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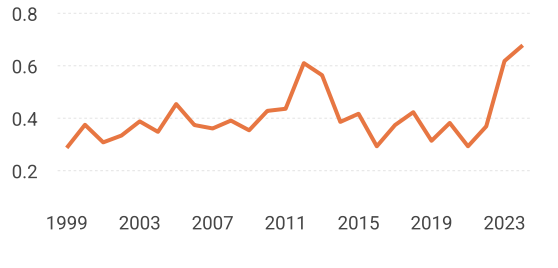

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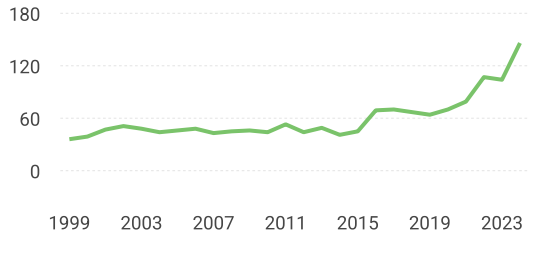

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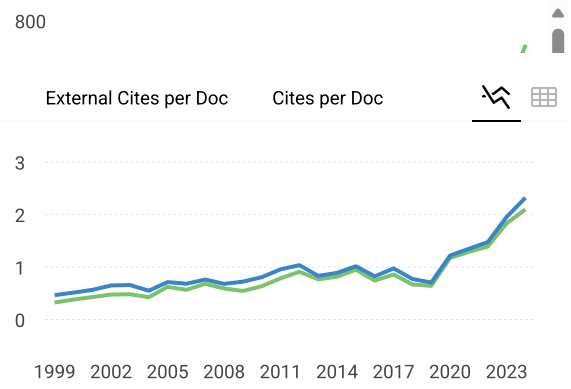

