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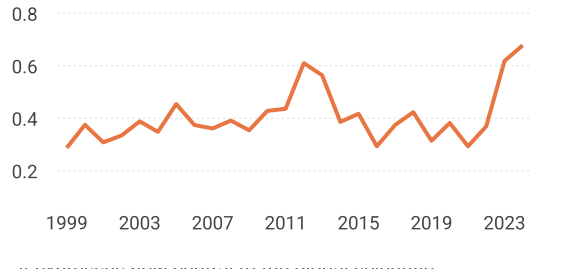

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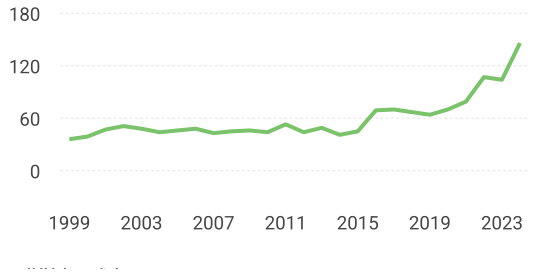

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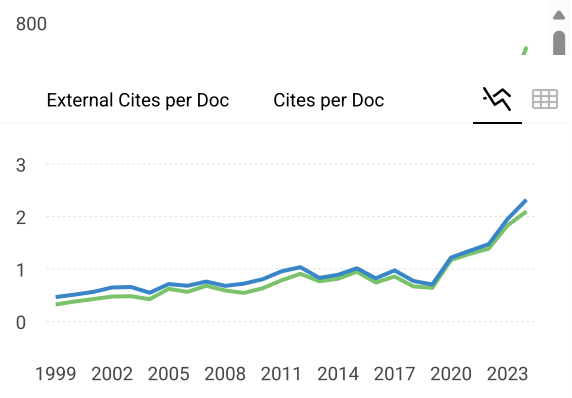

