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Original Research

Validation of Arabic Version of the Modified Dental Anxiety Scale and Assessment of Cut-off Points for High Dental Anxiety in a Saudi Population

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Abstract:

Background: Dental anxiety is a common problem faced by the patients and dental health professionals globally. High levels of anxiety in anticipation of encounters in a dental setting have been linked to a myriad of dental problems such as appointment avoidance and increased chair time. To validate the Arabic version of the modified dental anxiety scale (MDAS) and assess cut-off points for a high dental anxiety in a Saudi population.

Materials and Methods: We conducted a cross-sectional survey at the King Abdulaziz Medical City in Riyadh, Saudi Arabia in December 2012. The survey included randomly chosen Saudi patients aged 18 or above, who attended dental or family medicine clinics during the survey phase.

Results: A total of 24 (37.5%) respondents had missed or cancelled dental appointments due to dental anxiety. The internal consistency of MDAS subscales was high with Cronbach's alpha = 0.90. The factor analysis suggested a single dimension solution accounting for 71.7% of the variance. The cut-off point of 13 had the highest combination of the sensitivity, specificity and the largest area under the curve compared to cut-off points of 16 and 19 in our study population. Respondents with a history of missed appointments (due to anxiety) scored significantly higher on the MDAS than those who had no history of missed appointments (14.5 ± 5.6 vs. 10.1 ± 4.0, $P = 0.001$).

Conclusion: The Arabic MDAS showed high reliability and validity, supporting its use in further studies among Arabic-speakers. A cut-off point of 13 can be used to identify patients who are more likely to exhibit non-attendance behavior.

Key Words: Cut-off point, dental anxiety, modified dental anxiety scale, Saudi Arabia, sensitivity, specificity, validity

Introduction

High levels of anxiety in anticipation of encounters in dental settings are linked to avoidance of dental care, deteriorated oral health,[1,2] decline in quality of life,[3,4] and low patient satisfaction with the provision of dental care.[5] Moreover, dental anxiety leads to increased chair time for management of anxious patients and might necessitate pharmacological treatments to facilitate smooth and effective delivery of dental care.[6,7]

Anxiety is defined as "an aversive emotional state related to an anticipated or expected encounter with feared stimulus," the dental treatment being the primary stimulus in dental anxiety. Fear, on the other hand, is defined as a rational reaction to an objectively identified external danger that may induce a person to flee or attack in self-defense, these two concepts have been used interchangeably in dental literature.[8,9] The prevalence of dental anxiety has been reported to range from 5% to 22%.[10,11] Eli *et al*., reported that 6-15% of patients with high dental anxiety do in fact avoid dental treatment.[12] Only a few studies have explored dental anxiety in the Arab world, particularly Saudi Arabia. However, those studies had design or population selection limitations that hinder extrapolation of their results to a larger section of the Saudi population.

Self-administered scales to measure dental anxiety have been used extensively in the dental literature. Among the most common used are Corah's dental anxiety scale (DAS)[13] and the modified DAS (MDAS).[14] The MDAS has been shown to measure dental anxiety with high reliability and validity ($r > 0.8$).[15,16] It has been translated and used in many languages, including Norwegian,[17] Turkish,[18] Chinese,[19] Greek,[20] Spanish,[21] and Tamil.[22] Arabic version of MDAS has previously been used to screen for dental anxiety among Arabic-speakers in selected age groups.[10,23] This may have overestimated the prevalence of dental anxiety and hindered generalization of results at the population level. To the best of our knowledge, no study has employed MDAS at a community level in Saudi Arabia. The aims of this study were to validate the Arabic version of the MDAS and to assess the cut-off points for high dental anxiety in a sample of Saudi adults for future use of this instrument in predominantly Arabic-speaking countries.

Materials and Methods

Study setting, design, and participants

We conducted a cross-sectional, paper-based survey at the King Abdulaziz Medical City in Riyadh, Saudi Arabia in

December 2012. We invited Saudi patients aged 18 or above who attended Dental or Family Medicine Clinics during the survey phase. The participants were randomly chosen for inclusion in this study. Patients who refused to participate or suffered from any condition that might impair their cognitive abilities were excluded.