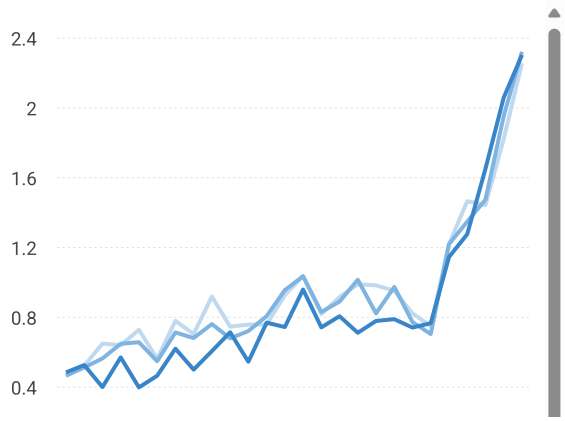

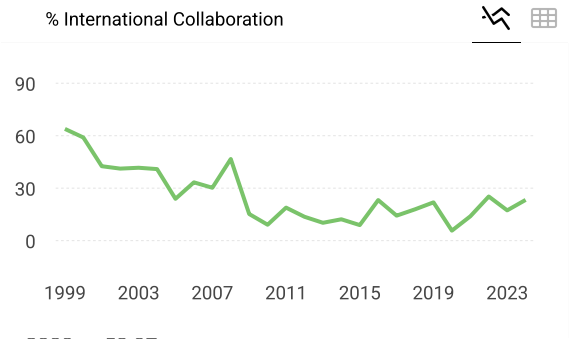

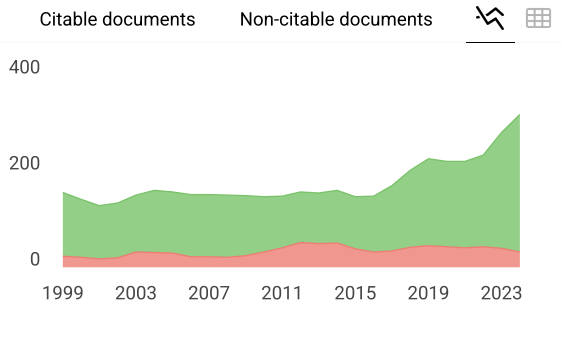

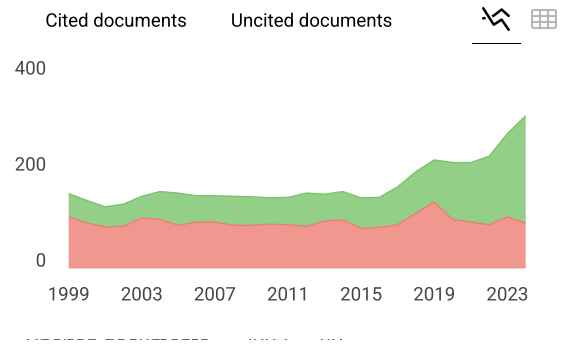

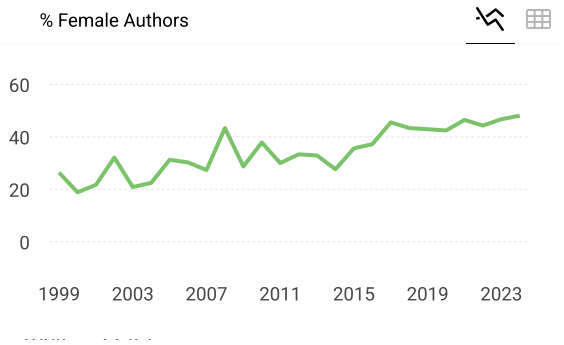

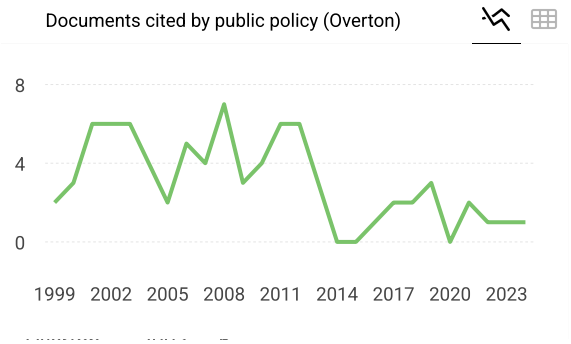

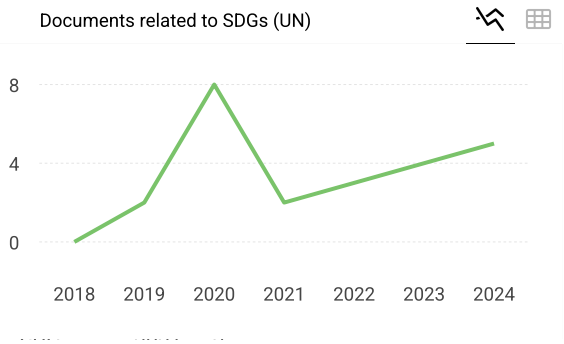

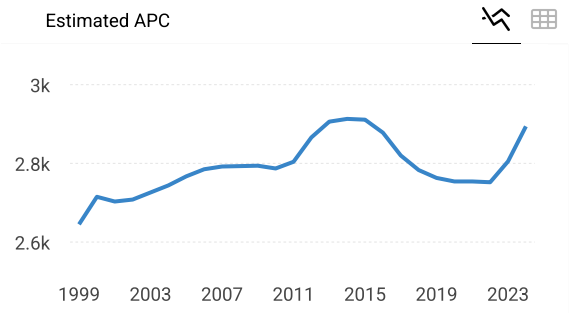

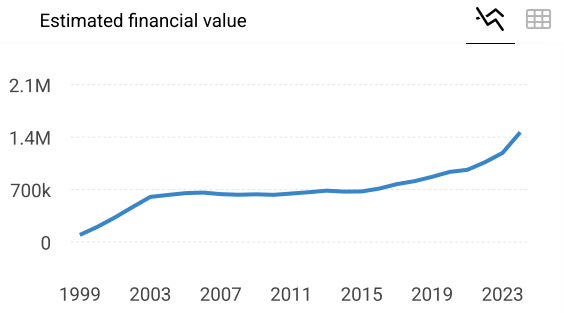

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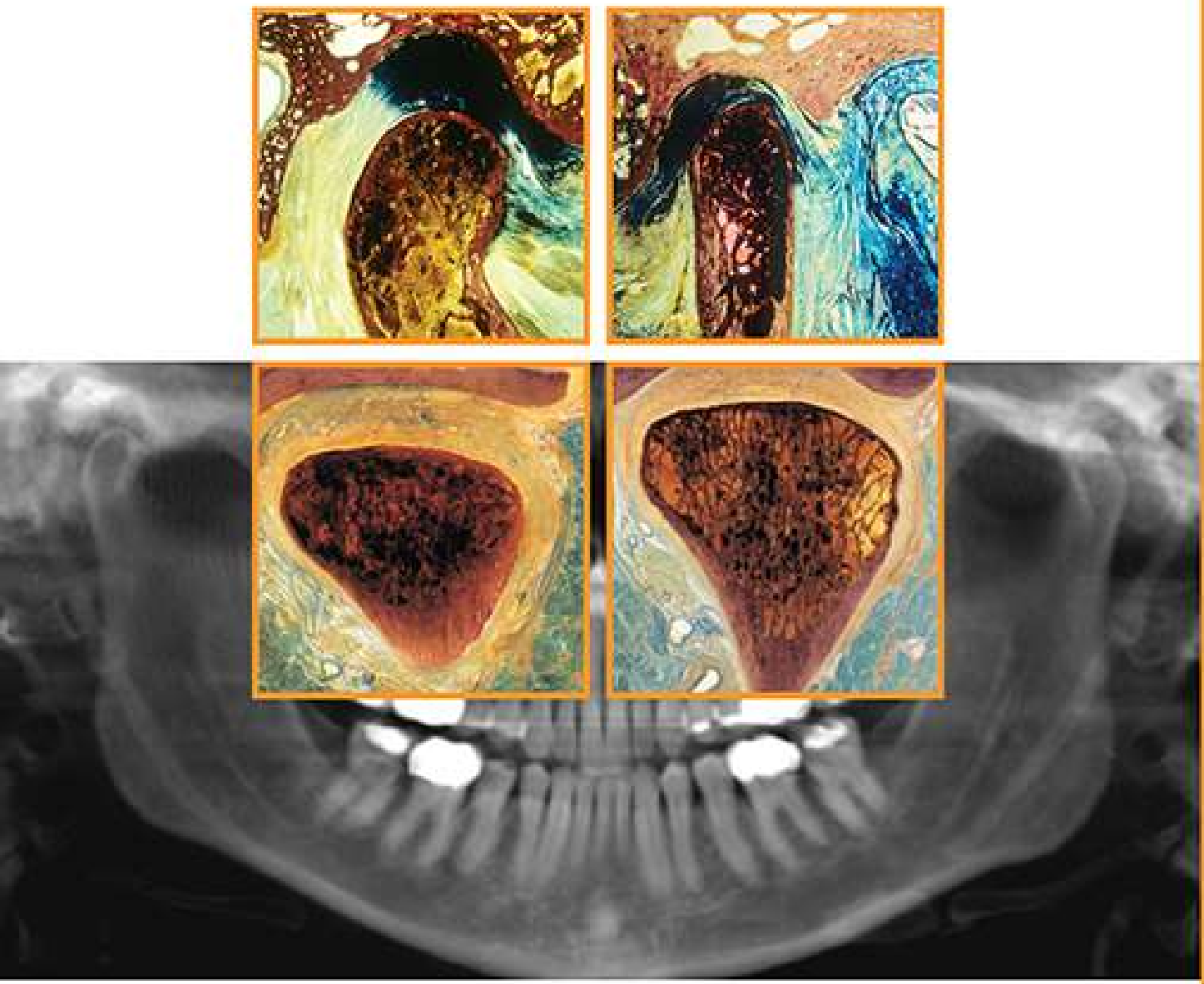

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Sanjivan Kandasamy BDSc, BScDent, DocClinDent, MMedSci, MOrthRCS, FRACDS, FDS RCS

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Psychometric properties of the Indonesian Fonseca anamnestic index and the presence/severity of temporomandibular disorders among Indonesian young adults

Adrian Ujin Yap PhD, MSc, BDS, Carolina Marpaung PhD, BDS & Indrayadi Gunardi DDS, BDS

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Psychometric properties of the Indonesian Fonseca anamnestic index and the presence/severity of temporomandibular disorders among Indonesian young adults

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ABSTRACT

Objective: The psychometric properties of the Indonesian FAI (FAI-I) and presence/severity of temporomandibular disorders (TMDs) among Indonesian young adults were explored.

Methods: The FAI-I was developed following the INfORM guidelines and used to determine the presence/severity of TMDs. Internal consistency/test-retest reliability were examined with Cronbach's alpha/intra-class correlation (ICC) coefficients. Construct/criteria validity were established by correlating (Spearman) the FAI-I to the five major TMD symptoms (5 Ts) and OHIP-14 ($p < 0.05$).

Results: Five hundred-one participants (mean age 19.73 ± 1.27 years; 75.2% women) were recruited from a local University. Of these, 40.7% had no TMD, while 49.9%, 8.8%, and 0.6% had mild, moderate, and severe TMD. While Cronbach's α = 0.57 and ICC = 0.72, correlation coefficients to total 5 Ts and OHIP-14 were 0.53 and 0.47, respectively.

Conclusion: The FAI-I had low internal consistency, good test-retest reliability, and good validity. Moderate-to-severe TMD was experienced by 9.4% of the young adults examined.

KEYWORDS
Temporomandibular disorders; translation; reliability; validity; prevalence

Introduction

Temporomandibular disorders (TMDs) are a heterogeneous group of musculoskeletal conditions characterized by pain and dysfunction of the temporomandibular joints (TMJs), muscles of mastication, and adjoining structures [1]. They affect up to 7% of adolescents and 15% of adults and are the third most common chronic pain problem globally after headaches and back pain [1,2]. Women, particularly those of reproductive age, appear to be more susceptible to TMDs [3,4]. The complex etiology of TMDs is contributed by various biopsychosocial risk factors, including genes, hormones, macro/micro-trauma, stress, anxiety, and depression [4,5]. The presence of TMDs, especially painful disorders, is associated with poorer general and oral health-related quality of life (OHRQoL) [6,7]. Moreover, therapeutic TMD interventions can improve the OHRQoL of individuals with TMDs [8].

The current Diagnostic Criteria for TMDs (DC/TMD) standard for assessing/diagnosing TMDs comprises a comprehensive TMD symptom questionnaire (SQ), protocolized clinical examination, and detailed rule sets for rendering Axis I TMD diagnoses [9]. In addition, measures for evaluating Axis II psychosocial and behavioral contributing factors are provided. Despite being both reliable and valid [9,10], the DC/TMD remains impractical for clinical triage and epidemiological studies, as it is difficult and time-consuming to administer. Besides being easy, fast, and cheap to dispense (preferably subject-administered), TMD screeners must also be reliable, valid, and accurate [11]. Although a screening instrument (TMD Pain Screener [TPS]) is offered by the DC/TMD, it only identifies painful TMDs, and painless intra-articular conditions are not assessed [11].

Since its debut in 1994, the Fonseca Anamnestic Index has remained one of the more popular screeners for TMD research due to its relative simplicity, efficiency, and low cost [12]. Developed based on the Helkimo's index [13], it consists of 10 items regarding pain-related (head and neck aches, TMJ and masticatory muscle pain) and function-related (TMJ sounds, opening, and lateral-movement difficulties) TMD symptoms as well as risk factors (parafunctional habits, malocclusion, and emotional tension). The psychometric

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properties of the FAI are well established [14–18], and it is consistent with other TMD screeners, such as the American Association of Orofacial Pain Questionnaire (AAOPQ) [19]. Furthermore, both the FAI and 5-item short-form FAI (SFAI) were determined to be accurate with reference to the Research Diagnostic Criteria for TMDs (RDC/TMD) and DC/TMD benchmarks [20–24]. The initial Portuguese and English FAI has been translated into many languages other than Indonesian [16–18].

