

Reliability and validity of the Modified Dental Anxiety Scale (MDAS) in a Turkish population

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Abstract – Objectives: Fear of dentistry is a common obstacle to obtaining dental care in Turkey. The aim of this study was to assess the reliability, validity and psychometric characteristics of the Turkish translation of the Modified Dental Anxiety Scale (MDAS) and compare it to the Dental Fear Survey (DFS) scores obtained in the same population. **Methods:** The Turkish translated version of the MDAS was administered to 115 dental patients; 21 subjects who suffered from dental phobia, requiring general anesthesia for dental procedures, and 94 who did not have dental anxiety, in addition to 442 subjects from the general population. **Results:** The Turkish translated version of the MDAS was internally consistent and reproducible. The patients with dentist phobia had the highest score. The Turkish MDAS correlated with the DFS ($r = 0.80, P < 0.001$). The MDAS scale correlated inversely ($r = -0.14, P < 0.005$) with level of education; however, it did not correlate with economic status. Women scored higher than men on the scale (mean = 12.3, SD = 5.2 vs. mean = 10.9, SD = 4.5, $P < 0.005$). At a cut-off point ≥ 15 , sensitivity was 0.80, specificity 0.74, positive predictive value 0.41 and negative predictive value 0.94. **Conclusion:** Although the specificity values were low, the Turkish MDAS demonstrated acceptable sensitivity, positive and negative predictive values. Thus, high reliability and validity of the MDAS supports its cross-cultural validity and indicated that it may be a valuable tool in quantifying fear of dentistry among Turks.

Key words: behavioral science; Dental Anxiety Scale; Turkish population

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Fear of dentists and dentistry is a common and potentially distressing problem both for the public and dental practitioners (1). Dental anxiety afflicts a significant proportion of people of all ages from different social classes and often results in inadequate oral health by complete avoidance of dental treatment, irregular dental attendance or poor cooperation (2–4). Severe dental anxiety is based on several factors (5, 6): influence of the family and social environment, and general fearfulness, pain, and traumatic experiences (6–8).

Two major measurement techniques to assess dental anxiety are based on the observation of behavioral and physiological alterations, and utilization of self-reported questionnaires and rating scales. Currently, the most commonly used method

is the self-reported questionnaires and rating scales (3, 9–11). These questionnaires exhibit adequate levels of internal consistency and correlate with other measures of the same construct. However, a single questionnaire cannot adequately cover all aspects of anxiety (1, 3). Longer questionnaires such as Kleinknecht's Dental Fear Survey (DFS) have a wide range of scores and are more sensitive and widely applicable to various populations. Therefore, they are widely used for anxiety research in adults. On the contrary, scales such as the Corah's Dental Anxiety Scale (CDAS) and the MDAS are specific for dental practice and assist in planning treatment options (1, 12, 13). An advantage of the MDAS is that because of its brevity, it is a cost-effective instrument for population-based

research. Dental unattendance may lead to poor dental health, so studies evaluating this problem should be performed in Turkey. To our knowledge, dental fear among Turkish population has not been previously investigated using the MDAS (14–16). The aim of the current study was to validate the MDAS in Turkish population to obtain a reliable and cost-effective assessment instrument that can be used in large population studies.

Materials and methods

Subjects

The studies were carried out in two different populations: first, the MDAS was compared with the DFS in 115 patients who attended the Outpatient Clinic of the School of Dental Medicine, Istanbul University. Ninety-four of these subjects did not express any fear of dentistry, whereas 21 patients had severe fear of dental treatment and were classified as having dental phobia by two dentists independently. This group displayed phobic behavior that interfered with dental treatment and accepted treatment only under general anesthesia in a previous and the current visit. Secondly, the MDAS and DFS were administered to 442 subjects who were employees of four different industrial companies settled in Kocaeli and Istanbul, Turkey. Seventy-nine (17.9%) of these had ‘white collar’ jobs and 363 (82.1%) had ‘blue collar’ jobs. Written informed consent was obtained after the study was fully explained to all participants.

Assessment measures

Two psychometric questionnaires and one history form were administered:

MDAS

This self-rating instrument was introduced by Humphris et al. (17). It differs from the CDAS by including an additional question about a local anaesthetic injection. Each question has five scores

ranging from ‘not anxious’, to ‘extremely anxious’, in an ascending order from 1 to 5. Each question thus carries a possible maximum score of 5 with a total possible maximum score of 25 for the entire scale. In this study, a Turkish translation of MDAS was used (9). In order to establish full congruity between the Turkish and English versions, the Turkish version was back-translated into English and tested for inconsistencies.

