

Cross-cultural Adaptation of Oral and Maxillofacial Frailty Assessment Tools for Geriatric Population of Kerala

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ABSTRACT

Aim: The aim of this study is to translate the oral and maxillofacial frailty index (OMFI) into Malayalam, culturally adapt it, and test its reliability and validity in the Kerala geriatric population.

Materials and methods: OMFI was translated, culturally adapted, and validated in Malayalam using a methodological and cross-sectional study design. The Malayalam version of OMFI underwent full linguistic validation and was tested on 200 patients at Amritakripa Hospital in Kalpetta. Principal component analysis with varimax rotation was used for exploratory factor analysis, and Cronbach's alpha was used to assess reliability.

Results: Two-hundred patients were recruited in this study. Participants ranged in age from 60 to 83 years; mean age was 68 years (SD: 15.21). In total 55.5% were male participants, and 30.5% were belonging to upper middle class as per the Kuppuswami scale. Only 12% of the participants were living alone. Kaiser–Meyer–Olkin was found to be 0.583, and Bartlett's test of sphericity was significant with a Chi-square test value of 1003.469. A principal axis factor analysis conducted on 20 items with orthogonal rotation (varimax). OMFI Malayalam version (5 items) had a good internal consistency (Cronbach's alpha = 0.751). Item-total correlations were reviewed for the items of OMFI.

Conclusion: The OMFI Malayalam version demonstrated acceptable validity and reliability and can be used to screen the oral frailty of the geriatric population in Kerala.

Clinical significance: As Kerala is having highest geriatric population in India, we need to assess the oral frailty burden of Kerala. This study provided the first measure to assess the oral frailty in elderly in Kerala.

Keywords: Cultural adaptation, Geriatric oral frailty, Oral and maxillofacial frailty, Oral frailty index.

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INTRODUCTION

The aging global population is one of the most significant medical and sociodemographic issues today.¹ According to the UN, older persons as those aged 60 years or over. The World Health Organization predicts that, by 2050, there will be twice as many people aged 60 years or older.² By 2025, there will be 158.7 million older people living in India outnumbering the population of children under the age of 14 years by 2050.³ The regions with the fastest population aging are Eastern and South-Eastern Asia, Latin America, and the Caribbean.⁴ The balance between the costs and benefits of population aging will be struck will heavily depend on one's health in old age.⁵

Frailty is a relatively new term in the vocabulary of age-related health concerns. The Japan Geriatrics Society has proposed *fururu* as the Japanese term for frailty, defining it as "a state of reduced ability to recover from stress resulting from an age-related decline in reserves."⁶ It is merely the first stage in the eventual beginning of a special care process; it is not a disease. It serves as a warning indicator for a significant chance of unfavorable health effects. Frailty frequently corresponds to the biological age that more accurately predicts mortality than chronological age. A common way to characterize it as a transitional period between healthy aging and incapacity. As it is a dynamic process, frailty is potentially reversible.⁷

Poor oral health could be a marker for frailty onset.⁸ Oral frailty is a novel concept introduced in Japan.⁹ Oral frailty refers to a state of reduced oral function that results from changes in the oral cavity, including teeth, gums, tongue, and other oral tissues. Oral frailty can lead to difficulties with chewing, swallowing, speaking, and

