

# Development of Modified Dental Beliefs Scale Among an Adolescent Rural Population

Mithun Pai<sup>1</sup>, Gururaghavendran Rajesh<sup>1</sup>, Shweta Yellapurkar<sup>2</sup>

<sup>1</sup>Department of Public Health Dentistry, Manipal College of Dental Sciences, Mangalore, Manipal Academy of Higher Education, Manipal, Karnataka, India, <sup>2</sup>Department of Oral Pathology and Microbiology, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Mangalore, Karnataka, India

Received : 01-09-20  
Revised : 15-10-20  
Accepted : 19-10-20  
Published : 15-04-21

**ABSTRACT** **Objective:** Modified dental beliefs scale (MDBS), the shortened form of the R-DBS, was developed in a multicultural population. The factor structure of MDDBS is not explored in an Indian context. The study explores psychometric properties and tests the fit of MDDBS in a rural coastal adolescent population in a vernacular language. **Materials and Methods:** The cross-sectional analysis was carried out at two randomly selected rural Institutes in Coastal Karnataka. Psychometric properties using a questionnaire were assessed. Validity and reliability were assessed by Cronbach's  $\alpha$ , split-half reliability, and test-retest analysis. Statistical analysis: Factor analysis with varimax rotation was employed to add a level of statistical precision and assist in the development the instrument. Two models were developed and tested for goodness of fit, root mean square error of approximation, and comparative fit. **Results:** The MDDBS revealed a Cronbach's  $\alpha$  value of 0.76. Split-half reliability and Guttman split-half reliability were found to be 0.86 and 0.86, respectively. Test-retest reliability was found to be 0.74 ( $P < 0.01$ ). Factor analysis revealed a five-factor solution explaining 67.8% of the variation in the scale. CFA revealed an appropriate goodness of fit for both models with better values for model two with chi-square value was statistically significant and the ratio value ( $\chi^2/df = 7.8$ ). **Conclusion:** The results of the present study indicate that the MDDBS is a reliable and valid tool for the present population subset, with good fit for the second model with two separate latent variables.

**KEYWORDS:** Adolescent, cross-cultural adaptation, modified dental beliefs scale, psychometric properties

## INTRODUCTION

The Dental Beliefs Survey (DBS) was developed to measure subjective perceptions of patients toward dentists and the dental treatment. Dental beliefs and perceptions of differing populations have been known as an important factor for utilization of dental services in a community. This instrument indicates the extent to which a patient perceives the behavior of the dental health professional, as a contributing factor for their dental fear and anxiety and helps in understanding the reasons for not utilizing dental health services in a community.<sup>[1]</sup>

The DBS contained 15 items related to four domains which were communication, belittlement, lack of control, and trust. The original 15-item questionnaire was the most commonly used tool for assessing dental beliefs, but studies by Milogram *et al.* suggested that the original DBS did not capture all the factors related to dental beliefs of a patient hence a modified version of DBS known as the Revised Dental Beliefs

**Address for correspondence:** Dr. Mithun Pai,  
Department of Public Health Dentistry,  
Manipal College of Dental Sciences, Mangalore,  
Manipal Academy of Higher Education, Manipal, Karnataka, India.  
E-mail: mithun.pai@manipal.edu.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**For reprints contact:** reprints@medknow.com

**How to cite this article:** Pai M, Rajesh G, Yellapurkar S. Development of modified dental beliefs scale among an adolescent rural population. J Int Soc Prevent Communit Dent 2021;11:132-7.

### Access this article online

#### Quick Response Code:



Website: [www.jispcd.org](http://www.jispcd.org)

DOI: 10.4103/jispcd.JISPCD\_367\_20

Survey (R-DBS) was introduced by Milgrom *et al.*<sup>[2,3]</sup> which was an expanded version of the original scale and included 28 items. The factor structure and psychometric properties of R-DBS have been tested in many populations across the world. The final model suggested a reduction in the number of questions and addition of a fourth subscale,<sup>[4]</sup> hence, a newer description of the R-DBS, the Modified Dental Beliefs Scale (MDBS), was developed by Acharya<sup>[5]</sup> contained 17 items as 11 items from R-DBS were eliminated as they were thought to be equivocal when adapted and were akin in content and meaning to other items or were deemed irrelevant by the participants. The range of the total scores for the MDBS is between 17 and 85 with higher scores in the MDBS indicating lesser negative dental beliefs.<sup>[6]</sup>

The factorial structure of MDBS was not explored in an Indian context and in an adolescent population in a rural setting, who are the most vulnerable population for dental diseases and dental absenteeism. Hence, the aim was to explore the substratal structure of MDBS and to test the fit of the original MDBS in Kannada (an Indian Language) in an adolescent population of rural coastal village in the city of Mangaluru.

