

Evidence to confirm the cut-off for screening dental phobia using the Modified Dental Anxiety Scale

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The Modified Dental Anxiety Scale (MDAS) is a brief patient self-complete questionnaire of five questions designed to assess trait dental anxiety. It has reasonable psychometric properties, low instrumental effects and can be integrated into everyday dental practice as a clinical aid and screen. A cut-off of 19 has been empirically determined, but in one previous study only. **Objective:** to determine that the cut-off value of 19 for the MDAS is confirmed to assist the identification of dental phobia. **Methods:** On line web survey of students (n = 1,108) from University of St Andrews conducted between December 2008 and March 2009. Measures included the MDAS, the Phobia Checklist and 3 questions on additional measures to assist patients. **Results:** The cut-off of 19 gave the highest joint values of sensitivity (87.5%) and specificity (89.3%). Area under the ROC curve = 0.918, 95% CI 0.900 to 0.934, $z = 6.23$, p (Area=0.5) = 0.0001. **Conclusion:** The cut-off value of 19 is confirmed as most appropriate for identifying individuals with dental phobia.

Key words: Dental anxiety, cut-off value, ROC analysis, questionnaire

INTRODUCTION

Dental anxiety is a common problem (Smith & Heaton, 2003), unpleasant for the sufferer (Kleinknect, Klepac & Alexander, 1973) interferes with the provision of dental treatment (Milgrom & Weinstein, 1993, Schuurs *et al.*, 1986) and daily life (Abrahamsson *et al.*, 2002). Individuals with high dental anxiety avoid treatment (Haugejorden & Klock, 2000; Kaakko, Getz, & Martin, 1998) or make special requests for assistance that can range from a short discussion with dental staff to general anaesthesia (Aartman *et al.*, 1999; Baker *et al.*, 2006; Lindsay, Humphris & Barnby, 1987). The challenge for dental personnel is to recognise the dentally-anxious person, to determine if treatment procedures require alteration and to help the patient receive dental care. The judicious use of some open-ended questions such as 'how do you feel about coming to the dentist' and then focusing on specific issues in response to the initial reply from the patient is an obvious but important step (Freeman & Humphris, 2006). To supplement this approach the member of the dental team might consider a standardised questionnaire to give an overall score or index of dental anxiety which can be related to aggregated population norms. A difficulty however with using such scales, in practice, is the level of dental anxiety that the patient reports before the team acknowledges that special procedures are needed to assist the patient. The use of a cut-off score for screening instruments of this type is a subject of some debate among clinicians from many disciplines, not only dentistry (Streiner & Norman, 2003). A cut-off is often difficult to jus-

tify when the assessment instrument reflects a dimension or construct. However for relatively rare conditions setting a cut-off may have certain benefits. The cut-off is simply a short hand for users of such scales to help identify individuals, in this case dental phobia.

Within dentistry the use of brief psychometric instruments for routine clinical assessment has not gained extensive support. This may be due to a number of factors. First, some dentists, for instance, are concerned that asking questions about dental anxiety may exacerbate the problem and alert patients to their feelings and make matters worse by compromising the patients' ability to cope (Dailey, Humphris & Lennon, 2001). The evidence to support this, however, is weak and contrary to this belief is the important work that shows if patient concerns are not addressed within a consultation the likelihood is that patients become more anxious (Maguire *et al.*, 1996). Secondly, a small number of studies have confirmed that the effect of completing a dental anxiety questionnaire has no significant effect on state anxiety (Carlsen *et al.*, 1993; Humphris, Clarke & Freeman, 2006; Humphris & Hull, 2007; Kent, 1986) and may even prove a benefit to patient well being (Dailey, Humphris & Lennon, 2002). Another key issue for dentists is the time taken for patients to complete a dental anxiety questionnaire. Add to this the viewing of the replies by the dental team and their interpretation, increases the possible resistance to include this 'instrumentation'. On close inspection of the literature however there is no evidence to quote that indicates the duration of completion of an anxiety scale

or the reading time to comprehend the respondent's answers. Hence, this potential burden of delay in progressing with the dental examination or treatment is difficult to estimate. Finally, dentists are not familiar with analysing individual responses to dental anxiety measures and consequently may prefer not to embark on such a process. Therefore with practice and minimal training the inclusion of routine anxiety assessment may reduce overall contact time between patient and dentist as patients welcome the opportunity to remind their dentist that they find a particular aspect of the dental visit challenging due to their anxiety level.