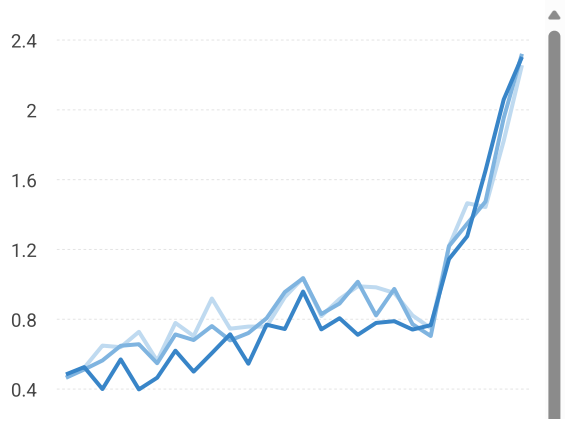

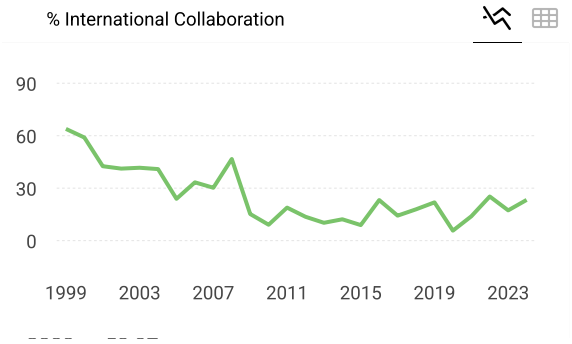

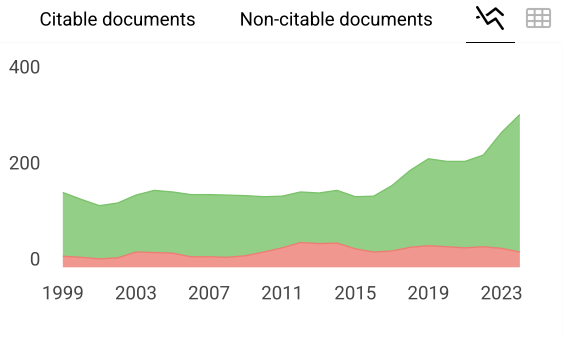

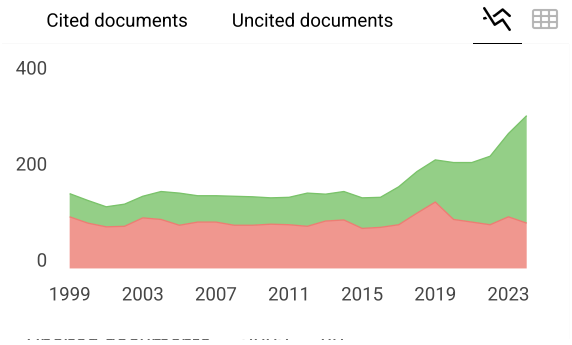

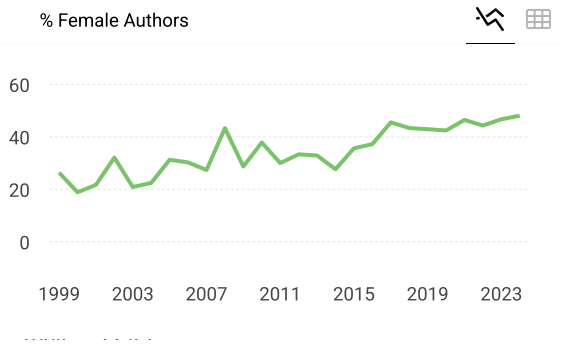

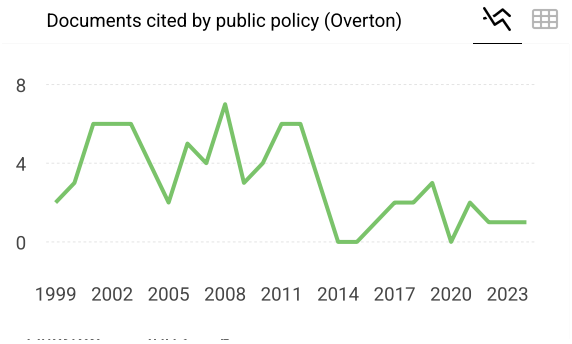

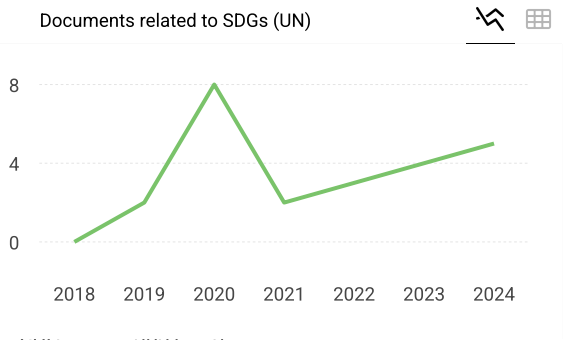

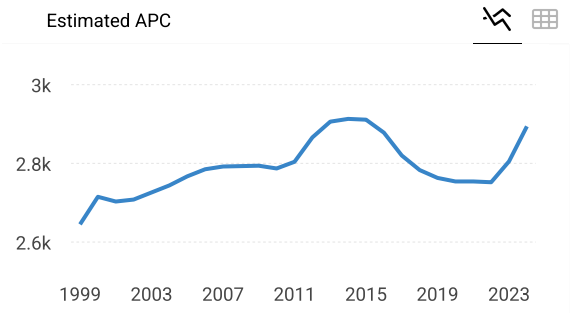

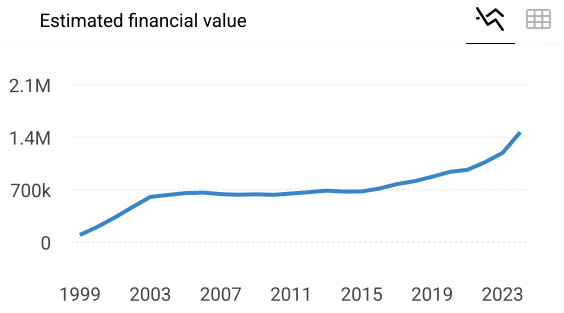

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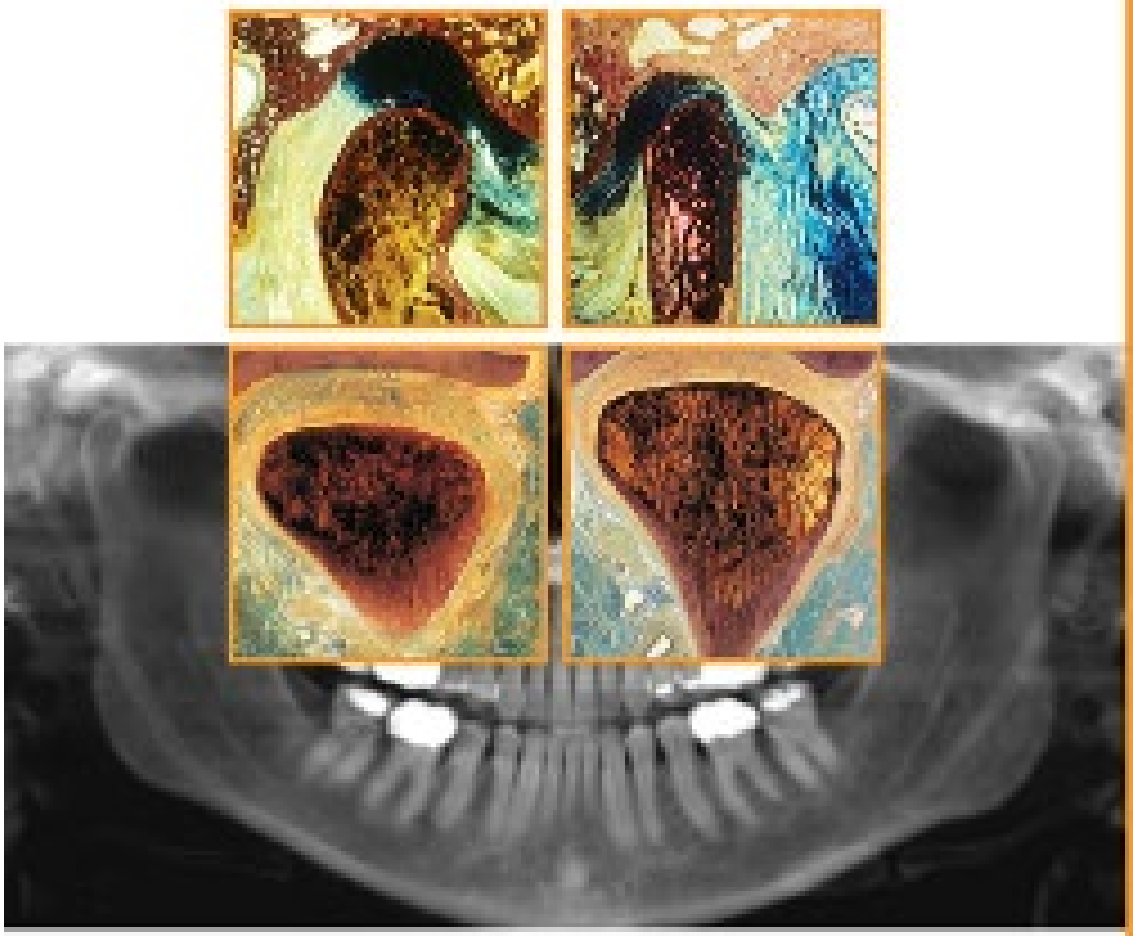

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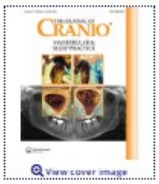

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Negative affectivity and emotions in youths with temporomandibular disorders across cultures

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ABSTRACT

Objective: The relationships between temporomandibular disorders (TMDs) and negative affectivity/emotions across cultures and the emotional predictors for TMDs in Southeast Asian youths were investigated.

Methods: The presence of TMDs and negative affectivity/emotions were determined with the Fonseca Anamnestic Index (FAI) and Depression, Anxiety, Stress Scales-21 (DASS-21). Statistical evaluations were done with non-parametric and logistic regression analyses (α

Results: The total sample comprised 400 Singaporean and 501 Indonesian youths (mean age 19.30 ± 1.48 years; 65.0% women) of whom 47.0% and 59.3% had mild-to-severe TMDs, respectively. For both cultures, participants with TMDs had significantly greater negative affectivity, depression, anxiety, and stress than those with no TMDs. Indonesian youths also presented higher levels of emotional distress than their Singaporean counterparts. Correlations between FAI and anxiety/stress scores were moderately strong.

Conclusion: Cultural variations can influence the expression of TMDs and emotional distress. Being female and anxious increased the risk of TMDs.

KEYWORDS
Temporomandibular disorders; Cross-cultural; depression; anxiety; stress

Introduction

Temporomandibular disorders (TMDs) are a cluster of musculoskeletal conditions characterized by pain and/or dysfunction of the temporomandibular joints (TMJs) and masticatory muscles [1]. The prevalence of TMDs ranges from 6.0 to 15.8%, based on formalized diagnostic criteria, and up to 75.0% when determined using self-reported questionnaires and/or physical examination [2,3]. Women, particularly those aged 20 to 40 years, are more susceptible to TMDs [1,4]. The diagnostic and screening instruments for TMDs were recently reviewed [5]. The current Diagnostic Criteria for TMDs (DC/TMD) standard employs a dual-axis approach, with Axis I focused on physical diagnoses and Axis II on psychosocial as well as behavioral status [6]. Despite its good psychometric properties, the use of the DC/TMD for large-scale epidemiological studies is burdensome due to the complex and time-consuming physical examination and diagnostic algorithms involved. Contemporary TMD screening inventories include the TMD pain screener, 3Q/TMD, and Fonseca Anamnestic Index (FAI), of which the FAI is more widely applied [7–9]. The FAI has been translated into different languages, and its reliability, validity, and diagnostic accuracy are well documented [10–14]. More recently, it was shown to be highly accurate when related to the DC/TMD (area under the receiver operating characteristic curve of 0.96 to 0.98), with high sensitivity (94.2 to 98.2%) and moderate specificity (87.7%) for pain-related and/or intra-articular TMDs [15]. Nevertheless, the FAI was observed to be multidimensional, with the primary component comprising five TMD-specific items, specifically muscle pain, TMJ pain, TMJ noises, opening, and side-movement difficulties [16].

The multifactorial etiology of TMDs is coherent with the "biopsychosocial model of illness," and negative emotions like depression, anxiety, and stress are frequently reported by individuals with TMDs [17,18]. Negative affectivity, a personality variable concerning the "experience of negative emotions and poor self-concept" can influence pain intensity and physical functioning in individuals with

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musculoskeletal conditions, including TMDs [19–21]. The DASS-21, which is also available in many languages, is a popular scale for assessing the emotional constructs of depression, anxiety, and stress [22,23]. Lee et al. [23] systematically reviewed the measurement properties of the DASS-21 and concluded that it demonstrated a bifactor structure (comprising overall and separate group factors) and should be used as a total score for negative affectivity (general factor of emotional distress) along with the three subscales. This was corroborated by Zanon et al. [24], who examined the dimensionality and reliability of DASS-21 in college students across eight countries. Negative affectivity contributes to each of the other constructs and was supported by the very strong correlations (r_s = 0.91 to 0.95) between total-DASS and the three subscale scores in TMD patients [25,26].

Southeast Asia, sometimes referred to as Indo-China, is the geographical region southeast of the Indian subcontinent south of China and northwest of Australia. It is composed of 11 countries with diverse histories, ethnicities, religions, and cultures. While mainland Southeast Asia is a mix of Indian and Chinese cultures, maritime Southeast Asia, including Singapore and Indonesia, comprise blends of Chinese, Indian, Austronesian, and Western (from colonialism) cultures, depending on country [27]. As the beliefs, customs, and social behaviors of people may influence the expression and interpretation of somatic and psychological symptoms [28], the connection between TMDs and negative emotional states in differing cultures requires exploration, given their latent impact on TMD management and treatment outcomes [29]. Moreover, negative emotions have been linked to impaired oral health-related quality of life (OHRQoL) in individuals with TMDs [30].

