Reliability and validity of a faces version of the Modified Child Dental Anxiety Scale

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Background. A new version of the Modified Child Dental Anxiety Scale (MCDAS) was formed by adding a faces rating scale to the original numeric form.

Aims. To describe the psychometric properties of the faces version of the Modified Child Dental Anxiety Scale (MCDAS_f), and to provide normative data for dental anxiety for children using the MCDAS_f. **Design.** To determine the test–retest reliability, 287 schoolchildren aged 8–10 years completed the MCDAS_f on two separate occasions 17 weeks apart. To determine the criterion validity, 207 schoolchildren aged 10–12 years completed the MCDAS_f and the

Introduction

Self-report measures are frequently used in the assessment of dental anxiety. One advantage of self-report measures is the ease of administration, taking a relatively short period of time to complete. They can also assess the reaction to different aspects of the dental experience. Corah's Dental Anxiety Scale (CDAS)¹ is one of the most frequently used methods of dental anxiety assessment in adults. When applied to children the wording of the CDAS is considered too complex and modified versions of the scale are used²⁻⁴. The Modified Child Dental Anxiety Scale (MCDAS) was thus (developed by Wong *et al.*⁵) based on CDAS¹. The MCDAS includes eight questions to assess dental anxiety about specific dental procedures. The scale includes a question CFSS-DS at the same sitting. Construct validity was assessed using a cohort of 206 consecutive child dental patients and their parents.

Results. The MCDAS_f showed good test–retest reliability (intraclass correlation coefficient = 0.80) and internal consistency (Cronbach's alpha = 0.82). The MCDAS_f significantly correlated with the CFSS-DS (r = 0.80, P < 0.001). Dental anxiety assessed using the MCDAS_f was related to the dmft (t = -2.17, P = 0.03), DMFT (t = -4.19, P < 0.001), and dental general anaesthetic experience (t = -4.46, P < 0.01). The mean MCDAS_f score for the normative sample (n = 475) was 19.81 (95% CI: 19.20, 20.43). **Conclusions.** The MCDAS_f is a reliable and valid measure of dental anxiety in children aged 8–12 years.

about local anaesthetic, and other dental procedures that may distress children, such as extraction, dental general anaesthesia (DGA), and relative analgesia (RA)⁶. A five-point Likert scale is used to assess dental anxiety with scores ranging from 'relaxed/not worried' (1) to 'very worried' (5). Total scores on the MCDAS range from 5 (little or no dental anxiety) to 40 (extreme dental anxiety). The measure has been demonstrated to be unidimensional; that is, a single construct⁵.

The MCDAS has been used in 8- to 15-yearolds and has been shown to be a reasonable measure of child dental anxiety exhibiting good internal consistency and validity^{5,7,8}. Normative data are available for both English⁵ and Greek–Cypriot schoolchildren⁷. Although the MCDAS has shown increased rates of full completion in comparison to the CFSS-DS^{5,7}, Buchanan⁸ reported improved completion rates with the Smiley Faces Program (SFP), a computerized dental anxiety scale; when compared to the CFSS-DS and the MCDAS, this may suggest that numeric rating scales may be too difficult for anxious or younger

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children to understand and complete.

A numeric rating scale is usually understood by children who are capable of good cognitive functioning; however, under the potentially anxiety-provoking environment of the dental situation the child may regress and experience a lowering of their cognitive ability⁹. With a reduction in cognitive functioning the MCDAS may be more difficult for the regressed child to understand. A further disadvantage of self-report measures with a numeric rating scale is their unsuitability in the assessment of dental anxiety in the very young.

In order to overcome these potential difficulties a pictorial version of the CDAS was developed for use in 7- to 9-year-old children, substituting pictorial response cards for the original response scale³, while a moveable barometer was devised to assist younger children in completing the Children's Fear Survey Schedule-Dental Subscale (CFSS-DS)¹⁰. Limited information is available for the reliability and validity of the pictorial modification of the CDAS and the barometer version of the CFSS-DS. Other assessments adopting a faces approach include the Facial Image Scale (FIS)¹¹, the DA5¹², and a computerized Smiley Faces Program (SFP)⁸. The Facial Image Scale has been validated in the assessment of anxiety in children immediately prior to entering the dental surgery¹¹. This scale is limited by the single item construct which may make it difficult to identify the construct of anxiety being measured¹³. The DA5 is a dental anxiety scale designed specifically for use with 5-year-old children¹². Responses are given using a fouritem face rating scale. Some evidence has been presented for the reliability and validity of the DA5; however, its application is limited to vounger children. More recently, a promising four-item computerized SFP has shown good reliability and criterion validity⁸; however, this method is likely to be limited by the need for access to computer equipment.

