

Conversion tables for the Corah and Modified Dental Anxiety Scales

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Dental anxiety assessment can be achieved by using brief multi-item scales. Corah's Dental Anxiety Scale has been used extensively since the 1970s. However the scale has some flaws which led to the design of the Modified Dental Anxiety Scale incorporating some minor but important improvements. To enable comparison between studies who have adopted one but not both scales a conversion algorithm was required. **Objective:** To produce regression equations and tables to enable researchers to convert derived scores from one scale to another. **Basic research design:** Cross-sectional survey. **Clinical setting:** 18 dental practices in Northern Ireland. **Participants:** Patients (n=1,028) were invited to participate. **Main Outcome measures:** Corah and Modified Dental Anxiety Scales **Results:** Twenty four patients refused (response rate 98%) providing 1,004 patients for analysis. Mean scores for both scales were close to those reported elsewhere. The correlation between the two scales was high ($r=0.89$). Regression equation and summary tables presented for conversion purposes. **Conclusions:** More accurate estimates of scale scores can be derived with this procedure than simple prorating.

Key words: Conversion tables, Corah, dental anxiety scales, Modified, psychometrics.

Introduction

The assessment of dental anxiety is important for two reasons: first, to assist the dentist in the management of anxious patients and secondly to provide evidence-based research into this psychological construct which has been shown to predict dental avoidance (Kent, 1997; Kvale *et al.*, 2004). Various dental anxiety measures have been developed (Newton and Buck, 2000; Schuurs and Hoogstraten, 1993). A frequently used inventory -Corah's Dental Anxiety Scale (CDAS) - was originally published as a one page report (Corah, 1969). The CDAS is a brief (four items) measure which has satisfactory reliability and some evidence for validity (Corah *et al.*, 1978). Improvements, however, were made to the scale – named the Modified Dental Anxiety Scale (MDAS) - to introduce a further question on local anaesthesia and to simplify and standardise the answering categories (Humphris *et al.*, 2000; Humphris *et al.*, 1995). One report has shown the MDAS measure is now frequently used in practice (Dailey *et al.*, 2001). Some statutory training bodies now require dental anxiety to be formally assessed by self-report questionnaire (QAA 2002). It is likely that these brief measures, as opposed to the lengthier scales such as the dental fear survey (Kleinkecht and Bernstein, 1978) will be employed increasingly by dentists in primary dental care settings. The choice of scale for research purposes may be less obvious and may depend on the theoretical model, research question and hypotheses. However, for a relatively succinct assessment with a scale possessing good psychometric properties the CDAS, and in particular the MDAS, are recommended.

To enable comparison of studies that have used the CDAS or MDAS a conversion algorithm is necessary to assist interpretation. Researchers in particular have a dilemma on whether to select a measure that is established or choose one that is more psychometrically sound but more recently designed. Hence the aim of this study was to collect responses to both scales in a primary dental care population and calculate regression equations, confidence intervals and conversion tables.

Methods

Design of study

A cross-sectional survey using convenience cluster sampling of dental practices within a prescribed region of Northern Ireland.

Sample

Eighteen practices were selected (32% of all general dental practitioners) within the Southern Health and Social Services Board (SHSSB) in Northern Ireland. The mean Noble deprivation index, based upon the postcode of the practice, was 19.6 for participating dentists which compares closely to the average (20.14) for the SHSSB region as a whole (Beatty, 2004). Approximately 50 eligible patients (range 51 to 58) were consecutively drawn from each practice within a maximum of six sessions per practice. Each patient was told by the interviewer that the purpose of the study was to investigate different ways of assessing dental anxiety by questionnaire. In addition, they were instructed to tell the dentist if they felt very dentally anxious as the staff in the practice knew

of the study and were prepared to assist where necessary. Entry criteria included: aged 16 years or above, gave written consent and English language spoken. Visitors to the practice or relatives of patients were excluded. All refusals were noted.

Measures

Corah's Dental Anxiety Scale (Figure 1) is a four item questionnaire asking respondents to indicate their emotional reaction to a dental visit in general and to the waiting room, dental chair, scaling and cavity preparation. The reliability reported by the originator was good (internal consistency = 0.86; test-retest= 0.82) (Corah, 1969; Corah *et al.*, 1978). The MDAS (Figure 1) has a simplified rating system and an extra item about the respondent's anxiety response to a local anaesthetic injection. Reliability for this measure was also favourable (internal consistency= 0.89; test-retest= 0.82) (Humphris *et al.*, 2000; Humphris *et al.*, 1995).