The derivation of a cut-off or a point along a numerical scale that indicates a condition is favoured by some clinicians as a time-saving indicator to determine whether a patient may be likely to possess a rare condition. Such an approach has been applied to other measures of psychological distress such as the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983). Another example is the Distress Thermometer (a single question item) which has been adopted by teams within oncology clinics and is currently being piloted. It has attracted some cautionary comment mainly because of the issue of an appropriate cut-off to apply (Mitchell, 2007). Similar concerns are raised with dental anxiety measures. Various cut-offs (≥ 12 , ≥ 13 or ≥ 15) have been applied to indicate highly anxious individuals using the Corah Dental Anxiety Scale (Corah, Gale & Illig, 1978; Thomson et al., 2009) More recently this dental anxiety scale was changed with the addition of a single question on local anaesthesia, a simplified answering scheme consistent across all items. The renamed measure: the Modified Dental Anxiety Scale (MDAS) has been used with many community and clinical samples (Humphris, Morrison & Lindsay, 1995). Norms are available for the UK (Humphris, Morrison & Lindsay, 1995) which have been recently updated (Humphris, Dyer & Robinson, 2009). An empirically derived cut-off level to identify those with sufficiently high dental anxiety to warrant additional help from a specialist has been proposed (Humphris, Morrison & Lindsay, 1995).

At present, however the appropriateness of 19 as the cut-off value for dental phobia remains uncertain, as the evidence was derived from a single study in north west England (Humphris, Morrison & Lindsay, 1995). Those that scored at or above 19 were more likely to have been referred for specialist treatment at a dental phobia clinic within a dental hospital. Further empirical investigation was warranted to generalise this finding. Hence the aim of this study was to confirm the cut-off value of 19 as appropriate to help identifying the dental phobic.

METHODS

Design

An on-line survey was undertaken between December 2008 to March 2009 using a questionnaire constructed for interactive single item presentation to a University student sample.

Sampling

Undergraduate and taught postgraduate students voluntarily participated via an online "Dental Anxiety Questionnaire"

link on the WebCT 6.0 virtual learning program. Further advertising was included within the weekly university memos and a pop-up window in the WebCT 'Campus Announcements' menu. Entry into two £25 voucher prize draws, separately conducted on 31 January 2009 and 31 March, 2009, was offered upon participation and submission of contact details. Data was collected from December 2008 until March 2009.

Measures

The MDAS instructs participants to rate their emotional reaction to the prospect of a dental visit the day previous, then when in the waiting room, receipt of drilling, scaling and a local anaesthetic injection. The MDAS uses a simple rating scale with 5 possible responses to each question. The responses range from 'not anxious' (scoring 1) to 'extremely anxious' (scoring 5). Reliability of the English language version of the MDAS is good (internal consistency= 0.89; test-retest= 0.82). The scale can be downloaded: <http://medicine.st-andrews.ac.uk/supplemental/humphris/dentalAnxiety.htm>.

The Phobia Checklist was adapted from the DSM-IV-TR criteria for specific phobia (American Psychiatric Association, 2000) and consists of the following questions:

- (i) I have a fear of dental treatment or withstand the dental treatment with intense fear;
 - (ii) I avoid or give up things because of this fear;
 - (iii) This fear is excessive or greater than justified; and
 - (iv) The anxiety or avoidance interferes significantly with daily functioning.
- (Oosterink, de Jongh & Hoogstraten, 2009).

Affirmation of all questions is assumed to indicate the presence of specific dental phobia. This measure has been validated with the Structured Clinical Interview for DSM-IV (SCID (First *et al.*, 1996)) as being a suitable screening measure for dental phobia. These results indicated excellent sensitivity (0.95) and specificity (0.99), with an overall hit rate of 97%. The current study re-worded the first statement (i) to: "I have a fear of dental treatment or I am able to withstand the dental treatment but with intense fear," in order to clarify the intended meaning.