Therefore, there remains a need for a simple but reliable and valid means of assessing dental anxiety in the young and/or nervous child. The MCDAS appears to be a useful measure of dental anxiety in this regard. It is, however, limited by the level of cognitive functioning required to complete the numeric rating scale. It would seem reasonable that the inclusion of faces to correspond to the Likert scale could be useful in assessing dental anxiety in the young as well as the anxious older child. Therefore, there is a need to modify the MCDAS with the addition of a faces analogue scale anchored above the original numeric form (Fig. 1) to allow for any decrease in age adequate functioning and cognitive function-

For the next eight questions I would like you to show me how relaxed or worried you get about the dentist and what happens at the dentist. To show me how relaxed or worried you feel, please use the simple scale below. The scale is just like a ruler going from 1 which would show that you are relaxed, to 5 which would show that you are very worried.

	·····,···.,···.,···.,	
1	would mean : relaxed / not worried	

- 2 would mean : very slightly worried
- 3 would mean : fairly worried
- 4 would mean : worried a lot
- 5 would mean : very worried

treatment but cannot put you to sleep?

How do you feel about	•	••	••	••	
going to the dentist generally?	1	2	3	4	5
having your teeth looked at?	1	2	3	4	5
having your teeth scraped and polished?	1	2	3	4	5
having an injection in the gum?	1	2	3	4	5
having a filling?	1	2	3	4	5
having a tooth taken out?	1	2	3	4	5
being put to sleep to have treatment?	1	2	3	4	5
having a mixture of 'gas and air' which will help you feel comfortable for					

1

2

З

Δ

5

Fig. 1. Faces version of the Modified Child Dental Anxiety Scale (MCDAS_f). ing as a consequence of the anxiety provoking environment of the dental situation⁹. Before any new measure can be applied it is essential to ensure that the scale measures what it purports to measure by an assessment of its validity, and that it does so in a stable and reproducible function, i.e. that the measure is a reliable one¹⁴ (Table 1).

The aim of this study was to evaluate the psychometric properties of the faces version of the Modified Child Dental Anxiety Scale (MCDAS_f), including the reliability, criterion and construct validity as well as providing normative data for children for the MCDAS_f.

Method

Reliability study

Sample. In order to determine the test–retest reliability of the MCDAS_f a nonprobability sample of 287, 8- to 10-year-old schoolchildren from greater Belfast were invited to take part. To assess the test–retest reliability the MCDAS_f was completed by participants on two separate occasions 17 weeks apart. The age and gender of the participants was recorded on all questionnaires, which were completed under standardized conditions during class.

Statistical analysis. The data were entered to SPSS version 12.0.1 and subjected to intraclass correlation coefficient and *t*-tests in order to assess test–retest reliability.

Criterion validity study

Sample. To investigate the criterion validity of the $MCDAS_f$ a nonprobability sample of 207, 10- to 12-year-old schoolchildren were invited

to complete the MCDAS_f and the CFSS-DS at the same sitting. The age and gender of the participants was recorded on all question-naires, which were completed under standard-ized conditions during class.

Statistical analysis. The data were entered to SPSS version 12.0.1 and subjected to Pearson correlation coefficient in order to assess criterion validity.

Construct validity study

Sample. A convenience sample of 206 consecutive new child patients and those attending for a recall course of treatment at a university dental hospital were invited to take part along with the accompanying adult in order to determine the construct validity of the MCDAS_f. Children were included if they were aged between 5 and 10 years, had been referred for dental care or continuous care, and had no disclosed learning difficulty. The parents completed a dental health questionnaire relating to demographic information and previous dental experiences. Parents reported the child's previous exposure to DGA. The participants' gender, age, and source of referral were recorded. The participants completed the MCDAS_f prior to any treatment or examination being undertaken. A clinical examination was conducted, without the use of probes, to detect caries into dentine $(d_{3cv}mft/D_{3cv}MFT \text{ level})$.