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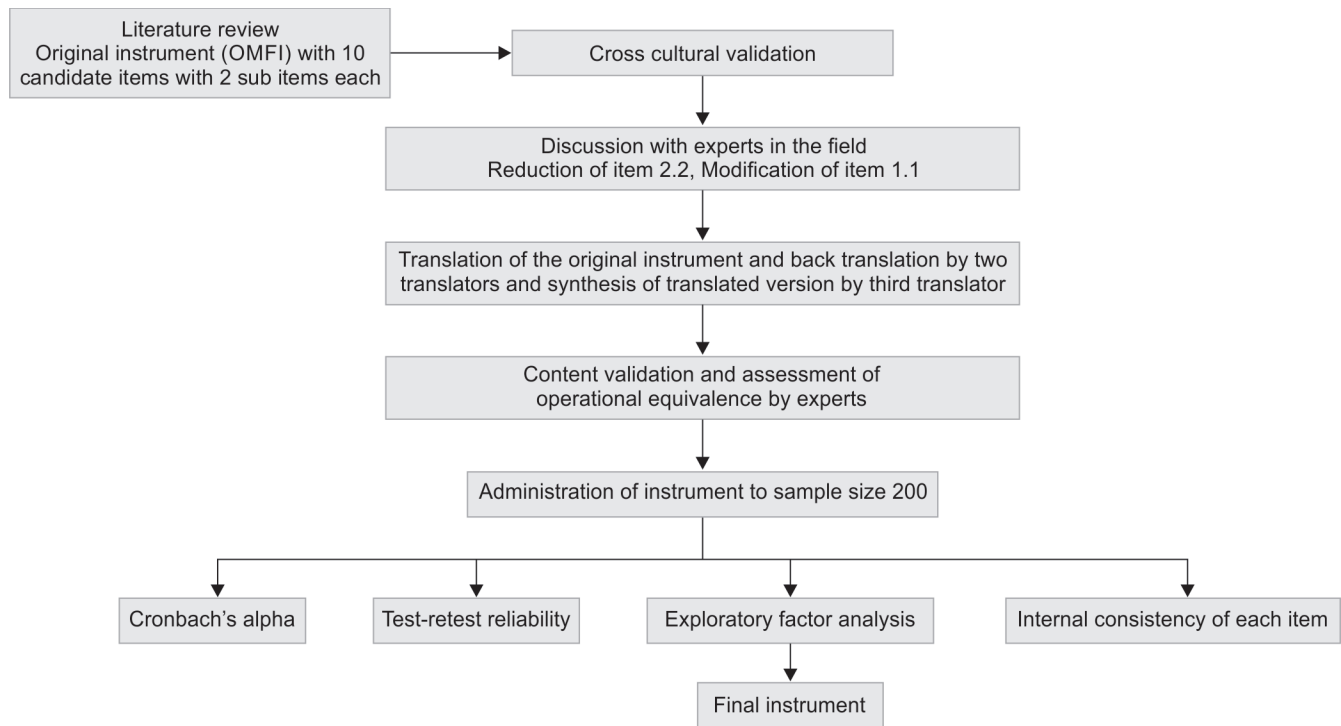
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maintaining oral hygiene, which can impact a person's overall health and quality of life. It is often associated with aging, as many of the changes that occur in the oral cavity are a natural part of the aging process. These changes may include tooth loss, periodontal disease, hypoglycemia, and changes in the texture and strength of oral tissues. Oral frailty is also associated with certain medical conditions and lifestyle factors, such as poor nutrition, smoking, and alcohol use. It can increase the risk of malnutrition, aspiration pneumonia, and other health problems, particularly in older adults. According to latest definition, oral frailty is the age-related functional decline of orofacial structures.¹⁰

Flowchart 1: Steps in cross-cultural adaptation (adapted from Gjersing et al. method³²)

In the oldest old age groups, many indicators of poor oral health are independently linked to decreased physical functioning and frailty.¹¹ Many studies have shown a connection between oral health and physical frailty.¹²⁻¹⁸ A cohort research from Japan found that those with oral frailty are more likely to experience physical frailty, sarcopenia, severe conditions needing nursing care, and even mortality.¹³ Understanding oral frailty and pre-frailty, allows one to reverse back to robust state. Prevention and management of oral frailty may involve regular dental care, maintaining good oral hygiene habits, improving nutrition, and managing any underlying medical conditions.

Assessment of oral frailty is an important aspect of preventive healthcare, as it can help identify individuals who are at risk of developing oral health problems and systemic diseases and improve their quality of life. Better-validated measurement tools are required for an accurate assessment of oral frailty. Most of the studies regarding oral frailty are conducted in Japan. A new measure for determining oral frailty in the elderly has been approved in Japan; the OMFI.¹⁹ It is a 10-item questionnaire with two sub-questions each. The 20 items were taken from a variety of geriatric health assessment indices that were currently in use as oral health measurement instruments.¹⁹ The Oral Health Impact Profile which assesses quality of life related to oral health, the Geriatric Oral Health Assessment Index, and the Liverpool Oral Rehabilitation Questionnaire, which assesses oral functions in patients with head and neck cancer, measurement instruments for swallowing disorders (dysphagia), orofacial pain symptoms, oral dyskinesia, temporomandibular disorders, salivary dysfunction, mouth dryness, chronic oral mucosal diseases, and taste alteration are some of the existing measurement tools on which it was based.^{19,20-25} The functional limitation and discomfort or pain in the oral and maxillofacial regions were examined using 10 potential items. Response options were 1 = never, 2 = occasionally, 3 =

fairly often, and 4 = very often, where higher scores indicate a more severe problem.¹⁹ According to a preliminary research, this tool can be utilized as a screening tool for evaluating oral frailty in elderly people.