## MATERIALS AND METHODS

### STUDY SETTING

A directory of all the institutions in the city of Mangaluru was obtained from the district authorities. Two rural establishments were selected randomly and participants who satisfied the inclusion criteria were invited to participate in the study. The participants familiar with Kannada were included in the study.

Two subject experts who were bilingual and were proficient in both Kannada and English were asked to translate MDBS to the local language. The experts worked independently from each other and translated the questionnaire which formed the initial templates for the main questionnaire, which were later compared to produce the final single common version.

### DATA COLLECTION PROCEDURE

A self-administered questionnaire which contained 17 items, with range of the total scores between 17 and 85, was used for the analysis.

### INITIAL ANALYSIS FOR TEST RETESTS RELIABILITY

Thirty adolescents were administered a self-administered questionnaire and re-administered the questionnaire after 15 days.<sup>[7]</sup> Participants who refused to provide consent were not included in the study. Those who were undergoing psychiatric therapy or

were suffering from generalized anxiety disorders and informed the same to the investigator or mentioned it in the questionnaire were excluded from the study.

Content validity was determined by inter-item correlations. Convergent validity measures as how the subscales (domains) are correlated to each other and is assessed by domain-wise correlation. The domains in the present scale were Professionalism, Communication, and Control. The instrument was measured for internal consistency by using (i) average inter-item correlation, (ii) average item total correlation, (iii) test-retest reliability, (iv) Cronbach's alpha,<sup>[7,8]</sup> and (v) split-half reliability.<sup>[9]</sup>

### PRINCIPAL COMPONENT ANALYSIS

(PCA) was used as the extraction method. PCA of the MDBS was performed in the participants and rotated to Varimax with Kaiser Normalization. The sample size is calculated by the ratio of respondents to variables should be at least 10:1 and that the factors are considered to be stable and to cross-validate with a ratio of 30:1. As the variables in the present instrument were 17 and expected factors were 6 a sample size of 280 was adequate.<sup>[10]</sup>

Confirmatory Factor Analysis (CFA) is a statistical tool to examine the construct validity of any hypothesis-based testing scale adds a level of statistical rigor and assists in development of shorter forms of an instrument or confirmation of its possible sub-domains.<sup>[11-13]</sup>

## RESULTS

Reliability and internal consistency: The reliability of factors extracted from a formatted multi-point questionnaires were assessed by Cronbach's alpha and was 0.76. Split-half and Guttman split-half reliability were found to be 0.86 and 0.86, respectively. Test-retest reliability was found to be 0.74 ( $P < 0.01$ ).

Intraclass correlation (ICC) estimates and their 95% confident intervals were based on a, two way mixed-effects model. ICC were found to be positive ranging from 0.30 to 0.57 hence can be interpreted as "moderate" to "good based on the reported 95% confidence interval of the estimated data. Cronbach's Alpha if Item Deleted value for each item is evaluated and is found greater than the calculated reliability value, as the values remain higher than the required values no items were deleted.

Content validity addresses the degree to which items of an instrument sufficiently represent the content domain; it is also the ability of the selected items to reflect the variables of the construct in the measure. In

the present data set it was observed that all correlations are positive, with the highest value being 0.53. Table 1 showed Pearson’s correlations between the different domains of Modified Dental Beliefs Scale.

