

# Oral Impact on Daily Performance (OIDP) scale for use in Sri Lankan Adolescents: Modification and validation of a Sinhalese version

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## Abstract

Background Oral Health Related Quality of Life (OHRQoL) surveys play an important role in understanding subjective patient experiences in oral health care. The Oral Impact on Daily Performance (OIDP) scale is a validated OHRQoL tool that measures the impact and extent to which an individual's daily activities may be compromised by their oral health. It is commonly used to facilitate oral health service planning. The aim of this study was to modify and validate a Sinhalese version of the OIDP for use in Sri Lankan adolescents. Methods The first stage involved cultural adaptation of the tool through translation and modification. After translation and cultural adaptation, the modified OIDP was tested on 220, 15-19 year old adolescents in Sri Lanka. The adolescents completed the modified OIDP scale together with the questions evaluation their self-rated oral health as a self-administered questionnaire. This involved the exploring factor structure, validation and a reliability assessment. Factorability was assessed by inspection of correlation matrix and Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity tests as a measure of sampling adequacy. An exploratory factor analysis was carried out using Principal Component Analysis method and factors were rotated using the oblimin method. Results 220 adolescents participated in factor analysis and validation studies. The Kaiser-Meyer-Olkin measure was 0.87 and Bartlett's test of Sphericity was significant ( $p < 0.001$ ) Cronbach's alpha was calculated as 0.88, indicating a high level of internal consistency. The principal component analysis produced two factors with Eigen values ranging from 1.12 to 4.40, explaining 70.0% of total variance. Concurrent validity was satisfactory as the OIDP score increased when the adolescents' perceived oral health decreased. Conclusion This study showed that the modified OIDP scale is applicable for use among adolescents in Sri Lanka. It has promising psychometric properties but further research is required to use this tool in other cohorts.

## Background

Recent reports have identified an increase in the global prevalence of dental caries in both children and adults [1]. Poor oral health may have a profound effect on general health and experience of pain, including problems with eating, chewing, smiling and communication. Additionally, discolored and damaged teeth have a major impact on people's daily living and wellbeing [2]. Research on quality of

life informs estimates of the burden of illness and serves as criteria in identifying priority groups for public health interventions. It may also be used to establish outcome measures for oral health promotion activities [3].

The Oral Impact on Daily Performance (OIDP) is one of the most commonly used oral health related quality of life instruments globally. It measures the impact and extent to which the ability to perform regular physical, psychological and social activities is compromised due to poor oral health [4]. It has been developed to be used in conjunction with normative measures to assess population dental needs in order to facilitate oral health service planning. The instrument presents a good fit for use in population surveys due to the relatively low response burden [5] and its alignment with the international classification of impairments, disabilities and handicaps (ICIDH) [6], which has been amended for dentistry [7].

The OIDP has not yet been dimensionally validated for a Sri Lankan population. There is a lack of evidence available on the dimensional validity of the scale and whether it should be interpreted as a unidimensional or a multidimensional construct during cross cultural validation [8, 9]. Further, while the OIDP scale has been widely used globally, most studies were carried in cohorts of adults or younger children, with relatively few studies in adolescents [5, 10]. The aim of this study was to (1) culturally adapt a Sinhalese version of the OIDP for use in Sri Lankan adolescents and explore its factor structure; and (2) assess the psychometric properties and validate this modified version in a cohort of Sri Lankan adolescents.

## Methods

The process of adapting the OIDP for Sri Lankan adolescents and evaluating of its psychometric properties involved three main stages, summarized in Fig 1.

### Stage 1: Modification for Sri Lankan adolescents

The first stage involved three main steps: linguistic translation; cultural adaptation and pretesting; and simplifying the scoring system and shortening the recall period. A panel of experts including three specialists in community dentistry, two specialists in community medicine, two specialists in restorative dentistry, one specialist in orthodontics, one specialist in oral & maxillo-facial surgery and

a sociologist were involved in this process.

Since the original version of the OIDP is in English, it was determined that a Sinhalese translation would be produced before any modifications were made. Translation and back translation method were applied and a third independent expert compared the back translated version with the original version and discrepancies were resolved with the consensus of the two translators [11].

The eight items of the modified OIDP were adapted for relevance to an adolescent population, while keeping the dimensions consistent with the original OIDP tool [12, 13]. Further details are in Table 1.