This study aimed to conduct a cross-national /cultural comparison of the relationships between TMDs and negative affectivity/emotions in Southeast Asian (SEA) youths. Emotional predictors for TMDs were also determined. A secondary objective was to establish the prevalence of different TMD symptoms in SEA youths. The research hypotheses were as follows: (a) TMD symptoms are associated with negative emotional states; (b) there are differences in negative affectivity/emotions among youths with and without TMDs across cultures; (c) depression, anxiety, and stress have a varied impact on the prospect of TMDs.

Materials and methods

Study populations

Approval for the research was attained from the ethics committees of the relevant institutions (protocol numbers: SHS2018005 and 377-S1/KEPK/FKG/8-2020).

Youths, aged 17 to 24 years, who were proficient in English or Bahasa Indonesian were recruited from tertiary educational institutions (college or university) in Singapore and Indonesia using a random sampling technique. Individuals with orofacial trauma/surgical procedures in the previous 2 weeks or debilitating physical or psychological illnesses were duly excluded. The minimum sample size was determined to be 371, based on a 95% confidence level, 5% margin of error, total enrollment of 36,000 students, and 42% prevalence of TMDs with the FAI [31]. Informed consent was attained from all volunteers before administrating an online survey encompassing demographic information and the English or Indonesian language versions of the FAI and DASS-21. While the Indonesian DASS-21 employed was the official one [32], the Indonesian FAI was created and validated following the International Network for Orofacial Pain and Related Disorders Methodology (INfORM) guidelines [33].

Study measures

The presence of TMDs was ascertained with the 10-item FAI, consisting of five primary TMD-specific symptoms and five non-specific TMD symptoms/risk factors (headache, neck pain, parafunction, malocclusion, and emotional tension) [16]. The items are evaluated on a 3-point scale with no = 0 points, sometimes = 5 points, and yes = 10 points. Total FAI scores are calculated with scores ≤ 15 points signifying no TMDs (NT) and ≥ 20 points indicating the presence of TMDs (with TMDs [WT]). Higher FAI scores suggest greater TMD severity, which was classified as follows: mild (20 to 40 points), moderate (45 to 65 points), and severe (70 to 100 points).

Negative emotional states were appraised with the 21-item DASS-21, which contained seven questions each for the emotional constructs of depression, anxiety, and stress. The items are assessed on a 4-point scale spanning from 0 = did not apply to me at all to 3 = applied to me very much or most of the time. Cut-off points for the various subscale severity classification (normal to extremely severe) are reflected in the DASS manual [22]. Total-DASS scores are calculated by

adding all three subscale scores, with higher scores indicating greater negative affectivity.

Statistical analysis

The IBM SPSS Statistics software version 26.0 (IBM Corporation, Armonk, NY, USA) was used for statistical evaluation with a significance level of 0.05. Categorical and numerical data were displayed as frequencies (with percentages) and means (with standard deviations)/medians (with interquartile ranges), respectively. Data distribution was appraised using the Shapiro-Wilks test. As data were not normally distributed, the Kruskal-Wallis/Mann-Whitney U test and Spearman's rank-order correlation were applied. Correlation strengths were stratified as follows: Weak (correlation coefficient [r_s] = 0.1 to 0.3), moderate (r_s = 0.4 to 0.6), and strong (r_s = 0.7 to 0.9) [34]. Univariate and multivariate logistic regression analyses were performed to determine the emotional predictors for TMDs and reported as odds ratios (ORs) with 95% confidence intervals (95% CIs). A stepwise variable selection technique was applied for multivariate analysis with the threshold set at $p < 0.10$ for excluding insignificant variables.

Results

Study sample and TMD prevalence/symptoms

Table 1 presents the demographics and distributions of the study populations. The total sample (n = 901) comprised 400 SG and 501 ID youths with a mean age of 19.30 ± 1.48 years (65.0% women). Based on the FAI, TMDs were present in 47.0% and 59.3% of the Singaporean and Indonesian youths, correspondingly. For both nationalities, the severity of TMDs was generally mild, with moderate-to-severe TMDs forming only 12.3% and 9.4% of the Singaporean and Indonesian cohorts, respectively. Table 2 displays the frequencies of the various TMD symptoms/risk factors. Propensities were similar for both nationalities, with the two most common specific and non-specific TMD symptoms being masticatory muscle pain/TMJ noises (48.2%/42.9%) and neck pain/headaches (68.7%/62.9%) in youths with TMDs. Among the three TMD risk factors, emotional tension featured most prominently (81.9%) in the youths with TMDs.

Negative affectivity and emotions

Table 3 shows the mean/median negative affectivity and emotion scores for the NT and WT groups, while Table 4 indicates the results of statistical comparisons. For both nationalities, participants with TMDs had significantly greater negative affectivity, depression, anxiety, and stress scores than those with no TMDs. Indonesian youths also reported significantly higher levels of emotional distress than their Singaporean counterparts, irrespective of the presence of TMDs. However, the difference in negative affectivity was insignificant between the Singaporean and Indonesian participants with TMDs (p = 0.054).

Correlates and predictors of TMDs

Table 5 reflects the correlation coefficients between FAI, negative affectivity, depression, anxiety, and stress scores. Significant and moderately strong correlations were observed between FAI, negative affectivity, anxiety, and stress, with r_s ranging from 0.46 to 0.50. Conversely, the relation between FAI and depression scores was weak (r_s = 0.37). Correlations between negative affectivity and the three negative emotional states were strong (r_s = 0.86 to 0.94), as were the relationships between depression, anxiety, and stress (r_s = 0.66 to 0.82). While the univariate model suggested that gender, country, negative affectivity, and all three emotional states were associated with TMDs, the multivariate analysis indicated that only female gender and anxiety predicted the

Table 1. Demographics and distribution of the study populations.

Demographics/ TMD severity	Total sample	Singapore (SG)	Indonesia (ID)
n (%)	901 (100)	400 (44.4%)	501 (55.6%)
Age			
Mean ± SD	19.30 ± 1.48	18.77 ± 1.54	19.73 ± 1.27
Median (IQR)	19.00 (2)	19.00 (1)	19.00 (2)
Gender			
Women n (%)	586 (65.0%)	209 (52.3%)	377 (75.2%)
Men n (%)	315 (35.0%)	191 (47.8%)	124 (24.8%)
No TMDs n (%)	416 (46.2%)	212 (53.0%)	204 (40.7%)
With TMDs n (%)	485 (53.8%)	188 (47.0%)	297 (59.3%)
Mild	389 (43.2%)	139 (34.8%)	250 (49.9%)
Moderate	89 (9.9%)	45 (11.3%)	44 (8.8%)
Severe	7 (0.8%)	4 (1.0%)	3 (0.6%)

TMD: Temporomandibular disorder; SD: Standard deviation; IQR: Interquartile range.

Table 2. Frequency of TMD symptoms and risk factors for the study populations.

TMD	Total		Singapore		Indonesia	
Symptoms/ risk factors	NT n (%)	WT n (%)	NT n (%)	WT n (%)	NT n (%)	WT n (%)
Opening difficulty	22 (5.2%)	146 (30.1%)	11 (5.2%)	64 (34.1%)	11 (5.4%)	82 (27.6%)
Side-movement difficulty	4 (1.0%)	66 (13.6%)	2 (0.9%)	33 (17.5%)	2 (1.0%)	33 (11.2%)
Muscle pain	41 (9.9%)	234 (48.2%)	14 (6.6%)	81 (43.1%)	27 (13.3%)	153 (51.5%)
Headache	77 (18.5%)	305 (62.9%)	42 (19.8%)	124 (66.0%)	35 (17.1%)	181 (60.9%)
Neck pain	86 (20.7%)	333 (68.7%)	61 (28.8%)	157 (83.5%)	25 (12.3%)	176 (59.3%)
TMJ pain	7 (1.7%)	145 (29.9%)	7 (3.3%)	69 (36.7%)	0 (0%)	76 (25.6%)
TMJ noises	27 (6.5%)	208 (42.9%)	15 (7.1%)	95 (50.5%)	12 (5.9%)	113 (38.0%)
Parafunction	50 (12.0%)	226 (46.6%)	27 (12.7%)	120 (63.8%)	23 (11.2%)	106 (35.7%)
Malocclusion	64 (15.4%)	271 (55.9%)	28 (13.2%)	106 (56.3%)	36 (17.6%)	165 (55.5%)
Emotional tension	148 (35.5%)	397 (81.9%)	66 (31.2%)	158 (84.1%)	82 (40.2%)	239 (80.5%)

TMD: Temporomandibular disorder; NT: No TMDs; WT: With TMDs.

