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ORIGINAL ARTICLE

Association of oral behaviours' frequency with psychological profile, somatosensory amplification, presence of pain and self-reported pain intensity

Ema Vrbanović[a]*, Marko Zlendić[a] and Iva Z. Alajbeg[a,b]*

[a]Department of Removable Prosthodontics, School of Dental Medicine, University of Zagreb, Zagreb, Croatia; [b]Department of Dentistry, Clinical Hospital Center Zagreb, Zagreb, Croatia

ABSTRACT

Objective: To investigate the association of the frequency of oral behaviours with psychological (anxiety, depression) and psychosomatic factors (somatosensory amplification) as well as with *pain presence* (Temporomandibular disorders-pain (TMDp) patients and control (CTR) participants) and *pain intensity* (no_low pain intensity (nLPI)/high pain intensity (HPI)).

Material and methods: Fifty-four TMDp patients (48 females and 6 males; 29.13 ± 10.46 years) and 46 controls (29 females and 17 males; 28.54 ± 9.71 years) were administered Oral Behaviours Checklist (OBC), Generalized Anxiety Disorder-7 Scale, Patient Health Questionnaire-9 for depression and Somatosensory Amplification Scale. Data were analysed with respect to the presence of TMD pain and to pain intensity. Mann–Whitney test and Spearman's rank correlation were used for analyses.

Results: No significant differences in examined variables between TMDp patients and CTR individuals were found. The frequency of oral behaviors (OBC total score and sleep-related oral behaviours) as well as anxiety, depression and somatosensory amplification scores were higher in HPI group when compared to nLPI group ($p < .05$). In univariate correlations, oral behaviours were positively correlated with somatosensory amplification ($p = .001$), anxiety ($p < .05$), depression ($p < .05$), female sex ($p < .05$) and pain intensity ($p < .05$) but not with pain presence. Multiple linear regression models showed that predictors for the higher frequency of oral behaviours were anxiety and female sex.

Conclusions: Oral behaviours were associated with pain intensity but not with pain presence and were primarily influenced by anxiety and female sex, suggesting that therapeutic approach should consider both, reducing pain intensity and management of the impact of psychological factors.

Conclusions:

Trial registration: ClinicalTrials.gov NCT04694274. Registered on 01/04/2021

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Oral parafunctional habits; pain intensity; anxiety; somatosensory amplification; depression

Introduction

Oral parafunctional behaviours include activities that are inconsistent with physiological functions such as mastication, deglutition, and vocal communication, resulting in issues such as masticatory muscle soreness or tooth wear. Also, any kind of repetitive oral habits, even those that are physiological, can be considered a potential risk for dental and orofacial related problems [1]. According to research, some form of repetitive oral behaviour affects up to 90% of the population [2,3]. Continuous wake-time and night-time clenching can cause jaw muscle exhaustion and pain and contribute to already present orofacial pain such as temporomandibular disorders (TMD) [4]. Even though the background of harmful oral habits is not completely clear, studies found a connection between psychoemotional distress such as symptoms of anxiety and depression, with the presence and severity of parafunctional activities [1,5,6]. Similar was proposed as a risk factor for TMD [7,8]. The overlapping of factors that are connected to both TMD and oral parafunctional behaviour might indicate that individuals of certain characteristics are likely to be more susceptible to both [9]. Studies have found that bodily hypervigilance, a state of increased awareness and selective focus on detected sensations, is a contributor to occlusal sensitivity [10]. Also, some studies proposed that those patients are more sensitive to orofacial pain [11,12]. Hypervigilance is one form of somatosensory amplification, a tendency to interpret a typical somatic experience (such as heat, cold, and touch) as powerful, unpleasant, and upsetting [13]. A previous study, based on a self-reporting online survey, proposed that people who have higher levels of anxiety report a higher frequency of oral behaviours when pain is present which suggests that pain has an additive effect on the relationship between anxiety and oral behaviours [14]. There is evidence that psychological factors closely related to modern lifestyles may be predictors of abnormal oral function [5]. In addition, it has been suggested that patients with chronic pain may have difficulty recognizing sensations, which in turn makes them vulnerable to physical expressions of psychological distress. People who are introspective and tend to focus and indulge

CONTACT Iva Alajbeg ialajbeg@sfzg.hr School of Dental Medicine, University of Zagreb, Gundulićeva 5, Zagreb 10 000, Croatia
*These authors contributed equally to this work.

in relatively weak sensations may be more likely to experience chronic pain [15].