DFS

Dental Fear Survey is also a well-established scale to assess dental fear and anxiety. The scale has been extensively investigated in the USA and found to have good reliability and validity. It consists of 20 items and has a representative five-point scale for rating of each item from high (5) to low (1) intensity of reaction (18). The DFS used in this study was the Turkish translation of the scale used by Kvale et al. (19).

History form

A questionnaire was used to obtain information about sociodemographic features such as sex, age, education, marital status and income level. Any adverse experience during dental treatment or dentist’s visit at least once previously was also enquired.

Results

Characteristics of the participants

The demographic data concerning the participants are presented in Table 1. The mean age of the subjects in the general population was 34.7 ± 6.9 years (range 17–62). Their mean education was 10.6 ± 3.3 years. The patients who attended the Dental Clinic were older than the remaining groups [$F(557; 2) = 21.20; P < 0.001$] on analysis of *post hoc* Scheffé test. There was no difference between groups on education, but dental phobic group had higher income level than remaining groups [$F(557;2) = 5.21; P < 0.01$]. In the

Table 1. Sociodemographic characteristics of the participants

	<i>n</i>	Age [range; mean (SD)]	Education (years) [mean (SD)]	Gender (female) [<i>n</i> (%)]	Marital status (married) [<i>n</i> (%)]	Income level (middle) [<i>n</i> (%)]
General population	442	17–62; 34.7 (6.9)	10.6 (3.3)	139 (31.4)	338 (76.3)	293 (66.1)
Dental phobics	21	19–56; 38.0 (11.2)	10.8 (2.9)	14 (66.7)	18 (85.7)	17 (81.0)
Regular dental patients	94	19–75; 40.9 (13.7)	10.6 (3.5)	54 (57.4)	60 (63.8)	66 (70.2)
Total	557	17–75; 35.9 (8.9)	10.6 (3.3)	207 (37.1)	416 (74.6)	376 (67.4)

general population group, there was no difference between the age of male (34.6 ± 6.9 years) and female (35.0 ± 6.9 years) subjects. Educational level did not differ between the male (10.7 ± 3.0 years) and female participants (10.2 ± 3.8 years) either. The income level of women was higher than that of men (2.9 ± 0.6 vs. 2.7 ± 0.6 ; $P < 0.05$).

Three hundred and ninety-two subjects (94.2%) in the general population had visited a dentist at least once previously in their life-time. Eighty-nine (22.4%) of these had an adverse experience during a previous dental treatment.

Reliability measures

The first step was to determine if MDAS scores could be accounted for by variables other than group membership as assessed among participants in a nonclinical population. In the general population, age correlated with the MDAS score ($r = 0.11$, $n = 442$, $P < 0.05$). The MDAS score was higher ($P < 0.05$) among women (12.3 ± 5.2) than men (10.9 ± 4.5). MDAS score correlated inversely with education ($r = -0.14$, $n = 442$, $P < 0.005$) but did not correlate with the economic status. The item-deleted mean scale scores were 9.46, 9.32, 8.95, 9.42, and 8.87. For all participants ($n = 557$), the Pearson's correlations were calculated between each item and item-deleted MDAS scores to establish partial construct validity of the scale. These correlation coefficients were 0.81, 0.82, 0.80, 0.72, and 0.69. All correlations reached a significance level of $P < 0.05$ or better.

Test-retest reliability was calculated using intra-class correlation coefficients from the scale scores of

30 persons who completed the scale on two occasions separated by one week interval. The test-retest intra-class correlations (ICC) of five individual variables were 0.54, 0.65, 0.68, 0.78 and 0.78, respectively, with a significance of at least $P < 0.001$, except the first item ($P < 0.01$) (Table 2). The test-retest ICC of the total scores was 0.74, with a significance of at least $P < 0.0002$. These data showed that the MDAS scores were stable over approximately a one-week interval.

Cronbach's alpha coefficients were calculated for the sample as a whole ($n = 557$, $\alpha = 0.91$) and for each of the subsamples: regular dental patients ($n = 94$, $\alpha = 0.93$), fearful patients ($n = 21$, $\alpha = 0.71$), general population ($n = 442$, $\alpha = 0.90$). These values indicated that the MDAS was an internally consistent measure across all test samples.