Bahasa Indonesia (BI), an Austronesian lingo, is the official language of the Indonesian archipelago. Indonesia is the fourth most populous country, making BI one of the most commonly spoken languages worldwide [25]. As English literacy is generally low among Indonesian people, the FAI must be converted to BI (Indonesian) before it can be employed locally and/or internationally. Therefore, the objectives of this study were to translate/cross-culturally adapt the English FAI into Indonesian and to assess the reliability/validity of the Indonesian FAI (FAI-I). The secondary aim was to examine the presence and severity of TMDs among Indonesian young adults.

Materials and methods

Translation procedures

Approval was obtained from the relevant ethics committee before commencing the study (project no: 377-S1/KEPK/FKG/8-2020). The translation and cultural equivalency procedures were performed following the International Network for Orofacial Pain and Related-disorders Methodology (INFORM) guidelines [26] and has been described in detail previously [16]. The translation/cross-cultural adaptation process involved the following six steps: (1) Forward translations, (2) Synthesis and resolution of discrepancies, (3) Backward translations, (4) Review and revision by an expert committee, (5) Evaluation and revision of the pre-final version, and (6) Psychometric assessment of the final version.

Briefly, the forward translation of the FAI from English to BI was independently carried out by two bilingual translators whose mother tongue was Indonesian. The two Indonesian language versions of the FAI were examined for discrepancies, and any inconsistencies were discussed and resolved by consensus. A synthesized common Indonesian translation was produced and subjected to backward translation into English by a third bilingual translator who was not exposed to the original English FAI and whose mother tongue was English. All adaptations of the FAI were examined for semantic, vernacular, conceptual, and other equivalences by an expert committee comprising two dental specialists, a psychologist, and a language expert, who were not involved in the earlier processes. The pre-final Indonesian FAI (FAI-I) was derived through consensus and evaluated by a sample of 30 participants to determine its face validity (the extent to which a test measures content according to laypersons), with special emphasis on the understanding and perception of the translated items. Any unclear terms or translation errors were isolated and duly rectified by the expert committee to create the final version of the FAI-I (Table 1).

Table 1. The English and Indonesian versions of the Fonseca Anamnestic Index (FAI).

Item number/Questions	Answers: No / Tidak	Sometimes / Kadang	Yes / Ya
1. Do you have difficulty opening your mouth wide? Apakah Anda kesulitan membuka mulut dengan lebar?			
2. Do you have difficulty moving your jaw to the sides? Apakah Anda mengalami kesulitan menggerakkan rahang ke samping?			
3. Do you feel fatigue or muscle pain when you chew? Apakah Anda merasa kelelahan atau nyeri otot saat Anda mengunyah?			
4. Do you have headaches? Apakah Anda mengalami nyeri kepala?			
5. Do you have neck pain or stiff neck? Apakah Anda mengalami nyeri leher atau kaku leher?			
6. Do you have ear aches or pain in that area (temporomandibular joint)? Apakah Anda mengalami nyeri telinga atau nyeri di daerah sendi temporomandibula?			
7. Have you ever noticed any noise in your temporomandibular joint while chewing or opening your mouth? Pernahkah Anda memperhatikan adanya kebisingan di sendi temporomandibula anda ketika Anda mengunyah atau membuka mulut?			
8. Do you have any habits, such as clenching or grinding your teeth? Apakah Anda memiliki kebiasaan seperti menahan gigitan dengan kuat atau menggemeretakkan gigi?			
9. Do you feel that your teeth do not come together well? Apakah Anda merasa gigi atas dan bawah Anda tidak bertemu dengan baik?			
10. Do you consider yourself a tense (nervous) person? Apakah Anda menganggap diri Anda orang yang tegang (gugup)?			

Study population

Participants for psychometric assessment of the FAI-I were randomly recruited from young adults, aged 18–24 years, attending a local university in the capital city of Jakarta over 3 months. Individuals with a history of orofacial trauma, debilitating systemic diseases or psychiatric disorders, and cognitive impairments were duly excluded. Based on a 95% probability, 5% confidence interval, 42% estimated proportion of mild-to-severe TMD based on the FAI [27], and a student population of 20,000, a minimal sample size of 368 was ascertained

with a sample size calculator (https://www.calculator.net). Involvement in the study was strictly voluntary, with no incentives offered. Informed consent was attained from the participants before administering an electronic questionnaire comprising the FAI-I and the Indonesian language versions of the DC/TMD SQ and Oral Health Impact Profile-14 (OHIP-14-I) [28,29].

Measures and psychometric assessment

The FAI-I (Table 1) was scored utilizing a 3-point rating scale with no, sometimes, and yes being assigned 0, 5, and 10 points, correspondingly. Total FAI-I scores that ranged from 0 to 100 points were computed, and TMD severity was categorized as indicated in Table 2. The five major TMD symptoms (5Ts-I) of the DC/TMD SQ, namely facial pain, headaches, TMJ sounds, closed and open locking, were scored with no and yes counted as 0 and 10 points. Total 5Ts-I scores that spanned from 0 to 50 points were subsequently calculated, with greater scores signifying more DC/TMD-specified symptoms. The OHIP-14-I was used for evaluating OHRQoL and was scored on a 5-point rating scale, with never, hardly, occasionally, fairly often, and very often being assigned 0, 1, 2, 3, and 4 points, accordingly. Total OHIP-14-I scores, which varied from 0 to 56 points, were obtained by adding all ordinal values. Higher total OHIP-14-I scores indicate worse or lower OHRQoL. Internal consistency (the extent to which test items measure different aspects of the same construct) was estimated with the Cronbach's alpha (α) coefficient, whereas test-retest reliability was evaluated by intra-class correlation (ICC) coefficient utilizing data from the 49 participants who repeated the FAI-I after 10 days. This interval period was chosen to minimize variations arising from the fluctuating nature of TMD symptoms. Construct (the extent to which a test measures what it is supposed to) and criterion (the extent to which the criteria of a test match other tests) validity were established by relating the FAI-I to 5Ts-I and OHIP-14-I scores, respectively [30]. While the 5Ts-I was selected because it identified TMD symptoms, the OHIP-14-I was employed because the presence of TMDs impairs OHRQoL [6,7].

Table 2. Classification of TMD severity according to the FAI-I.

TMD severity	Points	n (%)
No TMD	≤15	204 (40.7)
Mild TMD	20–40	250 (49.9)
Moderate TMD	45–65	44 (8.8)
Severe TMD	70–100	3 (0.6)

TMD: Temporomandibular Disorders; FAI-I: Indonesian Fonseca Anamnestic Index.

Statistical analysis

Statistical evaluations were conducted using the IBM SPSS Statistics for Windows version 24.0 (IBM Corporation, Armonk, NY, USA) with the significance level set at 0.05. TMD severity was reported as frequencies with proportions, while total 5Ts and OHIP-14 scores were presented as means with standard deviations and medians with interquartile ranges. For internal consistency, Cronbach's alpha was calculated and ordered as follows: Very low ($\alpha \leq 0.30$); low ($0.30 < \alpha \leq 0.60$); moderate ($0.60 < \alpha \leq 0.75$); high ($0.75 < \alpha \leq 0.90$); and very high ($\alpha > 0.90$) [31]. Low Cronbach's alpha reliability classifications indicate poor inter-relatedness of items or heterogeneous constructs. The internal consistency of the FAI-I was further explored by the sequential exclusion of individual items. An increase in α coefficients suggests that the item does not correlate well with the others, and a corrected item-total correlation of ≥ 0.20 was deemed satisfactory [31]. For test-retest reliability, ICC coefficient was computed and categorized as follows: Poor (< 0.40); fair to good (0.40–0.75); and excellent (> 0.75) [32]. The ICC of the individual FAI-I items was also examined. Data normality was evaluated with the Kolmogorov-Smirnov test. As total 5Ts-I and OHIP-14-I data were not normally distributed, differences in scores among the various TMD groups were appraised with the Kruskal Wallis/Mann-Whitney U test. Additionally, Spearman's rank-order correlation was applied to establish the relationships between FAI-I and DC/TMD-specified symptoms as well as OHRQoL. Correlation coefficient (r_s) was graded as follows: Weak (0.1–0.3), moderate (0.4–0.6), and strong (0.7–0.9) [33].