Although different studies investigated association of oral parafunctions with stress or myofascial pain, there is no clinical study that provides extensive exploration of association of oral parafunctional behaviours or repetitive oral habits with psychological and psychosomatic factors taking into account the presence and intensity of pain [16,17]. Therefore, the purpose of this study was to investigate the association of the frequency of oral behaviours with psychological and psychosomatic factors with respect to pain presence and pain intensity. In this study, the Oral Behaviours Checklist (OBC) was used as the 'self-report scale for identifying and quantifying the frequency of jaw overuse behaviour'. We hypothesized that anxiety, depression and somatosensory amplification are positively associated with the frequency of oral behaviours and that the relationship between psychological and psychosomatic factors with oral behaviours is influenced by the presence of pain and its intensity.

Materials and methods

Study setting and participants

This study was a clinical study conducted at the School of Dental Medicine, University of Zagreb, in accordance with the ethical standards of the Declaration of Helsinki. The research protocol was approved by the Dental Ethics Committee of the University of Zagreb (05-PA-30-VIII-6/2019). Data collection was conducted between January 2020 and July 2021.

During the data collection period, 209 patients referred to the Department of Removable Prosthodontics of the School of Dental Medicine due to orofacial pain and discomfort were assessed by an expert in TMD diagnosis and treatment (IA) in order to select patients with TMD-pain (TMDp).

Inclusion criteria were: age >18, report of temporomandibular region pain as the main complaint with either arthralgia, myalgia, or both (according to DC/TMD), average pain on Visual Analog Scale >30 mm and pain symptoms present for more than 3 months [18].

General exclusion criteria were: age <18 years, symptoms associated with disease of another part of the masticatory system, acute pain (pain present for less than 3 months prior to the first examination), history of condylar trauma, causes of headache not related to TMD (according to the International Classification of Headache Disorders, ICDH II), pain due to systemic diseases, fibromyalgia and confirmed psychiatric disorders.

Out of 209 initially examined patients, 155 did not meet the inclusion criteria meaning that 54 TMDp patients were selected for this study.

Also, this study initially examined 54 healthy control individuals (students, staff, and non-TMD patients of the School of Dental Medicine, University of Zagreb) that were pain-free. However, 8 of them did not want to carry on with the research so the control group (CTR) consisted of 46 participants. Eventually our final sample consisted of 54 TMDp patients and 46 age and gender matched non-painful, control participants. All participants provided written informed consent.

Clinical examination protocol

Participants were examined by well-trained and calibrated examiners (EV, MZ) according to the Croatian version of DC/TMD protocol. The DC/TMD Axis I and Axis II assessment instruments were previously translated using specific cultural equivalency procedures in forward–backward translation by a group experienced in TMD diagnosis and treatment with good knowledge of both Croatian and English. The translated version is now accepted by International Network for Orofacial Pain and Related Disorders Methodology, INfORM and available on the official internet site [19].

The examination procedure for detecting pain included palpation of the masticatory muscles (masseter muscles and temporal muscles) and lateral pole/around the lateral pole of both temporomandibular joint condyles, as well as the measurement of mandibular movements and the registration of possible pain in the temporomandibular joints and/or surrounding muscles during these movements. The pain elicited during the clinical assessments had to be familiar to the persons' principal complaint in order to meet the criteria for a TMD-pain diagnosis – either myalgia, arthralgia or both [20]. The diagnostic process followed the DC/TMD decision tree [21]. Also, the Characteristic Pain Intensity (CPI) was assessed using the Graded Chronic Pain Scale (GCPS) questionnaire as an integrated part of DC/TMD by computing the means of three items (current pain, worst pain, average pain) and multiplying them by 10 [21].