An instrument that has been validated in the past could not be valid in a different time, culture, or context.²⁶⁻³⁰ Kerala, like many other regions in the world, is facing the burden of an aging population. Kerala is aging faster than the rest of India. The state has a high life expectancy, with a large percentage of the population over the age of 60 years. This demographic shift has created a need for policies and programs that address the specific health and social needs of older adults. Together with numerous other quick social and economic developments, these demographic changes drastically altering the life of elderly people.³⁰ Oral healthcare is an essential component of overall health and well-being, and it is particularly important in Kerala's population, which has a high prevalence of dental problems. Dental caries, periodontal disease, and oral cancer are among the most common oral health issues in Kerala. There is a need to assess the oral frailty of Kerala population. So, to use OMFI tool for the assessment of oral frailty in the Kerala setting, the tool must be accurately translated into the target language and adjusted to the new context.²⁷ The OMFI tool is being tried to adapt to the geriatric population of Kerala in this study. The guidelines described in this document are based on the guidelines by Guillemin et al and Gjersing et al.^{31,32}

METHODS

Investigation of Conceptual and Item Equivalence

The first stage was to determine whether the questionnaire and the underlying concept had the same relationship in both the original and target settings. In addition, we evaluated whether the instrument's items are as relevant and acceptable in the target

population as they are in the original population. A literature review was conducted first because conceptual and item equivalence can be assessed through a literature review.²⁸ Findings from the literature review discussed with five experts in the field. The expert committee is composed of a geriatric medicine expert and four oral medicine specialists who are currently working in geriatric dentistry.

Forward and Back Translations

Then, the original instrument was translated from English to the native language (Malayalam). To make a higher quality translation, the process was carried out by two independent translators, to provide a higher quality translation. The goals behind the text to be translated and the topics involved were known to the translators. The two translated versions were examined by a third individual, who blended them into one. Both translators agreed on the synthesized version. This allowed us to see mistakes and different interpretations of the original's unclear items. The errors like unexpected meaning from the original tool were avoided. The translation was translated so that a 60-year-old could understand it.³³

Afterwards, two different persons performed a back translation of the synthesized text. They were ignorant of the purpose and ideas of the material. The two back translations were reviewed by the same person who synthesized the translated versions. The two back translations were then combined to form one. Words with different back translations were underlined and explored. As a result, the final version's quality was raised. Misunderstandings in the first translation amplified in the back translation.

Review by Expert Committee

A committee was then established to compare source and final versions based on the various translations and back translations that were acquired in the manner as described above. The five members (who were representative of the target group), consisted of dentist, geriatrician, oral medicine specialist, Ph.D. student, and one registered nurse with geriatric expertise. They were employees of Amrita Institute of Medical Sciences, Kochi. They have also gone through the introduction and the scaling of responses to each question. They made the decision to perform the translation and back translation procedure once again. They used redundancy concept³³ (repeating same instruction differently) and decentering approach³⁴ to reduce comprehensive errors and to improve cross-cultural adaptation respectively. The conclusion was item 1.1 (hypersensitivity in teeth) needs revision and item 2.2 (limitation in food due to its hardness) have low scores and hence should be eliminated. Overall, in content validation, the scores obtained were acceptable. The instrument was modified in response to the committee recommendations. The item 2.2 was eliminated as per expert opinion. None of the translators or members of the committee were financially reimbursed.

Pretesting

Thereafter, the instrument checked for equivalence in source and final versions (pretesting) was done. In the pretest, 30–40 geriatric patients from the school of dentistry were declared appropriate. Respondents were questioned regarding their understanding, acceptability, and emotional impact of the items (probe technique).^{31,35} Interviews were continued until all items had a certain percentage of knowledge ($\geq 90\%$). A final semantic adjustment (equivalence in the meaning of words) was made by

the research group based on the evidence from this pilot study. Unclear words and items identified in the pretest were discussed with members of the expert committee and target population. The final adjustment was made based on the subjective judgment of the research team after discussion with members of the expert committee.