A draft of the modified OIDP scale was pretested by interviewing a convenient sample of 20 adolescents, aged 15–19 years, all native Sinhalese speakers recruited from a secondary school in Gampaha Zone. The interviewer recorded any difficulties that subjects had encountered, along with their comments. All records were reviewed by a study investigator and a discussion session with the interviewer and some of the subjects was arranged in order to clarify their comments. A series of re-interviews were carried out two weeks following the initial interviews in a subset of 10 adolescents in order to gain further insights into the scoring system and recall period.

In original instrument, the total impact of each item is calculated by multiplying a frequency score with a severity score. The total score is the sum of all item scores for an individual [12]. The pre-testing process revealed that several adolescents gave a different set of responses in the re-interviews, unless the impacts were extremely low or extremely high. It was therefore determined by the panel of experts to limit the scoring system to a severity score only; these responses were more consistent than those given for frequency in the pre testing. This is consistent with findings reported by the authors of the original instrument which suggest that, as the multiplication of both frequency and severity scores did not show any significant improvement over using the frequency or severity score alone, either the frequency or the severity score could be used alone for simplicity [12]. The modified OIDP scale adopted the Likert scale from the original version.

The pretesting further revealed that adolescents had poor memory of their oral health impacts over six months, as they gave different answers during the re-interview. The consensus of the panel of experts was therefore to shorten the recall period to three months. This is consistent with previous

studies conducted in Brazil, France and India that also used the OIDP tool with a three months recall period [14–16], as well as a study that modified the OIDP scale for children in Thailand, without impacting on the validity of the tool [10].

## Stage 2: Exploring factor structure

The second stage involved exploring the factor structure of the modified OIDP scale. The factor analysis and the psychometric properties of the modified OIDP scale were assessed in a sample of 15–19 year school children from a secondary school in Gampaha zone, Dompe Medical officer of health area. Two classes were randomly selected from each grade to ensure the minimum sample size was met. A 1:20 subject to variable ratio was adopted to derive a minimum sample size of 160. Data collection commenced by providing students with the self-administered modified OIDP scale. All quantitative analyses were performed using the Statistical Package for Social Sciences (SPSS) version 23.

Using the approach described in Tabachnick and Fidell (2007), inspection of correlation matrix was performed to assess factorability [17]. Prior to proceeding further with factor extraction, Kaiser-Meyer-Olkin (KMO) a measure of Sampling Adequacy and Bartlett's Test of Sphericity tests were performed. Williams (2010) has suggested that the KMO index should be at least 0.50 and Bartlett's test of Sphericity should be significant ( $p < 0.05$ ) to be considered suitable for factor analysis [18, 19]. Factor extraction is generally applied to reduce a large number of items into common groups or factors [11]. After assessing the factorability of the scale, the factor analysis of the eight items of the modified OIDP scale was carried out using Principal Component Analysis (PCA) and Principal Axis Factoring (PAF), the two most commonly used factoring procedures in published literature [17, 18, 20]. Simultaneous use of multiple decision rules, namely Kaiser's criteria, Scree test and cumulative percent of variance extracted were recommended and considered [21]. Once the number of factors or components was decided, we adopted PCA with oblimin rotation which demonstrated a clearer and more interpretable structure relative to others methods. Tabachnick and Fidell (2007) suggested that factor loading of 0.3 was a good rule of thumb for the minimum factor loading of an item [17]. A factor with a fewer than three items is generally weak and unstable; five or more strongly loading

items (0.5) are desirable and indicate a solid factor [22]. Tabachnick and Fidell (2007) further advised that decisions about number of factors and appropriate rotational method should ultimately be based on realistic criteria, over an arbitrary rule of thumb [23]. These criteria were utilized during the selection of factors and relevant items for the modified OIDP scale.

### Stage 3: Validation

In the third stage of this study, psychometric analysis of the Sinhalese version of the modified OIDP involved the assessment of face, content and concurrent validity, as well as internal and test retest reliability assessment. The psychometric properties were assessed among the same sample who participated in the factor analysis study. During that process, in addition to the modified OIDP scale, a questionnaire relating to perceived oral treatment need and perceived oral health problems were given to the adolescents.