The assessment of behavioral and psychosomatic characteristics

All participants, both TMDp patients and CTR individuals, were asked to complete OBC, Generalized Anxiety Disorder-7 Scale (GAD-7), Patient Health Questionnaire-9 (PHQ-9) and Somatosensory Amplification Scale (SSAS).

OBC, GAD-7 and PHQ-9 are integral part of DC/TMD protocol and as such translated in Croatian according to accepted standards (see 'Clinical examination protocol') [21].

OBC consists of 21 items, two of which deal with *sleep-related oral behaviours* with questions about clenching and grinding while asleep and about positions in sleep that might have negative impacts on the masticatory system. The rest of the items deal with *waking-state oral behaviours* – assessing daytime habits, concerning teeth, tongue, lips, neck, jaws, that might have a negative impact on the masticatory system. For each question, a participant gives an answer explaining how often this activity occurs during the day, based on the previous month (none of the time/a little of the time/some of the time/most of the time/all of the time) or at night (how many nights in a week such behaviour occurs). A score of 0–4 points is provided to each item, resulting in a total aggregate (OBC-tot) ranging from 0 to 84 points. Sleep-related oral behaviours (activities during sleep) could range from 0 to 8 points, and waking-state oral

behaviours (activities during waking hours) could range from 0 to 76 [22].

GAD-7 is a seven-question survey to assess the severity of anxiety symptoms. The responses are based on a four-point scale, with 0 representing 'not at all', 1 representing 'a few days', 2 representing 'more than 1/2 of all days', and 3 representing 'practically every day'. The possible outcomes range from 0 to 21. Sensitivity of the GAD-7 (cut point 10) for diagnosing generalized anxiety disorder was 89% and specificity was 82% [23,24].

PHQ-9 is a nine item questionnaire designed to screen for depression. Participants were asked to rate how often they were disturbed by the stated difficulties on a scale of 0 (not at all) to 3 (almost every day). Scores range from 0 to 27, with cut-points of 5, 10, 15, and 20 indicating mild, moderate, and severe symptoms, respectively. A PHQ-9 score $\geq$10 had a sensitivity of 88% and a specificity of 88% for major depression and it was noted that PHQ-9 is a reliable and valid measure of depression severity [25].

SSAS is a 10-item self-report instrument designed to assess the tendency to detect somatic and visceral sensations and experience them as unusually intense, toxic and worrisome. Statements are scored on a Likert scale (0 = 'never' = 1 'a little' 2 = 'moderately', 3 = 'almost always,' 4 = 'always'), and the higher the score (maximum 40), the greater the tendency to somatic amplification [13]. The original version of the SSAS has good internal consistency (Cronbach's = 0.82) [26].

Grouping of participants

Along with primary grouping which was done according to *pain presence* (TMDp and CTR), participants were also grouped according to *pain intensity*. For that purpose, CPI, assessed using the GCPS, was used. Low-intensity pain TMD patients, with CPI $<$ 50, and participants in the CTR group formed a no_low pain intensity (nLPI) group, whereas TMD patients with CPI $\geq$ 50 formed a high pain intensity (HPI) group.

Sample size determination

Based on the results of the previous study [14], which compared TMD-pain patients with control participants, it was calculated that a total sample of 56 participants (i.e. 28 per group) was necessary to achieve 80% power with a significance level of 0.05 to detect the mean difference of 8 in OBC-tot scores (with an estimated standard deviation of 10.5) between the two groups using a two-sided unpaired test.

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 26.0 (Armonk, NY: IBM Corp). Analyses consisted of descriptive statistics and appropriate tests.