Table 3. Mean/median Depression Anxiety Stress Scale-21 (DASS-21) scores for the study populations.

	Total		Singapore		Indonesia	
Constructs	NT	WT	NT	WT	NT	WT
Negative affectivity						
Mean ± SD	11.61 ± 9.42	21.23 ± 11.19	8.11 ± 8.61	20.47 ± 12.73	15.25 ± 8.84	21.71 ± 10.09
Median (IQR)	10.00 (14)	20.00 (15)	6.00 (9)	19.00 (18)	15.00 (12)	21.00 (12)
Depression					3.87 ± 3.31	
Mean ± SD	3.32 ± 3.56	5.94 ± 4.39	2.79 ± 3.7	6.91 ± 5.16	3.00 (4)	5.33 ± 3.71
Median (IQR)	2.00 (5)	5.00 (5)	11.00 (4)	6.00		5.00 (5)
Anxiety		7.07 ± 3.90	2.30 ± 2.39	6.11 ± 4.05	5.00 ± 3.00	7.68 ± 3.68
Mean ± SD	3.62 ± 3.02	7.00 (6)	2.00 (3)	6.00 (5)	5.00 (4)	7.00 (5)
Median (IQR)	3.00 (5)					
Stress						
Mean ± SD	4.67 ± 3.94	8.22 ± 4.42	3.02 ± 3.49	7.45 ± 4.66	6.38 ± 3.64	8.70 ± 4.20
Median (IQR)	4.00 (6)	8.00 (6)	2.00 (5)	7.00 (7)	6.00 (5)	8.00 (5)

TMD: Temporomandibular disorder; NT: No TMDs; WT: With TMDs; SD: Standard deviation; IQR: Interquartile range.

Table 4. Results of statistical comparisons (*p*-values indicated).

Comparisons	Negative affectivity	Depression	Anxiety	Stress
Total NT vs WT	< 0.001*	< 0.001*	< 0.001*	< 0.001*
Singapore NT vs WT	< 0.001*	< 0.001*	< 0.001*	< 0.001*
Indonesia NT vs WT	< 0.001*	< 0.001*	< 0.001*	< 0.001*
No TMDs SG vs ID	< 0.001*	< 0.001*	< 0.001*	< 0.001*
With TMDs SG vs ID	0.054	0.003*	<0.001*	0.001*

TMD: Temporomandibular disorder; NT: No TMDs; WT: With TMDs; SG: Singapore; ID: Indonesia. *Indicates statistically significant differences. Results of Mann-Whitney U Test ($p < 0.05$).

Table 5. Correlations between FAI, negative affectivity, depression, anxiety, and stress scores.

	FAI	Negative affectivity	Depression	Anxiety	Stress
FAI	-	0.49**	0.37**	0.50**	0.46**
Negative affectivity	0.49**	-	0.86**	0.91**	0.94**
Depression	0.37**	0.86**	-	0.66**	0.71**
Anxiety	0.50**	0.91**	0.66**	-	0.82**
Stress	0.46**	0.94**	0.71**	0.82**	-

FAI: Fonseca anamnestic index.
**indicates statistically significant correlations. Results of Spearman's correlation ($p < 0.01$).

Table 6. Univariate and multivariable logistic regression analysis to determine predictors of TMD.

	Univariate analysis		Multivariate analysis*	
Variable	Odds Ratio (95%CI)	*p*-value	Odds Ratio (95%CI)	*p*-value
Gender				
Male	Reference			
Female	2.23 (1.69, 2.95)	<0.001*	1.80 (1.30, 2.48)	<0.001*
Country				
Singapore	Reference			
Indonesia	1.64 (1.26, 2.14)	<0.001*	0.75 (0.52, 1.07)	0.110
Age	1.04 (0.95, 1.14)	0.389	1.01 (0.91, 1.13)	0.794
Negative affectivity	1.10 (1.08, 1.11)	<0.001*		-
Depression	1.19 (1.15, 1.24)	<0.001*	1.03 (0.97, 1.08)	0.373
Anxiety	1.33 (1.27, 1.40)	<0.001*	1.29 (1.19, 1.38)	<0.001*
Stress	1.23 (1.18, 1.27)	<0.001*	1.03 (0.96, 1.09)	0.456

TMD: Temporomandibular disorder; CI: Confidence interval.
*Indicates significant variables. Results of logistic regression analysis ($p < 0.05$).

presence of TMDs with ORs of 1.80 and 1.29, respectively (Table 6).

Discussion

This research is one of the first cross-national/cultural TMD-related works established in SEA and offeres a more accurate depiction of the emotional phenotype

of SEA youths with TMDs. The connections between TMDs and negative affectivity/emotions were compared across nations/cultures, and the emotional predictors of TMDs were determined. Youths were targeted for investigation, as they represented the start age for the peak development of TMD symptoms [3]. The nation of Singapore and Indonesia were chosen, as they epitomized the two major ethnic groups in SEA. The culture of a nation refers to the norms, beliefs, customs, social behaviors, and values shared by the people of a sovereign country [35]. Though multi-racial, like most countries in the world, Chinese-Confucian and Austronesian-Islamic cultures feature predominantly in Singapore and Indonesia due to the high proportion (> 75%) of Chinese and Austronesians (Malayo-Polynesian descent) in their populations, respectively. Confucian-heritage cultures are characterized by the pursuit of personal improvements and achievements through self-effort [36]. Conversely, Islamic-heritage cultures place greater emphasis on religion and religiosity than self-endeavors [37]. All three research hypotheses were supported, as TMDs were associated with emotional distress, significant differences in negative affectivity/emotions were present across cultures, and only anxiety increased the odds of TMDs.

TMD prevalence and symptoms/risk factors

The FAI has been shown to accurately identify TMDs in both clinical and non-clinical samples [13–15]. Satisfactory reliability (intra-class correlation coefficient = 0.72) and validity, when related to the Oral Health Impact Profile-14 (r_s = 0.47) were presented by the Indonesian FAI [33,38]. The prevalence of TMDs in Indonesian youth was 12.3% higher than their Singaporean counterparts. TMD frequencies observed in this study (47.0 to 59.3%) were comparable to those of West (46.8%) and South Asian (53.3%) youths, based on the FAI [39,40]. However, TMD prevalence rates attained with formalized diagnostic criteria were considerably lower (6.0 to 15.8%) in the general population [2] and were akin to the occurrence of moderate-to-severe TMDs (9.4 to 12.3%) in the present cohorts. The inclusion of participants with mild TMDs may consequently require reconsideration for epidemiological studies.

For Singaporean and Indonesian youths with TMDs, the two most common TMD-specific symptoms were masticatory muscle pain and TMJ noises, while neck pain and headaches were the two most frequent non-specific TMD symptoms. These TMD-related symptoms were also widespread in Western youths with TMDs [41,42]. Neck pain and headaches frequently co-exist due to trigemino-cervical relationships and are also associated with emotional distress [43]. Among the three TMD risk factors, the prevalence of emotional tension was the highest, (81.9%) followed by malocclusion (55.9%) and parafunction (46.6%). Findings lend additional support to the relatively lesser role that dental occlusion and bruxism play in the pathophysiology of TMDs [44,45].