Results

Translation/cross-cultural adaptation and pre-final FAI-I

No major issues, including linguistic disparities, were faced during the forward/backward translations and creation of the pre-final FAI-I. The minor syntax inconsistencies were resolved by the expert committee with ease. Appraisal of the pre-final FAI-I showed no difficult items and verified that the FAI-I was easy to comprehend and answer. The completed FAI-I is displayed in Table 1.

Study population and TMD frequency

A total of 590 young adults were screened for eligibility. Of these, 62 met the exclusion criteria, and 27 declined

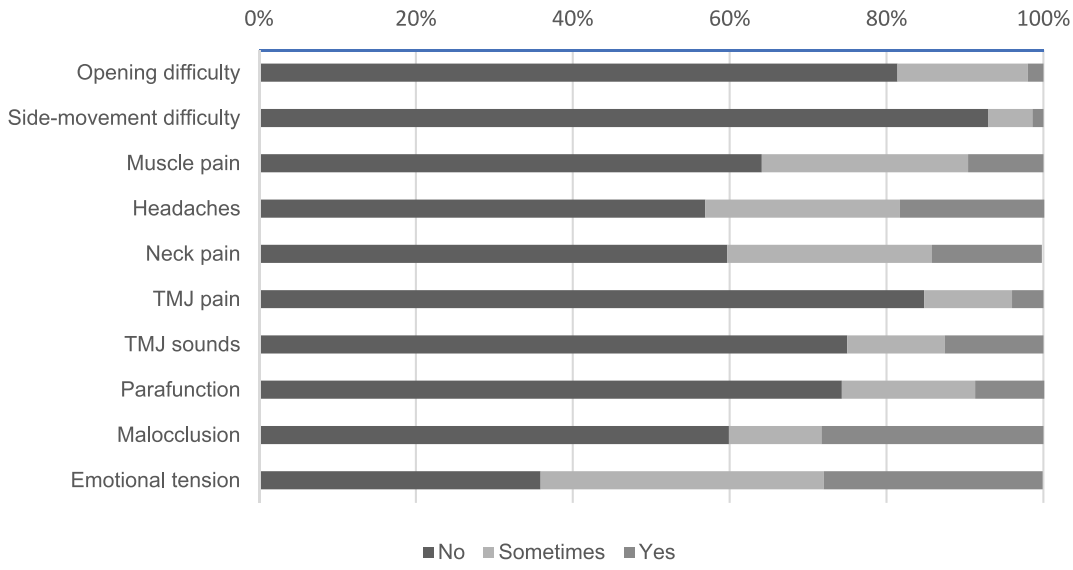

Figure 1. Distribution of responses for individual Indonesian Fonseca Anamnestic Index (FAI-I) items.

study participation, ensuing in a response rate of 94.9%. The mean age of the study population (n = 501), which comprised 75.2% women, was 19.73 ± 1.27 years. The frequency of TMD according to the FAI-I is presented in Table 2. While 40.7% of the participants experienced no TMD (NT), 49.9% had mild (MT), 8.8% had moderate (DT), and 0.6% had severe (ST) TMD. Figure 1 displays the distribution of responses for the individual FAI-I items. The most often reported symptoms/risk factors were emotional tension (61.4%), headaches (43.1%), and neck pain (40.3%).

Reliability of the FAI-I

Table 3 shows the internal consistency and test-retest reliability of the FAI-I. The α and ICC coefficients of the full FAI-I were 0.57 and 0.72 (95% CI 0.59–0.82), respectively. Even with the sequential exclusion of discrete items, α coefficient values remained < 0.6 (range 0.52–0.57) for the FAI-I. Corrected item-total correlations for the FAI-I spanned from 0.17 (item 8) to 0.36 (item 6). Besides item 8 (Do you have any habits, such as clenching or grinding your teeth?), all other items achieved the minimum acceptable correlation coefficient of 0.20. ICC coefficients varied from 0.52 to 0.83 for the individual items and were mostly excellent.

Table 3. Internal consistency and test-retest reliability of the FAI-I.

FAI-I	Cronbach's alpha if item excluded (n = 501)	Corrected item-total correlation	ICC (n = 49)	ICC (95% CI)
Item 1	0.55	0.25	0.79	0.65–0.87
Item 2	0.56	0.23	0.83	0.71–0.90
Item 3	0.52	0.34	0.52	0.29–0.70
Item 4	0.54	0.28	0.60	0.37–0.74
Item 5	0.54	0.32	0.76	0.60–0.85
Item 6	0.53	0.36	0.53	0.29–0.70
Item 7	0.54	0.26	0.74	0.59–0.85
Item 8	0.57	0.17	0.81	0.69–0.89
Item 9	0.56	0.24	0.83	0.72–0.90
Item10	0.56	0.21	0.81	0.69–0.89

FAI-I: Indonesian Fonseca Anamnestic Index; ICC: Intraclass correlation; CI: Confidence Interval.

Construct and criterion validity of the FAI-I

The mean/median total 5Ts-I and OHIP-14-I scores are reflected in Table 4, Table 5. Both total 5Ts-I and OHIP-14-I scores generally increased with greater TMD severity. Significant differences in total 5Ts-I and OHIP-14-I scores were ST, DT > MT > NT. Correlations of FAI-I scores to total 5Ts-I (r_s = 0.53) and total OHIP-14-I (r_s = 0.47) scores were moderately strong. However, the association between 5Ts-I and OHIP-14-I scores was weak (r_s = 0.31).

Discussion

The English FAI was translated and cross-culturally adapted into Indonesian.

Psychometric properties of the FAI-I were subsequently assessed using a sample of university students. The acquired data also served to approximate the prevalence and severity of TMDs among Indonesian young adults. Young adults were identified for the study, as they typified the peak incidence age for TMDs and constituted the vast majority of TMD patients [4,34]. The FAI-I demonstrated low internal consistency, good

Table 4. Mean and median total 5Ts-I and OHIP-14-I scores for the different TMD categories.

Variables	No TMD (NT)	Mild TMD (MT)	Moderate TMD (DT)	Severe TMD (ST)	*p*-value*	Post-hoc
Total 5Ts-I						
Mean (SD)	4.9 (7.5)	13.0 (10.5)	19.1 (9.4)	33.3 (5.8)	< 0.001	ST,DT>MT>NT
Median (IQR)	0.0 (0.0–10.0)	10.0 (0.0–20.0)	20.0 (10.0–30.0)	30.0 (30.0)		
Total OHIP-14-I						
Mean (SD)	7.19 (7.3)	12.8 (8.7)	18.9 (11.8)	37.0 (10.0)	< 0.001	ST,DT>MT>NT
Median (IQR)	5.0 (2.0–10.0)	11.0 (6.0–18.0)	19.0 (9.5–26.0)	37.0 (27.0–37.0)		

*Results of Kruskal Wallis/Mann-Whitney U post-hoc test ($p < 0.05$); 5T: 5 major TMD symptoms; OHIP-14: Oral Health Impact Profile-14; TMD: Temporomandibular disorders; SD: Standard deviation; IQR: Interquartile range; NT: No TMD; MT: Mild TMD; DT: Moderate TMD; ST: Severe TMD.

Table 5. Correlations between FAI-I, 5Ts-I, and OHIP-14-I scores.

Variables	FAI-I	5Ts
FAI-I	-	-
5Ts-I	0.53**	-
OHIP-14-I	0.47**	0.31**

**Results of Spearman's correlation ($p < 0.001$); FAI-I: Indonesian Fonseca Anamnestic Index; 5T: 5 major TMD symptoms; OHIP-14: Oral Health Impact Profile-14.

test-retest reliability, and good construct as well as criterion validity. The cross-cultural adaptation process involves the linguistic and cultural adjustments of instruments during conversion into another language [35]. The INfORM methodology, which is the international standard for converting the DC/TMD into different languages, was embraced to ensure valid instrument development that can generate comparable data across multi-language/cultural settings [26]. No notable issues were encountered during the forward-backward translation procedures of the FAI, and testing of the pre-final FAI-I revealed no problematic items.