The distribution of data was checked using the Shapiro–Wilk test.

For categorical variables, the chi-square test was used. To conduct a chi-square analysis, variables related to 'Marital status' (marriage with domestic partnership, as well as divorced with separated/never married) and 'Level of education' (college degree with masters degree) were merged.

Mann–Whitney *U* Tests were used to test the differences between groups (TMDp vs. CTR) and (HPI vs. nLPI) in oral behaviour scores (OBC-tot, waking-state oral behaviours, sleep-related oral behaviours), anxiety (GAD-7 scores), depression (PHQ-9 scores) and somatosensory amplification (SSAS scores).

Spearman's rank correlation was used to test associations of oral behaviours with anxiety, depression, somatosensory amplification, pain presence, pain intensity and sex.

Finally, multiple linear regression was conducted to determine the amount of variability of dependent variables (frequency of oral behaviours) explained uniquely by the individual predictor when controlling for the effect of other influencing factors. In multiple linear regression models predictors of oral behaviours were analysed when controlling for age. Considering the strong correlation between depression (PHQ-9 scores) and anxiety (GAD-7 scores; $r = 0.741$), depression was omitted from multivariate analysis to avoid multicollinearity. Gender, somatosensory amplification, anxiety and pain intensity were included as independent variables.

A value of $p < .05$ was considered statistically significant.

Results

Demographic data are present in Table 1. When comparing the marital status, no significant difference was found between TMDp and CTR group (Pearson Chi-Square = 0.577). Also, no difference was found concerning the level of education (Pearson Chi-Square = 0.249).

In the TMDp group the mean time from the onset of pain was 44.6 months. Average spontaneous pain (according to the Visual Analogue Scale) was 6.6. Myalgia (local myalgia, myofascial pain, or myofascial pain with referral), as the only diagnosis, was present in 31.5% of the subjects, arthralgia in 14.8% while 53.7% participants presented with both

Table 1. Demographic data.

Variables	TMDp ($n = 54$)	CTR ($n = 46$)
Age mean (SD)	29.13 (10.46)	28.54 (9.71)
Sex		
Female, *n* (%)	48 (88)	29 (63)
Male, *n* (%)	6 (12)	17 (37)
Marital status		
Married, *n* (%)	11 (20.4)	8 (19.5)
Domestic-partnership, *n* (%)	2 (3.7)	2 (4.9)
Divorced, *n* (%)	4 (7.4)	2 (4.9)
Separated, *n* (%)	1 (1.9)	/
Widow(er), *n* (%)	/	/
Never married, *n* (%)	36 (66.7)	29 (70.7)
Level of education (%)		
Elementary school, *n* (%)	4 (7.4)	/
High School, *n* (%)	15 (27.8)	/
Student, *n* (%)	16 (29.6)	25 (54.3)
College Degree, *n* (%)	16 (29.6)	14 (30.4)
Master's Degree, *n* (%)	3 (5.6)	7 (15.2)

Table 2. Comparison of variables according to the presence of pain (TMDp/CTR) and pain intensity (nLPI/HPI).

	Pain presence		Pain Intensity	
Variable	TMDp ($n = 54$)	CTR ($n = 46$)	nLPI ($n = 72$)	HPI ($n = 28$)
OBC-tot				
Median (IQR)	25 (16)	26.5 (8)	25 (9)	28 (14)
Z		−0.634		−2.111
p		.526		.035
Sleep-related oral behaviours				
Median (IQR)	5 (3)	4 (2)	4 (2)	5.50 (3)
Z		−1.178		−2.250
p		.239		.024
Waking-state oral behaviours				
Median (IQR)	22 (13)	22 (7)	20.50 (9)	23 (12)
Z		−0.609		−1.722
p		.542		.085
SSAS				
Median (IQR)	13.5 (10)	14.5 (7)	13.5 (8)	16.5 (9)
Z		−0.222		−2.207
p		.825		.027
GAD-7				
Median (IQR)	3.5 (4)	2 (5)	3 (5)	5 (4)
Z		−1.503		−2.824
p		.133		.005
PHQ-9				
Median (IQR)	3.5 (5)	3 (2)	3 (3)	6 (6)
Z		−1.492		−3.293
p		.136		.001

