Journal of Oral Rehabilitation

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Media Ranking in United Kingdom

SUBJECT AREA AND CATEGORY

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Dentistry (miscellaneous)

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114

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SCOPE

Journal of Oral Rehabilitation aims to be the most prestigious journal of dental research within all aspects of oral rehabilitation and applied oral physiology. It covers all diagnostic and clinical management aspects necessary to re-establish a subjective and objective harmonious oral function. Oral rehabilitation may become necessary as a result of developmental or acquired disturbances in the orofacial region, orofacial traumas, or a variety of dental and oral diseases (primarily dental caries and periodontal diseases) and orofacial pain conditions. As such, oral rehabilitation in the twenty-first century is a matter of skilful diagnosis and minimal, appropriate intervention, the nature of which is intimately linked to a profound knowledge of oral physiology, oral biology, and dental and oral pathology. The scientific content of the journal therefore strives to reflect the best of evidence-based clinical dentistry. Modern clinical management should be based on solid scientific evidence gathered about diagnostic procedures and the properties and efficacy of the chosen intervention (e.g. material science, biological, toxicological, pharmacological or psychological aspects). The content of the journal also reflects documentation of the possible side-effects of rehabilitation, and includes prognostic perspectives of the treatment modalities chosen.

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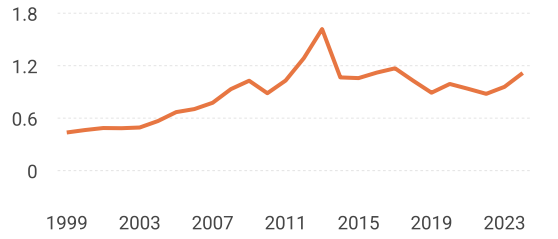

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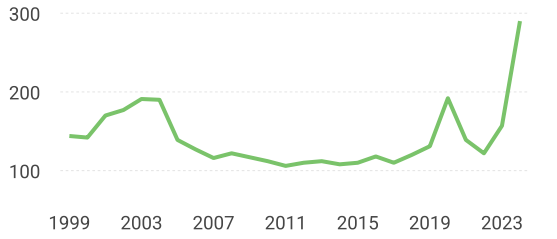

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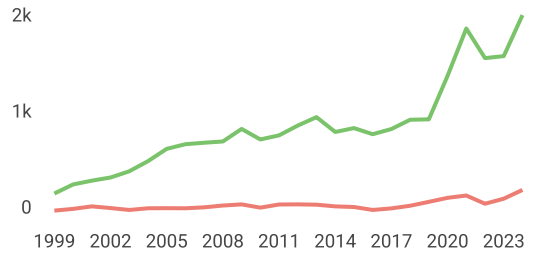

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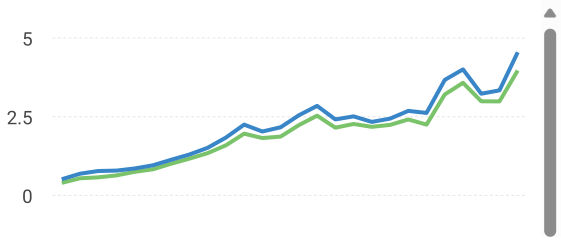

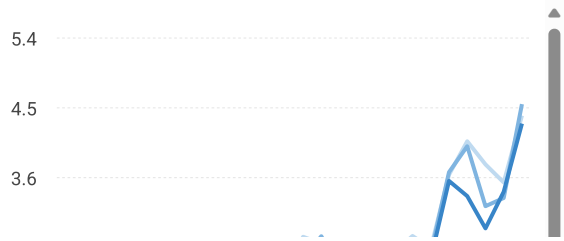

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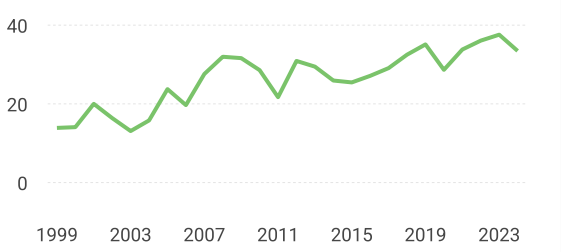

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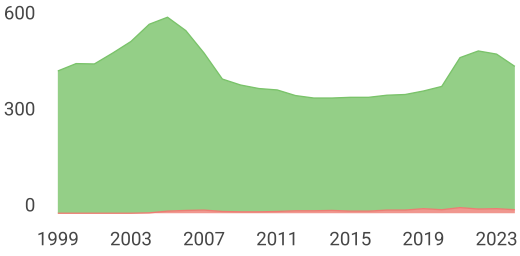

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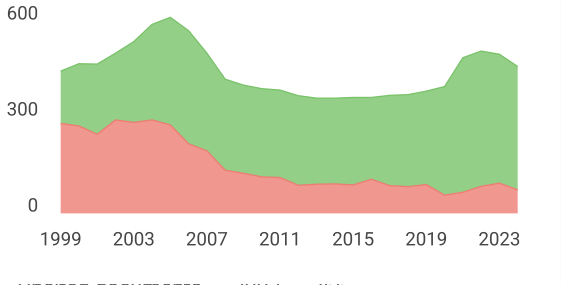

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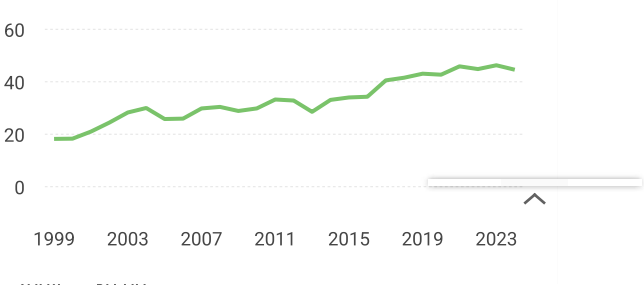

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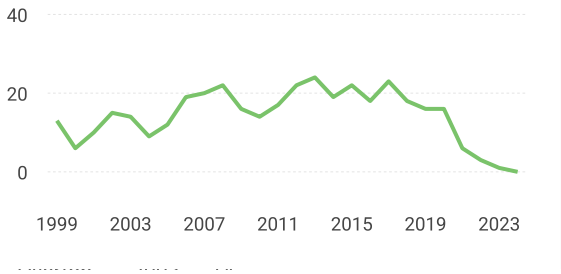

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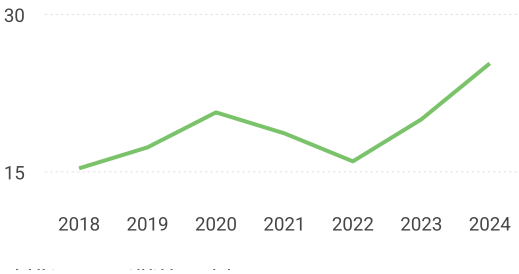

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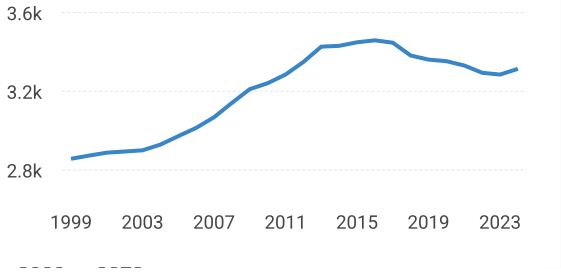

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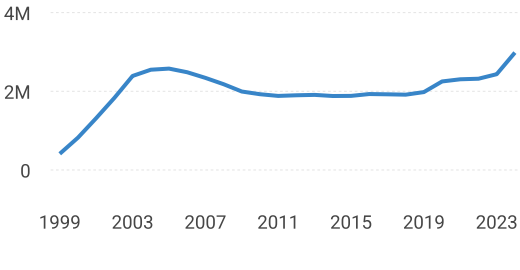

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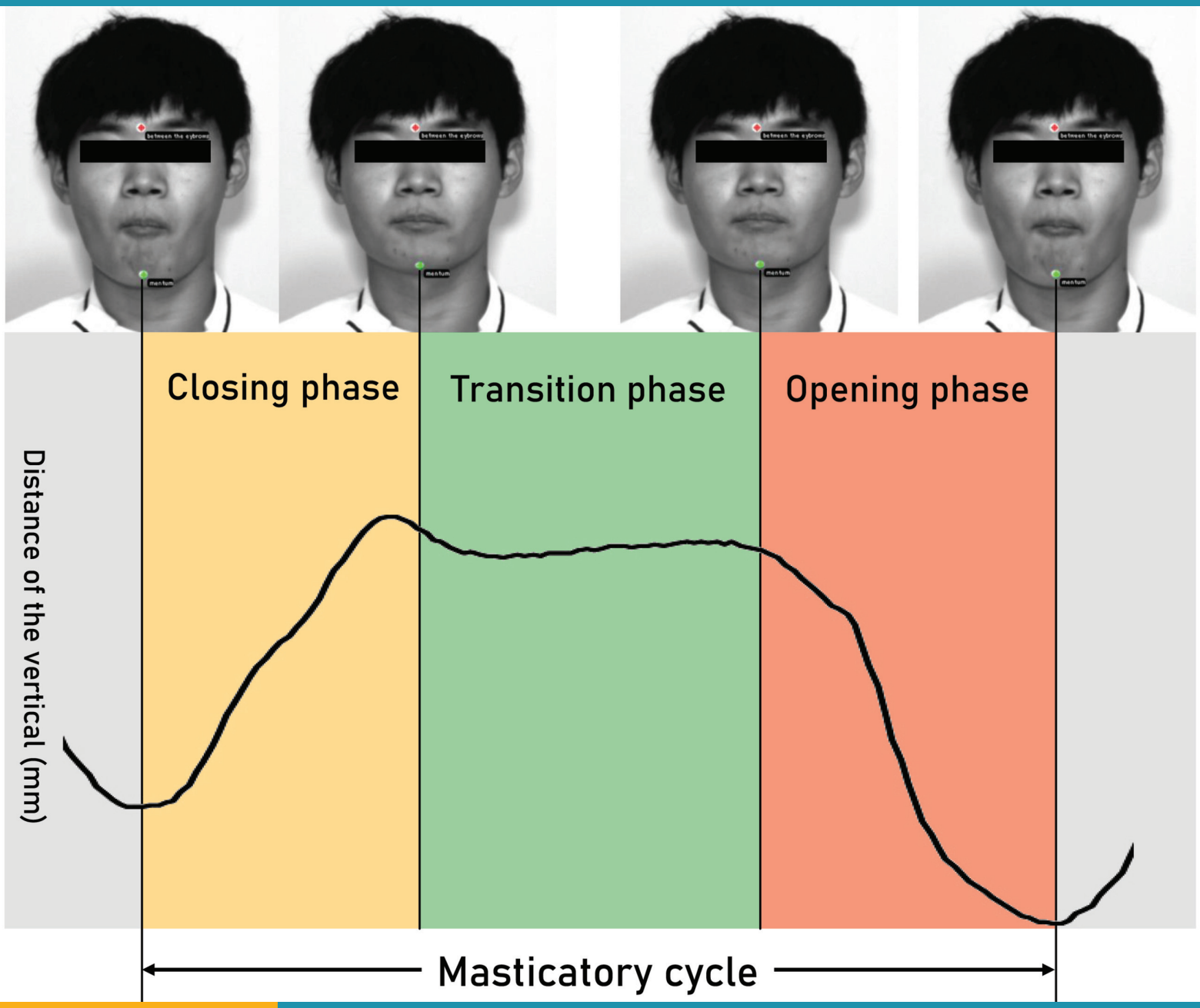

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Journal of Oral Rehabilitation aims to be the most prestigious journal of dental research within all aspects of oral rehabilitation and applied oral physiology. It covers all diagnostic and clinical management aspects necessary to reestablish a subjective and objective harmonious oral function.