**FACTOR ANALYSIS**

The Exploratory Factor Analysis demonstrated five domains with Initial Eigenvalues ranging from 5.8 –to 1.07 which in total showed a cumulative variance of 67.8 percent, the most common method used for retaining factors is based on Kaiser Criteria or mineigen greater than 1 criterion (K1) [Table 2].<sup>[14]</sup>

**CONFIRMATORY FACTOR ANALYSIS**

A series of two models were used for the confirmatory factor analysis for the present study. The first model had no modifications, with factor loadings based on the present theories of Acharya 2008, where factors were loaded in three domains as described

by the author and a second model based on the loadings in the present study with three domains but excluding component 1 and 2 which acted as separate variables with no assigned domains. In first model the chi-square value was statistically significant and the ratio value ( $\chi^2/d.f. = 8.12$ ) was higher with low confirmed fit. The RMSEA with GFI values indicated a poor model fit. Proposed modification indices were considered inappropriate for this theoretically based model. Models 2 too had weaker outcomes with regard to the model fit indices but were better than model one. The chi-square value was statistically significant and the ratio value ( $\chi^2/d.f. = 7.80$ ) which was lower than model one but values higher than the statistical norms and confirmed low fit. The values of chi square with degrees of freedom and tests for goodness of fit are described in Table 3.

**Table 1: Pearson’s correlations between the different domains of modified dental beliefs scale**

		MDBS (total)	MDBS (P)	MDBS (CM)	MDBS (CT)
MDBS(Total)	<i>r</i>	1	<b>0.798</b>	<b>0.927</b>	<b>0.904*</b>
	<i>P</i> -value	-	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>
MDBS(P)	<i>r</i>	<b>0.798**</b>	1	.591**	.528
	<i>P</i> -value	<b>&lt;0.001</b>	-	<0.001	<0.001
MDBS(CM)	<i>r</i>	<b>0.927**</b>	0.591**	1**	.836
	<i>P</i> -value	<b>&lt;0.001</b>	<0.001	-	<0.001
MDBS(CT)	<i>r</i>	<b>0.904**</b>	0.528	.836**	1**
	<i>P</i> -value	<b>&lt;0.001</b>	<0.001	<0.001	-

MDBS(P) = Professionalism; MDBS(CM) = Communication; MDBS(CT) = Control; *r* = correlations

\*\*Two-tailed *P*-value highly significant

**Table 2: Eigenvalues and unstandardized factor loadings in exploratory factor analysis of items of the modified dental beliefs scale**

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	6.079	35.757	35.757	6.079	35.757	35.757
2	1.668	9.810	45.566	1.668	9.810	45.566
3	1.433	8.429	53.996	1.433	8.429	53.996
4	1.317	7.745	61.741	1.317	7.745	61.741
5	1.138	6.693	68.434	1.138	6.693	68.434
6	0.888	5.224	73.658			
7	0.778	4.576	78.233			
8	0.662	3.892	82.125			
9	0.064	3.791	85.916			
10	0.561	3.300	89.216			
11	0.471	2.770	91.986			
12	0.337	1.984	93.970			
13	0.295	1.738	95.708			
14	0.244	1.437	97.145			
15	0.179	1.050	98.195			
16	0.166	0.974	99.169			
17	0.141	.0831	100.000			

## DISCUSSION

The cross-cultural adaptation process is an important process in behavioral sciences especially when an instrument (questionnaire) is used in a language other than the instrument (questionnaire) was previously conceived. In any psychometric studies, the attitudes and other key factors cannot be assessed directly and are usually measured indirectly through a set of questions which act as pointers. Hence psychometric properties reduce the risk of bias in the modified instrument. In the Indian subcontinent, the cross-cultural assessments are of more relevance as there are 22 official languages and around 780 vernacular languages.

The present study demonstrated a good reliability and validity of MDBS among the study population. The reliability of the MDBS was in accordance with the studies done by Acharya,<sup>[5]</sup> Coolidge *et al.*,<sup>[15]</sup> and Coolidge *et al.* <sup>[2]</sup> The high reliability of the scale is a very surprising factor as all the reliability values range from 0.96 to 0.75 which is consistently higher among all previously noted measurements.

### ANALYSIS OF FACTOR ANALYSIS

The exploratory factor analysis produced five factors with eigen values more than one with a total variance of 68%, This criterion known as the Kaiser Criterion suggests retaining all factors above the eigenvalue

**Table 3: Confirmatory factor analysis**

Models	d.f.	$\chi^2$	$\chi^2/d.f.$	CFI	GFI	AGFI	RMSEA
Model 1	116	952.5	8.12	0.633	0.71	0.56	0.16
Model 2	87	678.6	7.8	0.70	0.78	0.79	0.15

d.f. = degree of freedom;  $\chi^2$  = chi square; CFI = comparative fit index (CFI); GFI = goodness-of-fit index; AGFI = adjusted goodness-of-fit index; RMSEA = root mean square error of approximation