TMD painful diagnosis consisting of myalgia, arthralgia or both, TMDp; Control group – absence of TMD painful diagnosis, CTR; High pain intensity, HPI; no_low pain intensity, nLPI; Oral Behaviours Checklist, OBC-tot; Patient Health Questionnaire, PHQ-9; Generalized Anxiety Disorder questionnaire, GAD-7; Somatosensory Amplification Scale, SSAS; interquartile range, IQR.

Table 3. Correlations of oral behaviour scores with gender, psychological profile, somatosensory amplification, pain presence and pain intensity.

	OBC-tot	Waking-state oral behaviours	Sleep-related oral behaviours
Gender (0 = male, 1 = female)			
r	0.266*	0.290*	0.057
p	.007	.002	.571
pain intensity (0 = nLPI; 1 = HPI)			
r	0.212*	0.173	0.226*
p	.034	.085	.023
pain presence (0 = CTR; 1 = TMDp)			
r	−0.063	−0.061	−0.118
p	.528	.544	.240
SSAS			
r	0.331**	0.345**	0.103
p	<.001	<.001	.305
GAD-7			
r	0.248*	0.218*	0.164
p	.012	.029	.102
PHQ-9			
r	0.230*	0.205*	0.127
p	.021	.040	.205

** $p<.001$; *$p<.05$; TMD painful diagnosis consisting of myalgia, arthralgia or both, TMDp; Control group – absence of TMD painful diagnosis, CTR; High pain intensity, HPI; no_low pain intensity, nLPI; Oral Behaviours Checklist, OBC-tot; Patient Health Questionnaire, PHQ-9; Generalized Anxiety Disorder questionnaire, GAD-7; Somatosensory Amplification Scale, SSAS.

diagnoses. Thirty-two percent of participants reported headaches related to TMD.

When analysing participants depending on the sex, women presented significantly higher scores of OBC-tot (women: 28.56 ± 9.03, men: 22.78 ± 6.18; $Z = 2.641$, $p = .008$) and waking-state oral behaviours (women: 23.74 ± 805, men: 18.26 ± 6.28; $Z = 2.932$, $p = .003$) when compared to men. Also, somatosensory amplification scores showed to be significantly higher in women when compared to men (women: 15.04 ± 6.08, men: 11.78 ± 4.70; $Z = 2.219$, $p = .026$).

When evaluating the effect of pain presence (TMDp vs. CTR), no significant differences were found between TMDp patients and CTR participants for OBC-tot, sleep-related oral behaviours, waking-state oral behaviours, somatosensory amplification, anxiety and depression ($p > .05$; Table 2).

When evaluating the effect of pain intensity (HPI vs. nLPI), significantly higher values of OBC-tot, sleep-related oral behaviours, somatosensory amplification, depression and anxiety in participants with HPI when compared to those with nLPI were found ($p < .05$; Table 2).

In univariate correlations (Table 3), OBC-tot, as well as waking-state oral behaviours had higher correlations with somatosensory amplification ($p < .001$) than with anxiety ($p < .05$), depression ($p < .05$) and female sex ($p < .05$). Positive correlation of OBC-tot with pain intensity ($p < .05$) was observed, but not with the pain presence. Sleep-related oral behaviours correlated only with pain intensity ($p < .05$).