In order to assess the construct validity of the MCDAS_f participants referred for dental anxiety were considered to have high dental anxiety, whereas all other referrals were considered to have low dental anxiety. In order to assess the construct validity of the MCDAS_f, the relationship of dental anxiety to previous

Table 1.	Reliability	and	validity.
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Reliability	The ability of a scale to measure in a stable and reproducible fashion ¹⁴ .
Validity	
Criterion	The comparison of a new scale to a 'gold standard'. This may be <i>concurrent</i> where the 'gold standard' and the new measure scales are administered at the same time ¹⁴ .
Construct	Tests that the construct under investigation is correct. The scale should be able to discriminate between groups, e.g. dentally anxious and non-dentally anxious ¹⁴ . Scores should be related to other variables to which prior investigation suggests the construct to be related ¹⁴ .

dental experience, specifically obvious decay experience (d_{3cv} mft, D_{3cv} MFT) and DGA experience was also assessed.

Statistical analysis. The data were entered to SPSS version 12.0.1 and subjected to t-tests in order to examine the relationship of dental anxiety to referral type, obvious decay experience and DGA experience.

Normative study

Sample. Data from all school children who had completed the MCDAS_f on one occasion in the test–retest or criterion validity study were used to provide normative data for a child population.

Statistical analysis. The previously entered data were subjected to Cronbach's alpha to assess internal consistency.

Ethical considerations

Ethical approval was obtained from the Queen's University Research Ethics Committee. Before entering the study, each parent and child received written information explaining the study design and affirming that participation was voluntary. Written consent from both parent and child was obtained for inclusion.

Results

Test-retest reliability

Sample. Two hundred and eighty-seven children (191 girls) were sampled. Two hundred and forty participants aged 8–10 years with a mean age of 9.27 (95% CI: 9.18, 9.35), who had completed the MCDAS_f on two separate occasions were included in the statistical analysis. Thirty-five participants were excluded as they were only present on one administration of the MCDAS_f, and a further 12 were excluded due to missing values. This gave a response rate of 84%.

Findings. The MCDAS_f score was statistically significantly greater at the first administration [19.87 (95% CI: 19.06, 20.68)], than the second [19.08 (95% CI: 18.21, 19.96)]

(*t* = 2.25, *P* = 0.03). The intraclass correlation coefficients demonstrated good to excellent correlation with scores ranging from 0.60 to 0.83 for the individual items of the MCDAS_f between the first and second assessments. The intraclass correlation coefficient for the mean overall score for the MCDAS_f was 0.80 between the first and second assessments.

Criterion validity

Sample. All 207 who were invited to participate in the study took part. Eighteen participants were excluded due to missing values, giving a final response rate of 91%. One hundred and eightynine participants (86 girls) aged 9–12 years with a mean age of 11.43 (95% CI: 11.32, 11.55), were included in the statistical analysis.

Findings. The mean overall score for the MCDAS_f was 19.77 (95% CI: 18.72, 20.83), with a range of scores from 8 to 39. The mean overall score for the CFSS-DS was 31.46 (95% CI: 29.77, 33.15), with a range of scores from 15 to 68. The mean overall scores for the MCDAS_f and the CFSS-DS were highly statistically significantly correlated ($r_p = 0.80$, P < 0.001), with the MCDAS_f explaining over 60% of the CFSS-DS score variance.

Construct validity

Sample. Two hundred and six children attending a University Department of Paediatric Dentistry were invited to take part. Six were excluded due to missing values (four on parent questionnaire, two children consented and then refused to complete the scale), giving a final response rate of 97%. Two hundred children with a mean age of 7.98 (95% CI: 7.77, 8.19) were included in the analysis: 24 were aged 5 years; 29, aged 6 years; 45, aged 7 years; 46, aged 8 years; 38, aged 9 years; and 18, aged 10 years.