Ethical approval

This study was approved by the review board at King Abdullah International Medical Research Centre, Riyadh, Kingdom of Saudi Arabia vide grant number RR 12/176. Written informed consent was obtained from the participants. An invitation letter was given to the participants explaining that their participation was anonymous, voluntary and their declining to participate would not affect their medical care in any way.

Data collection tool

A questionnaire comprising three distinct parts was developed in English, then translated into Arabic by the principal investigator, and double-checked by a co-investigator (AEA). The first part had four items and collected information on demographic factors such as age, gender, highest education attained, and occupation. The second part had five items and included questions on participants' dental history and non-attendance behavior. The third part contained the MDAS, which was already available in Arabic language and was provided courtesy of Dr. G. Humphris from St. Andrews University, UK. MDAS consists of five items asking respondents to rate their anxiety level in response to situations in dental settings: A dental visit planned for the following day, being in the waiting area of a dental clinic, having a tooth drilled, having scaling of the teeth, and having a local anesthetic injection in the gums. Participants' responses were assessed on a 5-point Likert scale - not anxious, slightly anxious, fairly anxious, very anxious, extremely anxious, with 1 representing not anxious, and 5 corresponding to extremely anxious. The scores range from 5 to 25, and an empirical cut-off of 19 has been suggested and used in dental literature to indicate high dental anxiety, possibly dental phobia.[14]

Statistical analysis

Descriptive statistics such as means ± standard deviation were used to describe the continuous variables. Frequencies and percentages, *n* (%), were used to describe the categorical variables (Table 1). MDAS subscales were summarized frequencies and percentages. Chi-square tests and Independent samples Mann–Whitney U-test were used to assess the relationships between demographic characteristics and cancelled/missed dental appointments (Table 2) and MDAS scores (Table 3). We used Cronbach's alpha coefficient to determine the internal consistency of MDAS subscales. Scale items were considered to be homogeneous if Cronbach's alpha was > 0.70. The receiver operating characteristics (ROC) curve and its associated cut-off points comparisons were generated by SAS® versions 9.2 (SAS Institute Inc., Cary, NC, USA). Sensitivity, specificity, and area under the curve (AUC) were calculated at various cut-off points of MDAS such as 13, 16, and 19. All statistical assessments were 2-tailed, and the level of significance was set at $P = 0.05$.

Results

Characteristics of the participants

A total of 64 completed questionnaires were returned out of 80 that were distributed, with an overall response rate of 80%. Participants were almost equally distributed between the dental and family clinics - 53% and 47%, respectively. The median age of the participants was 28.5 years (range: 18-62), and females accounted for 61% ($n = 39$) of the sample. More than one-third of the participants ($n = 21$) had not been to a dental clinic in more than a year, and the most frequent visited clinic was operative dentistry in 45.7% of the respondents ($n = 21$). Other demographic and dental characteristics are listed in Table 1.

Non-attendance behavior

Approximately half of the participants (51.6%) delayed seeking dental care due to their dental anxiety, and over one-third (37.5%) had missed or cancelled already booked dental appointments for the same reason. Respondents who delayed dental appointments had higher cancellation rate (66.7% vs. 6.5%, $P = 0.001$) compared to respondents who had never delayed dental appointments (Table 1). MDAS score were significantly higher in participants with a history of missed dental appointments (14.5 ± 5.6 vs. 10.1 ± 4.0, $P = 0.001$) compared with the participants who had no history of missed dental appointments.

Dental anxiety

MDAS items related to tooth drilling and dental injection were associated with the highest proportion of anxiety. Median MDAS score was 12.0 (25^{th} percentile = 7, 75^{th} = 15). In our sample, 33.3% of participants had moderate anxiety (MDAS score: 13-18), and 9.5% had a high dental anxiety (MDAS score ≥ 19) based on conventional cut-off values. MDAS scores were higher in females (13.03 ± 5.58 vs. 9.92 ± 3.65, $P = 0.035$) indicating higher levels of anxiety, while rest of the demographic characteristics were not significantly different among the participants ($P > 0.05$) as shown in Table 2. MDAS subscales summary demonstrated in Table 3.