Assessment of Operational Equivalence

The operational equivalency of the instrument was then evaluated. (That is, whether similar questionnaire format, instructions, mode of administration, and measurement methods can be used in the target population as they were in the original setting). Consensus was reached with the help of review of the literature, discussions with experts in the field and members of the target population. The questionnaire contained nothing that was unrelated to the Kerala setting.

Main Study

Finally, the instrument was administered to participants in a formal study. Based on the results, the psychometric properties of the instrument were tested using recognized statistical methods.

Study Design

The study has a cross-sectional design. The study was approved by the Ethical Committee, Amrita Vishwa Vidyapeetham (IEC No.: ECASM-AIMS-2021-176, date: September 28, 2021). We included patients (age > 60 years) visiting the outpatient departments of Amrita Kripa Hospital, Kalpetta, who are willing to respond to our questionnaire. Patients with age above 60 years were evaluated clinically. Participants were promised full anonymity. The principal investigator explained the purpose of the study and informed consent for the participation (for an interview and dental examination) was taken in a written format from each respondent at the beginning itself. Data collection using the culturally modified tool was done by the principal investigator.

The sample size is based on the rule of thumb where at least 10 participants for each item in the tool will be recruited, with a 10:1 respondent to item ratio. So, the minimum sample size was 190 as one item (item 2.2) eliminated after expert evaluation. However, the study included 200 participants.

Follow-up interview for the test–retest reliability was conducted 2 weeks following the initial study. Thirty individuals (15 male and 15 female) agreed to participate in the survey. Data were collected between July 2021 and February 2022. Data collection was done by the principal investigator. Confirmatory factor analysis was performed for Choi et al.¹⁹ OMFI and the results were compared to modified OMFI using exploratory factor analysis.

Survey Items

The survey consisted of 10 candidate items for OMFI and 20 more detailed items for oral and maxillofacial functions (two detailed items per candidate item).¹⁹ Sociodemographic and oral health status related variables were also included.

Candidate Items for OMFI

The 10 candidate items that measure functional limitation and discomfort or pain in the oral and maxillofacial regions were included. Response options were 1 = never, 2 = occasionally, 3 = often, and 4 = very often, where high score indicates a more severe problem.

Sociodemographic Information and Oral Health Status

Gender, age, living alone, and socioeconomic status were the sociodemographic factors. The questions about oral health status comprised six items that included self-reported oral health conditions, denture status, number of natural teeth, tooth cleaning method, use of fluoridated paste, frequency of cleaning, approximate duration of use, changes toothbrush, and self-rated oral health.

Statistical Analysis

Cronbach's alpha was used to calculate the internal consistency of the 10 OMFI candidate items, and the intraclass correlation coefficient was used to calculate test-retest reliability³⁶ (after 30 days of initial test). A coefficient value greater than 0.70 indicates a high level of internal consistency. Spearman's correlation analysis was used to assess the validity of the 10 candidate items and the 20 detailed items for oral and maxillofacial functions. The Mann-Whitney *U* test and Kruskal-Wallis test were used to examine the relationships between the scores from the 10 candidate items and sociodemographic or oral health status variables, which supported the validity of the 10 candidate items. As a post hoc analysis, the Mann-Whitney *U* test with Bonferroni's correction was used. To recommend the best OMFI as a screening tool, five models were built by removing one item with the lowest internal consistency at a time in sequential order. The constructed model's relationships with major variables such as age, number of teeth, and self-reported oral health status were also investigated. The data were entered in excel and analyzed using SPSS version 25.0 for Windows. The statistical significance cutoff level was less than 0.05.

Sampling Adequacy and Sphericity

Before the performance of exploratory for its appropriateness in the factor analysis, the sampling adequacy was analyzed using the Kaiser-Meyer-Olkin (KMO). KMO must be more than 0.5 to be considered acceptable. Bartlett's test of sphericity was completed to figure out the common factors and to specify the appropriateness of the factor analysis model.³⁷

RESULTS

Patients' Sociodemographic Characteristics

Two-hundred patients were recruited in this study. Participants ranged in age from 60 to 83 years; mean age was 68 years. A total of 55.5% were male, and 30.5% were belonging to upper middle class as per Kuppusswami scale. Only 12% of the participants were living alone (Table 1).