Internal reliability was measured by using standardized Cronbach's alpha coefficient, inter-item correlations and corrected item correlations. [24]. It has been reported that Cronbach's alpha coefficient should be at least 0.7 for early stage of research, 0.8 for basic research and 0.9 for clinical instruments [11]. If the alpha is too high, it may suggest a high level of redundancy [11, 25]. Scale items should all be correlated with each other to varying degrees, with correlations in moderate range between 0.2 to 0.8 [11]. The test retest reliability is the degree of the agreement between two measurements using the same scale, with the same responders, at two different points; this provides an estimate of the degree to which the results are reproducible [26].

In this study, a randomly selected subgroup of 20 adolescents was given the modified OIDP scale to recomplete two weeks after their initial response. The total score of the two sets of data were compared to assess the correlation. As the modified OIDP scale presents continuous data which were not normally distributed, the non-parametric spearman rho test was used to calculate the total scores of the sub scales and for the total scale.

Validity of a scale refers to the degree to which it measures what is designed to measure. Since a gold standard measure cannot be identified to assess oral health related quality of life, criterion validity could not be achieved. Hence face and content validity were assessed by ascertaining

opinions from a second panel of experts [27]. The panel included three consultants in community dentistry, two consultants in community medicine, two consultants in restorative dentistry, one consultant in orthodontics and a sociologist. Each item in the instrument was checked for its relevance and appropriateness in the local context. Concurrent validity was assessed by testing modified OIDP scale against two subjective perceptions [10]; by assessing the self-reported perceived oral treatment need and perceived oral health problems. Due to the skewed nature of the modified OIDP scores, the non-parametric Kruksal-Wallis test was used to assess relationships between modified OIDP and subjective perceptions.

## Results

Following changes to item wording were agreed during the cultural adaptation. The impact of carrying out major work or social roles was adapted to instead ask about the level of impact of oral health on school and household activities. Moreover, the impact of smiling, laughing and showing teeth without embarrassment was adapted to instead ask being able to smile without embarrassment (Table 1). A total of 220 school going adolescents participated in the factor analysis study, with 100% of these students completing the questionnaire. There was a relatively equal distribution of genders with 50.9% male. The mean age was 16.2 (SD = 1.12) years. Only 4.1% of the respondents' fathers were unemployed while 85.0% of respondents' mothers were unemployed (Table 2).

The mean completion time of the tool was found to be approximately 5–8 minutes. The most prevalent oral health impact related to chewing and enjoying foods, reported by 36.8% of respondents. Difficulties with talking and pronouncing clearly was reported by 21.4% of respondents. The activities least affected by oral health were cleaning teeth and quality of sleep (both reported as being impacted by 12.3% of respondents).

An assessment of factorability found that all correlation coefficients were  $> 0.30$  with no item found to increase Cronbach's alpha when deleted. The KMO measure of sampling adequacy was 0.87 and Bartlett's test of Sphericity was significant ( $p < 0.001$ ), indicating that the data is suitable for factor analysis. Calculated Cronbach's alpha for the study was 0.88, indicating good internal consistency reliability of the scale.

The exploratory factor analysis identified two factors using an Eigen value greater than one criterion. The factors were described as 'social and psychological' and 'functional' which is consistent with previous factor analyses of the OIDP [8, 9]. These two factors were able to explain 69.0% of the total variance. Item 5 was the only item loaded to two domains with factor coefficient more than 0.3. While the factor loading for this item was higher under the functional factor, the nature of the item determined that it would best fit under the social and psychological' factor; this is also consistent with previous studies [8, 9]. After the rotation, modified OIDP scale was prepared with items which scored more than 0.3 as factor loadings under a given factor (Table 3).

The inter item correlation coefficients among 8 items of modified OIDP ranged from 0.18 (for the relationship between enjoying time with friends and teeth cleaning) to 0.72 (for the relationship between school and household activities and maintaining emotional status). The standard Cronbach's alpha coefficient was 0.88. No correlation was negative indicating homogeneity among the items (Table 4).

Furthermore, the corrected item total correlations coefficients were between 0.48 to 0.75 and Cronbach's alpha coefficient did not increase when any of the items were deleted (Table 5). These measures indicate the existence of important and significant relationships between the variables of the scale.