The focus for the journal is to present original research findings; to generate critical reviews and relevant case stories, and to stimulate commentaries and professional debates in Letters to the Editor. We will invite relevant commercial interests to engage in the journal in order to make it the international forumfor debate between dental clinical sciences and industry, which share a common goal: to improve the quality of oral rehabilitation.

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The cover image is based on the Original Article *Evaluation of masticatory performance by motion capture analysis of jaw movement* by Masaaki Imaoka et al., https://doi.org/10.1111/joor.13538.

ORIGINAL ARTICLES

Training of the lateral pterygoid muscle in the treatment of temporomandibular joint disc displacement with reduction: A randomised clinical trial

Christin Olbort, Falk Pfanne, Christian Schwahn, Olaf Bernhardt

Pages: 921-930 | First Published: 24 May 2023

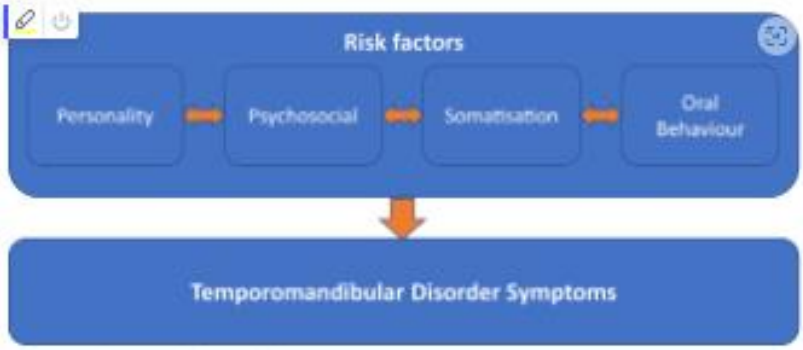
The aim was to investigate whether isometric training of the lateral pterygoid muscle (LPM) is equivalent to stabilisation appliance therapy with regard to the treatment of painful DDwR. The training program is based on the science of Janda.

Abstract | Full text | PDF | References | Request permissions

Personality, psychosocial and oral behavioural risk factors for temporomandibular disorder symptoms in Asian young adults

Adrian Ujin Yap, Carolina Marpaung

Pages: 931-939 | First Published: 31 May 2023



Association between the four risk factors to TMD symptoms.

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Open Access

Relationship Between Temporomandibular Ankylosis And Maximum Mouth Opening In Children

Kevser Kolçakoğlu, Salih Doğan, Gökmen Zararsız, Nükhet Kütük, Zeynep Burçin Gönen

Pages: 940-947 | First Published: 23 May 2023

Signs of Temporomandibular Ankylosis could occur among children, and oral measurements should be recorded. Soft tissue subnasal-pogonion distance showed a significant influence with four-finger width. The Maximum mouth opening showed a significant influence with three-finger width.

Abstract | Full text | PDF | References | Request permissions

Painful temporomandibular disorders in Confucian-heritage cultures: Their inter-relationship with bodily pain, psychological well-being and distress

Adrian Ujin Yap, Darren Zong Ru Lee

Pages: 948-957 | First Published: 29 May 2023

Abstract | Full text | PDF | References | Request permissions

Open Access

The effect of myotonic dystrophy type 1 on temporomandibular joint and dentofacial morphology: A CBCT analysis

Burcu Evlice, Hazal Duyan Yuksel, Ahmet Evlice, Filiz Koc

Pages: 958-964 | First Published: 09 June 2023

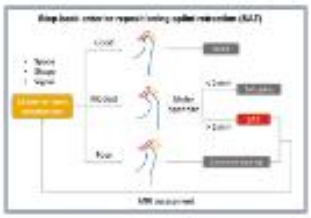
Adult patients with DM1 presented a high frequency of crossbite, tendency to skeletal Class II and morphological osseous alterations of TMJ. The progressive course of DM1 could affect prognosis of the dentomaxillofacial treatments. This CBCT study reveals DM1-specific morphological and osseous TMJ alterations.

Abstract | Full text | PDF | References | Request permissions

Step-back anterior repositioning splint retraction for temporomandibular joint disc displacement with reduction in adult patients

Hui Li, Da Shen, Zhihong Chen, Jian Li

Pages: 965-971 | First Published: 03 May 2023



Step-back anterior repositioning splint retraction is a modified orthodontic treatment method suitable for disc displacement with reduction of temporomandibular joint with unstable occlusion. The key assessment is made based on MRI results which reveal the bilaminar zone adaptation including the narrowing of intra-articular space, the curvature and signal intensity of the retrodiscal tissues.

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Sex hormones associated with temporomandibular pain on palpation in male adolescents—Results of the epidemiologic LIFE child study

Christian Hirsch, Oliver Schierz, Antje Körner, Wieland Kiess, Ronald Biemann, Annett Schrock, Jens Christoph Türp

Pages: 972-979 | First Published: 05 June 2023

Abstract | Full text | PDF | References | Request permissions

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Sleep disturbances are associated with pain intensity and pain-related functional interference in patients experiencing orofacial pain

Priya Thimma Ravindranath, Jared G. Smith, Rasooli Nia Niloofar, Candice Ebelthite, Tara Renton

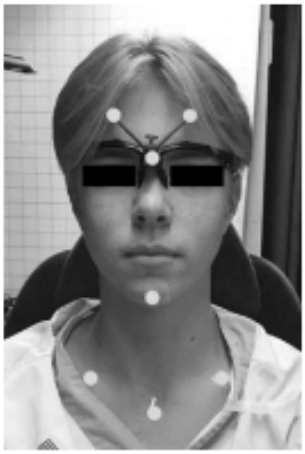
Pages: 980-990 | First Published: 27 May 2023

Open Access

Development of integrated jaw–neck motor function in children at 6, 10 and 13 years of age compared to adults: A kinematic longitudinal study

Evelina Nilsson, Birgitta Häggman-Henrikson, Erik Domellöf, Fredrik Hellström, Charlotte K. Häger, Catharina Österlund

Pages: 1002-1011 | First Published: 16 June 2023



This kinematic study longitudinally examined jaw–neck motor function in a sample of typically developing Swedish children (N < 20, 8 females) at 6, 10 and 13 year-old, and adults (N < 20, 9 females). Children showed pronounced movement variability and longer movement cycle time at 6 to 10 years and developmental progress in jaw–neck integration from 6 to 13 years, with 13-year-olds displaying adult-like movements. These results add new detailed understanding to the typical development of integrated jaw–neck motor function.

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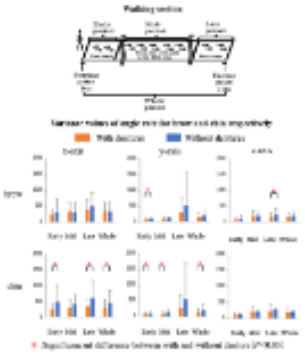
Influence of wearing complete dentures on control of head position during walking in edentulous older adults

Kento Shimizu, Hiroyuki Suzuki, Naoya Isoyama, Yuiko Yanagihara, Shunsuke Minakuchi

Pages: 1012-1019 | First Published: 23 May 2023



In this study, we evaluated the difference in head stability during walking in edentulous older adults with and without complete dentures using acceleration and angle rate sensors. The results showed that values such as the variance value of the angle rate of the brow and chin with complete dentures were significantly smaller than without complete dentures. These results suggest that complete dentures for edentulous older adults may stabilize the head during walking and contribute to walking stability.

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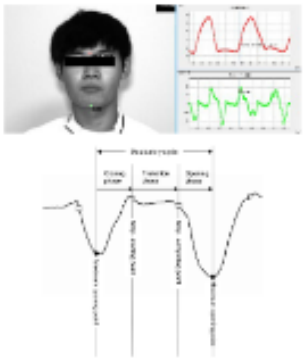
Evaluation of masticatory performance by motion capture analysis of jaw movement

Masaaki Imaoka, Kentaro Okuno, Ryuichiro Kobuchi, Taro Inoue, Kazuya Takahashi

Pages: 1020-1029 | First Published: 16 June 2023



The ability to analyse masticatory performance in healthy adults by motion capture of jaw movements at a single point on the mandibular skin, as a new simple method of masticatory performance. This study reveals that transition phase, which is the period between closed mouth and open mouth and the opposing teeth may occlude, was significantly correlation with the amount of glucose extracted which is reference value of MP, and a significant independent variable for normal masticatory performance.

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Developing diagnostic criteria for tooth wear, a preliminary beta version based on expert opinion, and a narrative literature review

Peter Wetselaar, Frank Lobbezoo, Ralph de Vries, Shamir B. Mehta, Niek J. M. Opdam, Bas A. C. Loomans

Pages: 1030-1042 | First Published: 14 May 2023

Diagnostic Criteria for Tooth Wear		
Axis I – Assessment Tools		Axis II - Patients Complaints
A. quantification B. questionnaires C. oral history taking D. qualification/phenotyping E. vertical dimension of occlusion, VDO F. chewing ability G. risk assessment		A. impaired esthetics B. hypersensitivity, sensitivity, pain, C. discomfort or dysfunction D. reduced quality of life E. interferences with dental sleep disorders
Axis III – Assessment Tools		Axis IV - Clinical Decision Making
H. saliva I. genetics J. surface dental hard tissues		A. define pathology B. counseling C. monitoring D. preventive measurements E. early intervention F. restorative treatment

The DC-tooth wear consists of four parts, namely Axes I–IV. Axis I includes the tools for the clinical examination, Axis II to assess the complaints of the patients in order to enable shared decision making, Axis III for assessing possible biomarkers and Axis IV to go through a careful process to determine the management of the multifactorial condition tooth wear is.

