the TMD diagnosis group are significantly higher in all tested areas than in subjects who do not present any TMD diagnosis (Table 1).

Discussion

Epidemiological studies reveal that 15–20% of the general population suffers from various forms of depression [5]. In the realm of stomatognathic system disorders, excessive muscle tension and chronic stress are major contributors, accounting for 34%, while mental illnesses contribute 7.1% [5]. Specifically, depression, especially in its masked form, notably impacts the function of the stomatognathic system [6]. This type of depression presents in the masticatory system as occlusal neurosis and increased muscle tension, indicative of motor depression [7]. These relationships are proven by the correlation found in our study between the PHQ-9 score and the muscular diagnosis and OBC, i.e. parafunctions in our group of subjects. Two additional studies corroborate the theory that the intensity of anxiety is a main factor in shaping clinical manifestations. [7,8]. The observation that a subset of TMD patients exhibit higher anxiety levels this relationship also occurs in the group of young adults which is confirmed by the results of our work. On the other hand, it is important to be aware that there

is such a link between anxiety levels and increased muscle activity because it can be helpful in choosing the right treatment [9]. The pattern of concurrent anxiety and depression symptoms has been consistently observed to be more frequent than depression alone both in the group of TMD patients and in the general population. Hence, it is evident that anxiety and depression play a significant and positive role in TMD patients, exacerbating the rates of depression and anxiety among those with delayed healing and treatment. Our study confirms these results in a young adults group.

Elevated stress levels can contribute to the development of bruxism, which in turn affects blood flow in the surrounding muscles. [10] This disruption can lead to a lack of coordination among the chewing muscles, altering their mechanical functions and causing muscle pain. Additionally, this condition may initiate inflammatory reactions in the joint, leading to further biomechanical changes and joint pain. A correlation between stress levels and OBC scores, as well as muscular diagnosis, has been found in our study, similarly to PHQ-9 levels.

While some studies found positive relationships between parafunctional habits and temporomandibular disorders, others did not [11]. Michelotti et al. [12] reported that there is a relationship between temporomandibular disorders and parafunctional habits.. Antoun et al. [13] could not find a significant difference in the OBC scores of hyperdivergent and normodivergent groups. Neither group displayed significant differences in terms of their OBC scores in cases of sleep or being awake.

In this study, the total OBC score correlated with anxiety, depression, stress, as reported above, and additionally insomnia and pain ($r=0,36$; 0,38; 0,32; 0,25 and 0,28 respectively; $P<0.05$), indicating that OBs may be related to patients' psychological states and involve complex interactions. Patients with depression or anxiety can demonstrate an increase in certain OBs, which may be intended to relieve psychological pressure. Therefore, more studies are needed to explain the relationship between OBs and patient psychology.

Temporomandibular disorders refer to the causes responsible for the impaired function of the temporomandibular joints and the associated neuromuscular system, which may provoke TMD-related pain [14]. The neuromuscular system responsible for chewing function has a high potential to adapt to changing conditions. Only when the compensatory capabilities of the masticatory- and the neuromuscular system are overstretched dysfunction occurs resulting in

clinical symptoms and manifests as pain, severe clicking, or limited mobility of the mandible, forcing the patient to seek help. Pain related to TMDs is typically reported in the chewing muscles, preauricular area, or the TMJ [15], but also may radiate to different regions, such as the dental arches, ears, temples, forehead, occiput, cervical region of spine or shoulder girdle, however patients may even report a sudden change in their bite coincident with the onset of the painful condition [16]. Serritella and others report that in a group of dysfunctional patients diagnosed between 1990-93 joint pain occurs in 74.42%, diagnosed between 2000-03 79.07%, and diagnosed between 2010-13 69.77% [17]. In the young adult population, joint pain in patients with TMD amounts to 44%, which suggests that TMD diagnosis in this group may be more difficult by the rarer occurrence of this characteristic TMD symptom. Previous research results show a connection between pain and TMD. Our results prove that pain measured by PS (pain scale) is statistically correlated with TMD. Graded Chronic Pain Scale (GCPS) is a short, reliable, and valid 3 instrument that assesses pain intensity and pain-related disability [18]. Study conducted by Kotiranta at al. [19] suggests that GCPS-related disability scoring can be used as a simple screening instrument to identify TMD patients with different degrees of health burdens. However in our research in the young adults group we did not find any statistically significant correlation between GCPS parameter and TMD. High levels of pain-related impairment (i.e. GCPS grades III or IV) were diagnosed in 10.5% of the sample of overall population [20], in the young adult population it is 5,6 %.