**Table 4: Comparison of Cronbach's alpha and relevant statistics with previous studies**

Scale	Authors	Country	Setting	Cronbach's alpha	Other relevant stats
MDBS (17 Items)	Pai <i>et al.</i> (Present study)	India	Urban	0.76	The exploratory factor analysis produced five factors with eigen values more than one with a total variance of 68%,
MDBS (17 Items)	Acharaya 2007	India	Semi Urban	0.85	The subscales of "professionalism" "communication," and "lack of control" had Cronbach's alpha values of 0.71, 0.74, and 0.70, respectively
DBS (15 items)	Karibe <i>et al.</i> (2019)	Japan	Urban	0.95	The factor analysis yielded two factors with eigenvalues above 1.0, which collectively accounted for 65.8% of the variance
(DBS-R) (28 items)	Abrahamsson <i>et al.</i> , 2006	Sweden	Mixed	0.96	(Cornbachs alpha in different groups students 0.95, general dental patients 0.95, periodontal patients 0.97, and dental-fear patients 0.95)
(DBS-R) (28 items)	Kvale <i>et al.</i> , 2004	Washington (USA)	Urban	0.95	The factor analysis yielded four factors, which collectively accounted for 63.9% of the variance.
DBS-R) (28 items)	Wu and Buchanan, 2020	China	Mixed (Majority Urban)	0.94	The mean overall score for the DBS-R was higher for the 24-item scale (85.2, 24 item and 72.7, 2 8 item)
DBS-R) (24 items)	Wu and Buchanan, 2020	China	Mixed (Majority Urban)	0.93	
DBS-R) (28 items)	Coolidge <i>et al.</i> , 2005	Seattle (USA)	Urban	0.95	0.86 For Professionalism, 0.91 for Communication, and 0.87 for Lack of Control
DBS-R) (25 items)	Coolidge <i>et al.</i> , 2005	Seattle (USA)	Urban	0.95	0.85, for Professionalism 0.88, Communication and 0.83, Lack of Control



of 1, hence five factors were included in the parent study. In the initial analysis done by Acharya, the 20-item questionnaire was reduced to 17 item and were divided into three domains as in the RDBS. The author discussed that as many questions reflected the same opinions over and over again and hence the extra questions were eliminated from the revised scale. In the original DBS, there were five domains as discussed by Kvale *et al.*<sup>[4]</sup> which is similar to the findings of the present study. As the studies of Abrahamsson *et al.*<sup>[16]</sup> and Kvale *et al.*<sup>[17]</sup> extracted four factors in their analysis done on both dental phobic and nonphobic population in Washington and Sweden, respectively, which do not reflect the findings of the present study. (The table with different studies with Cronbach's Alpha and other relevant statistics are presented in Table 4.)

#### CONFIRMATORY FACTOR ANALYSIS

The analysis using confirmatory factor analysis (CFA) is based more on the previously known theoretical models than the statistical component of the analysis and is governed by theoretical model-building strategies than just numerical rankings. This difference as to why five domains were extracted in exploratory factor analysis is understood in CFA as two of those factors represented no domains and were common for all the factors, hence when assed in the present study were removed from the analysis in Model 2 to know the differences in the latent variables. The model testing took place in various stages stating with the original model developed by Milgrom *et al.*<sup>[16]</sup> During the modeling procedures, the suggested domains did not show acceptable results from a statistical perspective and, as discussed above, this may be a result of different cultural and age-related factor with regard to individuals' attitudes and views on dental health professionals.

The results of the present study indicate that the MDDBS is a reliable and valid tool for the present population subset but certainly indicated a need for evaluation of the factor structure from that of the MBDS, which further opens up vistas pertaining to research on dental beliefs and its effect on adolescents across different sectors of society. The scale can be further developed and can be used to assess as to why adolescents, especially in the rural areas, do not utilize dental health services and can be used significantly to motivate people to do the same.

There may be certain limitations in the study, i.e., the employment of a Likert-type scale, tends to cause biases such as the central tendency bias and halo effect which are unavoidable. Further studies are needed to augment the influence of these biases on the Factorial properties DBS in general and MDDBS in particular among different age groups and individuals with different psychological backgrounds.