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A novel experimental model to investigate fungal involvement shows expression of Dectin-1 in periapical lesion pathogenesis

Arshad Hasan, Talat Roome, Mohsin Wahid, Shazia Akbar Ansari, Javeria Ali Khan, Amber Kiyani, Syeda Neha Ahmed Jilani

Pages: 1043-1057 | First Published: 01 June 2023

Abstract | Full text | PDF | References | Request permissions

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Evaluation of mid-buccal gingival recessions and occlusal interferences

Sühan Gürbüz, Hikmat Bakhishov, Eda Gizem Koçyiğit, Abdullah Işık, Burcu Balos Tuncer, Burcu Ozdemir

Pages: 1058-1069 | First Published: 19 June 2023

Characteristics of the study population according to the mbGR presence (n = 149).

Abstract | Full text | PDF | References | Request permissions

REVIEWS

Neuroimaging meta-analysis of brain mechanisms of the association between orofacial pain and mastication

Ta-Chung Chen, Chia-Shu Lin

Pages: 1070-1081 | First Published: 30 May 2023

Abstract | **Full text** | **PDF** | **References** | **Request permissions**

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Comparison between ultrasound and magnetic resonance imaging of the temporomandibular joint in juvenile idiopathic arthritis: A systematic review

Rossana Patricia Rotolo, Fabrizia d'Apuzzo, Felice Femiano, Ludovica Nucci, Giuseppe Minervini, Vincenzo Grassia

Pages: 1082-1092 | First Published: 10 June 2023

A systematic review evaluating the correlation between Ultrasound (US) and Magnetic Resonance Imaging (MRI) in patients with Juvenile Idiopathic Arthritis (JIA). The correlation between US and MRI in children with JIA was 'moderate' in acute arthritis while the chronic arthritis correlated positively only in two studies.

Abstract | **Full text** | **PDF** | **References** | **Request permissions**

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Prevalence of Temporomandibular Disorders in Orthognathic Surgery patients: A systematic review conducted according to PRISMA guidelines and the Cochrane Handbook for Systematic Reviews of Interventions

Nishath Sayed Abdul, Giuseppe Minervini

Pages: 1093-1100 | First Published: 12 June 2023

Abstract | **Full text** | **PDF** | **References** | **Request permissions**

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Post-traumatic stress, prevalence of temporomandibular disorders in war veterans: Systematic review with meta-analysis

Giuseppe Minervini, Rocco Franco, Maria Maddalena Marrapodi, Luca Fiorillo, Gabriele Cervino, Marco Cicciù

Pages: 1101-1109 | First Published: 10 June 2023

Abstract | **Full text** | **PDF** | **References** | **Request permissions**

Risk factors of tooth wear in permanent dentition: A scoping review

Julie Oudkerk, Charlotte Grenade, Anoushka Davarpanah, Alain Vanheusden, Sandrina Vandenput, Amélie K. Mainjot

Pages: 1110-1165 | First Published: 06 May 2023

Abstract | **Full text** | **PDF** | **References** | **Request permissions**

Received: 29 June 2022 | Revised: 16 January 2023 | Accepted: 28 May 2023

DOI: 10.1111/joor.13527

JOURNAL OF ORAL REHABILITATION WILEY

ORIGINAL ARTICLE

Personality, psychosocial and oral behavioural risk factors for temporomandibular disorder symptoms in Asian young adults

Adrian Ujin Yap[1,2,3] | Carolina Marpaung[3]

[1]Department of Dentistry, Ng Teng Fong General Hospital and Faculty of Dentistry, National University Health System, Singapore City, Singapore

[2]National Dental Research Institute Singapore, National Dental Centre Singapore and Duke-NUS Medical School, Singapore Health Services, Singapore City, Singapore

[3]Department of Prosthodontics, Faculty of Dentistry, Universitas Trisakti, Jakarta, Indonesia

Correspondence
Carolina Marpaung, Department of Prosthodontics, Faculty of Dentistry, Universitas Trisakti, Jl Kyai Tapa no 260, West Jakarta 1140, Indonesia.
Email: carolina@trisakti.ac.id

Abstract

Background: The relation between personality, psychosocial factors, somatisation, andoral behaviours as risk factors to temporomandibular disorder symptoms have notbeen well established.

Objectives: This study examined the association of temporomandibular disorder (TMD) symptoms with personality traits, psychological distress, somatisation and oral behaviours. The psychosocial and oral behavioural risk factors for TMD symptoms were also established in Asian young adults.

Methods: Participants were recruited from a large private University. Based on the quintessential five TMD symptoms (5Ts) of the DC/TMD, the participants were stratified into those with no (NT), painful (PT), dysfunctional (DT) and mixed (MT) TMD symptoms. Personality traits, psychological distress, somatisation and oral behaviours were evaluated with the Big Five Inventory-10 (BFI-10), Depression, Anxiety, Stress Scales-21 (DASS-21), Patient Health Questionnaire-15 (PHQ-15) and Oral Behaviours Checklist (OBC) accordingly. Data were examined using Kruskal–Wallis/Mann–Whitney *U* and Chi-squared tests, as well as multivariate logistic regression analysis ($\alpha = .05$).

Results: Of the 420 young adults (mean age 22.7 ± 1.1 years) evaluated, 41.4% had no TMD symptoms, while 17.4%, 20.0% and 21.2% reported PT, DT and MT, respectively. Though personality traits did not vary notably, participants with MT and PT had significantly higher levels of negative affectivity, anxiety and stress than the NT group. Moreover, those with MT and PT presented significantly greater somatisation and more oral behaviours than the DT and NT groups. Multivariate regression analyses indicated that anxiety, somatisation, sleep-related and waking-state nonfunctional oral activities were associated with painful and/or dysfunctional TMD symptoms.

Conclusions: Except for sleep-related oral activity, psychosocial and oral behavioural risk factors differed for painful, dysfunctional and mixed TMD symptoms in Asian young adults.

KEYWORDS
oral behaviours, personality, psychological distress, somatisation, temporomandibular joint disorders

Carolina Marpaung co-first author.

1 | BACKGROUND

Temporomandibular Disorders (TMDs) are a cluster of musculoskeletal and neuromuscular conditions characterised by pain and/or dysfunction of the Temporomandibular joints (TMJs), masticatory muscles and related structures.[1] They are the most common cause of nonodontogenic orofacial pain and affect up to 16% and 75% of the general population when determined by protocolised diagnostic criteria and self-reported questionnaires/physical examinations, respectively.[2,3] Women, particularly those of reproductive age, are more vulnerable to TMDs and constitute about 80% of TMD patients.[4,5] According to the contemporary Diagnostic Criteria for TMDs (DC/TMD) standard, common TMDs can be broadly classified into pain-related (TMJ arthralgia, masticatory muscle myalgia and headache attributed to TMDs) and intra-articular TMDs (primarily TMJ disc displacements, degenerative joint disease and subluxation).[6] Similarly, TMD symptoms could be categorised as painful and dysfunctional.

The complex aetiology of TMDs was found to adhere to the 'biopsychosocial model of illness' in prospective cohort studies.[7] This was also supported by cross-sectional and case–control studies indicating higher levels of psychosocial disorders among individuals with TMDs including depression, anxiety, stress and somatisation (manifestation of psychological distress through physical symptoms).[8–11] Asians have a greater propensity to somatise negative experiences than Westerners due partly to the stigma associated with mental illness in Asian cultures.[12–14] More recently, somatisation and stress were shown to be predictors for TMDs in nonclinical Asian youths, lending additional support to the notion that TMDs could be a form of functional somatic syndromes (FSSs).[15,16] Furthermore, people with TMDs often report multiple FSSs including fibromyalgia, tension-type headache, chronic fatigue and irritable bowel syndromes.[17,18]

Oral behaviours during sleep and wakefulness had also been associated with TMDs.[19–24] The odds of painful TMDs were increased by two to five folds in young adults with high levels of oral behaviours.[22] Besides bruxism (repetitive masticatory muscle activity typified by clenching and/or grinding of teeth), other oral behaviours such as the application of pressure to the jaws and unilateral chewing were frequently observed in individuals with TMDs.[23] A new method of grouping and scoring oral behaviours was just introduced by Donnarumma et al.[24] In addition to oral activities during sleep, subscales for nonfunctional (NFAs) and functional activities (FAs) were created for waking-state oral behaviours founded on the Oral Behaviour Checklist (OBC).[25]

Both TMDs and oral behaviours could be influenced by personality traits (a person's characteristic pattern of thoughts, attitudes, feelings and behaviours), which affect the way psychosocial distress is controlled and relieved.[26–31] While there are several personality taxonomies, the five-factor model or 'big five' is widely accepted and applied in research.[32–34] The five personality dimensions (OCEAN) are openness (the tendency to be curious, creative and imaginative), conscientiousness (the tendency to be well-organised, goal-oriented, reliable and self-disciplined), extraversion (the propensity to be warm, sociable and self-confident), agreeableness (the tendency to be polite, cooperative, empathetic and caring) and neuroticism (the tendency to experience negative emotions including depression, anxiety and stress). The limited literature available suggested that TMDs might be related to neurotic or 'distressed' personality profiles.[26–28] Conversely, specific oral behaviours were associated with contrasting personality types.[29–31] More specifically, individuals with bruxism were reported to exhibit conscientiousness, extraversion, as well as neuroticism. The variance could be contributed to differences in oral behaviour assessment methods and study samples including race/ethnicity.

Considering the aforesaid, the objective of this study was to investigate the association of TMD symptoms with personality traits, psychological distress, somatisation as well as oral behaviours. The psychosocial and behavioural risk factors for the presence of painful and/or dysfunctional TMD symptoms were also explored in Asian young adults. The research hypotheses were: (a) painful and dysfunctional TMDs are related to some personality traits, (b) painful and mixed TMD symptoms are accompanied by higher levels of psychological distress, somatisation, as well as oral behaviours and (c) the odds of painful, dysfunctional and mixed TMDs were increased by certain personality, psychosocial and oral behavioural factors.

2 | METHODS

2.1 | Study participants

Ethical approval for this study was granted by the Institutional Review Board at the Faculty of Dentistry, Trisakti University, Indonesia (reference number: 013/S3/KEPK/FKG/9/2021). Young adults attending a large private university in the capital city of Jakarta were recruited using a voluntary sampling method. Volunteers were solicited in person and over the internet through public postings. Individuals aged 18 to 24 years old who were proficient in English were included, while those with previous orofacial trauma/orthognathic surgery or undergoing professional care for debilitating physical and/or psychiatric conditions were excluded. A minimum of 374 participants are required for the study. This was computed with an online sample size calculator (https://www.calculator.net/sample-size-calculator.html) based on a confidence level of 95%, a precision of 5%, enrolment of 20 638 students at the university and 55% estimated prevalence of TMD symptoms among Asian young adults as determined in earlier studies.[15,35] Details of the study were presented to all potential participants and no financial compensations were offered for their involvement. After obtaining informed consent, the participants were directed to complete an electronic survey containing demographic information, the quintessential five TMD symptoms (5Ts) of the DC/TMD, Big Five Inventory-10 (BFI-10), Depression, Anxiety, Stress Scales-21 (DASS-21), Patient Health Questionnaire-15 (PHQ-15) and OBC.[25,33,36–38]

2.2 | Study measures

2.2.1 | TMD symptoms

Archetypal TMD symptoms were appraised with the 5Ts that comprised the five key items of the DC/TMD Symptom Questionnaire.[6] The 5Ts have high diagnostic accuracy for identifying pain-related and/or intra-articular TMDs with a sensitivity of 96.1%–99.2% and specificity of 100%.[37] The two painful (TMJ/masticatory muscle pain and headache) and three dysfunctional (TMJ noises, closed and open-locking) TMD symptoms were assessed over 30 days. Participants who answered 'no' to all five questions (5Ts-negative) were deemed to have 'no TMD' symptoms (NT), while those who answered 'yes' to any of the five items (5Ts-positive) were considered to be 'with TMD' symptoms (WT). The WT group was further stratified into those with painful (PT), dysfunctional (DT) and mixed (MT; both painful and dysfunctional) TMD symptoms.