Translation and Cultural Adaptation

The Malayalam version of OMFI was created through the process of translation and cultural adaptation (Supplementary Table 1). There were no major issues discovered during the process. However, minor changes in grammatical structures were required. The pilot testing revealed that there was no difficulty in understanding all 20 items of the OMFI among participants. Cultural adaptation was carried out by the expert review committee.

Internal Consistency

The internal consistency of the 10 candidate items by Cronbach's alpha varied between 0.14 and 0.73 (Table 2). The alpha coefficient

Table 1: Sociodemographic variables of the study population

<i>Age in years</i>	<i>Frequency</i>	<i>%</i>
60–65	80	40
66–70	62	31
71–75	35	17.5
>75	23	11.5
Gender		
Male	111	55.5
Female	89	44.5
Living alone		
Yes	24	12
No	176	88
SES		
Upper	12	6
Upper middle	61	30.5
Lower middle	35	17.5
Upper lower	55	27.5
Lower	37	18.5
No. of teeth present		
0	51	25.5
1–9	38	19
10–20	44	22
> 20	67	33.5
Tooth cleaning method		
Finger	14	8.7
Toothbrush	186	91.3
Tooth cleaning material		
Toothpaste	184	91.9
Toothpowder	13	6.7
Others	3	1.3
Fluoridated toothpaste		
Yes	86	43.0
No	112	55.7
Don't know	2	1.3
Frequency of cleaning teeth		
Once	79	39.6
Twice	114	57.0
After every meal	7	3.4
Approximate duration of use		
<1 minute	53	26.8
1–2 minutes	50	24.8
> 2 minutes	97	48.3
Changes toothbrush		
1–3 months	44	22.1
4–6 months	59	29.5
> 6 months	97	48.3
Self-rated oral health		
Good	119	59.5
Poor	81	40.5

Table 2: Internal consistency and test–retest reliability of the 10 candidate items for OMFI

	Internal consistency ^a (n = 200)		Test–retest reliability ^b
	Corrected item—total correlation	Cronbach's alpha if item deleted	Co-efficient
1. Pain and/or bleeding in tooth/Gum	0.147	0.685	0.908
2. Difficulties in chewing	0.28	0.661	0.551
3. The necessity of water when eating dry food	0.438	0.63	0.839
4. Jaw pain or difficulties in opening mouth	0.579	0.602	0.861
5. Intra oral pain or ulcer	0.413	0.635	0.454
6. Taste alteration or difficulty in taste perception	0.534	0.619	0.838
7. Difficulty in jaw/tongue movement	0.326	0.654	0.25
8. Difficulty in speaking/pronunciation	0.714	0.567	0.874
9. Difficulty in swallowing	0.138	0.688	0.729
10. Difficulty in facial expression	–0.106	0.727	0.605

Table 3: Correlations between the 10 candidate items for OMFI and 20 matched detailed items for oral and maxillofacial functions

	Detailed items for oral and maxillofacial functions	Corrected item—total correlation	
1. Pain and/or bleeding in tooth/gum	1.1 Hypersensitivity in tooth	–0.168	0.526
	1.2 Pain in tooth or gum	0.086	0.49
2. Difficulties in chewing	2.1 Limitation in food due to pain in tooth or gum	–0.145	0.522
	3.1 Swallowing difficulties due to oral dryness	0.084	0.488
3. The necessity of water when eating dry food	3.2 Night-time awakening due to oral dryness	0.09	0.486
	4.1 Noise in jaw upon opening the mouth or chewing	0.207	0.466
4. Jaw pain or difficulties in opening mouth	4.2 Pain in jaw upon opening the mouth or chewing	0.432	0.408
	5.1 Pain in the tongue, lips, or cheek	–0.006	0.505
5. Intraoral pain or ulcer	5.2 Limitation in food due to pain in the tongue, lips, or cheek	0.268	0.447
	6.1 Feeling of abnormal bitter or salty taste or strange taste	–0.026	0.505
6. Taste alteration or difficulty in taste perception	6.2 Limitation in food due to taste problems	0.407	0.428
	7.1 Tongue or lip biting during eating	0.277	0.454
7. Difficulty in jaw/tongue movement	7.2 Involuntary tongue movement or jaw tremor	0.196	0.463
	8.1 Difficulties in speaking	0.476	0.445
8. Difficulty in speaking/pronunciation	8.2 Difficulties in pronunciation	0.536	0.383
	9.1 Difficulties in swallowing water	0.102	0.481
9. Difficulty in swallowing	9.2 Difficulties in swallowing boiled bread	0.25	0.452
	10.1 Drooling saliva without knowing	–0.075	0.502
10. Difficulty in facial expression	10.2 Difficulties in smiling or swallowing	0.136	0.476

Reliability statistics: Cronbach's alpha, –0.486; no. of items, 20.

of each item had a range, from acceptable to poor. The items with highest and lowest internal consistencies were difficulties in speaking or pronunciation and difficulty in swallowing. The overall Cronbach's alpha for all the 10 candidate items were 0.675, which was acceptable.