A comparison of the correlations between test-retest scores in a sample of 20 adolescents two weeks apart was used to determine the stability of the modified OIDP. Spearman rho was calculated for each item's scale and for the total scale. All correlations were positively associated in test & retest conditions. Spearman rho scores were 0.79 for the social and psychological factor, 0.76 for the functional factor, and 0.75 for the total scale. These relatively strong correlations indicate a high level of stability of the modified scale (Table 4).

Concurrent validity was assessed by testing modified OIDP scale against self-reported perceived oral treatment need and perceived oral health problems (Table 6). The relationships were significant ( $p < 0.05$ ) indicating that the instrument could adequately discriminate between adolescents who had did not have perceived dental treatment needs and adolescents who had different perceptions of

overall health problems.

## Discussion

This study was the first attempt to culturally adapt and to dimensionally validate a Sinhalese version of the OIDP. The results from this study showed that Sinhalese version of modified OIDP scale has a good reliability and excellent validity among a sample of 15 to 19 year aged adolescents in Sri Lanka, indicating its applicability for adolescent populations of similar ages in Sri Lanka.

The modified OIDP scale for adolescents is a brief measure with high applicability in public health and reflects the socio dental needs, and it assess oral impacts in relation to eight independent daily performances [28]. The modifications of the scale were based on adolescent's capability in relation to their intellectual and cognitive development and as well as their memory recall ability. It was evident that adolescents had trouble in recalling impacts over the past six months. This is consistent with previous studies that used three month recall periods when measuring oral health related quality of life among children [10, 14-16, 29]. The OIDP scale for adolescents was therefore modified to have eight self-reported items with a three month recall period.

During the assessment of factor structure, PCA was applied and more than 68% of variance was explained by two factors; "social & psychological" and "functional" in addition to that it maximizes all variance in the items [30]. Patrick (1993) suggested that Health Related Quality of life (HRQoL) is a multidimensional, including social, psychological and functional dimensions [31]. Being a subset of HRQoL, it is assumed that OHRQoL is a multidimensional as well [8]. Taken together, these findings suggested that OIDP fits within the conceptual and theoretical frameworks of multidimensionality in OHRQoL measures.

The OIDP frequency scores showed item-to-scale correlations without negative values that are similar to those obtained in previous applications internationally, and no correlation was high enough for any item to be redundant [10, 15]. Internal consistency reliability in terms of Cronbach alpha of 0.88 indicates excellent psychometric properties compared with the recommended level 0.7 as standard [32]. Previous applications of the OIDP scale to various populations have yielded internal consistency values ranging from 0.5 to 0.9 [5, 15, 28, 33].

The psychometric properties of survey instruments are dependent on the language and cultural context in which they are used, especially in health. Quality of life measurement is an outcome measure of the overall health of an individual. It is dynamic and depends on the social environment [26]. Concurrent validity was tested between modified OIDP scores and perceived oral treatment need and perceived oral health problems and significant relationships were found. This is consistent with previous applications of the OIDP scale [10, 14, 15, 26, 33-36]. These results emphasize that perceptions of oral health and treatment need are strongly associated with oral health quality of life; the better the perceptions, the lower the prevalence of oral impacts [15, 26]. The use of a culturally specific tool to assess the oral health related quality of life among adolescents has been found to generate results which can be readily translated to relevant recommendations to improve the oral health of populations [37].

## Conclusion

The provision of oral health care in adolescents should address not just their clinical dental need, but also their socio dental need, taking into consideration their perceptions in terms of the quality of life impacts of oral conditions on their daily life. Based on our findings, it can be concluded that the modified OIDP scale for adolescents has excellent validity & good reliability, and can be used as a practical measure of oral health related quality of life in 15-19 year old adolescents in Sri Lanka. It has sound theoretical framework and good psychometric properties. Moreover it is short and relatively quick to administer. As with all health related quality of life measures, further evidence of its performance in different populations are necessary. Further work, including the exploration of the association between modified OIDP scores and the clinical indicators of oral health is necessary to determine the population oral health needs.

## Abbreviations

OHRQoL: Oral health Related Quality of Life; OIDP: Oral Impact on Daily Performance

## Declarations

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Consent to publish from the participants

Not applicable

## Author's contributions

UA: Research idea, study design, statistical analysis & drafting the manuscript, PJ & IR: Study design, data analysis/interpretation, supervision & mentorship, HC, SS, & SK: Data interpretation, technical supervision, all authors read and approved the final manuscript.