2.2.2 | Personality traits and psychological distress

The 'big five' personality traits were assessed with the BFI-10, the validated short version of BFI-44, which consists of two items for each of the OCEAN dimensions.[33,34] The items are scored on a 5-point response scale where 'disagree strongly' = 1 point, 'disagree a little' = 2 points, 'neither agree nor disagree' = 3 points, 'agree a little' = 4 points and 'agree strongly' = 5 points, One of the two items in each dimension is scored reversely. Dimension scores range from 2 to 10 points with higher scores indicating greater partiality towards the specific trait. Psychological distress, specifically the negative emotional states of depression, anxiety and stress, was evaluated with the DASS-21, the abbreviated version of the DASS-42.[37] The psychometric properties of the DASS-21 are well established and it has been shown to have a bifactor structure where the different subscales load on a general factor for negative affectivity (the disposition to experiencing negative emotions and poor self-concept).[39] The DASS-21 entails seven items for each of its three subscales, which are scored on a 4-point response scale spanning from 'did not apply to me at all' = 0 points to 'applied to me very much or most of the time' = 3 points. While total DASS-21 scores that convey negative affectivity vary between 0 and 63 points, subscale scores range from 0 to 21 points. Higher total and subscale scores indicate greater levels of negative affectivity, depression, anxiety and stress accordingly. The severity (normal to extremely severe) scoring guide for the three emotional states is presented in the DASS manual.[37]

2.2.3 | Somatic symptoms and oral behaviours

The presence and severity of nonspecific somatic (physical) symptoms/somatisation were examined with the PHQ-15.[39] It has good measurement properties and the 15 items are scored on a 3-point response scale where 'not bothered at all' = 0 points, 'bothered a little' = 1 point and 'bothered a lot' = 2 points.[38,40] Total PHQ-15 scores range from 0 to 30 points and scores of ≥5, ≥10 and ≥15 points specify mild, moderate and high somatic symptoms/somatisation, respectively. The frequency of oral behaviours was assessed with the OBC, which comprised 21 items concerning activities during sleep and wakefulness.[25] Both sleep and waking-state items are scored on a 5-point response scale extending from 'none of the time' = 0 points to '4-7 nights per week' or 'all of the time' = 4 points. Global oral behaviours (total OBC scores) vary between 0 and 84 points and are categorised as normal (0 to 16 points), low (17 to 24 points) and high (25 to 84 points) 'jaw use behaviours'.[22,41] The two sleep-related oral activities scrutinised are teeth clenching/grinding when asleep and sleeping in positions that put pressure on the jaws. Waking-state oral behaviours are grouped into six nonfunctional and six functional oral activities.[24] While the NFAs encompass grinding, clenching and holding activities, the FAs are related to normal jaw functioning such as chewing, talking, singing and yawning.[24]

2.3 | Statistical analyses

The IBM SPSS Statistics for Windows software Version 27.0 (IBM Corporation) was used for statistical analyses with a significance level of .05. Qualitative data were reported as frequencies with proportions and examined using the Chi-squared test. Quantitative data were subjected to normality testing with Shapiro–Wilk's test and presented as means/median with standard deviations (SD)/interquartile ranges (IQR). As data were non-normal, intergroup comparisons were done using Kruskal–Wallis and post-hoc Mann–Whitney *U* tests. Multivariate logistic regression analyses were conducted to establish the personality, psychosocial and oral behavioural risk factors for painful, dysfunctional and mixed TMD symptoms. Insignificant variables were removed using a stepwise variable selection technique with a threshold of $p < .10$. Outcomes were stated as odds ratios (ORs) with 95% confidence intervals (95% CI).

3 | RESULTS

A total of 428 young adults volunteered for the study. Of these, 8 were excluded due to age (≥25 years old) and the remaining 420 had a mean age of 22.7 ± 1.1 years and 85.5% were women. While 41.4% did not experience any TMD symptoms, PT, DT and MT were reported by 17.4%, 20.0% and 21.2% of the participants correspondingly (Table 1). The variance in age was insignificant, but considerable differences in gender distribution were noted with the WT group having 8.5% more women than the NT group. Tables 2 and 3 show the mean/median BFI and DASS-21 scores for the various TMD groupings. Although personality dimension (OCEAN) scores did not differ substantially, significant differences in negative affectivity (MT, PT > NT; MT > DT), anxiety (MT, PT > DT, NT) and stress (MT, PT > NT; MT > DT) scores were observed.

TABLE 1 Demographic characteristics of the study cohort ($n = 420$).

Variables	*n* (%)	Age			Gender		
		Mean (SD)	Median (IQR)	*p*-value* Post-hoc	Male *n* (%)	Female *n* (%)	*p*-value^ Post-hoc
Total	420 (100)	22.7 (1.1)	23.0 (2)	–	61 (14.5)	359 (85.5)	–
TMD symptoms							
No (5Ts-negative)	174 (41.4)	22.7 (1.2)	23.0 (2)	.796	34 (19.5)	140 (80.5)	**.011**
Yes (5Ts-positive)	246 (58.6)	22.6 (1.1)	23.0 (2)		27 (11.0)	219 (89.0)	
TMD groups							
No TMD symptoms (NT)	174 (41.4)	22.7 (1.2)	23.0 (2)	.195	34 (19.5)	140 (80.5)	.145
Painful TMD symptoms (PT)	73 (17.4)	22.8 (1.0)	23.0 (2)		6 (8.2)	67 (91.8)	
Dysfunctional TMD symptoms (DT)	84 (20.0)	22.7 (1.2)	23.0 (2)		11 (13.1)	73 (86.9)	
Mixed TMD symptoms (MT)	89 (21.2)	22.5 (1.1)	22.0 (1)		10 (11.2)	79 (88.8)	

Note: Results of *Kruskal–Wallis and ^Chi-squared tests. Bold indicates $p < .05$.
Abbreviations: IQR, interquartile range; SD, standard deviation.

TABLE 2 Mean/median Brief big five inventory (BFI) scores for the various groups.

Variables	No TMD (NT)	Painful TMD (PT)	Dysfunctional TMD (DT)	Mixed TMD (MT)	*p*-value* Post-hoc
Openness (O)					
Mean (SD)	6.2 (1.4)	6.2 (1.4)	6.1 (1.4)	6.6 (1.6)	.199
Median (IQR)	6.0 (2)	6.0 (2)	6.0 (2)	7.0 (2)	
Conscientiousness (C)					
Mean (SD)	6.8 (1.4)	6.5 (1.4)	6.6 (1.4)	6.4 (1.2)	.235
Median (IQR)	7.0 (2)	7.0 (2)	7.0 (2)	7.0 (1)	
Extraversion (E)					
Mean (SD)	7.0 (1.7)	6.8 (1.7)	6.6 (1.5)	7.0 (1.7)	.364
Median (IQR)	7.0 (2)	7.0 (2)	6.5 (2)	7.0 (2)	
Agreeableness (A)					
Mean (SD)	7.2 (1.4)	7.0 (1.1)	7.2 (1.5)	7.0 (1.4)	.392
Median (IQR)	7.0 (2)	7.0 (2)	7.0 (2)	7.0 (2)	
Neuroticism (N)					
Mean (SD)	6.5 (1.8)	7.0 (1.5)	6.8 (1.6)	6.9 (1.7)	.123
Median (IQR)	7.0 (3)	7.0 (2)	7.0 (2)	7.0 (2)	

Note: Results of *Kruskal–Wallis test.
Abbreviations: IQR, interquartile range; SD, standard deviation.

Table 4 indicates the mean/median PHQ-15 and OBC scores. The MT and PT groups had significantly greater somatic symptom scores than the DT and NT groups. While participants with DT and NT experienced mostly mild somatic symptoms, those with MT and PT presented moderate somatisation. Significant differences in total OBC scores were also discerned (MT, PT > DT > NT). Participants without (NT) and with TMD symptoms, specifically DT, PT and MT, reported normal and low jaw use behaviours, respectively. Significant differences in sleep-related oral activities (MT, PT, DT > NT), waking-state NFA (MT, PT, DT > NT; MT > DT) and waking-state FA (PT > DT, NT) scores were also discerned.

The outcomes of logistic regression analyses are displayed in Table 5. After adjusting for potential confounders, the odds of painful TMD symptoms were increased by somatisation (OR = 1.24; 95% CI = 1.10–1.41), sleep-related oral activities (OR = 1.23; 95% CI = 1.05–1.45) and waking-state NFA (OR = 1.15; 95% CI = 1.01–1.31), whereas the odds of dysfunctional TMD symptoms were elevated by only sleep-related oral activities (OR = 1.35; 95% CI = 1.16–1.57). The odds of mixed TMD symptoms were increased by anxiety (OR = 1.37; 95% CI = 1.12–1.69), sleep-related oral activities (OR = 1.23; 95% CI = 1.04–1.45) and waking-state NFA (OR = 1.34; 95% CI = 1.18–1.52).

TABLE 3 Mean/median Depression, anxiety, stress scales-21 (DASS-21) scores for the various groups.

Variables	No TMD (NT)	Painful TMD (PT)	Dysfunctional TMD (DT)	Mixed TMD (MT)	*p*-value* Post-hoc
Negative affectivity					
Mean (SD)	13.1 (10.2)	15.9 (9.9)	13.3 (9.7)	16.9 (10.1)	**.004**
Median (IQR)	12.0 (14)	15.0 (13)	11.5 (13)	16.0 (14)	MT, PT > NT MT > DT
Depression					
Mean (SD)	3.2 (3.5)	3.5 (3.5)	3.1 (3.3)	3.6 (3.8)	.611
Median (IQR)	2.0 (5)	2.0 (5)	2.0 (4)	2.0 (4)	
Anxiety					
Mean (SD)	4.0 (3.3)	5.2 (3.4)	4.1 (3.6)	5.9 (3.4)	**<.001**
Median (IQR)	4.0 (5)	5.0 (4)	3.0 (5)	5.0 (4)	MT, PT > DT, NT
Stress					
Mean (SD)	5.9 (4.4)	7.2 (4.3)	6.0 (4.2)	7.4 (4.1)	**.010**
Median (IQR)	6.0 (5)	7.0 (6)	5.5 (7)	7.0 (6)	MT, PT > NT MT > DT

Note: Results of *Kruskal–Wallis/Mann–Whitney *U* tests. Bold indicates $p < .05$.
Abbreviations: IQR, interquartile range; SD, standard deviation.