In multiple linear regression models (Table 4) a significant predictor for the OBC-tot was anxiety, which accounted for 19.2% of the variance ($R^2 = 0.13$). A significant predictor for waking-state oral behaviours was anxiety followed by female gender. The whole regression model accounted for 18.8% of the variance ($R^2 = 0.188$). An increase in anxiety by one scalar point increased waking-state oral behaviours score by 0.499 scalar points. Also, women reported waking-state oral behaviours scores that were 3.856 times higher than in men. A borderline association was found between the sleep-related oral behaviours and high pain intensity ($p = .045$). The whole regression model accounted for 6.2% of the variance ($R^2 = 0.062$).

Discussion

This study showed that higher scores of somatosensory amplification, depression symptoms, anxiety symptoms and high pain intensity were associated with more frequent oral behaviours. Anxiety, high-pain intensity and female sex were found to be predictive of damaging oral habits.

When evaluating pain presence, no differences of the examined variables between TMDp patients with that of controls were found, which conflicts with previous studies that characterized TMD patients as hypervigilant, more anxious, and more liable to somatization than healthy individuals [27,28]. According to Chow et al. [14] participants with self-reported pain had higher trait anxiety, somatosensory amplification, and OBC scores than those with no pain. Differences in outcomes between our study and study by Chow et al. [14] could be explained through differences in the study protocol. Their procedure included an online survey that looked only at students' self-reported symptoms without a clinical TMD diagnosis or a controlled environment [14]. Moreover, we need to take into account our data collection period that took place during the COVID-19 crisis [29]. It's probable that the difference in psychological and

Table 4. Multiple linear regression for predicting the effect of each variable on the frequency of oral behaviours.

	B	S.E.	*β*	*p*
OBC-tot				
SSAS	0.168	0.154	0.113	.280
GAD-7	0.597	0.240	0.245	.018*
Gender (0 = male, 1 = female)	3.879	2.046	0.187	.061
Pain intensity (0 = nLPI, 1 = HPI)	2.144	1.940	0.110	.272
Age	−0.041	0.082	−0.047	.616
Waking-state oral behaviours				
SSAS	0.181	0.140	0.134	.200
GAD-7	0.499	0.218	0.232	.024*
Gender (0 = male, 1 = female)	3.856	1.856	0.204	.040*
Pain intensity (0 = nLPI, 1 = HPI)	1.280	1.760	0.072	.469
Age	−0.078	0.074	−0.099	.293
Sleep-related oral behaviours				
SSAS	−0.008	0.038	−0.023	.838
GAD-7	0.070	0.060	0.128	.240
Gender (0 = male, 1 = female)	−0.055	0.507	−0.011	.914
Pain intensity (0 = nLPI, 1 = HPI)	0.972	0.479	0.215	.045*
Age	0.039	0.020	0.194	.053

*Statistically significant.
B: No standardized variable coefficient.
S.E.: Standard Error.
β: Standardized variable coefficient.

psychosomatic characteristics between TMDp and CTR participants shrank because of the stressful global scenario, which is why we couldn't detect a significant difference between groups when considering the presence of pain. What we found is that most examined variables had higher values in patients with HPI when compared with a nLPI group consisting of patients with either no pain or a lesser degree of pain. This could mean that high level of pain is a more important factor than the mere presence of pain when observing psychological and psychosomatic factors as well as oral parafunctional behaviour. This claim is not supported by the study of van der Meulen et al. [30] that found no correlation between facial pain and oral parafunctions. However, a sufficient amount of studies supported claims that behavioural habits can be a modulatory factor in the severity of TMD [31–33]. In a biopsychosocial model, oral behaviours, especially parafunctional habits, in combination with psychosocial factors, might be a plausible trigger for the start of TMD pain or cause higher discomfort [34]. Moreover, Su et al. [35] found that higher pain intensity was significantly associated with higher levels of anxiety, somatization, depression, stress and lower optimism.