Patients may experience a more regional muscle condition such as myofascial pain. Clinically, myofascial pain is characterized by the presence of localized, firm, hypersensitive bands of muscle tissue called trigger points (TrP) [21]. There are two different kinds of trigger points: active and latent. Active trigger points cause pain in the muscle continuously, and latent trigger points are painful only when they are pressed or irritated [22]. Muscle-related disorders represent the largest subgroup among the various TMD diagnoses [23]. Fernandez de las Penas et al. [24] noticed that in the group of women aged between 20 to 28 masseter and temporalis muscles in TMD patients group, presented a significantly greater amount of active and latent TrP than in the control group. Our results prove and confirm that in young adults group latent TrP occurrences in TMD diagnosis group are significantly higher in all tested areas than in subjects who do not present any TMD diagnosis. However, no studies on TrP occurrence in the general populations were found, more data is needed to be able to compare the results of our group of young adults.

Occlusal factors and orthodontic treatment have been thought to be significant in the development of TMDs [25], yet more recently new studies emerged showing that a different approach might be needed. According to the available evidence, orthodontic treatment cannot cause nor treat TMD, as opposed to the theory that some practices in the orthodontics field may be trigger factors for the development of TMD symptoms [26,27]. This study analyzed if there was a correlation between orthodontic treatment and parafunction (OBC), as well as orthodontic treatment and different TMD diagnoses. Based on the results we can state no relevant correlation between the above in the young adult population.

Olliver et al., conducted a 30-year study in which they concluded the lack of association between malocclusion during adolescence and TMJ sounds development later in life [28].
Further evaluating the role of malocclusion in the etiology of TMD, other variables have been analyzed in this study, such as overbite, overjet and midline deviation. There is a link between overbite <4 mm and TMD diagnosis, as Mélou et al. showed in their study as well [29]. No other correlations have been observed. Several authors suggest the lack of correlation between overbite, overjet and TMD [30,31,32].

Investigating further occlusal variables, Fushima et al. [33] suggest that midline deviation should be considered, as they found that cases of internal TMJ derangement were mainly the result of skeletal asymmetry of the mandible, rather than of teeth displacement, however the study lacks of a control group. Celić et al. in their study [34] showed a weak yet statistically significant correlation between malocclusion, midline deviation, overjet and TMD in a group of young male adults. The reason their results differ from ours may lay in the difference in the sex of the recruits, them being exclusively male. Padala et al. [35] showed statistically non-significant correlations between occlusal factors and TMD. Scientific evidence is insufficient and contradictory therefore more studies are needed to clearly state the role of midline shift [36]. However, TMD is a multifactorial pathology, and as we should take occlusal variables less strictly [37], malocclusion may still be a minor, yet important factor, especially in the patient's eyes as TMD patients seem to be more vigilant on their occlusion and may notice easily occlusal instability, therefore orthodontic and prosthodontic treatment might be beneficial [38].