Procedure

This cross-sectional survey could be accessed via a link ('Dental Anxiety Questionnaire') on participants' WebCT course lists. The introductory page contained all participant information, including the fact that completion of the questionnaire would act as their informed consent. Two links were provided underneath entitled, "Complete Questionnaire Now!" and "Debriefing Form & Prize Entry." Participants clicked on the first link, completed the questionnaire, returned to the introduction page and submitted their details via the second link if they wished to do so. Multiple completion by the same participant was prevented by internal software integrated into the web-based system. Contact details for the project supervisor were presented on the introduction page. Contact details of the University student support

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service, local GPs and other professional organisations (e.g. NHS24) were included on the debriefing webpage.

Statistical analysis

Data were initially analysed using SPSS v16, and reliability analysis conducted with FACTOR (Lorenzo-Seva & Ferrando, 2006). Means and standard deviations were calculated across the major demographic factors. A cut off of 19 has been advocated previously, as the level for which it is likely that a dental practitioner would consider using additional approaches to manage the patient such as relaxation, systematic desensitisation or pharmacological adjunct. The percent of individuals who scored 19 and above was calculated across the demographic and behavioural variables. Cross tabulations were performed with categorical variables. Receiver operator characteristic (ROC) curve analysis (Zweig & Campbell, 1993) was performed with the Phobia Checklist assigned as the criterion variable (1 = case, 0 = not a case) and the MDAS total score as the measure under investigation using MedCalc® for Windows, v10.3.1 (MedCalc Software, Mariakerke, Belgium).

Ethical approval was obtained from the University Teaching and Ethics Committee (UTREC) at the University of St Andrews, Fife.

RESULTS

A total of 1,168 questionnaires were submitted, 60 had missing data and were excluded from data analysis. The remaining sample contained 1,108 full time undergraduate and taught postgraduates, representing 16.6% of the total undergraduate and taught postgraduate population (N = 6,649) enrolled at the University of St Andrews, 2008-2009 (Table 1).

The present sample contained 754 females and 354 males (68% and 32%, respectively). The total population enrolled during the 2008-09 academic year contained 3,837 females and 2,812 males (58 % and 42%, respectively). The female:male ratio of the current study was therefore higher than the total population (Table 2).

The survey completion was excellent with no missing values for the MDAS questionnaire. Some respondents did not feel able to supply their age or social class, although this was limited to less than 1% of the sample. The internal consist-

Table 1. Frequency breakdown and N size for respondents including MDAS total score means (SD) and percent ≥ 19

	N	%	Mean	SD	% 19+
Total	1108	100	12.28	4.42	11.2
Gender					
Male	354	31.9	11.19	4.10	6.8
Female	754	68.1	12.78	4.48	13.3
Age (years)					
16-25	1040	93.9	12.26	4.38	11.2
26-40	46	4.2	12.09	4.74	8.7
41+	22	2.0	13.59	5.65	18.2
Faculty of study					
Arts	592	53.4	12.40	4.32	10.6
Science	419	37.8	12.01	4.50	11.0
Divinity	29	2.6	13.97	5.05	27.6
Medicine	67	6.0	12.16	4.44	10.4
Refused	1	0.1			
Region of Origin					
UK	781	70.5	12.63	4.54	13.2
EU (excluding UK)	116	10.5	11.26	3.95	5.2
USA/Canada	137	12.4	10.99	3.70	4.4
Elsewhere	73	6.5	12.55	4.52	12.3
Refused	1	0.1			

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Table 2 Item frequency breakdown of MDSA across male and female samples

Male											
Question	Visit Tomorrow		Waiting Room		Use of drill		Scale and polish		Injection		
	N	%	N	%	N	%	N	%	N	%	
Not anxious	175	49	149	42	28	8	164	47	64	18	
Slightly anxious	117	33	110	31	99	28	115	33	115	33	
Fairly anxious	44	12	66	19	116	33	47	13	81	23	
Very anxious	14	4	23	7	77	22	22	6	55	16	
Extremely anxious	4	1	6	2	34	10	6	2	38	11	
Base N	354	100	354	100	354	100	354	100	354	100	
Female											
Not anxious	289	38	175	49	38	5	322	43	70	9	
Slightly anxious	280	37	117	33	145	19	225	30	176	23	
Fairly anxious	105	14	44	12	213	28	146	19	193	26	
Very anxious	54	7	14	4	211	28	43	6	156	21	
Extremely anxious	26	3	4	1	147	20	18	2	159	21	
Base N	754	100	754	100	754	100	754	100	754	100	