Forty-two per cent (84) of the participants had been referred for the management of dental anxiety, of which 39% (33) were boys. Fifty-eight per cent (116) of the participants had been referred for non-dental-anxietyrelated conditions, of which 60% (70) were boys. There was a statistically significantly greater proportion of boys in the non-anxiety referral group ($\chi^2_{[1]} = 8.65$, *P* = 0.003). There was no statistically significant difference between the mean age of participants who had been referred for dental anxiety [7.84 (95% CI: 7.50, 8.18)], and those who had been referred for non-anxiety reasons [8.08 (95% CI: 7.81, 8.35)] (*t* = -1.14, *P* = 0.26). Forty per cent (79) of the participants had experience of DGA.

Findings. The participants who had been referred for dental anxiety [25.33 (95% CI: 24.00, 26.67)] had a statistically significantly greater mean overall score than those who had been referred for non-anxiety reasons [20.00 (95% CI: 18.94, 21.06)] (t = 6.28, P < 0.001) as assessed by the MCDAS_f. The participants who had been referred for dental anxiety had statistically significantly greater mean scores than non-anxiety referrals for all items on the MCDAS_f, except DGA. There was a tendency for the participants who had been referred for dental anxiety to have a higher mean score for the item DGA (Table 2).

The sample was divided on the basis of a

median split for the variables d3cvmft and D_{3cv}MFT. One hundred and nine participants with a d_{3cv}mft of 5 or less were considered to have low obvious decay experience, whereas 90 participants had high obvious decay experience with a d_{3cy}mft greater than or equal to 6. Participants in the high d_{3cy} mft group had a statistically significant greater mean overall score for dental anxiety assessed by the MCDAS_f [23.35 (95% CI: 22.04, 24.66)], than those in the low d_{3cv} mft group [21.35 (95% CI: 20.11, 22.60)] (t = -2.17, P = 0.03). One hundred and fourteen participants with a D_{3cv}MFT of 1 or less were considered to have low obvious decay experience, whereas 68 participants had high obvious decay experience with a D_{3cv}MFT greater than or equal to 2. Participants in the high D_{3cv}MFT had a statistically significant greater mean overall score for dental anxiety assessed by the MCDAS_f [24.66 (95% CI: 23.03, 26.29)], than those in the low $D_{3cy}MFT$ group [20.68 (95% CI: 19.58, 21.77)] (t = -4.19, P < 0.001). Participants with DGA experience had a statistically significant greater mean score for dental anxiety assessed by the

	Mean	95% CI	t	Р
Mean overall score				
Anxiety referral $(n = 84)$	25.33	24.00, 26.67	6.28	< 0.001
Non-anxiety referral $(n = 116)$	20.00	18.94, 21.06		
Dentist generally				
Anxiety referral ($n = 84$)	2.57	2.29, 2.86	5.60	< 0.001
Non-anxiety referral ($n = 116$)	1.68	1.51, 1.85		
Teeth looked at				
Anxiety referral ($n = 84$)	1.99	1.76, 2.22	2.51	0.01
Non-anxiety referral ($n = 116$)	1.66	1.51, 1.80		
Scraped and polished				
Anxiety referral ($n = 84$)	3.11	2.79, 3.43	3.60	< 0.001
Non-anxiety referral ($n = 116$)	2.44	2.23, 2.65		
Injection in the gum				
Anxiety referral ($n = 84$)	4.06	3.75, 4.37	3.15	0.002
Non-anxiety referral ($n = 116$)	3.42	3.26, 3.68		
Filling				
Anxiety referral ($n = 84$)	3.31	3.00, 3.61	4.66	< 0.001
Non-anxiety referral ($n = 116$)	2.41	2.16, 2.65		
Tooth taken out				
Anxiety referral $(n = 84)$	4.04	3.75, 4.32	3.33	< 0.001
Non-anxiety referral ($n = 116$)	3.37	3.10, 3.64		
DGA				
Anxiety referral ($n = 84$)	3.10	2.73, 3.47	1.97	0.05
Non-anxiety referral ($n = 116$)	2.64	2.35, 2.92		
RA				
Anxiety referral $(n = 84)$	3.17	2.84, 3.49	3.68	< 0.001
Non-anxiety referral ($n = 116$)	2.39	2.12, 2.66		

Table 2. Comparison of individual item scores on the MCDAS_f by referral type.