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## Availability of data and materials

Data underlying the findings are available upon the request.

## Ethics approval and consent to participate

The study is accordance with Helsinki Declaration. The study protocol has been approved by Ethics Committee of Medical Faculty, Colombo, Sri Lanka (Ref No EC 15-171). Written informed consent for the participation for the study were obtained by the parent or guardian (children under 16 years old) and students above the 16 years old, given their written informed consent to participate for the study.

## Competing interests

The authors declare that they have no competing interests.

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## Tables

Table 1 Cultural adaptation and item modification of OIDP scale

No	Performances assessed in original tool	Item included in the modified tool
1	Eating and enjoying food	Impact on chewing and enjoying foods
2	Speaking and pronouncing clearly	Impact on talking and pronouncing clearly
3	Cleaning teeth	Impact on cleaning teeth
4	Sleeping and relaxing	Impact on good sleep without disturbances
5	Smiling, laughing and showing teeth without embarrassment	Impact on being able to smile without embarrassment
6	Maintaining usual emotional state without being irritable	Impacts on maintaining usual emotional state without being irritable
7	Carrying out major work or social role	Impact on school and household activities
8	Enjoying contact with people	Impact on enjoying time with friends

Table 2 Demographic characteristics of the participants in factor analysis and validation study (n = 220)

Characteristics		N(%)
Age	15=>16	71 (32.3)
	16=>17	62 (28.2)
	17=>18	43 (19.5)
	18=>19	44 (20.0)
Sex	Male	112 (50.9)
	Female	108 (49.1)
Mother's occupation category	Unemployed	187 (85.0)
	Primary	29(13.2)
	Secondary	4(1.8)
	Tertiary/ Senior	0(0)
Father's occupation category	Unemployed	9 (4.1)
	Primary	195 (88.6)
	Secondary	16 (7.3)
	Tertiary/ Senior	0 (0)

Table 3 Factor analysis of modified OIDP 8 items (n=220)

Modified OIDP items		Factor <sup>a</sup>	
Q	Question	Factor 1	Factor 2
Q1	Impact on chewing and enjoying foods	0.545	
Q2	Impact on talking and pronouncing clearly	0.791	
Q3	Impact on cleaning teeth	0.960	
Q4	Impact on good sleep without disturbances		0.672
Q5	Impact being able to smile without embarrassment	0.462	0.391
Q6	Impacts on maintaining usual emotional state without being irritable		0.864
Q7	Impact on school and household activities		0.837
Q8	Impact on enjoying with friends		0.910

Results from oblimin rotation with Kaiser Normalization: Bold types indicates loading >0.5<sup>a</sup>; Factor 1: Functional , Factor 2: Social & Psychological

Table 4 Reliability analysis: Inter-item correlation for the 8 items of the modified OIDP (n= 220)

Performance Scores	Chewing	Talking	Cleaning	Sleeping	Smiling	Emotion	Activities	Enjoying
Chewing	1.0							
Talking	0.50	1.0						
Cleaning	0.43	0.62	1.0					
Sleeping	0.51	0.54	0.39	1.0				
Smiling	0.33	0.62	0.39	0.52	1.0			
Emotion	0.42	0.43	0.24	0.60	0.48	1.0		
Activities	0.44	0.50	0.36	0.65	0.52	0.72	1.0	
Enjoying	0.36	0.40	0.18	0.59	0.41	0.58	0.67	1.0

Table 5 Reliability Analysis: Corrected item- total correlations (n= 220)

Items	Corrected item-total correlations	Cronbach's alpha if it deleted
Chewing and enjoying foods	0.57	0.86
Talking and pronouncing clearly	0.72	0.84
Cleaning teeth	0.48	0.87
Good sleep without disturbances	0.73	0.83
Being able to smile without embarrassment	0.61	0.85
Maintaining usual emotional state without being irritable	0.65	0.84
School and household activities	0.75	0.84
Enjoying with friends	0.59	0.85

Table 6 Concurrent validity test for the modified OIDP scores between different categories of related outcome variables (n= 220)