TABLE 4 Mean/median Patient health questionnaire-15 (PHQ-15) and Oral Behaviour Checklist (OBC) scores for the various groups.

Variables	No TMD (NT)	Painful TMD (PT)	Dysfunctional TMD (DT)	Mixed TMD (MT)	*p*-value* Post-hoc
Somatic symptoms					
Mean (SD)	5.1 (4.9)	10.7 (5.9)	5.6 (4.9)	10.1 (5.9)	**<.001**
Median (IQR)	4.0 (5)	10.0 (10)	5.0 (5)	9.0 (8)	PT, MT > DT, NT
Oral behaviours (OB)					
Global OB					
Mean (SD)	14.9 (6.5)	19.3 (5.4)	17.3 (5.7)	20.1 (6.8)	**<.001**
Median (IQR)	14.0 (9)	20.0 (8)	16.5 (8)	20.0 (10)	MT, PT > DT > NT
Sleep-related oral activities					
Mean (SD)	2.7 (2.0)	3.7 (1.6)	3.6 (1.5)	3.8 (1.7)	**<.001**
Median (IQR)	3.0 (3)	4.0 (1)	4.0 (1)	4.0 (2)	MT, PT, DT > NT
Waking-state nonfunctional oral activities (NFA)					
Mean (SD)	1.5 (2.2)	2.7 (2.5)	2.2 (2.5)	3.7 (2.7)	**<.001**
Median (IQR)	1.0 (2)	2.0 (3)	2.0 (3.0)	4.0 (3)	MT, PT, DT > NT MT > DT
Waking-state functional oral activities (FA)					
Mean (SD)	6.3 (2.7)	7.3 (2.3)	6.4 (2.5)	6.8 (3.0)	**.022**
Median (IQR)	6.0 (4)	7.0 (3)	6.0 (4)	7.0 (4)	PT > DT, NT

Note: Results of *Kruskal–Wallis/Mann–Whitney *U* tests. Bold indicates $p < .05$.
Abbreviations: IQR, interquartile range; SD, standard deviation.

4 | DISCUSSION

This study focussed on young adults as they characterised the majority of TMD patients and represented the age when TMD symptoms start to peak.[42,43] University students were singled out, due to their relatively high rates of psychological distress, bodily pain, bruxism and TMD symptoms, which could be linked with new autonomy/responsibilities, altered life/living conditions and academic stresses/demands.[44,45] The prevalence of TMD symptoms in our sample of Southeast Asian young adults was within the range reported internationally and corroborated reports of high frequencies of TMDs in South and West Asian university students.[3,46,47] As personality traits did not differ significantly among the various TMD groupings. the first research hypothesis was rejected. The second and third research hypotheses were partly supported as participants with MT and PT had considerably higher levels of psychological distress and the odds of painful, dysfunctional and mixed TMD symptoms were significantly increased by explicit psychosocial and oral behavioural factors.

TABLE 5 Risk factors for the presence of painful, dysfunctional and mixed TMD symptoms.

	Painful TMD symptoms		Dysfunctional TMD symptoms		Mixed TMD symptoms	
Variables	**Odds ratio (95% CI)**	***p*-Value**	**Odds ratio (95% CI)**	***p*-Value**	**Odds ratio (95% CI)**	***p*-Value**
Gender						
Male	Reference					
Female	1.51 (0.54–4.24)	.432				
Personality traits						
Openness					1.18 (0.95–1.17)	.128
Conscientiousness					0.96 (0.75–1.23)	.121
Extraversion			0.88 (0.75–1.04)	.143		
Agreeableness						
Neuroticism	1.15 (0.96–1.38)	.121			1.05 (0.83–1.32)	.698
Psychological distress						
Negative affectivity	0.99 (0.95–1.02)	.470	1.01 (0.95–1.08)	.700	0.94 (0.87–1.00)	.062
Depression						
Anxiety	1.13 (0.92–1.38)	.257			**1.37 (1.12–1.69)**	**.003**
Stress	1.01 (0.81–1.27)	.930			0.97 (0.78–1.20)	.770
Somatisation	**1.24 (1.10–1.41)**	**.001**			1.08 (0.95–1.23)	.236
Oral behaviours						
Global OB					0.98 (0.92–1.05)	.560
Sleep-related oral activity	**1.23 (1.05–1.45)**	**.011**	**1.35 (1.16–1.57)**	**<.001**	**1.23 (1.04–1.45)**	**.014**
Waking-state NFA	**1.15 (1.01–1.31)**	**.031**	1.10 (0.97–1.24)	.148	**1.34 (1.18–1.52)**	**<.001**
Waking-state FA	1.10 (0.98–1.23)	.119				

Note: Results of multivariate logistic regression analyses. Bold indicates $p < .05$.

Abbreviations: OB, oral behaviours; NFA, nonfunctional oral activity; FA, functional oral activity.

4.1 | Personality traits and psychological distress

Results of intergroup comparisons indicated that personality traits did not influence the presence of TMD symptoms. Findings differed from those of earlier work suggesting that TMDs are connected to neurotic or 'distressed' personalities.[26–28] The disparity could be attributed to differences in research settings and race/ethnicity as well as the rather high scores for neuroticism in the NT group. Significant differences in negative affectivity, anxiety and stress scores were detected among the four TMD groups. Participants with MT had significantly higher levels of negative affectivity, anxiety and stress than the DT and NT groups reiterating the observations in TMD patients.[48,49] Findings corroborated earlier research specifying the greater role of anxiety and stress in the development of TMDs in Southeast Asian youths who often have normal levels of depression.[50,51] Anxiety and stress are intertwined and may be mediated via the effects of glucocorticoids on corticotropin-releasing hormones in limbic structures.[52] Moreover, anxiety and stress were also recently found to be moderately correlated to TMD and somatic symptoms in a nonclinical community sample of young people.[15]

4.2 | Somatic symptoms and oral behaviours

Individuals with PT and MT had significantly higher levels of somatic symptoms than the DT and NT groups. While participants with DT and NT experienced mostly mild somatic symptoms, those with TMD pain (PT and MT) presented moderate somatisation reinforcing the belief that TMDs are a type of FSSs.[15,16] Women are known to experience more numerous, frequent and intense somatic symptoms than men and gender differences in somatic perceptions, symptoms acknowledgement/disclosure, socialisation and psychological distress had been implicated.[53] Findings were congruent with the high prevalence of moderate-to-high somatisations in TMD patients and the preponderance of women among them.[2,8] This study is one of the first to apply the new method of grouping/scoring the OBC that categorises oral behaviours into sleep-related activities and waking-state NFA/FA.[24] Significant differences in total OBC, sleep-related oral activity, waking-state NFA and waking-state FA scores were discerned among the four TMD groups supporting the potential role of oral parafunction (abnormal function not related to mastication, deglutition or speech) in the aetiology of TMDs. However,

this affiliation may depend partly on the presence of other risk factors given the generally low levels of jaw use behaviours conveyed by the participants. Furthermore, there is currently no evidence demonstrating a direct causal relationship between oral behaviours and TMDs.[19,20] While substantial differences in global oral behaviours, sleep-related oral activities and waking-state NFA were observed between individuals with (MT, PT and DT) and without TMD symptoms, notable variance in waking-state FA was observed only between the PT and NT groups. Repetitive parafunctional and functional oral activities could generate excessive and/or protracted stresses on the stomatognathic system ensuing in possible pain-related and intra-articular TMDs.[54] When the various types of TMD symptoms were compared, considerable differences in global oral behaviours (MT, PT > DT), waking-state NFA (MT > DT) and FA (PT > DT) were perceived. No significant differences in sleep-related oral activities were observed among the MT, PT and DT groups. This can be explained by either sleep-related oral activities contributing to all TMD symptoms or decreased oral behaviour awareness during sleep. Multivariate logistic regression analyses, where all explanatory variables were examined simultaneously, were subsequently performed to establish the risk factors for painful, dysfunctional and mixed TMD symptoms.

4.3 | Risk factors for TMD symptoms

The outcomes of multivariate analyses indicated that apart from sleep-related oral activities, psychosocial and oral behavioural risk factors differed for painful, dysfunctional and mixed TMD symptoms. Sleep-related oral activities increased the odds of painful, dysfunctional and mixed TMDs by 23%, 35% and 23% correspondingly. Waking-state NFA appeared to affect TMD pain increasing the odds of painful TMD symptoms by 15% and mixed TMD symptoms by 34%. While somatisation amplified the odds of painful TMD symptoms by 24%, anxiety increased the odds of mixed TMD symptoms by 37%. Unlike earlier studies, psychological distress did not appear to increase the risk of painful and dysfunctional TMD symptoms substantially even though significant differences in negative affectivity, anxiety and stress were discerned among TMD groups.[15,50] Besides the lower levels of psychological distress in community samples when compared to TMD patients,[49] this outcome could also be accounted for by the absence of oral behaviours assessment in many prior studies. Psychological distress influences oral behaviours as well as somatic, and TMD symptoms and is thus a confounding variable.[15,21,23,35] It is plausible that the effects of psychological distress are mediated by somatisation and oral parafunction during sleep and wakefulness.

Collectively, the results reinforced the need to assess young adults for somatisation, sleep and awake oral activities together with psychological distress during TMD management. In addition to standard TMD interventions such as medication and splint therapy, cognitive-behavioural therapies could be advantageous for alleviating TMD and somatic symptoms and their accompanying oral behaviours and psychological distress.[55]

4.4 | Study limitations

This observational study has its limitations. First, like other cross-sectional investigations, causal and temporal relationships between TMD symptoms and the various variables cannot be ascertained. Temporal associations are pertinent considering the fluctuating nature of TMD symptoms and can only be established with prospective longitudinal studies. Second, the study was focussed on university students that do not represent all young adults in the country. Furthermore, the majority of the participants were women as they have a greater propensity to contribute to online surveys than men.[56] Though the results may be subjected to a gender bias, the odds of TMDs in the female participants paralleled that of other studies.[4] Third, the study is also disposed to other information partialities, such as social desirability, recall and confirmation biases, that accompany self-reported data.[57] Future research could incorporate out-of-school/working young adults, more male participants, as well as objective examinations for rendering TMD diagnoses. The research should also be extended to TMD patients given their conceivable phenotypic differences.