Negative affectivity/emotions and TMDs

The DASS is the only psychological inventory that offers the concomitant assessment of depression, anxiety, and stress. The three subscales of the DASS-21 have been validated across different cultures and draw on the general dimension of negative affectivity [23–25]. The latter was evidenced by the very strong correlations (r_s = 0.86 to 0.94) between negative affectivity and the three subscale scores in the present and other TMD studies [26]. While the depression scale evaluates the state of low mood and hopelessness, the anxiety scale measures physiological arousals, situational anxiety, and anxious effects. The stress scale assesses difficulty relaxing, nervous arousals, and ease of being upset, irritable, and impatient [32].

For both nationalities/cultures, the presence of TMDs was associated with significantly greater negative affectivity and higher levels of emotional distress. While subscale scores were all normal in the NT groups, mild depression/stress (5 to 6/8 to 9 points) and moderate-to-severe anxiety (6 to 9 points) were typically observed in the WT groups. This corresponded to the correlations between FAI and the subscale scores, with anxiety yielding the strongest (r_s = 0.50) and depression the weakest (r_s = 0.37) associations. Anxiety may, hence, contribute more to TMDs than depression in young people and should be emphasized in TMD research as well as management. Outcomes corroborated the biopsychosocial model of TMDs and underscored the importance of emotional factors in the etiology of TMDs [17,18].

For both NT and WT groups, Indonesian youths presented considerably higher levels of depression, anxiety, and stress than Singaporean youths. It can, thus, be inferred that youths from Austronesian-Islamic cultures experienced more emotional distress than their equivalents from Chinese-Confucian cultures, independent of the presence of TMDs. Results were somewhat unanticipated, considering the known national preoccupation with the "fear of losing out (kiasuism)," competitiveness,

and academic success in Singapore, which could lead to high levels of anxiety and self-doubt [36,46]. However, Ho et al. [46] found that such "kiasu" behaviors were not unique to Singapore and may well be embraced and exhibited by people globally. Academic competition, in reality, could be much stiffer in Indonesia than in Singapore, given that it is the fourth most populous nation in the world. Besides variations in culture (particularly the focus on self-effort), academic settings and stressors, the divergence could also be influenced by a myriad of health risk behaviors, socio-political, and environmental factors, including sedentary lifestyles, substance use, standard of living, economic inequalities, community situations, family/peer relationships, and coping strategies [47]. Moreover, genes and epigenetic factors that bridge gene and environmental mechanisms could also contribute somewhat [48]. Though negative affectivity scores were significantly different between Singaporean and Indonesian youths without TMDs, they were insignificant between those with TMDs. This suggests that youths from both cultures might have a similar disposition to experience negative emotional states in the presence of TMDs and can result from a breakdown in hedonic (pleasure) systems mediated by mesocorticolimbic circuitry [49].

Predictors of TMDs

Multivariate logistic regression analysis, where all demographic/emotional variables were examined together, specified that only the female gender and anxiety predicted the presence of TMDs in SEA youths. While the female gender increased the risk of TMDs by 80%, anxiety amplified it by 29%. The predisposition of women to TMDs is well established and has been explained by sex hormones (which play a vital role in the regulation of the hypothalamic-pituitary-adrenal [HPA] stress axis), sociocultural and environmental factors, in addition to gender differences in stress levels and pain sensitivity [4]. Even though all three emotional states were associated with TMDs in patient populations [18], Bonjardim et al. [50] and Lei et al. [51] determined that only anxiety is significantly related to TMD signs and symptoms in Latin-American and East Asian youths. The latter was validated by this study comprising SEA youths in the community. Pathological anxiety, along with chronic stress, has been linked to fear neurocircuitry alterations involving exaggerated amygdala (brain region for processing emotions and motivations) responses and impaired regulation of prefrontal cortex and hippocampus processes arising from structural degeneration [52]. The latter may lead to an increased risk of developing depression and clarifies, in part, the high co-morbidity between anxiety and depression in patients with chronic diseases, including TMDs [53,54].

A paradigm shift from reactive management (illness care) to proactive prevention of TMDs (health care) is merited. Considering the relationship between TMDs and emotional distress in this and other studies, integrative approaches to anxiety, stress, and resilience through positive psychological interventions (PPIs) could plausibly reduce the incidence of TMDs in youths [55]. PPIs are designed to enhance positivity as well as optimum functioning and include mindfulness meditation, gratitude, forgiveness, and optimism exercises, meaning-oriented and empathy-related interventions, and conventional cognitive-behavioral therapy. PPIs are anticipated to play an increasing role in TMD therapy, especially since psychological well-being was recently determined to decrease the likelihood of TMDs [56].

Study limitations

The current study has some design and methodological limitations. First, only youths attending tertiary educational institutions in Singapore and Indonesia were enlisted. Non-schooling youths were not investigated and may present dissimilar emotional profiles. Furthermore, youths from only two countries were assessed, and findings cannot be generalized to all SEA youths, due to national and cultural differences. Second, causal relationships between TMDs and negative emotions cannot be established with the cross-sectional study design utilized. Longitudinal cohort studies are necessary to verify causality, but they pose several problems, including participant attrition. Third, as with all self-reported instruments, findings are predisposed to various partialities, including recall, response, social desirability, and other biases. Future work could involve other SEA countries, both schooling and non-schooling youths, and incorporate secondary TMD screening measures. Cross-cultural calibration of the assessment tools should also be considered [57].

Conclusion

Within the limitations of this research, the following conclusions were drawn:

1. Cultural variations can influence TMD prevalence and the experience of emotional distress.
2. The presence of TMDs was associated with significantly greater negative affectivity and higher levels of emotional distress in SEA youths.

3. Being female and anxious could increase the prospect of TMDs.

4. Anxiety appears to contribute more to TMDs than depression in young people and should be emphasized in TMD research and management.

5. A paradigm shift from reactive management to proactive prevention of TMDs involving integrative approaches to anxiety/stress and resilience is merited.

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Negative affectivity and emotions in youths with temporomandibular disorders across cultures

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Negative affectivity and emotions in youths with temporomandibular disorders across cultures

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ABSTRACT

Objective: The relationships between temporomandibular disorders (TMDs) and negative affectivity/emotions across cultures and the emotional predictors for TMDs in Southeast Asian youths were investigated.

Methods: The presence of TMDs and negative affectivity/emotions were determined with the Fonseca Anamnestic Index (FAI) and Depression, Anxiety, Stress Scales-21 (DASS-21). Statistical evaluations were done with non-parametric and logistic regression analyses (α

Results: The total sample comprised 400 Singaporean and 501 Indonesian youths (mean age 19.30 ± 1.48 years; 65.0% women) of whom 47.0% and 59.3% had mild-to-severe TMDs, respectively. For both cultures, participants with TMDs had significantly greater negative affectivity, depression, anxiety, and stress than those with no TMDs. Indonesian youths also presented higher levels of emotional distress than their Singaporean counterparts. Correlations between FAI and anxiety/stress scores were moderately strong.

Conclusion: Cultural variations can influence the expression of TMDs and emotional distress. Being female and anxious increased the risk of TMDs.

KEYWORDS
Temporomandibular disorders; Cross-cultural; depression; anxiety; stress

Introduction

Temporomandibular disorders (TMDs) are a cluster of musculoskeletal conditions characterized by pain and/or dysfunction of the temporomandibular joints (TMJs) and masticatory muscles [1]. The prevalence of TMDs ranges from 6.0 to 15.8%, based on formalized diagnostic criteria, and up to 75.0% when determined using self-reported questionnaires and/or physical examination [2,3]. Women, particularly those aged 20 to 40 years, are more susceptible to TMDs [1,4]. The diagnostic and screening instruments for TMDs were recently reviewed [5]. The current Diagnostic Criteria for TMDs (DC/TMD) standard employs a dual-axis approach, with Axis I focused on physical diagnoses and Axis II on psychosocial as well as behavioral status [6]. Despite its good psychometric properties, the use of the DC/TMD for large-scale epidemiological studies is burdensome due to the complex and time-consuming physical examination and diagnostic algorithms involved. Contemporary TMD screening inventories include the TMD pain screener, 3Q/TMD, and Fonseca Anamnestic Index (FAI), of which the FAI is more widely applied [7–9]. The FAI has been translated into different languages, and its reliability, validity, and diagnostic accuracy are well documented [10–14]. More recently, it was shown to be highly accurate when related to the DC/TMD (area under the receiver operating characteristic curve of 0.96 to 0.98), with high sensitivity (94.2 to 98.2%) and moderate specificity (87.7%) for pain-related and/or intra-articular TMDs [15]. Nevertheless, the FAI was observed to be multidimensional, with the primary component comprising five TMD-specific items, specifically muscle pain, TMJ pain, TMJ noises, opening, and side-movement difficulties [16].