Reliability

Internal consistency within MDAS subscales was high with Cronbach's alpha = 0.90 (95% confidence interval: 0.85-0.93). All items contributed to the final score and removal of any item decreased the overall consistency except for the item on "teeth scaling," whose removal led to a very small increase in Cronbach's alpha = 0.904 as shown in Table 4.

Validity

The Arabic translation of the original English MDAS provided to the authors was reviewed and judged to be of good standard.

Table 1: Demographic characteristics and its relation to cancelled/missed appointment.

Characteristics	Levels	No *n*=40 (62.5%)	Yes *n*=24 (37.5%)	*P* value
Age (years)	<25	15 (62.5)	9 (37.5)	1.000
	≥25	25 (62.5)	15 (37.5)	
Gender of participants	Male	17 (68.0)	8 (32.0)	0.467
	Female	23 (59.0)	16 (41.0)	
Education level	High school or less	14 (53.8)	12 (46.2)	0.237
	University	26 (68.4)	12 (31.6)	
Sampling site	Dental clinic	26 (76.5)	8 (23.5)	0.014*
	Non-dental clinic	14 (46.7)	16 (53.3)	
Average monthly income	≤10000 SR	17 (58.6)	12 (41.4)	0.417
	>10000 SR	14 (70.0)	6 (30.0)	
Delayed dental appointment	No	29 (93.5)	2 (6.5)	0.001*
	Yes	11 (33.3)	22 (66.7)	
Frequent dental visits	No	18 (60.0)	12 (40.0)	0.602
	Yes	18 (66.7)	9 (33.3)	
MDAS (mean±SD)		10.1±4.0	14.5±5.6	0.001#

*Chi-square test is significant at alpha=0.05. #Independent sample *t*-test is significant at alpha=0.05, MDAS: Modified dental anxiety scale, SD: Standard deviation

Table 2: MDAS scores by demographic and dental-related characteristics.

Characteristics	Levels overall	Mean±SD (11.7±5.1)	*P* value
Age (years)	<25	12.52±4.85	0.309
	≥25	11.37±5.26	
Gender of participants	Male	9.92±3.65	0.035
	Female	13.03±5.58	
Education level	High school or less	11.15±5.27	0.307
	University	12.24±5.01	
Sampling site	Dental clinic	11.06±4.78	0.273
	Non-dental clinic	12.6±5.41	
Average monthly income	≤10000 SR	11.21±4.48	0.413
	>10000 SR	10.4±5.14	
Delayed dental appointment	No	9.43±3.44	0.001*
	Yes	13.94±5.46	
Frequent dental visits	No	11.43±5.02	0.296
	Yes	12.69±5.16	

*Independent samples Mann–Whitney U-test is significant at alpha=0.05, MDAS: Modified dental anxiety scale, SD: Standard deviation

However, there was some ambiguity around the Arabic word used to describe "teeth scaling" in MDAS as that was translated to a rarely used formal Arabic word. Discussions with dentists, dental hygienists and patients supported the use of the Arabic word "calculus cleaning" in place of "teeth scaling," which was better understood and is commonly used by the dental professionals when communicating with the patients. A group of eight patients were interviewed and asked for the clarity and ease of answering the questionnaire. Face validity was good as expressed by participants' opinions and the minimal missing data in the returned questionnaires. Multidimensionality of the Arabic version of MDAS was examined by principal components extraction with varimax rotation. The factor analysis suggested a one-factor or single dimension solution accounting for 71.7% of the variance. All scales had high factor loadings, which ranged from 0.91 (waiting area) to 0.72 (dental hygiene).