Presence and severity of TMDs

TMD-related symptoms/risk factors were present in 59.3% of the participants, with 9.4% having moderate-to-severe TMD. Findings were consistent with other studies on Southeast, South, and West Asian young adults, which reported FAI-based TMD prevalence of 41.8–53.3%, with 9.4–10.7% experiencing moderate-to-severe TMD [27,36,37]. However, in a study on Brazilian university students, considerably higher TMD prevalence (71.9%) and moderate-to-severe TMD (21.9%) were conveyed [38]. Although the incongruence could arise from ethnic and socio-economic differences, it might be largely due to variances in psychological factors [39]. In addition to the challenges of transitioning into adulthood, university students often need to deal with new living, social, and learning environments, peer pressure/conflicts, academic demands, achievement frustrations, as well as financial difficulties that could lead to higher levels of stress, anxiety, depression, and even suicide risk [40].

The FAI was found to be multidimensional, with the primary dimension comprising items 1, 2, 3, 6, and 7 through factor analysis [41]. Items relating to non-TMD -specific symptoms (i.e., head and neck aches) and risk factors (i.e., parafunctional habits, malocclusion, and emotional tension) formed the second dimension and were duly excluded in the creation of the SFAI [23]. Among the three risk factors, only psycho-emotional distress has been explicitly related to the development of TMDs [42]. Due to its multidimensionality and the inclusion of non-TMD-specific symptoms/risk factors, the FAI might overestimate the actual prevalence of TMDs. This is particularly pertinent, given the high frequencies of emotional tension, headaches, and neck pain reported. Moreover, the occurrence of moderate-to-severe TMD described was consistent with the prevalence cited in Axis I epidemiological studies. Based on the RDC/TMD, the frequency of TMDs in the general population varied between 6.0 and 15.8% [43]. The mild TMD category should, thus, be discounted when assessing TMD prevalence with the FAI. Alternatively, the SFAI, which has 90.7–97.5% sensitivity and 93.0–96.5% specificity in relation to the DC/TMD could be applied [24].

Reliability of the FAI-I

The internal consistency of the FAI-I was low, with an α coefficient of 0.57. Even with the sequential exclusion of individual items, α coefficients remained < 0.7. This finding corroborated the multidimensionality of the FAI and the existence of heterogeneous constructs. However, α coefficients obtained with other language versions of the FAI were higher, ranging from 0.67–0.83 [16–18,22]. Cronbach's alphas are a function of the number of test items, average covariance between item pairs, and variance of the total score. Variations in item correlations and total scores are influenced by the

sample size as well as the population surveyed. While the present study involved a relatively large non-clinical sample, psychometric evaluations of the other language versions of the FAI had generally involved smaller sample sizes and clinical samples consisting of TMD patients and controls. The use of non-clinical samples is posited to yield more realistic Cronbach's alphas, given the much higher proportion of individuals with no-to-mild TMD and lower TMD severity scores in the general population [44]. Test-retest reliability of the FAI-I was good, with an ICC coefficient of 0.72. Good to excellent test-retest reliability was also observed with other language versions of the FAI and may be attributed partly to its relative simplicity and the few test items involved [16–18,22].

Validity of the FAI-I

The construct and criterion validity of the FAI-I was assessed by relating FAI-I severity categories/scores to total 5Ts-I and OHIP-14-I scores. Although the DC/TMD-based 5Ts measured the same construct as the FAI, it only concerned pain-related (facial pain and headaches) and intra-articular (TMJ sounds, closed, and open locking) symptoms. TMDs are often correlated to OHIP-14 scores and have been associated with poorer OHRQoL [6,7]. As such, the FAI-I (if valid) could predict total OHIP-14-I outcomes. Total 5Ts-I and OHIP-14-I scores were observed to increase with greater TMD severity. Participants with ST, DT, and MT had significantly higher total 5Ts-I and OHIP-14-I scores than the NT group. Scores for the ST and DT groups also differed significantly from the MT group. The correlation between FAI-I and total 5Ts-I scores was moderately strong (r_s = 0.53) and is anticipated to be stronger if the non-TMD-specific items were exempted. Discrepancies in TMD symptom reporting periods might also contribute to the weaker association observed. While the 5Ts-I were assessed over 30 days, the evaluation period for the FAI is somewhat ambiguous. Future enhancement of the FAI could entail refinements to the definition of "sometimes" and "yes".

A moderately strong correlation was also noted between FAI-I and total OHIP-14-I scores (r_s = 0.47). This finding affirmed that of a recent study on prospective orthodontic patients, where a moderately strong association (r_s = 0.57) was perceived utilizing the English versions of the same measures [45]. The relationship is likely to be stronger if TMD-specific OHRQoL measures, like the OHIP-TMD, were employed, as they generally have greater sensitivity, specificity, and responsivity [46]. Some items of the OHIP-14-I (e.g., sense of taste and embarrassment) may not be relevant to TMDs. However, a weak correlation (r_s = 0.31) was detected between the total 5Ts-I and OHIP-14-I scores, which could be partly due to the low prevalence of TMJ closed and open locking (i.e., TMJ disc displacements without reduction with limited opening and TMJ subluxation) in the general population [47].

Study limitations

This study had a few limitations that will be addressed hereafter. First, a non-clinical population was selected over clinical samples involving TMD and control patients. While this could have resulted in the lower internal consistency observed, the α coefficient attained is probably more realistic, given that the FAI is often applied in the general population where TMD symptoms may be intermittent and mild. Second, the participants only included university students who were mostly women and do not represent all young adults in Indonesia. Future research should incorporate more men as well as non-student/working young adults. Nevertheless, findings could indicate the "worst possible" outcome, given the higher prevalence of psychological distress and TMD among university students [38,40]. Third, all the measures were participant-centric and prone to a variety of biases. Although, selection bias was allayed by the very high response rate (94.9%), information partialities arising from self-report, social desirability, and recall biases [48]. Lastly, it is important to note the FAI was designed merely as a TMD screener. Definitive TMD diagnoses can only be derived through thorough history taking, physical examination, adjunctive diagnostic imaging, and validated diagnostic criteria.

Conclusion

This study translated/cross-culturally adapted the English FAI into BI, evaluated the psychometric properties of the FAI-I, and examined the presence/severity of TMDs in Indonesian young adults. Findings suggest that the FAI-I had low internal consistency, good test-retest reliability, and good construct/criterion validity. Due to its multidimensionality, the mild TMD category of the FAI should be discounted when assessing TMD prevalence. Alternately, the use of the short-form FAI (SFAI), where non-TMD-specific symptoms/risk factors are omitted, could be considered. Moderate-to-severe TMD was experienced by 9.4% of the Indonesian young adults examined, which corroborated the TMD prevalence reported in the current literature.

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Data availability statement

Data for this study are available from the corresponding author upon judicious request.

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Psychometric properties of the Indonesian Fonseca anamnestic index and the presence/severity of temporomandibular disorders among Indonesian young adults

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ABSTRACT

Objective: The psychometric properties of the Indonesian FAI (FAI-I) and presence/severity of temporomandibular disorders (TMDs) among Indonesian young adults were explored.

Methods: The FAI-I was developed following the INfORM guidelines and used to determine the presence/severity of TMDs. Internal consistency/test-retest reliability were examined with Cronbach's alpha/intra-class correlation (ICC) coefficients. Construct/criteria validity were established by correlating (Spearman) the FAI-I to the five major TMD symptoms (5 Ts) and OHIP-14 ($p < 0.05$).

Results: Five hundred-one participants (mean age 19.73 ± 1.27 years; 75.2% women) were recruited from a local University. Of these, 40.7% had no TMD, while 49.9%, 8.8%, and 0.6% had mild, moderate, and severe TMD. While Cronbach's α = 0.57 and ICC = 0.72, correlation coefficients to total 5 Ts and OHIP-14 were 0.53 and 0.47, respectively.

Conclusion: The FAI-I had low internal consistency, good test-retest reliability, and good validity. Moderate-to-severe TMD was experienced by 9.4% of the young adults examined.