The multifactorial etiology of TMDs is coherent with the "biopsychosocial model of illness," and negative emotions like depression, anxiety, and stress are frequently reported by individuals with TMDs [17,18]. Negative affectivity, a personality variable concerning the "experience of negative emotions and poor self-concept" can influence pain intensity and physical functioning in individuals with

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musculoskeletal conditions, including TMDs [19–21]. The DASS-21, which is also available in many languages, is a popular scale for assessing the emotional constructs of depression, anxiety, and stress [22,23]. Lee et al. [23] systematically reviewed the measurement properties of the DASS-21 and concluded that it demonstrated a bifactor structure (comprising overall and separate group factors) and should be used as a total score for negative affectivity (general factor of emotional distress) along with the three subscales. This was corroborated by Zanon et al. [24], who examined the dimensionality and reliability of DASS-21 in college students across eight countries. Negative affectivity contributes to each of the other constructs and was supported by the very strong correlations (r_s = 0.91 to 0.95) between total-DASS and the three subscale scores in TMD patients [25,26].

Southeast Asia, sometimes referred to as Indo-China, is the geographical region southeast of the Indian subcontinent south of China and northwest of Australia. It is composed of 11 countries with diverse histories, ethnicities, religions, and cultures. While mainland Southeast Asia is a mix of Indian and Chinese cultures, maritime Southeast Asia, including Singapore and Indonesia, comprise blends of Chinese, Indian, Austronesian, and Western (from colonialism) cultures, depending on country [27]. As the beliefs, customs, and social behaviors of people may influence the expression and interpretation of somatic and psychological symptoms [28], the connection between TMDs and negative emotional states in differing cultures requires exploration, given their latent impact on TMD management and treatment outcomes [29]. Moreover, negative emotions have been linked to impaired oral health-related quality of life (OHRQoL) in individuals with TMDs [30].

This study aimed to conduct a cross-national /cultural comparison of the relationships between TMDs and negative affectivity/emotions in Southeast Asian (SEA) youths. Emotional predictors for TMDs were also determined. A secondary objective was to establish the prevalence of different TMD symptoms in SEA youths. The research hypotheses were as follows: (a) TMD symptoms are associated with negative emotional states; (b) there are differences in negative affectivity/emotions among youths with and without TMDs across cultures; (c) depression, anxiety, and stress have a varied impact on the prospect of TMDs.

Materials and methods

Study populations

Approval for the research was attained from the ethics committees of the relevant institutions (protocol numbers: SHS2018005 and 377-S1/KEPK/FKG/8-2020).

Youths, aged 17 to 24 years, who were proficient in English or Bahasa Indonesian were recruited from tertiary educational institutions (college or university) in Singapore and Indonesia using a random sampling technique. Individuals with orofacial trauma/surgical procedures in the previous 2 weeks or debilitating physical or psychological illnesses were duly excluded. The minimum sample size was determined to be 371, based on a 95% confidence level, 5% margin of error, total enrollment of 36,000 students, and 42% prevalence of TMDs with the FAI [31]. Informed consent was attained from all volunteers before administrating an online survey encompassing demographic information and the English or Indonesian language versions of the FAI and DASS-21. While the Indonesian DASS-21 employed was the official one [32], the Indonesian FAI was created and validated following the International Network for Orofacial Pain and Related Disorders Methodology (INfORM) guidelines [33].

Study measures

The presence of TMDs was ascertained with the 10-item FAI, consisting of five primary TMD-specific symptoms and five non-specific TMD symptoms/risk factors (headache, neck pain, parafunction, malocclusion, and emotional tension) [16]. The items are evaluated on a 3-point scale with no = 0 points, sometimes = 5 points, and yes = 10 points. Total FAI scores are calculated with scores ≤ 15 points signifying no TMDs (NT) and ≥ 20 points indicating the presence of TMDs (with TMDs [WT]). Higher FAI scores suggest greater TMD severity, which was classified as follows: mild (20 to 40 points), moderate (45 to 65 points), and severe (70 to 100 points).

Negative emotional states were appraised with the 21-item DASS-21, which contained seven questions each for the emotional constructs of depression, anxiety, and stress. The items are assessed on a 4-point scale spanning from 0 = did not apply to me at all to 3 = applied to me very much or most of the time. Cut-off points for the various subscale severity classification (normal to extremely severe) are reflected in the DASS manual [22]. Total-DASS scores are calculated by

adding all three subscale scores, with higher scores indicating greater negative affectivity.

Statistical analysis

The IBM SPSS Statistics software version 26.0 (IBM Corporation, Armonk, NY, USA) was used for statistical evaluation with a significance level of 0.05. Categorical and numerical data were displayed as frequencies (with percentages) and means (with standard deviations)/medians (with interquartile ranges), respectively. Data distribution was appraised using the Shapiro-Wilks test. As data were not normally distributed, the Kruskal-Wallis/Mann-Whitney U test and Spearman's rank-order correlation were applied. Correlation strengths were stratified as follows: Weak (correlation coefficient [r_s] = 0.1 to 0.3), moderate (r_s = 0.4 to 0.6), and strong (r_s = 0.7 to 0.9) [34]. Univariate and multivariate logistic regression analyses were performed to determine the emotional predictors for TMDs and reported as odds ratios (ORs) with 95% confidence intervals (95% CIs). A stepwise variable selection technique was applied for multivariate analysis with the threshold set at $p < 0.10$ for excluding insignificant variables.

Results

Study sample and TMD prevalence/symptoms

Table 1 presents the demographics and distributions of the study populations. The total sample (n = 901) comprised 400 SG and 501 ID youths with a mean age of 19.30 ± 1.48 years (65.0% women). Based on the FAI, TMDs were present in 47.0% and 59.3% of the Singaporean and Indonesian youths, correspondingly. For both nationalities, the severity of TMDs was generally mild, with moderate-to-severe TMDs forming only 12.3% and 9.4% of the Singaporean and Indonesian cohorts, respectively. Table 2 displays the frequencies of the various TMD symptoms/risk factors. Propensities were similar for both nationalities, with the two most common specific and non-specific TMD symptoms being masticatory muscle pain/TMJ noises (48.2%/42.9%) and neck pain/headaches (68.7%/62.9%) in youths with TMDs. Among the three TMD risk factors, emotional tension featured most prominently (81.9%) in the youths with TMDs.

Negative affectivity and emotions

Table 3 shows the mean/median negative affectivity and emotion scores for the NT and WT groups, while Table 4 indicates the results of statistical comparisons. For both nationalities, participants with TMDs had significantly greater negative affectivity, depression, anxiety, and stress scores than those with no TMDs. Indonesian youths also reported significantly higher levels of emotional distress than their Singaporean counterparts, irrespective of the presence of TMDs. However, the difference in negative affectivity was insignificant between the Singaporean and Indonesian participants with TMDs (p = 0.054).

Correlates and predictors of TMDs

Table 5 reflects the correlation coefficients between FAI, negative affectivity, depression, anxiety, and stress scores. Significant and moderately strong correlations were observed between FAI, negative affectivity, anxiety, and stress, with r_s ranging from 0.46 to 0.50. Conversely, the relation between FAI and depression scores was weak (r_s = 0.37). Correlations between negative affectivity and the three negative emotional states were strong (r_s = 0.86 to 0.94), as were the relationships between depression, anxiety, and stress (r_s = 0.66 to 0.82). While the univariate model suggested that gender, country, negative affectivity, and all three emotional states were associated with TMDs, the multivariate analysis indicated that only female gender and anxiety predicted the

Table 1. Demographics and distribution of the study populations.