Test-retest Reliability

Test-retest reliability was found to be acceptable. The items with the highest and lowest correlation coefficient were pain and/or bleeding in the tooth or gum and difficulty in jaw or tongue movement, respectively (Table 3).

Ten candidate items for OMFI and 20 detailed items for oral and maxillofacial functions exhibited a reliability of 0.486 (Table 3).

Examination of Validity

Correlations of the 10 Candidate Items for OMFI with 20 Matched Detailed Items for Oral and Maxillofacial Functions

The scores of the 10 candidate items for OMFI were analyzed according to gender, age, level of education, and income. The results showed significant associations of the scores with gender, use of Fluoridated toothpaste, and self-rated oral health. Women

had significantly higher score than men ($p = 0.018$). However, age, socioeconomic status, living alone etc. were not significantly correlated with the scores.

Relationship between the 10 Candidate Items for OMFI and Oral Health Status of Participants

Those who reported good self-rated oral health had higher values than those with poor oral health ($p = 0.023$). The participants who use fluoridated toothpaste had higher score than those who do not use the same ($p = 0.03$). The scores of 10 candidate items had no significant correlation with number of teeth, tooth cleaning method, tooth cleaning material, change of toothbrush etc. (Table 4).

Suggestion of Optimal Items for OMFI

For the establishment of a valid screening tool for oral and maxillofacial frailty, five models were constructed after removing values with low internal consistency in terms of self-rated oral health. The item with the lowest internal consistency (difficulties in facial expression) was removed and model 1 was composed of the nine remaining items. Next, the items with the low internal consistency were removed in the order of difficulties in swallowing (model 2, eight items), difficulty in chewing (model 3, seven items), pain and/or bleeding in tooth/gum (model 4, six items), intraoral pain/ulcer (model 5, five items) (Table 5).

Model 1 (9 items, deleted item 10); Model 2 (8 items, deleted items 9 and 10); Model 3 (7 items, deleted items 2, 9, and 10); Model 4 (6 items, deleted items 1, 2, 9, and 10), Model 5 (5 items, deleted items 1, 2, 5, 9, and 10).

The relationship between the five models and main variables such as age, self-reported oral health, and the number of teeth showed that model 5 had the highest levels of significance (Table 5). Based on the percentile, scores were standardized. Samples with score less than 9 will be considered as robust, 9–12: pre-oral frailty, greater than 12: oral frailty. Four-point Likert scale was used for response (1 never, 2 occasionally, 3 fairly often, 4 very often). Based on Parsimony principle, it could be suggested that oral and maxillofacial frailty in geriatric population of Kerala could be evaluated using the five items in model 5: the necessity of water when eating dry food, Jaw pain or difficulty in opening the mouth, taste alteration or difficulties in taste perception, difficulties in jaw or tongue movements, and difficulties in speaking or pronunciation. The sum scores of the five items could be the OMFI and used as the severity of oral and maxillofacial frailty.

DISCUSSION

In terms of older persons, the number of complaints concerning loss of chewing capacity decreases between the ages of 60 and 70 years and addressing this functional issue is becoming critical. These findings led to the introduction of the concepts of oral frailty and oral hypofunction in Japan.^{9,38,39} Frail older individuals had significantly poorer oral function than prefrail and robust individuals according to a clinical investigation study in Japan.⁴⁰ Early intervention for oral function-related factors could lead to the prevention of general hypofunction in older adults according to a recent cross-sectional study.¹⁷ There has not been much research into assessment tools for oral frailty. According to 2011 Census, there are 7.4 million people who are above 60 years of age in Kerala.³⁶ Around 12.6% of the population is above 60 years of age which is the highest in the country. Because an oral function examination for the elderly in their 60s is required to promote effective oral frailty