KEYWORDS
Temporomandibular disorders; translation; reliability; validity; prevalence

Introduction

Temporomandibular disorders (TMDs) are a heterogeneous group of musculoskeletal conditions characterized by pain and dysfunction of the temporomandibular joints (TMJs), muscles of mastication, and adjoining structures [1]. They affect up to 7% of adolescents and 15% of adults and are the third most common chronic pain problem globally after headaches and back pain [1,2]. Women, particularly those of reproductive age, appear to be more susceptible to TMDs [3,4]. The complex etiology of TMDs is contributed by various biopsychosocial risk factors, including genes, hormones, macro/micro-trauma, stress, anxiety, and depression [4,5]. The presence of TMDs, especially painful disorders, is associated with poorer general and oral health-related quality of life (OHRQoL) [6,7]. Moreover, therapeutic TMD interventions can improve the OHRQoL of individuals with TMDs [8].

The current Diagnostic Criteria for TMDs (DC/TMD) standard for assessing/diagnosing TMDs comprises a comprehensive TMD symptom questionnaire (SQ), protocolized clinical examination, and detailed rule sets for rendering Axis I TMD diagnoses [9]. In addition, measures for evaluating Axis II psychosocial and behavioral contributing factors are provided. Despite being both reliable and valid [9,10], the DC/TMD remains impractical for clinical triage and epidemiological studies, as it is difficult and time-consuming to administer. Besides being easy, fast, and cheap to dispense (preferably subject-administered), TMD screeners must also be reliable, valid, and accurate [11]. Although a screening instrument (TMD Pain Screener [TPS]) is offered by the DC/TMD, it only identifies painful TMDs, and painless intra-articular conditions are not assessed [11].

Since its debut in 1994, the Fonseca Anamnestic Index has remained one of the more popular screeners for TMD research due to its relative simplicity, efficiency, and low cost [12]. Developed based on the Helkimo's index [13], it consists of 10 items regarding pain-related (head and neck aches, TMJ and masticatory muscle pain) and function-related (TMJ sounds, opening, and lateral-movement difficulties) TMD symptoms as well as risk factors (parafunctional habits, malocclusion, and emotional tension). The psychometric

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properties of the FAI are well established [14–18], and it is consistent with other TMD screeners, such as the American Association of Orofacial Pain Questionnaire (AAOPQ) [19]. Furthermore, both the FAI and 5-item short-form FAI (SFAI) were determined to be accurate with reference to the Research Diagnostic Criteria for TMDs (RDC/TMD) and DC/TMD benchmarks [20–24]. The initial Portuguese and English FAI has been translated into many languages other than Indonesian [16–18].

Bahasa Indonesia (BI), an Austronesian lingo, is the official language of the Indonesian archipelago. Indonesia is the fourth most populous country, making BI one of the most commonly spoken languages worldwide [25]. As English literacy is generally low among Indonesian people, the FAI must be converted to BI (Indonesian) before it can be employed locally and/or internationally. Therefore, the objectives of this study were to translate/cross-culturally adapt the English FAI into Indonesian and to assess the reliability/validity of the Indonesian FAI (FAI-I). The secondary aim was to examine the presence and severity of TMDs among Indonesian young adults.

Materials and methods

Translation procedures

Approval was obtained from the relevant ethics committee before commencing the study (project no: 377-S1/KEPK/FKG/8-2020). The translation and cultural equivalency procedures were performed following the International Network for Orofacial Pain and Related-disorders Methodology (INFORM) guidelines [26] and has been described in detail previously [16]. The translation/cross-cultural adaptation process involved the following six steps: (1) Forward translations, (2) Synthesis and resolution of discrepancies, (3) Backward translations, (4) Review and revision by an expert committee, (5) Evaluation and revision of the pre-final version, and (6) Psychometric assessment of the final version.

Briefly, the forward translation of the FAI from English to BI was independently carried out by two bilingual translators whose mother tongue was Indonesian. The two Indonesian language versions of the FAI were examined for discrepancies, and any inconsistencies were discussed and resolved by consensus. A synthesized common Indonesian translation was produced and subjected to backward translation into English by a third bilingual translator who was not exposed to the original English FAI and whose mother tongue was English. All adaptations of the FAI were examined for semantic, vernacular, conceptual, and other equivalences by an expert committee comprising two dental specialists, a psychologist, and a language expert, who were not involved in the earlier processes. The pre-final Indonesian FAI (FAI-I) was derived through consensus and evaluated by a sample of 30 participants to determine its face validity (the extent to which a test measures content according to laypersons), with special emphasis on the understanding and perception of the translated items. Any unclear terms or translation errors were isolated and duly rectified by the expert committee to create the final version of the FAI-I (Table 1).

Table 1. The English and Indonesian versions of the Fonseca Anamnestic Index (FAI).

Item number/Questions	Answers: No / Tidak	Sometimes / Kadang	Yes / Ya
1. Do you have difficulty opening your mouth wide? Apakah Anda kesulitan membuka mulut dengan lebar?			
2. Do you have difficulty moving your jaw to the sides? Apakah Anda mengalami kesulitan menggerakkan rahang ke samping?			
3. Do you feel fatigue or muscle pain when you chew? Apakah Anda merasa kelelahan atau nyeri otot saat Anda mengunyah?			
4. Do you have headaches? Apakah Anda mengalami nyeri kepala?			
5. Do you have neck pain or stiff neck? Apakah Anda mengalami nyeri leher atau kaku leher?			
6. Do you have ear aches or pain in that area (temporomandibular joint)? Apakah Anda mengalami nyeri telinga atau nyeri di daerah sendi temporomandibula?			
7. Have you ever noticed any noise in your temporomandibular joint while chewing or opening your mouth? Pernahkah Anda memperhatikan adanya kebisingan di sendi temporomandibula anda ketika Anda mengunyah atau membuka mulut?			
8. Do you have any habits, such as clenching or grinding your teeth? Apakah Anda memiliki kebiasaan seperti menahan gigitan dengan kuat atau menggemeretakkan gigi?			
9. Do you feel that your teeth do not come together well? Apakah Anda merasa gigi atas dan bawah Anda tidak bertemu dengan baik?			
10. Do you consider yourself a tense (nervous) person? Apakah Anda menganggap diri Anda orang yang tegang (gugup)?			

Study population

Participants for psychometric assessment of the FAI-I were randomly recruited from young adults, aged 18–24 years, attending a local university in the capital city of Jakarta over 3 months. Individuals with a history of orofacial trauma, debilitating systemic diseases or psychiatric disorders, and cognitive impairments were duly excluded. Based on a 95% probability, 5% confidence interval, 42% estimated proportion of mild-to-severe TMD based on the FAI [27], and a student population of 20,000, a minimal sample size of 368 was ascertained

with a sample size calculator (https://www.calculator.net). Involvement in the study was strictly voluntary, with no incentives offered. Informed consent was attained from the participants before administering an electronic questionnaire comprising the FAI-I and the Indonesian language versions of the DC/TMD SQ and Oral Health Impact Profile-14 (OHIP-14-I) [28,29].

Measures and psychometric assessment

The FAI-I (Table 1) was scored utilizing a 3-point rating scale with no, sometimes, and yes being assigned 0, 5, and 10 points, correspondingly. Total FAI-I scores that ranged from 0 to 100 points were computed, and TMD severity was categorized as indicated in Table 2. The five major TMD symptoms (5Ts-I) of the DC/TMD SQ, namely facial pain, headaches, TMJ sounds, closed and open locking, were scored with no and yes counted as 0 and 10 points. Total 5Ts-I scores that spanned from 0 to 50 points were subsequently calculated, with greater scores signifying more DC/TMD-specified symptoms. The OHIP-14-I was used for evaluating OHRQoL and was scored on a 5-point rating scale, with never, hardly, occasionally, fairly often, and very often being assigned 0, 1, 2, 3, and 4 points, accordingly. Total OHIP-14-I scores, which varied from 0 to 56 points, were obtained by adding all ordinal values. Higher total OHIP-14-I scores indicate worse or lower OHRQoL. Internal consistency (the extent to which test items measure different aspects of the same construct) was estimated with the Cronbach's alpha (α) coefficient, whereas test-retest reliability was evaluated by intra-class correlation (ICC) coefficient utilizing data from the 49 participants who repeated the FAI-I after 10 days. This interval period was chosen to minimize variations arising from the fluctuating nature of TMD symptoms. Construct (the extent to which a test measures what it is supposed to) and criterion (the extent to which the criteria of a test match other tests) validity were established by relating the FAI-I to 5Ts-I and OHIP-14-I scores, respectively [30]. While the 5Ts-I was selected because it identified TMD symptoms, the OHIP-14-I was employed because the presence of TMDs impairs OHRQoL [6,7].