Demographics/ TMD severity	Total sample	Singapore (SG)	Indonesia (ID)
n (%)	901 (100)	400 (44.4%)	501 (55.6%)
Age			
Mean ± SD	19.30 ± 1.48	18.77 ± 1.54	19.73 ± 1.27
Median (IQR)	19.00 (2)	19.00 (1)	19.00 (2)
Gender			
Women n (%)	586 (65.0%)	209 (52.3%)	377 (75.2%)
Men n (%)	315 (35.0%)	191 (47.8%)	124 (24.8%)
No TMDs n (%)	416 (46.2%)	212 (53.0%)	204 (40.7%)
With TMDs n (%)	485 (53.8%)	188 (47.0%)	297 (59.3%)
Mild	389 (43.2%)	139 (34.8%)	250 (49.9%)
Moderate	89 (9.9%)	45 (11.3%)	44 (8.8%)
Severe	7 (0.8%)	4 (1.0%)	3 (0.6%)

TMD: Temporomandibular disorder; SD: Standard deviation; IQR: Interquartile range.

Table 2. Frequency of TMD symptoms and risk factors for the study populations.

TMD	Total		Singapore		Indonesia	
Symptoms/ risk factors	NT n (%)	WT n (%)	NT n (%)	WT n (%)	NT n (%)	WT n (%)
Opening difficulty	22 (5.2%)	146 (30.1%)	11 (5.2%)	64 (34.1%)	11 (5.4%)	82 (27.6%)
Side-movement difficulty	4 (1.0%)	66 (13.6%)	2 (0.9%)	33 (17.5%)	2 (1.0%)	33 (11.2%)
Muscle pain	41 (9.9%)	234 (48.2%)	14 (6.6%)	81 (43.1%)	27 (13.3%)	153 (51.5%)
Headache	77 (18.5%)	305 (62.9%)	42 (19.8%)	124 (66.0%)	35 (17.1%)	181 (60.9%)
Neck pain	86 (20.7%)	333 (68.7%)	61 (28.8%)	157 (83.5%)	25 (12.3%)	176 (59.3%)
TMJ pain	7 (1.7%)	145 (29.9%)	7 (3.3%)	69 (36.7%)	0 (0%)	76 (25.6%)
TMJ noises	27 (6.5%)	208 (42.9%)	15 (7.1%)	95 (50.5%)	12 (5.9%)	113 (38.0%)
Parafunction	50 (12.0%)	226 (46.6%)	27 (12.7%)	120 (63.8%)	23 (11.2%)	106 (35.7%)
Malocclusion	64 (15.4%)	271 (55.9%)	28 (13.2%)	106 (56.3%)	36 (17.6%)	165 (55.5%)
Emotional tension	148 (35.5%)	397 (81.9%)	66 (31.2%)	158 (84.1%)	82 (40.2%)	239 (80.5%)

TMD: Temporomandibular disorder; NT: No TMDs; WT: With TMDs.

Table 3. Mean/median Depression Anxiety Stress Scale-21 (DASS-21) scores for the study populations.

	Total		Singapore		Indonesia	
Constructs	NT	WT	NT	WT	NT	WT
Negative affectivity						
Mean ± SD	11.61 ± 9.42	21.23 ± 11.19	8.11 ± 8.61	20.47 ± 12.73	15.25 ± 8.84	21.71 ± 10.09
Median (IQR)	10.00 (14)	20.00 (15)	6.00 (9)	19.00 (18)	15.00 (12)	21.00 (12)
Depression					3.87 ± 3.31	
Mean ± SD	3.32 ± 3.56	5.94 ± 4.39	2.79 ± 3.7	6.91 ± 5.16	3.00 (4)	5.33 ± 3.71
Median (IQR)	2.00 (5)	5.00 (5)	11.00 (4)	6.00		5.00 (5)
Anxiety		7.07 ± 3.90	2.30 ± 2.39	6.11 ± 4.05	5.00 ± 3.00	7.68 ± 3.68
Mean ± SD	3.62 ± 3.02	7.00 (6)	2.00 (3)	6.00 (5)	5.00 (4)	7.00 (5)
Median (IQR)	3.00 (5)					
Stress						
Mean ± SD	4.67 ± 3.94	8.22 ± 4.42	3.02 ± 3.49	7.45 ± 4.66	6.38 ± 3.64	8.70 ± 4.20
Median (IQR)	4.00 (6)	8.00 (6)	2.00 (5)	7.00 (7)	6.00 (5)	8.00 (5)

TMD: Temporomandibular disorder; NT: No TMDs; WT: With TMDs; SD: Standard deviation; IQR: Interquartile range.

Table 4. Results of statistical comparisons (*p*-values indicated).

Comparisons	Negative affectivity	Depression	Anxiety	Stress
Total NT vs WT	< 0.001*	< 0.001*	< 0.001*	< 0.001*
Singapore NT vs WT	< 0.001*	< 0.001*	< 0.001*	< 0.001*
Indonesia NT vs WT	< 0.001*	< 0.001*	< 0.001*	< 0.001*
No TMDs SG vs ID	< 0.001*	< 0.001*	< 0.001*	< 0.001*
With TMDs SG vs ID	0.054	0.003*	<0.001*	0.001*

TMD: Temporomandibular disorder; NT: No TMDs; WT: With TMDs; SG: Singapore; ID: Indonesia. *Indicates statistically significant differences. Results of Mann-Whitney U Test ($p < 0.05$).

Table 5. Correlations between FAI, negative affectivity, depression, anxiety, and stress scores.

	FAI	Negative affectivity	Depression	Anxiety	Stress
FAI	-	0.49**	0.37**	0.50**	0.46**
Negative affectivity	0.49**	-	0.86**	0.91**	0.94**
Depression	0.37**	0.86**	-	0.66**	0.71**
Anxiety	0.50**	0.91**	0.66**	-	0.82**
Stress	0.46**	0.94**	0.71**	0.82**	-

FAI: Fonseca anamnestic index.
**indicates statistically significant correlations. Results of Spearman's correlation ($p < 0.01$).

Table 6. Univariate and multivariable logistic regression analysis to determine predictors of TMD.

	Univariate analysis		Multivariate analysis*	
Variable	Odds Ratio (95%CI)	*p*-value	Odds Ratio (95%CI)	*p*-value
Gender				
Male	Reference			
Female	2.23 (1.69, 2.95)	<0.001*	1.80 (1.30, 2.48)	<0.001*
Country				
Singapore	Reference			
Indonesia	1.64 (1.26, 2.14)	<0.001*	0.75 (0.52, 1.07)	0.110
Age	1.04 (0.95, 1.14)	0.389	1.01 (0.91, 1.13)	0.794
Negative affectivity	1.10 (1.08, 1.11)	<0.001*		-
Depression	1.19 (1.15, 1.24)	<0.001*	1.03 (0.97, 1.08)	0.373
Anxiety	1.33 (1.27, 1.40)	<0.001*	1.29 (1.19, 1.38)	<0.001*
Stress	1.23 (1.18, 1.27)	<0.001*	1.03 (0.96, 1.09)	0.456

TMD: Temporomandibular disorder; CI: Confidence interval.
*Indicates significant variables. Results of logistic regression analysis ($p < 0.05$).

presence of TMDs with ORs of 1.80 and 1.29, respectively (Table 6).

Discussion

This research is one of the first cross-national/cultural TMD-related works established in SEA and offeres a more accurate depiction of the emotional phenotype

of SEA youths with TMDs. The connections between TMDs and negative affectivity/emotions were compared across nations/cultures, and the emotional predictors of TMDs were determined. Youths were targeted for investigation, as they represented the start age for the peak development of TMD symptoms [3]. The nation of Singapore and Indonesia were chosen, as they epitomized the two major ethnic groups in SEA. The culture of a nation refers to the norms, beliefs, customs, social behaviors, and values shared by the people of a sovereign country [35]. Though multi-racial, like most countries in the world, Chinese-Confucian and Austronesian-Islamic cultures feature predominantly in Singapore and Indonesia due to the high proportion (> 75%) of Chinese and Austronesians (Malayo-Polynesian descent) in their populations, respectively. Confucian-heritage cultures are characterized by the pursuit of personal improvements and achievements through self-effort [36]. Conversely, Islamic-heritage cultures place greater emphasis on religion and religiosity than self-endeavors [37]. All three research hypotheses were supported, as TMDs were associated with emotional distress, significant differences in negative affectivity/emotions were present across cultures, and only anxiety increased the odds of TMDs.