Several authors were invested in the observation of different potential TMD etiology factors. One of the majorly analyzed ones is wisdom teeth extraction [39,40,41]. Notably, the studies

seem to be consistent with the results, confirming the correlation of the mentioned above, in an overall population as well as in a population of young people. A further analysis of the variables included in this study led us to the confirmation of the association between wisdom tooth surgical removal and TMD, and what's more - the association has been found only with surgical removal, whereas regular wisdom tooth extraction did not have statistically significant correlation with any of the analyzed diagnoses. Furthermore, the only diagnosis which correlated with the wisdom tooth surgical removal was the muscular diagnosis, referring to TMJ associated muscles disorders. An equally significant aspect is the possible role of impacted wisdom teeth in the development of TMDs [42], which leads us to question which of the two variables is more significant for the development of TMD: surgical wisdom teeth removal or the presence of the impacted wisdom tooth itself. That said, the decision whether to remove the wisdom teeth or not should be carefully clinically evaluated, considering the possible TMD development in both scenarios.

Conclusions

Emotional or psychological problems play a role in the development of TMDs in the group of young adults similarly to the general population. This highlights the importance of assessing mental health in patients with temporomandibular disorders in all age groups.
Occurrence of joint pain in young adults with TMD is significantly lower than in the general population. The consequence is a more difficult diagnosis procedure and a latter diagnosis, since patients without pain are less likely to seek medical help.

Occlusal factors and orthodontic treatment are generally not correlated with TMD in the young adults group, showing no difference from the general population in the most recent studies.

In this study, we found a consistent correlation between surgical wisdom tooth removal and TMD occurrence, which correspond to the results of the studies done on the general population.

Apart from the pain occurrence, there is no other difference shown between young adults and the general population, leaving us with a similar diagnosis procedure in all age groups of adults.

Table 1. Differences in latent TrP occurrences

	Masseter	Temporalis	TMJ	Posterior mandibular region	Submandibular region	Lateral pterygoid area	Tendon of the temporalis
p	0,003	< 0.001	< 0.001	0,01	0,001	0,003	0,001
TMD	72%	28%	44%	36%	28%	84%	84%
No TMD	40,6%	18,8%	26,6%	28,1%	18,8%	75%	51,6%

Table 2. Differences in anxiety level

Generalized anxiety (PHQ-9)	TMD	No TMD
Minimal Anxiety	28%	48,438%
Mild Anxiety	48%	25%
Moderate Anxiety	8%	20,313%

]

Table 3. Overall analysis of etiological factors of TMD

	OBC		Diagnosis		TMD		TMD related muscular disorders	
	p	r	p	r	p	r	p	r
OBC	-	-	0,699	0,09	0,845	0,062	0,207	0,188
Diagnosis	0,699	0,09	-	-	-	-	-	-
GAD-7 generalized anxiety	0,001	0,359	0,043	0,302	0,04	0,305	0,125	0,254
PHQ-9 depressive symptoms	0,001	0,378	0,069	0,312	0,498	0,195	0,035	0,340
Co-occurrence of elevated levels of depression and anxiety symptoms	<0,001		0,013		0,134		0,015	
PSS 10	0,001	0,322	0,086	0,235	0,411	0,141	0,05	0,259
ASB	0,03	0,246	0,198	0,191	0,023	0,290	0,772	0,076
PS	0,032	0,278	0,02	0,246	0,024	0,24	0,368	0,095
GCPS	0,441	0,211	0,629	0,17	0,127	0,284	0,451	0,203
PDface	0,014		0,298		0,928		0,099	
overbite	0,309	0,162	0,951	0,006	0,037	0,21	0,299	0,104
surgical extraction of wisdom teeth	0,402	0,151	0,264	0,173	0,273	0,171	0,109	0,223

Past orthodontic treatment	0,592	0,108	0,584	0,058	0,148	0,153	0,628	0,051
Overbite	0,933	0,018	0,197	0,135	0,688	0,043	0,038	0,214
Overjet	0,794		0,253		0,777		0,452	
Midline deviation	0,656		0,141		0,896		0,148	
Previous craniofacial trauma.	0,266	0,171	0,107	0,224	0,242	0,179	0,015	0,307

Disclosure

Authors contribution

Conceptualisation: Julia Wójcicka
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Formal analysis: Julia Wójcicka, Danil Charnushevich
Investigation: Julia Wójcicka, Szymon Dudziński
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