DGA, dental general anaesthesia; RA, relative analgesia.

MCDAS_f [24.66 (95% CI: 23.37, 25.95)] than those with no DGA experience [20.66 (95% CI: 19.50, 21.82)] (t = -4.46, < 0.001).

Normative data

Sample. Overall, 494 schoolchildren aged 8–12 years completed the $MCDAS_f$ at a single administration. Four hundred and seventy-five children aged 8–12 years with a mean age of 10.18 (95% CI: 10.07, 10.30) were included in the statistical analysis.

Findings. The mean overall score on the MCDAS_f was 19.81 (95% CI: 19.20, 20.43), the mean overall scores for each age group are presented in Table 3. The individual item scores are presented in Table 4. The greatest level of dental anxiety was expressed on the item 'having an injection in the gum'. A receiver operating characteristic (ROC) curve was plotted using the participants' scores who had been referred for dental anxiety (included in the construct validity study) as the criterion group and the normative data as normals in order to determine

Table 3. Mean overall score by age group for normative sample completing the $\ensuremath{\mathsf{MCDAS}}_{\ensuremath{\mathsf{f}}\xspace}$.

	n	Mean	95% CI
Mean overall score	475	19.81	19.20, 20.43
Normative sample			
8-year-olds	30	21.37	18.91, 23.82
9-year-olds	140	19.44	18.40, 20.49
10-year-olds	139	19.79	18.69, 20.89
11-year-olds	45	19.64	17.51, 21.78
12-year-olds	121	19.95	18.56, 21.34

Table 4. Individual item mean scores for normative sample completing the MCDAS_f.

n = 475	Mean	95% CI
Mean overall score	19.81	19.20, 20.43
Dentist generally	1.63	1.54, 1.71
Teeth looked at	1.51	1.44, 1.59
Scraped and polished	2.35	2.24, 2.45
Injection in the gum	3.51	3.39, 3.63
Filling	2.39	2.27, 2.51
Tooth taken out	3.08	2.95, 3.21
DGA	2.69	2.56, 2.83
RA	2.65	2.52, 2.78

DGA, dental general anaesthesia; RA, relative analgesia.

the sensitivity and specificity of the MCDAS_f. When a cut-off point of 26 was adopted the sensitivity and specificity at this level were 51% and 79%, respectively. The internal consistency for the MCDAS_f using the normative sample population (n = 475), indicated a high level of reliability (Cronbach's alpha = 0.82). An exploratory factor analysis was completed. Fiftyfive per cent of the variance in the data was explained by the two Factors 1 (eigenvalue 2.66: variance 33.3%) and 2 (eigenvalue 2.08: variance 26.0%) following Varimax rotation. When each of the feared dental items was correlated as a function of the statistically significant Factors of 1 and 2, two groups emerged. Factor 2 (Examination Factor) consisted of 'going to the dentist generally', 'having your teeth looked at' and 'having your teeth scraped and polished', whereas Factor 1 (Treatment Factor) consisted of all other treatment items. The Cronbach's alpha for Factor 1 was 0.78, whereas the Cronbach's alpha for Factor 2 was 0.74.

Discussion

This study evaluated the psychometric properties of the faces version of the MCDAS. The MCDAS_f demonstrated excellent test-retest reliability over a relatively long period. Although there was a significant decrease in the MCDAS_f scores between the first and second administrations of the questionnaire, this was likely to have been due to a reduction in the experimental state anxiety of the participants as they would have been more familiar with the MCDAS_f at the second administration. A recall of 6 months has been suggested for children, while a shorter interval is suggested for those with a high rate of decay¹⁵. A recall interval of 4 months is often adopted for caries prone children. The test-retest interval was chosen as 17 weeks to determine the reliability over this suggested recall interval and so determine the applicability of the MCDAS_f to a clinical study of children with a high rate of obvious decay experience.