Table 3 Dental phobic checklist

Item No.	Item wording	Yes %	No %
1	I have fear of dental treatment or I am able to withstand dental treatment but with intense fear	21.7	78.3
2	I avoid or give up things because of this fear	8.8	91.2
3	This fear is excessive or greater than justified	16.9	83.0
4	The anxiety or avoidance interferes significantly with daily functioning	3.0	97.0
	'Yes' to all four questions	0.7	99.3

ency coefficient of the scale was excellent (0.929, 95%CI 0.919, 0.933).

Of the 1,108 respondents it was found that there were eight classified as dentally phobic, that is they answered affirmative to all of the Dental Phobia Checklist items. There was only one person from these eight respondents who did not score 19 or above. On close inspection this single individual had a total MDAS score of 13. The item: local anaesthesia was scored 'extremely anxious'. It was found that there were eight (0.72%) classified as dentally phobic identified by the Phobia Checklist (Table 3).

The cut-off of 19 gave the highest joint average values of sensitivity (87.5%) and specificity (89.3%) (Table 4). The area under the ROC curve = 0.918, 95% CI 0.900 to 0.934, $z = 6.23$, p (Area=0.5) = 0.0001 (Figures 1 and 2). Therefore a randomly

selected patient from the phobic group has a test value larger than that for a randomly chosen patient from the non phobic group 92% of the time (Zweig & Campbell, 1993). The true (population) value lies within 90 and 93%. The positive predictive value (PPV) was 0.06 (Altman & Bland, 1994).

DISCUSSION

The primary aim of this study was to investigate the suitability of the MDAS cut-off value for identifying those with dental phobia. This was the first study to assess the ability of the MDAS to discriminate between those who are flagged up as dentally phobic or not according to the Phobia Checklist - a screening tool, for a community non-patient sample. Findings demonstrated that the MDAS was good at detect-

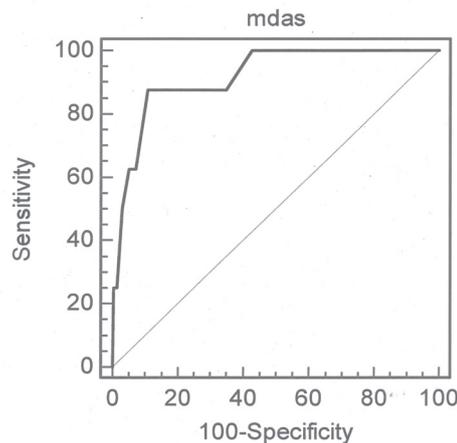
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Table 4 MDAS total scores with sensitivity and specificity presented (95% CIs) at each score value

Criterion	Sensitivity	95% CI	Specificity	95% CI
>12	100.00	62.9 - 100.0	57.09	54.1 - 60.0
>13	87.50	47.4 - 97.9	64.87	62.0 - 67.7
>14	87.50	47.4 - 97.9	72.55	69.8 - 75.2
>15	87.50	47.4 - 97.9	78.68	76.1 - 81.1
>16	87.50	47.4 - 97.9	81.70	79.3 - 84.0
>17	87.50	47.4 - 97.9	86.00	83.8 - 88.0
>18*	87.50	47.4 - 97.9	89.30	87.3 - 91.1
>19	62.50	24.7 - 91.0	92.96	91.3 - 94.4
>20	62.50	24.7 - 91.0	94.97	93.5 - 96.2
>21	50.00	16.0 - 84.0	97.07	95.9 - 98.0
>22	25.00	3.9 - 65.0	98.54	97.6 - 99.2
>23	25.00	3.9 - 65.0	99.09	98.3 - 99.6
>24	25.00	3.9 - 65.0	99.73	99.2 - 99.9
>25	0.00	0.0 - 37.1	100.00	99.7 - 100.0

* denotes cut-off

Figure 1 Receiver Operator Characteristic diagram displayed for MDAS total score with Phobia Checklist screen as 'gold standard' (dotted line denotes scale response with no predictive power, i.e. Area Under Curve = 0.5)



ing dental phobia with the recommended cut-off of 19. This supports previous research (Humphris *et al.*, 1995) that determined the original MDAS cut off.