Assessment of cut-off point for high dental anxiety

MDAS discriminative validity was acceptable in our study, as respondents with a history of missing dental appointments (due to anxiety) scored significantly higher on MDAS than those whose did not miss appointments ($P = 0.001$). An ROC curve was plotted for the performance of the MDAS scores in distinguishing participants (validation criterion) who had missed treatment and cancelled an appointment at least once (Graph 1). Cut-off points of 13 and 16 were compared to the conventional cut-off of 19 with respect to different validity measures as shown in Table 5. The cut-off point of 13 had the best combination of the sensitivity, specificity and the largest area under the curve.

Discussion

This study employed a commonly used, valid and reliable self-assessment tool for dental anxiety. Age range was in line with other similar studies and females exhibited higher scores than males - A pattern that was consistent with other studies.[18-20,24] Arigbede *et al.* showed that gender was the only predictor of high dental anxiety scores in MDAS.[25] We found no statistically significant association between age and the MDAS scores, although these variables had a weak negative correlation indicating higher anxiety in younger patients. This trend of

younger patients exhibiting higher anxiety levels has also been noticed in other studies with Tunc *et al.*, reporting a significant positive association between age and the MDAS.[18,22,24,25] Lack of significant associations between other demographic and dental characteristics and the MDAS could be due to our small sample at this stage. The current study serves as a pilot for a future community-level study.

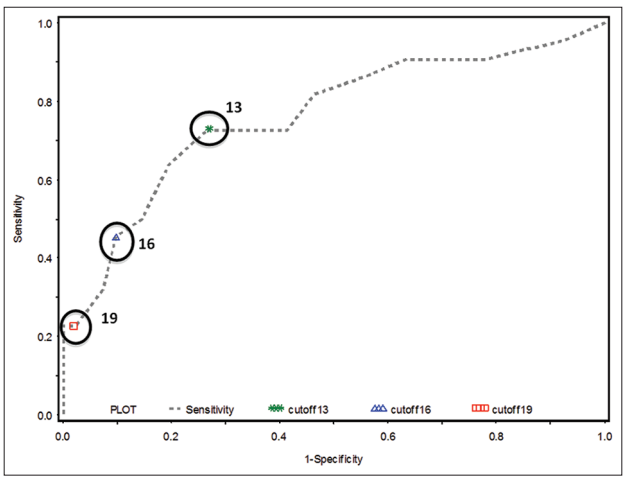
We found that avoidance behavior was significantly associated with higher MDAS scores. This finding further validates the use of MDAS to screen for highly anxious patients who are prone to avoid regular dental care. Three previous studies have used the MDAS in Arabic speaking populations, although those studies were mainly comprised of young people. However, we did not find any information on their reliability and validity measures.[10,23,26] Hence, there was a need to validate MDAS for Arabic speakers before conducting population-wide studies. This study helped filled that gap. We have established good face validity with a slight modification in a word in the previous translation, and high internal consistency for the Arabic version of this scale.

A cut-off point of 19 was proposed based on a large population study in the UK.[14] This cut-off point has frequently been used to ascertain the proportion of highly-anxious participants in different studies. However, other cut-off points have also been employed in other studies that include: Cut-off point of 13,[18] 15,[18] 16,[17,24] and 17.[18] We found that ROC curve and associated validity measures for a cut-off point of 13 had the best combination with a sensitivity of 0.73 and a specificity of 0.73. The other cut-off points had varying levels of specificity and sensitivity. For instance, a cut-off point of 16 produced a high specificity (0.90) but lower sensitivity (0.45) in our study sample. However, this cut-off point was associated

Table 3: MDAS subscales.