Validity measures

Comparison of the scales showed that there were high correlations (Pearson) between the MDAS and the DFS ($r = 0.80$, $n = 183$, $P < 0.001$). These data supported the convergent validity of the MDAS.

As expected, patients with dental phobia had the highest score on the MDAS with a mean score of 17.0 ± 3.7 (Table 3). The mean MDAS scores in the regular dental patients group and the general population were 11.2 ± 4.9 and 11.3 ± 4.7 respectively. A variance analysis was performed to compare MDAS scores across these groups. Dental phobics differed significantly from the regular dental patients and the general population.

We compared MDAS total scores of subjects who had an adverse experience during a previous dental treatment with those of the subjects in the general population who did not. Subjects with an adverse experience ($n = 89$, 22.4%) had a higher MDAS scores (12.24 ± 4.40) than the remaining subjects (10.18 ± 3.78) ($P < 0.001$).

Sensitivity and specificity

Ninety-four regular dental patients and 21 dental phobics were included in the assessment of

Table 2. The intra-class correlation coefficients for test-retest reliability of the individual items of MDAS

Item numbers	ICC	UV	LV	F(95%)	P-value
1	0.54	0.78	0.04	2.17	<0.01
2	0.65	0.83	0.28	2.87	<0.002
3	0.68	0.84	0.34	3.16	<0.001
4	0.78	0.89	0.53	4.48	<0.0001
5	0.78	0.89	0.54	4.60	<0.00001
Total	0.74	0.88	0.46	3.86	<0.0002

UV, upper value; LV, lower value.

Table 3. MDAS total score in various study groups $F(557;2) = 14.48$, $P < 0.001$

	<i>n</i>	Mean (SD)	Range	Median	Items endorsed (median)	Per cent of subjects with a score equal or above 15
General population	442	11.3 (4.7)	5.0–25.0	10.0	1.0	23.5
Regular dental patients	94	11.2 (4.9)	5.0–24.0	10.0	1.0	25.5
Dental phobics	21	17.0 (3.7)	10.0–25.0	16.0	4.0	90.5

Table 4. The number of subjects ($n = 115$), sensitivity (SENS), specificity (SPEC), positive predictive value (PPV), and negative predictive value (NPV) according to MDAS and cut-off scores are shown

Anxiety Scale	Cut-off score	TP	FP	FN	TN	SENS	SPEC	PPV	NPV
MDAS	≥ 13	19	32	2	62	0.90	0.65	0.37	0.96
MDAS	≥ 15	17	24	4	70	0.80	0.74	0.41	0.94
MDAS	≥ 17	10	13	11	81	0.48	0.86	0.43	0.88

TP = true positive, FP = false positive, FN = false negative, TN = true negative.

Formulas:

SENS = $TP / (TP + FN)$.

SPEC = $TN / (FP + TN)$.

PPV = $TP / (TP + FP)$.

NPV = $TN / (FN + TN)$ (21).

sensitivity and specificity. The three cut-off points were selected arbitrarily (MDAS score ≥ 13 , ≥ 15 and ≥ 17). As shown in Table 4, as the cut-off points increased, the sensitivity decreased from 0.90 to 0.80 and 0.48 and the specificity increased from 0.65 to 0.74 and 0.86. For example, the cut-off point ≥ 13 provided negative and positive predictive values of 0.96 and 0.37, whereas cut-off point of ≥ 15 provided values of 0.94 and 0.41, respectively. When the cut-off point increased to ≥ 17 , the negative and positive predictive values were 0.88 and 0.43, respectively. One hundred and four subjects (23.5%) in the general population had a total score above 15.

Discussion

The CDAS, which was published by Corah et al. (20) for the assessment of dental anxiety, is a reliable, valid and useful predictor of patient's stress in the dental operator. However, it has been criticized for not covering all aspects of dental fear (21). MDAS has a more simplified answering scheme and includes an additional question about local anesthetic injection (11). Moreover, MDAS includes questions regarding conventional treatment as well as being easy and quick to complete (22).

When compared with DFS, the Turkish translated version of the MDAS showed comparable and high inter-item correlation and internal consistency, high test-retest correlation, and convergent validity. Our findings are in accordance with those reported by Johansson & Berggren (12) and Moore et al. (4); however, the small number of patients in our dental fear group led to large confidence intervals.