5 | CONCLUSION

TMD symptoms were experienced by 58.6% of the Asian young adults examined. While 17.4% and 20.0% had painful and dysfunctional complaints, 21.2% reported mixed TMD symptoms. Personality traits did not appear to influence the presence of TMD symptoms. Notwithstanding, individuals with painful and mixed TMD symptoms had substantially higher levels of negative affectivity, anxiety, stress, somatisation and oral behaviours compared with their peers with no TMDs. While sleep-related oral activities increased the odds of painful and/or dysfunctional TMD symptoms, waking-state nonfunctional activities increased the odds of TMD pain. Somatisation and anxiety were risk factors for painful and mixed TMD symptoms, respectively. Results validated the utility of the new method of grouping/scoring the OBC and emphasised the need to screen for psychological distress, somatisation and parafunctional oral behaviours in young adults with TMD symptoms. Further research is warranted to confirm the multifaceted interrelationship between psychosocial and oral behavioural factors in the aetiology of painful and/or intra-articular TMDs.

AUTHOR CONTRIBUTIONS

Adrian Ujin Yap contributed to conceptualisation, data curation, formal analysis, investigation, methodology, project administration, resources, supervision, validation, visualisation and writing the original draft. Carolina Marpaung contributed to conceptualisation, data curation, formal analysis, investigation, methodology, project

administration, resources, software, supervision, validation, and review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors have no financial or personal conflict of interest to declare concerning this article.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Adrian Ujin Yap https://orcid.org/0000-0003-0361-6209
Carolina Marpaung https://orcid.org/0000-0002-9621-6257

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Personality, psychosocial and oral behavioural risk factors for temporomandibular disorder symptoms in Asian young adults

by Carolina Damayanti Marpaung

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Personality, psychosocial and oral behavioural risk factors for temporomandibular disorder symptoms in Asian young adults

Adrian Ujin Yap[1,2,3] | Carolina Marpaung[3]

[1]Department of Dentistry, Ng Teng Fong General Hospital and Faculty of Dentistry, National University Health System, Singapore City, Singapore

[2]National Dental Research Institute Singapore, National Dental Centre Singapore and Duke-NUS Medical School, Singapore Health Services, Singapore City, Singapore

[3]Department of Prosthodontics, Faculty of Dentistry, Universitas Trisakti, Jakarta, Indonesia

Correspondence
Carolina Marpaung, Department of Prosthodontics, Faculty of Dentistry, Universitas Trisakti, Jl Kyai Tapa no 260, West Jakarta 1140, Indonesia.
Email: carolina@trisakti.ac.id

Abstract

Background: The relation between personality, psychosocial factors, somatisation, andoral behaviours as risk factors to temporomandibular disorder symptoms have notbeen well established.

Objectives: This study examined the association of temporomandibular disorder (TMD) symptoms with personality traits, psychological distress, somatisation and oral behaviours. The psychosocial and oral behavioural risk factors for TMD symptoms were also established in Asian young adults.

Methods: Participants were recruited from a large private University. Based on the quintessential five TMD symptoms (5Ts) of the DC/TMD, the participants were stratified into those with no (NT), painful (PT), dysfunctional (DT) and mixed (MT) TMD symptoms. Personality traits, psychological distress, somatisation and oral behaviours were evaluated with the Big Five Inventory-10 (BFI-10), Depression, Anxiety, Stress Scales-21 (DASS-21), Patient Health Questionnaire-15 (PHQ-15) and Oral Behaviours Checklist (OBC) accordingly. Data were examined using Kruskal–Wallis/Mann–Whitney *U* and Chi-squared tests, as well as multivariate logistic regression analysis ($\alpha = .05$).

Results: Of the 420 young adults (mean age 22.7 ± 1.1 years) evaluated, 41.4% had no TMD symptoms, while 17.4%, 20.0% and 21.2% reported PT, DT and MT, respectively. Though personality traits did not vary notably, participants with MT and PT had significantly higher levels of negative affectivity, anxiety and stress than the NT group. Moreover, those with MT and PT presented significantly greater somatisation and more oral behaviours than the DT and NT groups. Multivariate regression analyses indicated that anxiety, somatisation, sleep-related and waking-state nonfunctional oral activities were associated with painful and/or dysfunctional TMD symptoms.

Conclusions: Except for sleep-related oral activity, psychosocial and oral behavioural risk factors differed for painful, dysfunctional and mixed TMD symptoms in Asian young adults.

KEYWORDS
oral behaviours, personality, psychological distress, somatisation, temporomandibular joint disorders

Carolina Marpaung co-first author.

1 | BACKGROUND

Temporomandibular Disorders (TMDs) are a cluster of musculoskeletal and neuromuscular conditions characterised by pain and/or dysfunction of the Temporomandibular joints (TMJs), masticatory muscles and related structures.[1] They are the most common cause of nonodontogenic orofacial pain and affect up to 16% and 75% of the general population when determined by protocolised diagnostic criteria and self-reported questionnaires/physical examinations, respectively.[2,3] Women, particularly those of reproductive age, are more vulnerable to TMDs and constitute about 80% of TMD patients.[4,5] According to the contemporary Diagnostic Criteria for TMDs (DC/TMD) standard, common TMDs can be broadly classified into pain-related (TMJ arthralgia, masticatory muscle myalgia and headache attributed to TMDs) and intra-articular TMDs (primarily TMJ disc displacements, degenerative joint disease and subluxation).[6] Similarly, TMD symptoms could be categorised as painful and dysfunctional.

The complex aetiology of TMDs was found to adhere to the 'biopsychosocial model of illness' in prospective cohort studies.[7] This was also supported by cross-sectional and case–control studies indicating higher levels of psychosocial disorders among individuals with TMDs including depression, anxiety, stress and somatisation (manifestation of psychological distress through physical symptoms).[8–11] Asians have a greater propensity to somatise negative experiences than Westerners due partly to the stigma associated with mental illness in Asian cultures.[12–14] More recently, somatisation and stress were shown to be predictors for TMDs in nonclinical Asian youths, lending additional support to the notion that TMDs could be a form of functional somatic syndromes (FSSs).[15,16] Furthermore, people with TMDs often report multiple FSSs including fibromyalgia, tension-type headache, chronic fatigue and irritable bowel syndromes.[17,18]

Oral behaviours during sleep and wakefulness had also been associated with TMDs.[19–24] The odds of painful TMDs were increased by two to five folds in young adults with high levels of oral behaviours.[22] Besides bruxism (repetitive masticatory muscle activity typified by clenching and/or grinding of teeth), other oral behaviours such as the application of pressure to the jaws and unilateral chewing were frequently observed in individuals with TMDs.[23] A new method of grouping and scoring oral behaviours was just introduced by Donnarumma et al.[24] In addition to oral activities during sleep, subscales for nonfunctional (NFAs) and functional activities (FAs) were created for waking-state oral behaviours founded on the Oral Behaviour Checklist (OBC).[25]

Both TMDs and oral behaviours could be influenced by personality traits (a person's characteristic pattern of thoughts, attitudes, feelings and behaviours), which affect the way psychosocial distress is controlled and relieved.[26–31] While there are several personality taxonomies, the five-factor model or 'big five' is widely accepted and applied in research.[32–34] The five personality dimensions (OCEAN) are openness (the tendency to be curious, creative and imaginative), conscientiousness (the tendency to be well-organised, goal-oriented, reliable and self-disciplined), extraversion (the propensity to be warm, sociable and self-confident), agreeableness (the tendency to be polite, cooperative, empathetic and caring) and neuroticism (the tendency to experience negative emotions including depression, anxiety and stress). The limited literature available suggested that TMDs might be related to neurotic or 'distressed' personality profiles.[26–28] Conversely, specific oral behaviours were associated with contrasting personality types.[29–31] More specifically, individuals with bruxism were reported to exhibit conscientiousness, extraversion, as well as neuroticism. The variance could be contributed to differences in oral behaviour assessment methods and study samples including race/ethnicity.

Considering the aforesaid, the objective of this study was to investigate the association of TMD symptoms with personality traits, psychological distress, somatisation as well as oral behaviours. The psychosocial and behavioural risk factors for the presence of painful and/or dysfunctional TMD symptoms were also explored in Asian young adults. The research hypotheses were: (a) painful and dysfunctional TMDs are related to some personality traits, (b) painful and mixed TMD symptoms are accompanied by higher levels of psychological distress, somatisation, as well as oral behaviours and (c) the odds of painful, dysfunctional and mixed TMDs were increased by certain personality, psychosocial and oral behavioural factors.

2 | METHODS

2.1 | Study participants

Ethical approval for this study was granted by the Institutional Review Board at the Faculty of Dentistry, Trisakti University, Indonesia (reference number: 013/S3/KEPK/FKG/9/2021). Young adults attending a large private university in the capital city of Jakarta were recruited using a voluntary sampling method. Volunteers were solicited in person and over the internet through public postings. Individuals aged 18 to 24 years old who were proficient in English were included, while those with previous orofacial trauma/orthognathic surgery or undergoing professional care for debilitating physical and/or psychiatric conditions were excluded. A minimum of 374 participants are required for the study. This was computed with an online sample size calculator (https://www.calculator.net/sample-size-calculator.html) based on a confidence level of 95%, a precision of 5%, enrolment of 20 638 students at the university and 55% estimated prevalence of TMD symptoms among Asian young adults as determined in earlier studies.[15,35] Details of the study were presented to all potential participants and no financial compensations were offered for their involvement. After obtaining informed consent, the participants were directed to complete an electronic survey containing demographic information, the quintessential five TMD symptoms (5Ts) of the DC/TMD, Big Five Inventory-10 (BFI-10), Depression, Anxiety, Stress Scales-21 (DASS-21), Patient Health Questionnaire-15 (PHQ-15) and OBC.[25,33,36–38]

2.2 | Study measures

2.2.1 | TMD symptoms

Archetypal TMD symptoms were appraised with the 5Ts that comprised the five key items of the DC/TMD Symptom Questionnaire.[6] The 5Ts have high diagnostic accuracy for identifying pain-related and/or intra-articular TMDs with a sensitivity of 96.1%–99.2% and specificity of 100%.[37] The two painful (TMJ/masticatory muscle pain and headache) and three dysfunctional (TMJ noises, closed and open-locking) TMD symptoms were assessed over 30 days. Participants who answered 'no' to all five questions (5Ts-negative) were deemed to have 'no TMD' symptoms (NT), while those who answered 'yes' to any of the five items (5Ts-positive) were considered to be 'with TMD' symptoms (WT). The WT group was further stratified into those with painful (PT), dysfunctional (DT) and mixed (MT; both painful and dysfunctional) TMD symptoms.