An acceptable level of internal consistency of the MCDAS_f was demonstrated, with a Cronbach's alpha of 0.82. This represented the homogeneity of the scale demonstrating that

all items on the scale tapped the same construct. An acceptable Cronbach's alpha is considered greater than 0.70, but no greater than 0.90^{14} . The internal consistency of the MCDAS_f is comparable to that of the MCDAS reported as 0.84^5 , and the CFSS-DS which has been reported as 0.85^{16} to 0.92^7 . The MCDAS_f was therefore found to be a reliable measure of child dental anxiety, which demonstrated good test–retest reliability and good internal consistency.

As predicted there was a high correlation noted between the MCDAS_f and the 'gold standard' measure of the child dental anxiety inventory-the CFSS-DS¹⁷, with the MCDAS_f explaining over 60% of the CFSS-DS score variance. The MCDAS_f has the advantage of being shorter and therefore faster to complete that the 15-item CFSS-DS. Therefore, the MCDAS_f had very good criterion validity.

With regard to construct validity, the MCDAS_f behaved as predicted by demonstrating good relationships with referral diagnosis, obvious decay experience, and DGA experience. The MCDAS_f was able to distinguish between children who had been referred for the management of dental anxiety and those referred for non-anxiety-related reasons. It was assumed that those referred for dental anxiety were dentally anxious, whereas those referred for non-anxiety-related reasons were not dentally anxious. It is a limitation of the study as this assumption may have been incorrect as the dental anxiety assessment was based on the referring dentist's perception. Dentists may fail to report the patient's dental anxiety status when referring for a complex dental condition. Anticipated gender distributions were noted, with a significantly larger proportion of girls in the dental anxiety referral group and a significantly larger proportion of boys in the nonanxiety referral group^{3,18–21}.

It was anticipated that those children with a higher level of obvious decay experience would be more dentally anxious than those with a lower level of obvious decay experience. Bedi *et al.*²² found that adolescents with high dental anxiety had a significantly higher DMFT than their peers with low dental anxiety. This finding has been confirmed for younger children, as dentally anxious 5-year-olds were found to have had significantly more caries experience than non-dentally anxious children²³. Dental extractions, sedation and DGA are considered to be the most traumatic treatment interventions, and so it was anticipated that those children with DGA experience would be more dentally anxious, supporting the findings of Milsom *et al.*²³ who reported increased dental anxiety in 5-year-old children with DGA experience. The anticipated relationships between caries, DGA experience, and dental anxiety were demonstrated, giving further evidence for the construct validity of the MCDAS_f.

The normative value for dental anxiety in this child population was 19.81. Furthermore, for those children who scored 26 or over on the MCDAS_f they were shown to have a 51%probability of being extremely dentally anxious and requiring specialist management for their dental fears. In this sample the MCDAS_f was found to have a two-factor structure, consisting of the shorter scales named 'examination' and 'treatment', respectively. This factor structure for the MCDAS_f may be helpful when using the scale in clinical research to identify which aspect of dental anxiety is affected by interventions, such as, for example, the child's responses to attendance and non-invasive treatment or the child's responses to invasive treatment. An area for further research is the confirmation of this two-factor structure in other child populations.

When applied to younger children conventional self-report measures have been modified by the addition of picture response scales or moveable barometers^{3,10}; in this study the MCDAS was modified by a faces picture response scale. These were chosen due to the clarity of the images and their correspondence the descriptors of the interval of the five-point numeric format. The MCDAS_f was completed by children as young as 5 years in a clinical setting. To assist the younger children the nurse read the questions while the child pointed to the appropriate face on the scale to indicate their anxiety. Older children completed the scale unassisted. The MCDAS_f was completed by children aged 8 years in a school setting. The MCDAS_f would appear to be valid and reliable as well as useful in the assessment of dental anxiety in a wide age range of children attending for dental care.

What this paper adds

- This is the first study to outline the reliability and validity of the MCDAS_t, a self-report measure of dental anxiety.
- Normative data and cut-off values for the MCDAS_f are outlined.

Why this paper is important for paediatric dentists

 A new self-report measure suitable for children aged 5 years and above is described, providing a useful tool for the assessment of dental anxiety in young and/or older children.

Conclusions

Therefore, it may be concluded that the $MCDAS_f$ may be used with confidence to assess dental anxiety in children. The $MCDAS_f$ is a reliable measure of dental anxiety in children aged 8–12 years, demonstrating good reliability and validity.

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