Variable	N	Mean	(SD)	P value*
Perceived oral treatment need				
Yes	82	2.60	3.85	0.003
No	103	1.56	4.00	
Don't know	35	2.08	3.91	
Perceived oral health problems				
None	145	.96	1.45	0.000
Little	56	3.27	5.71	
Moderate	15	5.41	5.91	
Severe	4	10.96	2.45	
Very severe	0	-	-	

\*Kruksal-Wallis test was performed

## Figures

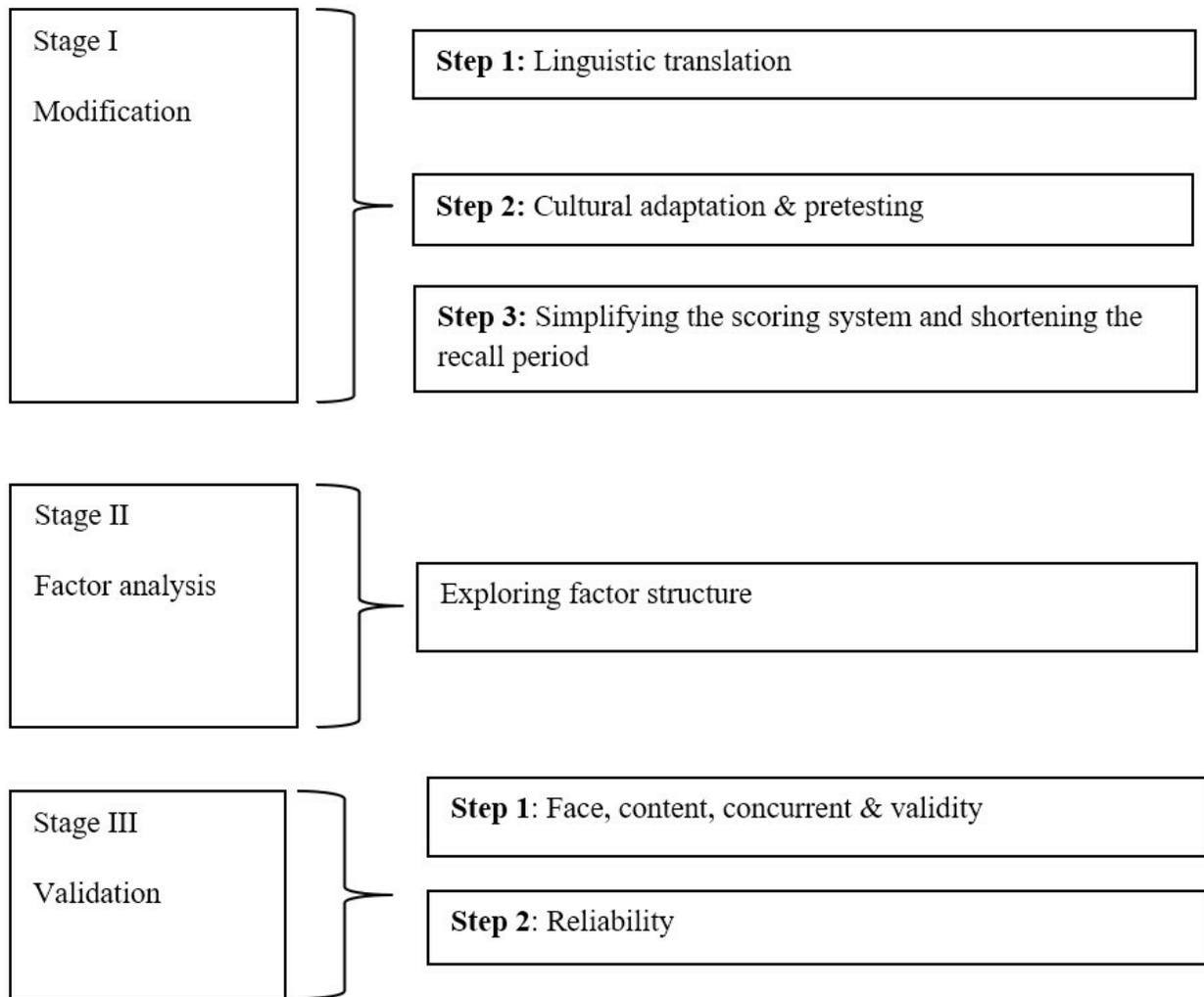


Figure 1

Schematic presentation of the modification and validation procedure of OIDP scale