Table 2. Classification of TMD severity according to the FAI-I.

TMD severity	Points	n (%)
No TMD	≤15	204 (40.7)
Mild TMD	20–40	250 (49.9)
Moderate TMD	45–65	44 (8.8)
Severe TMD	70–100	3 (0.6)

TMD: Temporomandibular Disorders; FAI-I: Indonesian Fonseca Anamnestic Index.

Statistical analysis

Statistical evaluations were conducted using the IBM SPSS Statistics for Windows version 24.0 (IBM Corporation, Armonk, NY, USA) with the significance level set at 0.05. TMD severity was reported as frequencies with proportions, while total 5Ts and OHIP-14 scores were presented as means with standard deviations and medians with interquartile ranges. For internal consistency, Cronbach's alpha was calculated and ordered as follows: Very low ($\alpha \leq 0.30$); low ($0.30 < \alpha \leq 0.60$); moderate ($0.60 < \alpha \leq 0.75$); high ($0.75 < \alpha \leq 0.90$); and very high ($\alpha > 0.90$) [31]. Low Cronbach's alpha reliability classifications indicate poor inter-relatedness of items or heterogeneous constructs. The internal consistency of the FAI-I was further explored by the sequential exclusion of individual items. An increase in α coefficients suggests that the item does not correlate well with the others, and a corrected item-total correlation of ≥ 0.20 was deemed satisfactory [31]. For test-retest reliability, ICC coefficient was computed and categorized as follows: Poor (< 0.40); fair to good (0.40–0.75); and excellent (> 0.75) [32]. The ICC of the individual FAI-I items was also examined. Data normality was evaluated with the Kolmogorov-Smirnov test. As total 5Ts-I and OHIP-14-I data were not normally distributed, differences in scores among the various TMD groups were appraised with the Kruskal Wallis/Mann-Whitney U test. Additionally, Spearman's rank-order correlation was applied to establish the relationships between FAI-I and DC/TMD-specified symptoms as well as OHRQoL. Correlation coefficient (r_s) was graded as follows: Weak (0.1–0.3), moderate (0.4–0.6), and strong (0.7–0.9) [33].

Results

Translation/cross-cultural adaptation and pre-final FAI-I

No major issues, including linguistic disparities, were faced during the forward/backward translations and creation of the pre-final FAI-I. The minor syntax inconsistencies were resolved by the expert committee with ease. Appraisal of the pre-final FAI-I showed no difficult items and verified that the FAI-I was easy to comprehend and answer. The completed FAI-I is displayed in Table 1.

Study population and TMD frequency

A total of 590 young adults were screened for eligibility. Of these, 62 met the exclusion criteria, and 27 declined

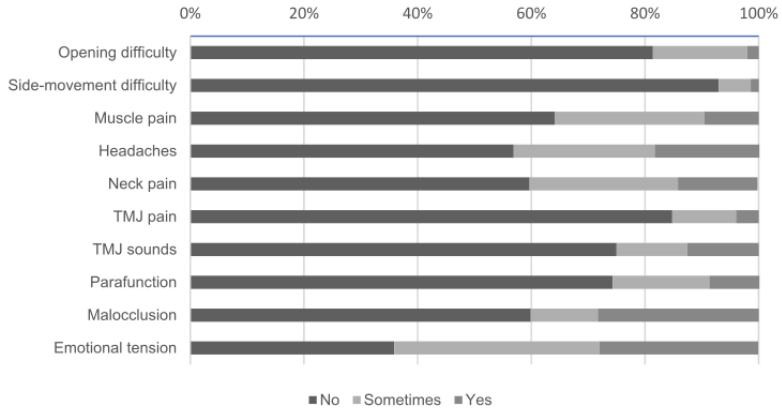

Figure 1. Distribution of responses for individual Indonesian Fonseca Anamnestic Index (FAI-I) items.

study participation, ensuing in a response rate of 94.9%. The mean age of the study population (n = 501), which comprised 75.2% women, was 19.73 ± 1.27 years. The frequency of TMD according to the FAI-I is presented in Table 2. While 40.7% of the participants experienced no TMD (NT), 49.9% had mild (MT), 8.8% had moderate (DT), and 0.6% had severe (ST) TMD. Figure 1 displays the distribution of responses for the individual FAI-I items. The most often reported symptoms/risk factors were emotional tension (61.4%), headaches (43.1%), and neck pain (40.3%).

Reliability of the FAI-I

Table 3 shows the internal consistency and test-retest reliability of the FAI-I. The α and ICC coefficients of the full FAI-I were 0.57 and 0.72 (95% CI 0.59–0.82), respectively. Even with the sequential exclusion of discrete items, α coefficient values remained < 0.6 (range 0.52–0.57) for the FAI-I. Corrected item-total correlations for the FAI-I spanned from 0.17 (item 8) to 0.36 (item 6). Besides item 8 (Do you have any habits, such as clenching or grinding your teeth?), all other items achieved the minimum acceptable correlation coefficient of 0.20. ICC coefficients varied from 0.52 to 0.83 for the individual items and were mostly excellent.

Table 3. Internal consistency and test-retest reliability of the FAI-I.

FAI-I	Cronbach's alpha if item excluded (n = 501)	Corrected item-total correlation	ICC (n = 49)	ICC (95% CI)
Item 1	0.55	0.25	0.79	0.65–0.87
Item 2	0.56	0.23	0.83	0.71–0.90
Item 3	0.52	0.34	0.52	0.29–0.70
Item 4	0.54	0.28	0.60	0.37–0.74
Item 5	0.54	0.32	0.76	0.60–0.85
Item 6	0.53	0.36	0.53	0.29–0.70
Item 7	0.54	0.26	0.74	0.59–0.85
Item 8	0.57	0.17	0.81	0.69–0.89
Item 9	0.56	0.24	0.83	0.72–0.90
Item10	0.56	0.21	0.81	0.69–0.89

FAI-I: Indonesian Fonseca Anamnestic Index; ICC: Intraclass correlation; CI: Confidence Interval.

Construct and criterion validity of the FAI-I

The mean/median total 5Ts-I and OHIP-14-I scores are reflected in Table 4, Table 5. Both total 5Ts-I and OHIP-14-I scores generally increased with greater TMD severity. Significant differences in total 5Ts-I and OHIP-14-I scores were ST, DT > MT > NT. Correlations of FAI-I scores to total 5Ts-I (r_s = 0.53) and total OHIP-14-I (r_s = 0.47) scores were moderately strong. However, the association between 5Ts-I and OHIP-14-I scores was weak (r_s = 0.31).

Discussion

The English FAI was translated and cross-culturally adapted into Indonesian.

Psychometric properties of the FAI-I were subsequently assessed using a sample of university students. The acquired data also served to approximate the prevalence and severity of TMDs among Indonesian young adults. Young adults were identified for the study, as they typified the peak incidence age for TMDs and constituted the vast majority of TMD patients [4,34]. The FAI-I demonstrated low internal consistency, good

Table 4. Mean and median total 5Ts-I and OHIP-14-I scores for the different TMD categories.

Variables	No TMD (NT)	Mild TMD (MT)	Moderate TMD (DT)	Severe TMD (ST)	*p*-value*	Post-hoc
Total 5Ts-I						
Mean (SD)	4.9 (7.5)	13.0 (10.5)	19.1 (9.4)	33.3 (5.8)	< 0.001	ST,DT>MT>NT
Median (IQR)	0.0 (0.0–10.0)	10.0 (0.0–20.0)	20.0 (10.0–30.0)	30.0 (30.0)		
Total OHIP-14-I						
Mean (SD)	7.19 (7.3)	12.8 (8.7)	18.9 (11.8)	37.0 (10.0)	< 0.001	ST,DT>MT>NT
Median (IQR)	5.0 (2.0–10.0)	11.0 (6.0–18.0)	19.0 (9.5–26.0)	37.0 (27.0–37.0)		

*Results of Kruskal Wallis/Mann-Whitney U post-hoc test ($p < 0.05$); 5T: 5 major TMD symptoms; OHIP-14: Oral Health Impact Profile-14; TMD: Temporomandibular disorders; SD: Standard deviation; IQR: Interquartile range; NT: No TMD; MT: Mild TMD; DT: Moderate TMD; ST: Severe TMD.