TMD prevalence and symptoms/risk factors

The FAI has been shown to accurately identify TMDs in both clinical and non-clinical samples [13–15]. Satisfactory reliability (intra-class correlation coefficient = 0.72) and validity, when related to the Oral Health Impact Profile-14 (r_s = 0.47) were presented by the Indonesian FAI [33,38]. The prevalence of TMDs in Indonesian youth was 12.3% higher than their Singaporean counterparts. TMD frequencies observed in this study (47.0 to 59.3%) were comparable to those of West (46.8%) and South Asian (53.3%) youths, based on the FAI [39,40]. However, TMD prevalence rates attained with formalized diagnostic criteria were considerably lower (6.0 to 15.8%) in the general population [2] and were akin to the occurrence of moderate-to-severe TMDs (9.4 to 12.3%) in the present cohorts. The inclusion of participants with mild TMDs may consequently require reconsideration for epidemiological studies.

For Singaporean and Indonesian youths with TMDs, the two most common TMD-specific symptoms were masticatory muscle pain and TMJ noises, while neck pain and headaches were the two most frequent non-specific TMD symptoms. These TMD-related symptoms were also widespread in Western youths with TMDs [41,42]. Neck pain and headaches frequently co-exist due to trigemino-cervical relationships and are also associated with emotional distress [43]. Among the three TMD risk factors, the prevalence of emotional tension was the highest, (81.9%) followed by malocclusion (55.9%) and parafunction (46.6%). Findings lend additional support to the relatively lesser role that dental occlusion and bruxism play in the pathophysiology of TMDs [44,45].

Negative affectivity/emotions and TMDs

The DASS is the only psychological inventory that offers the concomitant assessment of depression, anxiety, and stress. The three subscales of the DASS-21 have been validated across different cultures and draw on the general dimension of negative affectivity [23–25]. The latter was evidenced by the very strong correlations (r_s = 0.86 to 0.94) between negative affectivity and the three subscale scores in the present and other TMD studies [26]. While the depression scale evaluates the state of low mood and hopelessness, the anxiety scale measures physiological arousals, situational anxiety, and anxious effects. The stress scale assesses difficulty relaxing, nervous arousals, and ease of being upset, irritable, and impatient [32].

For both nationalities/cultures, the presence of TMDs was associated with significantly greater negative affectivity and higher levels of emotional distress. While subscale scores were all normal in the NT groups, mild depression/stress (5 to 6/8 to 9 points) and moderate-to-severe anxiety (6 to 9 points) were typically observed in the WT groups. This corresponded to the correlations between FAI and the subscale scores, with anxiety yielding the strongest (r_s = 0.50) and depression the weakest (r_s = 0.37) associations. Anxiety may, hence, contribute more to TMDs than depression in young people and should be emphasized in TMD research as well as management. Outcomes corroborated the biopsychosocial model of TMDs and underscored the importance of emotional factors in the etiology of TMDs [17,18].

For both NT and WT groups, Indonesian youths presented considerably higher levels of depression, anxiety, and stress than Singaporean youths. It can, thus, be inferred that youths from Austronesian-Islamic cultures experienced more emotional distress than their equivalents from Chinese-Confucian cultures, independent of the presence of TMDs. Results were somewhat unanticipated, considering the known national preoccupation with the "fear of losing out (kiasuism)," competitiveness,

and academic success in Singapore, which could lead to high levels of anxiety and self-doubt [36,46]. However, Ho et al. [46] found that such "kiasu" behaviors were not unique to Singapore and may well be embraced and exhibited by people globally. Academic competition, in reality, could be much stiffer in Indonesia than in Singapore, given that it is the fourth most populous nation in the world. Besides variations in culture (particularly the focus on self-effort), academic settings and stressors, the divergence could also be influenced by a myriad of health risk behaviors, socio-political, and environmental factors, including sedentary lifestyles, substance use, standard of living, economic inequalities, community situations, family/peer relationships, and coping strategies [47]. Moreover, genes and epigenetic factors that bridge gene and environmental mechanisms could also contribute somewhat [48]. Though negative affectivity scores were significantly different between Singaporean and Indonesian youths without TMDs, they were insignificant between those with TMDs. This suggests that youths from both cultures might have a similar disposition to experience negative emotional states in the presence of TMDs and can result from a breakdown in hedonic (pleasure) systems mediated by mesocorticolimbic circuitry [49].

Predictors of TMDs

Multivariate logistic regression analysis, where all demographic/emotional variables were examined together, specified that only the female gender and anxiety predicted the presence of TMDs in SEA youths. While the female gender increased the risk of TMDs by 80%, anxiety amplified it by 29%. The predisposition of women to TMDs is well established and has been explained by sex hormones (which play a vital role in the regulation of the hypothalamic-pituitary-adrenal [HPA] stress axis), sociocultural and environmental factors, in addition to gender differences in stress levels and pain sensitivity [4]. Even though all three emotional states were associated with TMDs in patient populations [18], Bonjardim et al. [50] and Lei et al. [51] determined that only anxiety is significantly related to TMD signs and symptoms in Latin-American and East Asian youths. The latter was validated by this study comprising SEA youths in the community. Pathological anxiety, along with chronic stress, has been linked to fear neurocircuitry alterations involving exaggerated amygdala (brain region for processing emotions and motivations) responses and impaired regulation of prefrontal cortex and hippocampus processes arising from structural degeneration [52]. The latter may lead to an increased risk of developing depression and clarifies, in part, the high co-morbidity between anxiety and depression in patients with chronic diseases, including TMDs [53,54].

A paradigm shift from reactive management (illness care) to proactive prevention of TMDs (health care) is merited. Considering the relationship between TMDs and emotional distress in this and other studies, integrative approaches to anxiety, stress, and resilience through positive psychological interventions (PPIs) could plausibly reduce the incidence of TMDs in youths [55]. PPIs are designed to enhance positivity as well as optimum functioning and include mindfulness meditation, gratitude, forgiveness, and optimism exercises, meaning-oriented and empathy-related interventions, and conventional cognitive-behavioral therapy. PPIs are anticipated to play an increasing role in TMD therapy, especially since psychological well-being was recently determined to decrease the likelihood of TMDs [56].

Study limitations

The current study has some design and methodological limitations. First, only youths attending tertiary educational institutions in Singapore and Indonesia were enlisted. Non-schooling youths were not investigated and may present dissimilar emotional profiles. Furthermore, youths from only two countries were assessed, and findings cannot be generalized to all SEA youths, due to national and cultural differences. Second, causal relationships between TMDs and negative emotions cannot be established with the cross-sectional study design utilized. Longitudinal cohort studies are necessary to verify causality, but they pose several problems, including participant attrition. Third, as with all self-reported instruments, findings are predisposed to various partialities, including recall, response, social desirability, and other biases. Future work could involve other SEA countries, both schooling and non-schooling youths, and incorporate secondary TMD screening measures. Cross-cultural calibration of the assessment tools should also be considered [57].

Conclusion

Within the limitations of this research, the following conclusions were drawn:

1. Cultural variations can influence TMD prevalence and the experience of emotional distress.
2. The presence of TMDs was associated with significantly greater negative affectivity and higher levels of emotional distress in SEA youths.

3. Being female and anxious could increase the prospect of TMDs.

4. Anxiety appears to contribute more to TMDs than depression in young people and should be emphasized in TMD research and management.

5. A paradigm shift from reactive management to proactive prevention of TMDs involving integrative approaches to anxiety/stress and resilience is merited.

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