Table 4: Relationship of the 10 candidate items for OMFI with participant’s characteristics and oral health status

Categories	Frequency	Total score		p-value
		Mean	SD	
Age in years				
60–70	142	44.4	6.2	0.943
Above 70	58	44.0	3.8	
Gender				
Male	111	21.7	1.7	0.018*
Female	89	22.7	3.8	
Living alone				
Yes	24	23.1	3.9	0.082
No	176	22.0	2.7	
SES				
Upper	12	21.3	1.4	0.068
Upper middle	61	21.9	2.5	
Lower middle	35	22.7	3.0	
Upper lower	55	21.6	2.3	
Lower	37	23.0	4.0	
Tooth cleaning method				
Finger	13	22.2	3.6	0.781
Toothbrush	136	22.4	3.2	
Tooth cleaning material				
Toothpaste	137	22.4	3.2	0.79
Toothpowder	10	22.7	2.9	
Others	2	21.0	1.4	
Fluoridated toothpaste				
Yes	64	22.5	2.5	0.03*
No	83	22.4	3.4	
Don't know	2	16.5	7.8	
Frequency of cleaning teeth				
Once	59	22.3	2.4	0.367
Twice	85	22.6	3.7	
After every meal	5	20.6	0.5	
Approximate duration of use				
<1 minute	40	22.4	1.9	0.254
1–2 minutes	37	23.1	3.9	
>2 minutes	72	22.0	3.3	
Changes toothbrush				
1–3 months	33	21.6	2.8	0.094
4–6 months	44	23.2	3.5	
> 6 months	72	22.3	3.1	
No. of teeth present				
0	51	21.4	1.5	0.068
1–9	38	23.0	4.5	
10–20	44	22.1	2.5	
> 20	67	22.2	2.7	
Self-rated oral health				
Good	21.76	119.0	2.5	0.023

SES, socio-economic status

Table 5: Relationships of the five constructed models of Malayalam version of OMFI with main variables

	N	Model 1		Model 2		Model 3		Model 4		Model 5	
		Mean ± SD	p	Mean ± SD	p	Mean ± SD	p	Mean ± SD	p	Mean ± SD	p
60–65	80	21 ± 3.7		19.7 ± 3.4		16.7 ± 3.3		13.3 ± 3		10.8 ± 2.6	
66–70	62	20.8 ± 2.4		19.4 ± 2.4		16.4 ± 2.3		12.9 ± 2.1		10.5 ± 1.9	
71–75	35	20.7 ± 1.9		19.3 ± 2.2		16.2 ± 2.3		12.7 ± 1.8		10.3 ± 1.8	
> 75	23	20.6 ± 2.3	0.892	19.2 ± 2.6	0.792	16 ± 2.4	0.59	12.7 ± 2.3	0.579	10.2 ± 2.1	0.559
Gender											
Male	111	20.4 ± 1.8		19.2 ± 2		16.1 ± 2		12.6 ± 1.7		10.3 ± 1.6	
Female	89	21.3 ± 3.8	0.033	19.9 ± 3.6	0.056	16.8 ± 3.4	0.062	13.4 ± 3.2	0.027	10.9 ± 2.7	0.057
Living alone											
Yes	24	21.9 ± 3.9		20.6 ± 3.7		17.6 ± 3.5		14 ± 3		11.5 ± 2.6	
No	176	20.7 ± 2.7	0.058	19.4 ± 2.7	0.039	16.3 ± 2.6	0.027	12.8 ± 2.4	0.028	10.4 ± 2.1	0.022
SES											
Upper	12	19.9 ± 1.7		18.7 ± 2.1		15.6 ± 2.3		12.2 ± 1.7		9.7 ± 1.9	
Upper middle	61	20.4 ± 2.6		19 ± 2.8		15.9 ± 2.6		12.5 ± 2.2		10.1 ± 2.1	
Lower middle	35	21.5 ± 3		20.3 ± 3		17.3 ± 3		13.7 ± 2.9		11.2 ± 2.5	
Upper lower	55	20.4 ± 2.2		19.2 ± 2.1		16.2 ± 2		12.7 ± 1.9		10.4 ± 1.6	
Lower	37	21.7 ± 4	0.059	20.3 ± 3.6	0.065	17.1 ± 3.4	0.039	13.5 ± 3.2	0.077	11.2 ± 2.7	0.027
Tooth cleaning method											
Finger	13	20.8 ± 3.5		19.3 ± 3.3		16.2 ± 3.3		12.8 ± 2.9		10.5 ± 2.8	
Toothbrush	136	21.1 ± 3.1	0.683	19.8 ± 3.1	0.554	16.8 ± 2.9	0.465	13.3 ± 2.7	0.588	10.8 ± 2.4	0.737
Tooth cleaning material											
Toothpaste	137	21.1 ± 3.2		19.8 ± 3		16.8 ± 2.9		13.3 ± 2.7		10.8 ± 2.4	
Toothpowder	10	21.1 ± 3.3		19.4 ± 3.8		16.1 ± 3.7		13 ± 3.5		10.5 ± 3	
Others	2	20 ± 1.4	0.883	19 ± 1.4	0.854	16 ± 1.4	0.735	12.5 ± 0.7	0.888	10 ± 0	0.849