## CONCLUSION

There is evidence that MDDBS is a reliable and valid instrument for assessing attitudes of patients toward dentists and dentistry. The results of the present study, however, consolidate the use of MDDBS as a multifaceted intricate tool with good fit for the second model with two separate latent variables.

#### ACKNOWLEDGMENTS

None.

#### FINANCIAL SUPPORT AND SPONSORSHIP

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

#### CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

#### AUTHORS CONTRIBUTIONS

All authors had contributed to study conception, data collection, data acquisition and analysis, data interpretation, and manuscript writing. All authors have read and approved the manuscript.

#### ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT

Ethical approval was obtained prior to the study process from Institutional Ethics Committee (protocol ref no. 17133).

#### PATIENT DECLARATION OF CONSENT

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their clinical information to be reported in the journal.

#### DATA AVAILABILITY STATEMENT

The data set is available on request from corresponding author.

## REFERENCES

1. Kulich KR, Berggren U, Hakeberg M, Gustafsson JE. Factor structure of the dental beliefs survey in a dental phobic population. *Eur J Oral Sci* 2001;109:235-40.
2. Coolidge T, Hillstead MB, Farjo N, Weinstein P, Coldwell SE. Additional psychometric data for the spanish modified dental anxiety scale, and psychometric data for a spanish version of the revised dental beliefs survey. *BMC Oral Health* 2010;10:12.
3. Erciyas K, Hamamci Z, Buyukozturk S, Erciyas AF. Revised dental beliefs survey: Reliability and validity of a 22-item modified Turkish version. *J Oral Rehabil* 2009;36:831-9.
4. Kvale G, Milgrom P, Getz T, Weinstein P, Johnsen TB. Beliefs about professional ethics, dentist-patient communication, control and trust among fearful dental patients: The factor structure of the revised dental beliefs survey. *Acta Odontol Scand* 2004;62:21-9.

5. Acharya S. Factors affecting dental anxiety and beliefs in an Indian population. *J Oral Rehabil* 2008;35:259-67.
6. Hathiwala S, Acharya S, Patil S. Personality and psychological factors: Effects on dental beliefs. *J Indian Soc Pedod Prev Dent* 2015;33:88-92.
7. Streiner DL, Norman GR, Cairney J. *Health Measurement Scales: A Practical Guide to Their Development and Use*. Oxford: Oxford University Press; 2015.
8. Tavakol M, Dennick R. Making sense of Cronbach's alpha. *Int J Med Educ* 2011;2:53-5.
9. Mattos GC, Mambrini JV, Paiva SM, Abreu MH. Evaluating psychometric properties of an instrument addressing comprehensiveness of care among dentists. *Braz Dent J* 2017;28:638-46.
10. Morgado FF, Meireles JF, Neves CM, Amaral A, Ferreira ME. Scale development: Ten main limitations and recommendations to improve future research practices. *Psicologia: Reflexão e Crítica* 2017;30.
11. Yong AG, Pearce S. A beginner's guide to factor analysis: Focusing on exploratory factor analysis. *Tutor Quant Methods Psychol* 2013;9:79-94.
12. Costello AB, Osborne J. Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Pract Assess Res Evaluation* 2005;10:7.
13. Gallagher MW, Brown TA. Introduction to confirmatory factor analysis and structural equation modeling. Teo T, editor. *Handbook of Quantitative Methods for Educational Research*. Leiden, Netherlands: Brill Sense; 2013. p. 287-314.
14. Hayton JC, Allen DG, Scarpello V. Factor retention decisions in exploratory factor analysis: A tutorial on parallel analysis. *Organ Res Methods* 2004;7:191-205.
15. Coolidge T, Heima M, Coldwell SE, Weinstein P, Milgrom P. Psychometric properties of the Revised Dental Beliefs Survey. *Community Dent Oral Epidemiol* 2005;33:289-97.
16. Abrahamsson KH, Ohrn K, Hakeberg M. Dental beliefs: Factor structure of the revised dental beliefs survey in a group of regular dental patients. *Eur J Oral Sci* 2009;117:720-7.
17. Kvale G, Berg E, Nilsen CM, Raadal M, Nielsen GH, Johnsen TB, *et al.* Validation of the dental fear scale and the dental belief survey in a Norwegian sample. *Community Dent Oral Epidemiol* 1997;25:160-4.