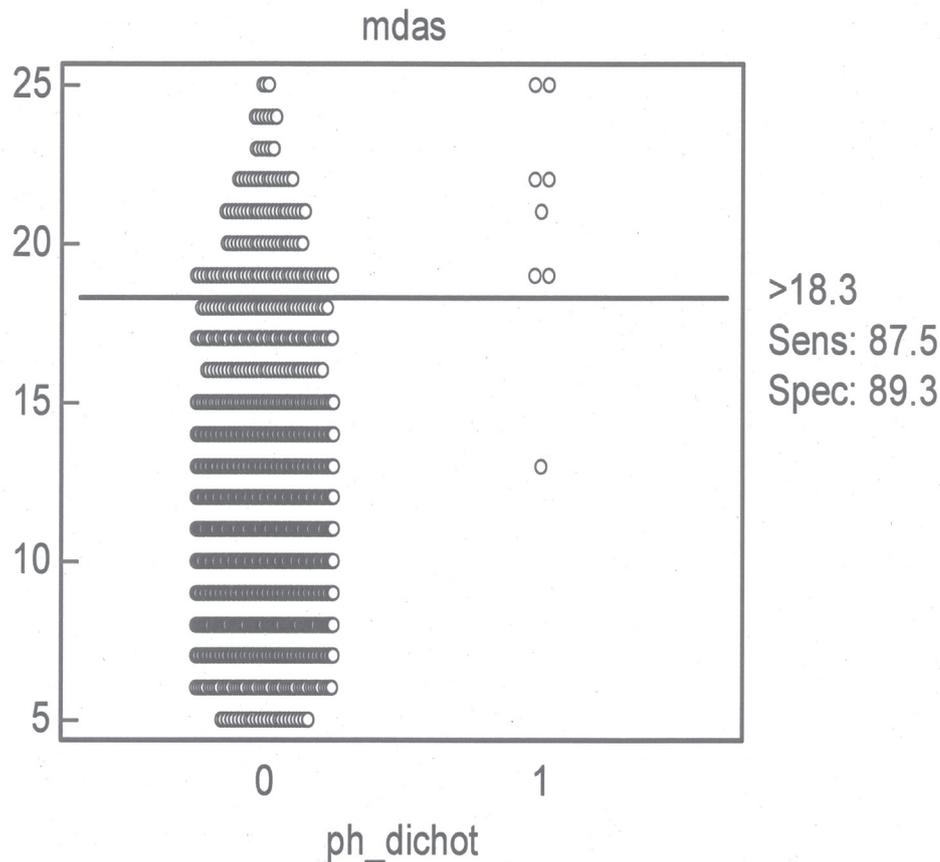
An identical cut off value parallels additional findings from this study with previous studies that have employed the MDAS. This includes the demonstration of good psychometric properties for the MDAS across a range of countries (Acharya, 2008; Coolidge *et al.*, 2008; Coolidge, Chambers, Garcia *et al.*, 2008; Tunc *et al.*, 2005). Also included are the differences observed across demographic variables, such as gender and age. In the current study 13% of women scored above the MDAS cut off, in comparison to almost 7% of men. This corresponds with the gender differences observed across MDAS scores in other studies from the UK (Humphris, Dyer & Robinson, 2009) and elsewhere (Coolidge, Chambers, Garcia *et al.*, 2008; Tunc, Firat, Onur *et al.*, 2005; Yuan *et al.*, 2008). Dental staff should note that extra vigilance may be required with female patients because they are twice as likely to report a

score of 19 or above than males.