There was a weak but significant correlation between MDAS and age ($r = 0.11$, $n = 442$,

$P < 0.05$) in the general population. Thomson et al. (23) reported that, an increase in dental anxiety prevalence was observed at age 26 years when compared with age 18 years. Women (12.3 ± 5.2) scored higher ($P < 0.05$) on the MDAS scale than men (10.9 ± 4.5). Apart from Thomson et al. (23) and Berggren & Carlsson (24) who reported no significant difference between male and female participants, our results were in agreement with previous studies (3, 4, 6–8, 16, 18, 25–27). This result may be explained by Peretz and Efrad's (10) statement that women were over-represented in neurotic categories involving anxiety and worry in various cultures. Interestingly, we found negative correlation between MDAS total score and education ($r = -0.14$). This observation is in agreement with the report of Moore et al. (4) and is in contrast with the findings reported by Haugejorden & Klock (21). Stamm et al. (28) stated that a useful working model should produce a sensitivity of ≥ 0.75 and a specificity of ≥ 0.85 . In this study, at the cut-off point ≥ 15 were 0.80, 0.74, 0.41, 0.94. These data provided acceptable sensitivity and negative and positive predictable values; however, specificity was rather low. Regular outpatient and fearful patient groups were classified by clinicians using strict clinical criteria based on observation of phobic attitude and behavior. We believe that the low specificity rate is caused by the discrepancy between anxiety level reported on a self-rating assessment instrument and the apparent fearful behavior. Thus, 25.5% of the subjects in the regular outpatient group rated above the cut-off score on the MDAS (Table 4). These patients might have been able to overcome their anxiety in the dentist's office. Factors that lead these patients to suppress their anxiety are not clear.

Similar to many previous studies (4, 10, 11, 22), the items related with injection and drilling had the highest MDAS scores (Table 5). This is reported to

Table 5. MDAS items in the general population in Turkey and comparison with different countries ($n = 442$)

	Present study ($n = 442$)	Helsinki ($n = 200$) (11)	Belfast ($n = 200$) (11)
Injection	2.6 (1.2)	1.8 (0.6)	2.7 (1.4)
Drill	2.5 (1.1)	2.2 (1.1)	2.9 (1.4)
Waiting room	2.1 (1.1)	1.8 (0.9)	2.4 (1.3)
Scale and polish	2.1 (1.1)	1.8 (1.0)	1.9 (1.3)
Visit tomorrow	2.0 (1.1)	1.7 (0.9)	2.4 (1.2)
MDAS total score	11.3 (4.7)	9.4 (3.9)	12.4 (5.9)
Cronbach's alpha	0.90	0.89	0.90

The values are expressed as mean (SD).

be due to experiencing pain on injection, prolonged length of numbness and the objectionable taste of the anaesthetic solution. The most anxiety-provoking aspect of the drill included the sensory vibrations felt during drilling, despite a local anaesthetic injection (22).

As evidenced by the finding that 23.5% of the subjects in the general population had a MDAS score above the cut-off point, that dental fear is common in Turkey. This rate is 3.00% in Helsinki (Finland) and 19.5% in Belfast (Northern Ireland) (Table 5). Although mean total scores in these three countries are close to each other, there are differences in dental anxiety prevalence between the three countries. Humphris et al. (11) compared MDAS results with those obtained using the CDAS and demonstrated that the Scandinavian respondents report lower levels of dental anxiety than English-speaking subjects. Humphris et al. (11) speculated that the differences may be due to the previous exposure of a high percentage of subjects in Helsinki to the dental hospital because of an efficient medical insurance system. The fact, that 94.2% of the Turkish participants from the general population visited a dentist at least once previously, makes this explanation for the high rate of phobic subjects rather improbable. However, it is also possible that adverse previous experiences and unrecognized difficulties in the dental health delivery system may have contributed to the high phobia prevalences in Northern Ireland and Turkey.

We believe that large-scale epidemiological studies are needed in order to illuminate the background of the widely prevalent dental fears in the general population in Turkey. This study demonstrated that being older, female, and having less education are risk factors for dental fears. Thus, dental anxiety does not reflect mental health but may be related to attitudes stemming from modifiable sociodemographic factors. It is conceivable that dental fears can be eliminated by improving education.

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