When observing results from univariate correlation analysis we found that oral behaviours (OBC-tot and waking-state oral behaviours) correlated with anxiety, depression and somatosensory amplification. The association between somatosensory amplification and oral behaviours is in accordance with study by Chow et al. [14]. Moreover, a study by Bucci et al. [10] found greater occlusal tactile acuity in patients with TMD showing that they are more sensitive to sensations present in the orofacial region which might be attributed to greater somatosensory amplification. However, SSAS has been criticized for concentrating on measuring overall physical hypervigilance rather than oral fixations and orofacial symptoms [13]. Aronson et al. [36] concluded that the SSAS is more likely an index of negative emotionality and general distress than a valid measure of somatic sensitivity. Since, according to the results of multiple linear regression, somatosensory amplification did not turn out to be predictive of oral behaviours, we believe that when investigating hypervigilance in relation to oral parafunction, it may be more beneficial to concentrate on the orofacial area rather than evaluating emotional reactions to a variety of inputs from other body regions.

Our result, which showed significant association between OBC-tot/sleep-related oral behaviours scores and higher pain intensity, supports results by Blanco Aguilera et al. [37] who found that the individuals who reported more sleep bruxism also felt the most intense pain.

They pointed out that significant association was only discovered in disorders that cause more severe pain, such as myalgia accompanied by arthralgia. This is, also, supported by our multivariate analysis where sleep-related oral behaviours showed association with high-pain intensity.

Anxiety was found to be predictive of oral behavioural habits in the current study's multiple regression model. Ahlberg et al. [38] discovered a link between self-reported bruxism and psychological states like anxiety or stress. According to one systematic review, the link between oral habits and anxiety is debateable. However, it appears that bruxism may be linked to some particular symptoms on the anxiety disorder spectrum [39].

It is important to note that, when compared to men, women in the whole study sample, showed to have higher scores of oral behaviours and somatosensory amplification. Multiple regression showed that the predictor for oral behaviour is partly female sex. Such results can be explained by differences in psychosocial and biological stress response factors between the sexes [40]. Increased concern for one's health can cause negative psychological experiences to overflow into negative somatic experiences. While men are more responsive to acute stressors, women become more distressed which potentially diminishes their ability to respond to the problem consequently leading to chronic pain experiences and therefore causing the psychological basis for more frequent oral parafunctional activities [41].

We need to mention that all questionnaires measuring anxiety and depression symptoms and frequency of oral behavioural habits were self-reported. This might be considered a limitation since the answers were subjective interpretations of participants. Nevertheless, used questionnaires are all validated and routinely used in TMD research [21]. It is, though, advisable to create a highly specific questionnaire that would focus on occlusal and facial hypervigilance. Another limitation would be a COVID-19 crisis which created a unique research environment for all participants and may have influenced the study outcomes, thus it is important to keep this in mind when interpreting our findings. Lastly, although being based on power analysis, the sample size for this study was still rather small, which might potentially contribute to a sort of 'bias' and hence expose the study to imbalances across groups.

Conclusion

This study has shown the following:

Individuals with increased somatosensory amplification, higher anxiety and depression scores and high levels of pain intensity reported more frequent oral behaviours.

Oral behaviours were associated with pain intensity but not with the presence of pain and were primarily influenced by anxiety and the female sex.

This suggests that, in individuals with TMDp of high intensity, the therapeutic approach should not only focus on reducing the intensity of pain but also on reducing and/or managing the impact of psychological factors. In this way possible adverse effects, that oral behaviours could have on the entire masticatory system, might be reduced.

Consent to participate

Informed consent was obtained from all individual participants included in the study.

Consent to publish

Patients signed informed consent regarding publishing their data.

Author contribution

E.V. conducted the study, interpreted the data, wrote and edited the manuscript, made tables and visualizations; M. Z. conducted the study, collected the data, made tables, wrote and edited the manuscript; I. Z. A. designed and conducted the study, statistically analysed and interpreted the data, edited and critically revised the manuscript before submission.

Disclosure statement

The authors declare that they have no potential conflicts of interest.

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Data availability statement

Data can be requested from the corresponding author upon justified request.

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