The breakdown of MDAS scores showed that the drilling and local anaesthetic items on average attracted higher anxiety ratings than the other three items (anticipated visit, waiting room, scaling). Moreover, the total MDAS scores for each of the visit, waiting room and scaling items all equalled less than a quarter of those found with the drilling and local anaesthetic items. This occurred with both genders and demonstrates that anxiety levels can vary extensively across different types of dental treatment. The high anxiety levels attributed to the local anaesthetic item also provide further support for its inclusion within the MDAS (Humphris, Morrison, & Lindsay, 1995). Overall, this study has shown that the MDAS would be an appropriate tool for measurement of patients' dental anxiety within the dental setting. This is advocated by the high internal consistency of the MDAS shown here and across other studies (Coolidge, Chambers, Garcia *et al.*, 2008; Newton & Edwards, 2005). Furthermore,

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Figure 2 Dot plot of MDAS total score data points (circle) split across screening for dental phobia using the Phobia Checklist, with MDAS cut-off value of 19 displayed (Sens: sensitivity; Spec: specificity)



pre-treatment completion of the MDAS should increase the likelihood that patients receive optimal levels of care suited to their anxiety profiles.

The use of a screening instrument for identifying dental phobic patients should be applied with some caution. The Phobia Checklist uses the criteria as specified by the DSM-R classification of phobic states. The previous study by Oosterink *et al.* identified 1.7% of their dental practice sample as dentally phobic. The current study selected a student group as the investigators believed that they would be of a young age when typically dental anxiety is most prevalent. In addition, we expected the university students to have little difficulty in reading and understanding the checklist items. The level of dental phobia identified in this student sample was low in comparison to community surveys of phobia prevalence (Becker *et al.*, 2007; Depla *et al.*, 2008). For example, the prevalence of dental phobia in almost 2,000 Dutch residents was 3.7% (Oosterink, de Jongh, & Hoogstraten, 2009). Possible reasons for not finding higher levels of dental phobia include: the checklist is stringent and set to identify only those with

clear dental phobia; those with dental phobia avoided the advertised request to participate in the study.

The evidence from this study is supportive of the MDAS providing the researcher and dental practitioner with a validated tool to identify patients who do *not* possess dental phobia when such patients score below 19. The very rare patient who presents with dental phobia below the cut off is likely to demonstrate injection or needle phobia that has not generalised to the other aspects of the dental experience. Patients who scored 19 or above are highly dentally anxious but not necessarily dental phobic as shown by the low PPV. Further evidence to confirm dental phobia would be required through a structured clinical interview with a particular focus on the level of avoidance that the patient has demonstrated to receive dental examination or treatment. The low level of dental phobia revealed in this study using the Phobia Checklist suggests that the criterion is set high (as already mentioned above). Confirmation of the phobia level would be advisable from further representative samples and perhaps even consideration of the suitability of the Phobia Checklist. Deriv-

ing and selecting a 'gold standard' for clinically defining a 'condition' is a notoriously difficult task especially when the condition is rare. The Phobia Checklist was chosen however as the DSM system has the advantage of explicitly detailing the features that the majority of clinicians would agree an Axis 1 condition such as phobia to possess. Hence alternative psychometric systems in existence may use unwittingly a criterion that is set at the lower bound.

Psychometric research of this nature to provide the scale user with additional information about the scale's behaviour is an important endeavour as interpretation of the scale values derived from respondents may assist in the clinical management and decision making for patients. Empirical evidence is required to demonstrate that using dental anxiety scales such as the MDAS does provide a measurable benefit in patient outcome.

This study is the first to report the use of the MDAS via a web-based system. There were no missing data from the respondents to the five items of the scale confirming the positive results from other studies that have compared paper and web-based version of health assessments (Graham & Papanonatos, 2008; Ritter *et al.*, 2004). Evidence shows that internet versus mailed questionnaires are similar in reliability (Vallejo *et al.*, 2007). The MDAS in this study showed clear unidimensionality which parallels the recent finding from the paper based English version (Humphris, Dyer, & Robinson, 2009). Reports from studies that have formally tested differences between the electronic and traditional methods of data collection present fairly consistent results. Psychology students in Spain were found to have equivalent factor structures of the General Health Questionnaire (GHQ28) but not the Symptom Checklist (Ahern, 2007). A further report confirmed using the new technology in assessing health conditions via the web (Bressani & Downs, 2002) compared with pencil and paper version of life skills measures. Additional work to make direct comparison between these various methods of MDAS completion is indicated, although preliminary evidence is supportive of comparability of psychometrics.

CONCLUSIONS

This new data set has determined that the MDAS showed high reliability, and was discriminative of dental phobia using a 19 cut-off value. The cut-off was highly consistent with identifying those who were not dentally phobic.

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