countermeasures, an oral frailty assessment tool appropriate for the setting must be developed.

In this study, OMFI was successfully translated, culturally adapted, and its reliability and validity into Malayalam version were verified using the established methodology. The good comprehensibility and simplicity of completion of Malayalam version were reinforced by the feedback from the participants included in the study. This Malayalam version also demonstrated acceptable psychometric properties of reliability and validity for the evaluation.

The elderly living in community settings of Kerala where Malayalam is spoken can be significantly benefitted by this translated, culturally adapted, and validated reliable questionnaire. Again, more studies are needed on their cultural experiences and the influence of their culture on healthcare-seeking practice or healthcare belief system.

We adapted five candidate items for the modified OMFI focusing on self-rated oral health. The overall internal consistency of the original 10 candidate items was acceptable as the Cronbach's alpha value of 0.675 with excellent test-retest reliabilities. However, the internal consistency of each item was relatively low to modest with Cronbach's alpha ranging from 0.14 to 0.71. These levels could be attributed to different distributions of responses according to candidate items which is similar to the Choi et al. study.¹⁹

The distributions of responses to the items "pain and/or bleeding in the tooth or gum" and "difficulties in swallowing" differed greatly from those to the items "difficulties in swallowing" and "Jaw pain/difficulties in opening mouth." The relatively low prevalence of these symptoms was partially due to the characteristics of participants included in the present study, that is, elderly people attending the hospital. Also, majority of people were 60–70 years age group.

The results of the confirmatory factor analysis supported the validity of the OMFI questionnaire. Bartlett's test of sphericity was significant ($p < 0.001$) with a χ^2 value of 1003.469. This showed that the sample size was probably acceptable for factor analysis, which was supported by the recommendations of a minimum of 100–200 participants by several studies.^{41–43}

As a result of trying to develop a simpler screening tool with fewer items, we generated one model with five items. Most of the items were related to functional limitation except one (taste alteration). According to latest definition, oral frailty is age-related decline of orofacial tissues which is highly associated with oral function.¹⁰ Hence, model 5 could be used as the final item for modified OMFI, and the scores from the five items could be used to assess the severity of oral and maxillofacial frailty of geriatric population of Kerala. Dry mouth, jaw pain, tongue movement, taste alteration, and difficulty in speaking/pronunciation are concluded

as the components of oral and maxillofacial frailty for geriatric population of Kerala.

A significant strength of this study is that it provided the first measure to assess the oral frailty in elderly in Kerala. Elaborated translations and cultural adaptation procedures were conducted. Additionally, the sample size in this study was adequate.

There are several limitations to this study. Sample was limited to patients attending the outpatient department of a hospital, not community dwelling elderly. The population was less frail as most of them belonged to age 60–69 years. So, the sample may not represent the target population. Also, the original and modified OMFI tool assessed oral frailty purely subjectively.

Nonetheless, the validity and reliability of the Malayalam version of OMFI were verified as adequate in this study. In future, this tool can be used in community settings for initial screening of the oral frailty among elderly. The tool can be used as an initial screening tool to assess the oral frailty as a part of routine dental check-up.

CONCLUSION

The findings of the study found that the Malayalam version of OMFI, developed initially by Choi et al. is a valid and reliable and useful tool to assess oral frailty among geriatric population of Kerala. The validated tool can be used as a screening tool to assess the oral frailty in elderly as a part of routine dental check-up in Kerala. The OMFI used in this study may be tested in multiple centers to validate in the Indian context.

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