2.2.2 | Personality traits and psychological distress

The 'big five' personality traits were assessed with the BFI-10, the validated short version of BFI-44, which consists of two items for each of the OCEAN dimensions.[33,34] The items are scored on a 5-point response scale where 'disagree strongly' = 1 point, 'disagree a little' = 2 points, 'neither agree nor disagree' = 3 points, 'agree a little' = 4 points and 'agree strongly' = 5 points, One of the two items in each dimension is scored reversely. Dimension scores range from 2 to 10 points with higher scores indicating greater partiality towards the specific trait. Psychological distress, specifically the negative emotional states of depression, anxiety and stress, was evaluated with the DASS-21, the abbreviated version of the DASS-42.[37] The psychometric properties of the DASS-21 are well established and it has been shown to have a bifactor structure where the different subscales load on a general factor for negative affectivity (the disposition to experiencing negative emotions and poor self-concept).[39] The DASS-21 entails seven items for each of its three subscales, which are scored on a 4-point response scale spanning from 'did not apply to me at all' = 0 points to 'applied to me very much or most of the time' = 3 points. While total DASS-21 scores that convey negative affectivity vary between 0 and 63 points, subscale scores range from 0 to 21 points. Higher total and subscale scores indicate greater levels of negative affectivity, depression, anxiety and stress accordingly. The severity (normal to extremely severe) scoring guide for the three emotional states is presented in the DASS manual.[37]

2.2.3 | Somatic symptoms and oral behaviours

The presence and severity of nonspecific somatic (physical) symptoms/somatisation were examined with the PHQ-15.[39] It has good measurement properties and the 15 items are scored on a 3-point response scale where 'not bothered at all' = 0 points, 'bothered a little' = 1 point and 'bothered a lot' = 2 points.[38,40] Total PHQ-15 scores range from 0 to 30 points and scores of ≥5, ≥10 and ≥15 points specify mild, moderate and high somatic symptoms/somatisation, respectively. The frequency of oral behaviours was assessed with the OBC, which comprised 21 items concerning activities during sleep and wakefulness.[25] Both sleep and waking-state items are scored on a 5-point response scale extending from 'none of the time' = 0 points to '4-7 nights per week' or 'all of the time' = 4 points. Global oral behaviours (total OBC scores) vary between 0 and 84 points and are categorised as normal (0 to 16 points), low (17 to 24 points) and high (25 to 84 points) 'jaw use behaviours'.[22,41] The two sleep-related oral activities scrutinised are teeth clenching/grinding when asleep and sleeping in positions that put pressure on the jaws. Waking-state oral behaviours are grouped into six nonfunctional and six functional oral activities.[24] While the NFAs encompass grinding, clenching and holding activities, the FAs are related to normal jaw functioning such as chewing, talking, singing and yawning.[24]

2.3 | Statistical analyses

The IBM SPSS Statistics for Windows software Version 27.0 (IBM Corporation) was used for statistical analyses with a significance level of .05. Qualitative data were reported as frequencies with proportions and examined using the Chi-squared test. Quantitative data were subjected to normality testing with Shapiro–Wilk's test and presented as means/median with standard deviations (SD)/interquartile ranges (IQR). As data were non-normal, intergroup comparisons were done using Kruskal–Wallis and post-hoc Mann–Whitney *U* tests. Multivariate logistic regression analyses were conducted to establish the personality, psychosocial and oral behavioural risk factors for painful, dysfunctional and mixed TMD symptoms. Insignificant variables were removed using a stepwise variable selection technique with a threshold of $p < .10$. Outcomes were stated as odds ratios (ORs) with 95% confidence intervals (95% CI).

3 | RESULTS

A total of 428 young adults volunteered for the study. Of these, 8 were excluded due to age (≥25 years old) and the remaining 420 had a mean age of 22.7 ± 1.1 years and 85.5% were women. While 41.4% did not experience any TMD symptoms, PT, DT and MT were reported by 17.4%, 20.0% and 21.2% of the participants correspondingly (Table 1). The variance in age was insignificant, but considerable differences in gender distribution were noted with the WT group having 8.5% more women than the NT group. Tables 2 and 3 show the mean/median BFI and DASS-21 scores for the various TMD groupings. Although personality dimension (OCEAN) scores did not differ substantially, significant differences in negative affectivity (MT, PT > NT; MT > DT), anxiety (MT, PT > DT, NT) and stress (MT, PT > NT; MT > DT) scores were observed.

TABLE 1 Demographic characteristics of the study cohort ($n=420$).

Variables	*n* (%)	Age			Gender		
		Mean (SD)	Median (IQR)	*p*-value* Post-hoc	Male *n* (%)	Female *n* (%)	*p*-value^ Post-hoc
Total	420 (100)	22.7 (1.1)	23.0 (2)	–	61 (14.5)	359 (85.5)	–
TMD symptoms							
No (5Ts-negative)	174 (41.4)	22.7 (1.2)	23.0 (2)	.796	34 (19.5)	140 (80.5)	**.011**
Yes (5Ts-positive)	246 (58.6)	22.6 (1.1)	23.0 (2)		27 (11.0)	219 (89.0)	
TMD groups							
No TMD symptoms (NT)	174 (41.4)	22.7 (1.2)	23.0 (2)	.195	34 (19.5)	140 (80.5)	.145
Painful TMD symptoms (PT)	73 (17.4)	22.8 (1.0)	23.0 (2)		6 (8.2)	67 (91.8)	
Dysfunctional TMD symptoms (DT)	84 (20.0)	22.7 (1.2)	23.0 (2)		11 (13.1)	73 (86.9)	
Mixed TMD symptoms (MT)	89 (21.2)	22.5 (1.1)	22.0 (1)		10 (11.2)	79 (88.8)	

Note: Results of *Kruskal–Wallis and ^Chi-squared tests. Bold indicates $p<.05$.
Abbreviations: IQR, interquartile range; SD, standard deviation.

TABLE 2 Mean/median Brief big five inventory (BFI) scores for the various groups.

Variables	No TMD (NT)	Painful TMD (PT)	Dysfunctional TMD (DT)	Mixed TMD (MT)	*p*-value* Post-hoc
Openness (O)					
Mean (SD)	6.2 (1.4)	6.2 (1.4)	6.1 (1.4)	6.6 (1.6)	.199
Median (IQR)	6.0 (2)	6.0 (2)	6.0 (2)	7.0 (2)	
Conscientiousness (C)					
Mean (SD)	6.8 (1.4)	6.5 (1.4)	6.6 (1.4)	6.4 (1.2)	.235
Median (IQR)	7.0 (2)	7.0 (2)	7.0 (2)	7.0 (1)	
Extraversion (E)					
Mean (SD)	7.0 (1.7)	6.8 (1.7)	6.6 (1.5)	7.0 (1.7)	.364
Median (IQR)	7.0 (2)	7.0 (2)	6.5 (2)	7.0 (2)	
Agreeableness (A)					
Mean (SD)	7.2 (1.4)	7.0 (1.1)	7.2 (1.5)	7.0 (1.4)	.392
Median (IQR)	7.0 (2)	7.0 (2)	7.0 (2)	7.0 (2)	
Neuroticism (N)					
Mean (SD)	6.5 (1.8)	7.0 (1.5)	6.8 (1.6)	6.9 (1.7)	.123
Median (IQR)	7.0 (3)	7.0 (2)	7.0 (2)	7.0 (2)	

Note: Results of *Kruskal–Wallis test.
Abbreviations: IQR, interquartile range; SD, standard deviation.

Table 4 indicates the mean/median PHQ-15 and OBC scores. The MT and PT groups had significantly greater somatic symptom scores than the DT and NT groups. While participants with DT and NT experienced mostly mild somatic symptoms, those with MT and PT presented moderate somatisation. Significant differences in total OBC scores were also discerned (MT, PT > DT > NT). Participants without (NT) and with TMD symptoms, specifically DT, PT and MT, reported normal and low jaw use behaviours, respectively. Significant differences in sleep-related oral activities (MT, PT, DT > NT), waking-state NFA (MT, PT, DT > NT; MT > DT) and waking-state FA (PT > DT, NT) scores were also discerned.

The outcomes of logistic regression analyses are displayed in Table 5. After adjusting for potential confounders, the odds of painful TMD symptoms were increased by somatisation (OR = 1.24; 95% CI = 1.10–1.41), sleep-related oral activities (OR = 1.23; 95% CI = 1.05–1.45) and waking-state NFA (OR = 1.15; 95% CI = 1.01–1.31), whereas the odds of dysfunctional TMD symptoms were elevated by only sleep-related oral activities (OR = 1.35; 95% CI = 1.16–1.57). The odds of mixed TMD symptoms were increased by anxiety (OR = 1.37; 95% CI = 1.12–1.69), sleep-related oral activities (OR = 1.23; 95% CI = 1.04–1.45) and waking-state NFA (OR = 1.34; 95% CI = 1.18–1.52).

TABLE 3 Mean/median Depression, anxiety, stress scales-21 (DASS-21) scores for the various groups.

Variables	No TMD (NT)	Painful TMD (PT)	Dysfunctional TMD (DT)	Mixed TMD (MT)	*p*-value* Post-hoc
Negative affectivity					
Mean (SD)	13.1 (10.2)	15.9 (9.9)	13.3 (9.7)	16.9 (10.1)	**.004**
Median (IQR)	12.0 (14)	15.0 (13)	11.5 (13)	16.0 (14)	MT, PT > NT MT > DT
Depression					
Mean (SD)	3.2 (3.5)	3.5 (3.5)	3.1 (3.3)	3.6 (3.8)	.611
Median (IQR)	2.0 (5)	2.0 (5)	2.0 (4)	2.0 (4)	
Anxiety					
Mean (SD)	4.0 (3.3)	5.2 (3.4)	4.1 (3.6)	5.9 (3.4)	**<.001**
Median (IQR)	4.0 (5)	5.0 (4)	3.0 (5)	5.0 (4)	MT, PT > DT, NT
Stress					
Mean (SD)	5.9 (4.4)	7.2 (4.3)	6.0 (4.2)	7.4 (4.1)	**.010**
Median (IQR)	6.0 (5)	7.0 (6)	5.5 (7)	7.0 (6)	MT, PT > NT MT > DT

Note: Results of *Kruskal–Wallis/Mann–Whitney *U* tests. Bold indicates $p < .05$.
Abbreviations: IQR, interquartile range; SD, standard deviation.

TABLE 4 Mean/median Patient health questionnaire-15 (PHQ-15) and Oral Behaviour Checklist (OBC) scores for the various groups.