Items	Levels	*n* (%)
Dental visit tomorrow	Not anxious	22 (34.4)
	Slightly anxious	22 (34.4)
	Anxious	12 (18.8)
	Very anxious	3 (4.7)
	Extremely anxious	5 (7.8)
Waiting area	Not anxious	25 (39.1)
	Slightly anxious	19 (29.7)
	Anxious	12 (18.8)
	Very anxious	6 (9.4)
	Extremely anxious	2 (3.1)
Tooth drilling	Not anxious	9 (14.1)
	Slightly anxious	22 (34.4)
	Anxious	15 (23.4)
	Very anxious	12 (18.8)
	Extremely anxious	6 (9.4)
Dental hygiene	Not anxious	31 (48.4)
	Slightly anxious	21 (32.8)
	Anxious	2 (3.1)
	Very anxious	9 (14.1)
	Extremely anxious	1 (1.6)
Dental injection	Not anxious	12 (18.8)
	Slightly anxious	17 (26.6)
	Anxious	7 (10.9)
	Very anxious	18 (28.1)
	Extremely anxious	10 (15.6)

MDAS: Modified dental anxiety scale



Graph 1: Receiver operating characteristics curve showing modified dental anxiety scale scores performance across different cut-off points.

Table 4: Internal reliability matrix for the MDAS.

MDAS items	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Cronbach's alpha if item deleted
Dental visit tomorrow	9.66	16.388	0.824	0.714	0.857
Waiting area	9.75	16.857	0.832	0.743	0.858
Tooth drilling	9.08	16.581	0.793	0.655	0.864
Dental hygiene	9.95	18.776	0.599	0.366	0.904
Dental injection	8.88	15.857	0.713	0.518	0.887

MDAS: Modified dental anxiety scale

Table 5: Validity measures (95% CI) in relation to different cut-off points.

Cut-off	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	AUC (95% CI)
13	0.73 (0.496, 0.884)	0.73 (0.568-0.852)	0.59 (0.390-0.770)	0.83 (0.665-0.930)	0.73 (0.595-0.863)
16	0.45 (0.251, 0.673)	0.90 (0.759-0.968)	0.71 (0.420-0.904)	0.76 (0.608-0.862)	0.68 (0.530-0.827)
19	0.23 (0.087, 0.458)	0.98 (0.856-0.999)	0.83 (0.365-0.991)	0.70 (0.564-0.812)	0.60 (0.447-0.756)

PPV: Positive predictive value, NPV: Negative predictive value, AUC: Area under the curve, CI: Confidence interval

with the highest sensitivity and specificity in a Norwegian study.[17] A cut-off point of 19, which has been suggested as the most appropriate point to classify subjects with high dental anxiety,[14] produced the highest specificity (0.98) but the lowest sensitivity (0.23) compared to the other cut-off points in our study. This same cut-off, however, displayed higher sensitivity in another study.[17] The cut-off point of 15 was associated with the highest validity measures among a sample of Turkish dental patients with a group of dental phobia patients.[18] We recommend a cut-off point of 13 in a Saudi population as it has a balanced specificity and sensitivity, and highest AUC. This finding supports exploration of various cut-off points in relatively small population samples to establish population-specific validation measures before embarking on full-scale population studies. This exploration is also necessary in the light of cultural differences in anxiety expression among diverse populations. The positive predictive value associated with the cut-off point of 13 was high (0.59) in our study compared to other similar studies.[18,27] On the other hand, the negative predictive value was lower for all cut-off points in our study compared to other similar studies.[17,18,27] This can be partly explained by the difference in sample size and prevalence of dental anxiety in the populations under consideration in other studies.

This study is the first to document different validity measures in relation to the Arabic version of MDAS. Our findings at this stage recommend using this valid and easy to administer questionnaire for scanning dental anxiety in clinical settings. The prevalence of high anxiety and its effect on avoidance behavior merits further studies among wider Saudi population. The limitations of this study were the small sample size and inclusion of patients from clinical settings. Furthermore, test-retest reliability was not explored due to the cross-sectional design that included data collection at only single instance. Nevertheless, this study provided valuable information on the validity of the instrument among Arabic-speakers, and it will serve as the pilot phase for a larger population-based study.

Conclusion

- The Arabic version of MDAS showed high reliability and validity, supporting its use in further studies among Arabic-speakers.
- Various cut-off points can be used to maximize the score's ability in distinguishing patients who are more likely to exhibit non-attendance behavior.

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