Table 5. Correlations between FAI-I, 5Ts-I, and OHIP-14-I scores.

Variables	FAI-I	5Ts
FAI-I	-	-
5Ts-I	0.53**	-
OHIP-14-I	0.47**	0.31**

**Results of Spearman's correlation ($p < 0.001$); FAI-I: Indonesian Fonseca Anamnestic Index; 5T: 5 major TMD symptoms; OHIP-14: Oral Health Impact Profile-14.

test-retest reliability, and good construct as well as criterion validity. The cross-cultural adaptation process involves the linguistic and cultural adjustments of instruments during conversion into another language [35]. The INfORM methodology, which is the international standard for converting the DC/TMD into different languages, was embraced to ensure valid instrument development that can generate comparable data across multi-language/cultural settings [26]. No notable issues were encountered during the forward-backward translation procedures of the FAI, and testing of the pre-final FAI-I revealed no problematic items.

Presence and severity of TMDs

TMD-related symptoms/risk factors were present in 59.3% of the participants, with 9.4% having moderate-to-severe TMD. Findings were consistent with other studies on Southeast, South, and West Asian young adults, which reported FAI-based TMD prevalence of 41.8–53.3%, with 9.4–10.7% experiencing moderate-to-severe TMD [27,36,37]. However, in a study on Brazilian university students, considerably higher TMD prevalence (71.9%) and moderate-to-severe TMD (21.9%) were conveyed [38]. Although the incongruence could arise from ethnic and socio-economic differences, it might be largely due to variances in psychological factors [39]. In addition to the challenges of transitioning into adulthood, university students often need to deal with new living, social, and learning environments, peer pressure/conflicts, academic demands, achievement frustrations, as well as financial difficulties that could lead to higher levels of stress, anxiety, depression, and even suicide risk [40].

The FAI was found to be multidimensional, with the primary dimension comprising items 1, 2, 3, 6, and 7 through factor analysis [41]. Items relating to non-TMD-specific symptoms (i.e., head and neck aches) and risk factors (i.e., parafunctional habits, malocclusion, and emotional tension) formed the second dimension and were duly excluded in the creation of the SFAI [23]. Among the three risk factors, only psycho-emotional distress has been explicitly related to the development of TMDs [42]. Due to its multidimensionality and the inclusion of non-TMD-specific symptoms/risk factors, the FAI might overestimate the actual prevalence of TMDs. This is particularly pertinent, given the high frequencies of emotional tension, headaches, and neck pain reported. Moreover, the occurrence of moderate-to-severe TMD described was consistent with the prevalence cited in Axis I epidemiological studies. Based on the RDC/TMD, the frequency of TMDs in the general population varied between 6.0 and 15.8% [43]. The mild TMD category should, thus, be discounted when assessing TMD prevalence with the FAI. Alternatively, the SFAI, which has 90.7–97.5% sensitivity and 93.0–96.5% specificity in relation to the DC/TMD could be applied [24].

Reliability of the FAI-I

The internal consistency of the FAI-I was low, with an α coefficient of 0.57. Even with the sequential exclusion of individual items, α coefficients remained < 0.7. This finding corroborated the multidimensionality of the FAI and the existence of heterogeneous constructs. However, α coefficients obtained with other language versions of the FAI were higher, ranging from 0.67–0.83 [16–18,22]. Cronbach's alphas are a function of the number of test items, average covariance between item pairs, and variance of the total score. Variations in item correlations and total scores are influenced by the

sample size as well as the population surveyed. While the present study involved a relatively large non-clinical sample, psychometric evaluations of the other language versions of the FAI had generally involved smaller sample sizes and clinical samples consisting of TMD patients and controls. The use of non-clinical samples is posited to yield more realistic Cronbach's alphas, given the much higher proportion of individuals with no-to-mild TMD and lower TMD severity scores in the general population [44]. Test-retest reliability of the FAI-I was good, with an ICC coefficient of 0.72. Good to excellent test-retest reliability was also observed with other language versions of the FAI and may be attributed partly to its relative simplicity and the few test items involved [16–18,22].

Validity of the FAI-I

The construct and criterion validity of the FAI-I was assessed by relating FAI-I severity categories/scores to total 5Ts-I and OHIP-14-I scores. Although the DC/TMD-based 5Ts measured the same construct as the FAI, it only concerned pain-related (facial pain and headaches) and intra-articular (TMJ sounds, closed, and open locking) symptoms. TMDs are often correlated to OHIP-14 scores and have been associated with poorer OHRQoL [6,7]. As such, the FAI-I (if valid) could predict total OHIP-14-I outcomes. Total 5Ts-I and OHIP-14-I scores were observed to increase with greater TMD severity. Participants with ST, DT, and MT had significantly higher total 5Ts-I and OHIP-14-I scores than the NT group. Scores for the ST and DT groups also differed significantly from the MT group. The correlation between FAI-I and total 5Ts-I scores was moderately strong (r_s = 0.53) and is anticipated to be stronger if the non-TMD-specific items were exempted. Discrepancies in TMD symptom reporting periods might also contribute to the weaker association observed. While the 5Ts-I were assessed over 30 days, the evaluation period for the FAI is somewhat ambiguous. Future enhancement of the FAI could entail refinements to the definition of "sometimes" and "yes".

A moderately strong correlation was also noted between FAI-I and total OHIP-14-I scores (r_s = 0.47). This finding affirmed that of a recent study on prospective orthodontic patients, where a moderately strong association (r_s = 0.57) was perceived utilizing the English versions of the same measures [45]. The relationship is likely to be stronger if TMD-specific OHRQoL measures, like the OHIP-TMD, were employed, as they generally have greater sensitivity, specificity, and responsivity [46]. Some items of the OHIP-14-I (e.g., sense of taste and embarrassment) may not be relevant to TMDs. However, a weak correlation (r_s = 0.31) was detected between the total 5Ts-I and OHIP-14-I scores, which could be partly due to the low prevalence of TMJ closed and open locking (i.e., TMJ disc displacements without reduction with limited opening and TMJ subluxation) in the general population [47].

Study limitations

This study had a few limitations that will be addressed hereafter. First, a non-clinical population was selected over clinical samples involving TMD and control patients. While this could have resulted in the lower internal consistency observed, the α coefficient attained is probably more realistic, given that the FAI is often applied in the general population where TMD symptoms may be intermittent and mild. Second, the participants only included university students who were mostly women and do not represent all young adults in Indonesia. Future research should incorporate more men as well as non-student/working young adults. Nevertheless, findings could indicate the "worst possible" outcome, given the higher prevalence of psychological distress and TMD among university students [38,40]. Third, all the measures were participant-centric and prone to a variety of biases. Although, selection bias was allayed by the very high response rate (94.9%), information partialities arising from self-report, social desirability, and recall biases [48]. Lastly, it is important to note the FAI was designed merely as a TMD screener. Definitive TMD diagnoses can only be derived through thorough history taking, physical examination, adjunctive diagnostic imaging, and validated diagnostic criteria.

Conclusion

This study translated/cross-culturally adapted the English FAI into BI, evaluated the psychometric properties of the FAI-I, and examined the presence/severity of TMDs in Indonesian young adults. Findings suggest that the FAI-I had low internal consistency, good test-retest reliability, and good construct/criterion validity. Due to its multidimensionality, the mild TMD category of the FAI should be discounted when assessing TMD prevalence. Alternately, the use of the short-form FAI (SFAI), where non-TMD-specific symptoms/risk factors are omitted, could be considered. Moderate-to-severe TMD was experienced by 9.4% of the Indonesian young adults examined, which corroborated the TMD prevalence reported in the current literature.

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Data availability statement

Data for this study are available from the corresponding author upon judicious request.

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