Variables	No TMD (NT)	Painful TMD (PT)	Dysfunctional TMD (DT)	Mixed TMD (MT)	*p*-value* Post-hoc
Somatic symptoms					
Mean (SD)	5.1 (4.9)	10.7 (5.9)	5.6 (4.9)	10.1 (5.9)	**<.001**
Median (IQR)	4.0 (5)	10.0 (10)	5.0 (5)	9.0 (8)	PT, MT > DT, NT
Oral behaviours (OB)					
Global OB					
Mean (SD)	14.9 (6.5)	19.3 (5.4)	17.3 (5.7)	20.1 (6.8)	**<.001**
Median (IQR)	14.0 (9)	20.0 (8)	16.5 (8)	20.0 (10)	MT, PT > DT > NT
Sleep-related oral activities					
Mean (SD)	2.7 (2.0)	3.7 (1.6)	3.6 (1.5)	3.8 (1.7)	**<.001**
Median (IQR)	3.0 (3)	4.0 (1)	4.0 (1)	4.0 (2)	MT, PT, DT > NT
Waking-state nonfunctional oral activities (NFA)					
Mean (SD)	1.5 (2.2)	2.7 (2.5)	2.2 (2.5)	3.7 (2.7)	**<.001**
Median (IQR)	1.0 (2)	2.0 (3)	2.0 (3.0)	4.0 (3)	MT, PT, DT > NT MT > DT
Waking-state functional oral activities (FA)					
Mean (SD)	6.3 (2.7)	7.3 (2.3)	6.4 (2.5)	6.8 (3.0)	**.022**
Median (IQR)	6.0 (4)	7.0 (3)	6.0 (4)	7.0 (4)	PT > DT, NT

Note: Results of *Kruskal–Wallis/Mann–Whitney *U* tests. Bold indicates $p < .05$.
Abbreviations: IQR, interquartile range; SD, standard deviation.

4 | DISCUSSION

This study focussed on young adults as they characterised the majority of TMD patients and represented the age when TMD symptoms start to peak.[42,43] University students were singled out, due to their relatively high rates of psychological distress, bodily pain, bruxism and TMD symptoms, which could be linked with new autonomy/responsibilities, altered life/living conditions and academic stresses/demands.[44,45] The prevalence of TMD symptoms in our sample of Southeast Asian young adults was within the range reported internationally and corroborated reports of high frequencies of TMDs in South and West Asian university students.[3,46,47] As personality traits did not differ significantly among the various TMD groupings, the first research hypothesis was rejected. The second and third research hypotheses were partly supported as participants with MT and PT had considerably higher levels of psychological distress and the odds of painful, dysfunctional and mixed TMD symptoms were significantly increased by explicit psychosocial and oral behavioural factors.

TABLE 5 Risk factors for the presence of painful, dysfunctional and mixed TMD symptoms.

	Painful TMD symptoms		Dysfunctional TMD symptoms		Mixed TMD symptoms	
Variables	Odds ratio (95% CI)	*p*-Value	Odds ratio (95% CI)	*p*-Value	Odds ratio (95% CI)	*p*-Value
Gender						
Male	Reference					
Female	1.51 (0.54–4.24)	.432				
Personality traits						
Openness					1.18 (0.95–1.17)	.128
Conscientiousness					0.96 (0.75–1.23)	.121
Extraversion			0.88 (0.75–1.04)	.143		
Agreeableness						
Neuroticism	1.15 (0.96–1.38)	.121			1.05 (0.83–1.32)	.698
Psychological distress						
Negative affectivity	0.99 (0.95–1.02)	.470	1.01 (0.95–1.08)	.700	0.94 (0.87–1.00)	.062
Depression						
Anxiety	1.13 (0.92–1.38)	.257			**1.37 (1.12–1.69)**	**.003**
Stress	1.01 (0.81–1.27)	.930			0.97 (0.78–1.20)	.770
Somatisation	**1.24 (1.10–1.41)**	**.001**			1.08 (0.95–1.23)	.236
Oral behaviours						
Global OB					0.98 (0.92–1.05)	.560
Sleep-related oral activity	**1.23 (1.05–1.45)**	**.011**	**1.35 (1.16–1.57)**	**<.001**	**1.23 (1.04–1.45)**	**.014**
Waking-state NFA	**1.15 (1.01–1.31)**	**.031**	1.10 (0.97–1.24)	.148	**1.34 (1.18–1.52)**	**<.001**
Waking-state FA	1.10 (0.98–1.23)	.119				

Note: Results of multivariate logistic regression analyses. Bold indicates $p < .05$.

Abbreviations: OB, oral behaviours; NFA, nonfunctional oral activity; FA, functional oral activity.

4.1 | Personality traits and psychological distress

Results of intergroup comparisons indicated that personality traits did not influence the presence of TMD symptoms. Findings differed from those of earlier work suggesting that TMDs are connected to neurotic or 'distressed' personalities.[26–28] The disparity could be attributed to differences in research settings and race/ethnicity as well as the rather high scores for neuroticism in the NT group. Significant differences in negative affectivity, anxiety and stress scores were detected among the four TMD groups. Participants with MT had significantly higher levels of negative affectivity, anxiety and stress than the DT and NT groups reiterating the observations in TMD patients.[48,49] Findings corroborated earlier research specifying the greater role of anxiety and stress in the development of TMDs in Southeast Asian youths who often have normal levels of depression.[50,51] Anxiety and stress are intertwined and may be mediated via the effects of glucocorticoids on corticotropin-releasing hormones in limbic structures.[52] Moreover, anxiety and stress were also recently found to be moderately correlated to TMD and somatic symptoms in a nonclinical community sample of young people.[15]

4.2 | Somatic symptoms and oral behaviours

Individuals with PT and MT had significantly higher levels of somatic symptoms than the DT and NT groups. While participants with DT and NT experienced mostly mild somatic symptoms, those with TMD pain (PT and MT) presented moderate somatisation reinforcing the belief that TMDs are a type of FSSs.[15,16] Women are known to experience more numerous, frequent and intense somatic symptoms than men and gender differences in somatic perceptions, symptoms acknowledgement/disclosure, socialisation and psychological distress had been implicated.[53] Findings were congruent with the high prevalence of moderate-to-high somatisations in TMD patients and the preponderance of women among them.[2,8] This study is one of the first to apply the new method of grouping/scoring the OBC that categorises oral behaviours into sleep-related activities and waking-state NFA/FA.[24] Significant differences in total OBC, sleep-related oral activity, waking-state NFA and waking-state FA scores were discerned among the four TMD groups supporting the potential role of oral parafunction (abnormal function not related to mastication, deglutition or speech) in the aetiology of TMDs. However,

this affiliation may depend partly on the presence of other risk factors given the generally low levels of jaw use behaviours conveyed by the participants. Furthermore, there is currently no evidence demonstrating a direct causal relationship between oral behaviours and TMDs.[19,20] While substantial differences in global oral behaviours, sleep-related oral activities and waking-state NFA were observed between individuals with (MT, PT and DT) and without TMD symptoms, notable variance in waking-state FA was observed only between the PT and NT groups. Repetitive parafunctional and functional oral activities could generate excessive and/or protracted stresses on the stomatognathic system ensuing in possible pain-related and intra-articular TMDs.[54] When the various types of TMD symptoms were compared, considerable differences in global oral behaviours (MT, PT > DT), waking-state NFA (MT > DT) and FA (PT > DT) were perceived. No significant differences in sleep-related oral activities were observed among the MT, PT and DT groups. This can be explained by either sleep-related oral activities contributing to all TMD symptoms or decreased oral behaviour awareness during sleep. Multivariate logistic regression analyses, where all explanatory variables were examined simultaneously, were subsequently performed to establish the risk factors for painful, dysfunctional and mixed TMD symptoms.

4.3 | Risk factors for TMD symptoms

The outcomes of multivariate analyses indicated that apart from sleep-related oral activities, psychosocial and oral behavioural risk factors differed for painful, dysfunctional and mixed TMD symptoms. Sleep-related oral activities increased the odds of painful, dysfunctional and mixed TMDs by 23%, 35% and 23% correspondingly. Waking-state NFA appeared to affect TMD pain increasing the odds of painful TMD symptoms by 15% and mixed TMD symptoms by 34%. While somatisation amplified the odds of painful TMD symptoms by 24%, anxiety increased the odds of mixed TMD symptoms by 37%. Unlike earlier studies, psychological distress did not appear to increase the risk of painful and dysfunctional TMD symptoms substantially even though significant differences in negative affectivity, anxiety and stress were discerned among TMD groups.[15,50] Besides the lower levels of psychological distress in community samples when compared to TMD patients,[49] this outcome could also be accounted for by the absence of oral behaviours assessment in many prior studies. Psychological distress influences oral behaviours as well as somatic, and TMD symptoms and is thus a confounding variable.[15,21,23,35] It is plausible that the effects of psychological distress are mediated by somatisation and oral parafunction during sleep and wakefulness.

Collectively, the results reinforced the need to assess young adults for somatisation, sleep and awake oral activities together with psychological distress during TMD management. In addition to standard TMD interventions such as medication and splint therapy, cognitive-behavioural therapies could be advantageous for alleviating TMD and somatic symptoms and their accompanying oral behaviours and psychological distress.[55]

4.4 | Study limitations

This observational study has its limitations. First, like other cross-sectional investigations, causal and temporal relationships between TMD symptoms and the various variables cannot be ascertained. Temporal associations are pertinent considering the fluctuating nature of TMD symptoms and can only be established with prospective longitudinal studies. Second, the study was focussed on university students that do not represent all young adults in the country. Furthermore, the majority of the participants were women as they have a greater propensity to contribute to online surveys than men.[56] Though the results may be subjected to a gender bias, the odds of TMDs in the female participants paralleled that of other studies.[4] Third, the study is also disposed to other information partialities, such as social desirability, recall and confirmation biases, that accompany self-reported data.[57] Future research could incorporate out-of-school/working young adults, more male participants, as well as objective examinations for rendering TMD diagnoses. The research should also be extended to TMD patients given their conceivable phenotypic differences.

5 | CONCLUSION

TMD symptoms were experienced by 58.6% of the Asian young adults examined. While 17.4% and 20.0% had painful and dysfunctional complaints, 21.2% reported mixed TMD symptoms. Personality traits did not appear to influence the presence of TMD symptoms. Notwithstanding, individuals with painful and mixed TMD symptoms had substantially higher levels of negative affectivity, anxiety, stress, somatisation and oral behaviours compared with their peers with no TMDs. While sleep-related oral activities increased the odds of painful and/or dysfunctional TMD symptoms, waking-state nonfunctional activities increased the odds of TMD pain. Somatisation and anxiety were risk factors for painful and mixed TMD symptoms, respectively. Results validated the utility of the new method of grouping/scoring the OBC and emphasised the need to screen for psychological distress, somatisation and parafunctional oral behaviours in young adults with TMD symptoms. Further research is warranted to confirm the multifaceted interrelationship between psychosocial and oral behavioural factors in the aetiology of painful and/or intra-articular TMDs.

AUTHOR CONTRIBUTIONS

Adrian Ujin Yap contributed to conceptualisation, data curation, formal analysis, investigation, methodology, project administration, resources, supervision, validation, visualisation and writing the original draft. Carolina Marpaung contributed to conceptualisation, data curation, formal analysis, investigation, methodology, project

administration, resources, software, supervision, validation, and review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors have no financial or personal conflict of interest to declare concerning this article.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Adrian Ujin Yap https://orcid.org/0000-0003-0361-6209
Carolina Marpaung https://orcid.org/0000-0002-9621-6257

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