Procedure

Consecutive participants during study sessions were invited to enter the study at the general dental practices on days where non-specialist, that is routine services, were provided. The order of the questionnaire was randomised by session using a computer generated random sequence. Data were collected from July to August 2004 by two trained interviewers who explained the study to the participants, obtained consent and collected completed questionnaires. The interviewers had received, in two training sessions, instructions on how to approach potential recruits to the study and not to prompt participants while they completed the questionnaires. Where reading difficulties were encountered the interviewer was instructed to assist but not to advise on choosing a response. Research protocol was authorised by Local Research Ethics Committee.

CORAH'S DENTAL ANXIETY SCALE	
1. If you had to go to the dentist to-morrow how would you feel?	
I would look forward to it as a reasonably enjoyable experience	<input type="checkbox"/> =[1]
I wouldn't care one way	<input type="checkbox"/> =[2]
or the other	<input type="checkbox"/> =[3]
I would be a little uneasy about it	<input type="checkbox"/> =[4]
I would be afraid that it would be unpleasant and painful	<input type="checkbox"/> =[5]
I would be very frightened of what the dentist might do	<input type="checkbox"/> =[5]
2. While you are waiting at the dentists for you turn in the dental chair, do you feel?	
Relaxed	<input type="checkbox"/> =[1]
A little uneasy	<input type="checkbox"/> =[2]
Tense	<input type="checkbox"/> =[3]
Anxious	<input type="checkbox"/> =[4]
So anxious that I break out in a sweat and feel physically sick	<input type="checkbox"/> =[5]
3. While you are in the dentist's chair while he gets his drill ready to begin work on your teeth, how do you feel?	
Relaxed	<input type="checkbox"/> =[1]
A little uneasy	<input type="checkbox"/> =[2]
Tense	<input type="checkbox"/> =[3]
Anxious	<input type="checkbox"/> =[4]
So anxious that I break out in a sweat and feel physically sick	<input type="checkbox"/> =[5]
4. You are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments he will use to scrape your teeth around your gums how do you feel?	
Relaxed	<input type="checkbox"/> =[1]
A little uneasy	<input type="checkbox"/> =[2]
Tense	<input type="checkbox"/> =[3]
Anxious	<input type="checkbox"/> =[4]
So anxious that I break out in a sweat and feel physically sick	<input type="checkbox"/> =[5]

MODIFIED DENTAL ANXIETY SCALE	
1. If you went to your dentist for TREATMENT TOMORROW , how would you feel ?	
Not anxious	<input type="checkbox"/> =[1]
Slightly anxious	<input type="checkbox"/> =[2]
Fairly anxious	<input type="checkbox"/> =[3]
Very anxious	<input type="checkbox"/> =[4]
Extremely anxious	<input type="checkbox"/> =[5]
2. If you were sitting in the WAITING ROOM (waiting for treatment), how would you feel ?	
Not anxious	<input type="checkbox"/> =[1]
Slightly anxious	<input type="checkbox"/> =[2]
Fairly anxious	<input type="checkbox"/> =[3]
Very anxious	<input type="checkbox"/> =[4]
Extremely anxious	<input type="checkbox"/> =[5]
3. If you were about to have your TEETH DRILLED , how would you feel ?	
Not anxious	<input type="checkbox"/> =[1]
Slightly anxious	<input type="checkbox"/> =[2]
Fairly anxious	<input type="checkbox"/> =[3]
Very anxious	<input type="checkbox"/> =[4]
Extremely anxious	<input type="checkbox"/> =[5]
4. If you were about to have your TEETH SCALED AND POLISHED , how would you feel ?	
Not anxious	<input type="checkbox"/> =[1]
Slightly anxious	<input type="checkbox"/> =[2]
Fairly anxious	<input type="checkbox"/> =[3]
Very anxious	<input type="checkbox"/> =[4]
Extremely anxious	<input type="checkbox"/> =[5]
5. If you were about to have a LOCAL ANAESTHETIC INJECTION in your gum, above an upper back tooth, how would you feel ?	
Not anxious	<input type="checkbox"/> =[1]
Slightly anxious	<input type="checkbox"/> =[2]
Fairly anxious	<input type="checkbox"/> =[3]
Very anxious	<input type="checkbox"/> =[4]
Extremely anxious	<input type="checkbox"/> =[5]

Figure 1. Corah's Dental Anxiety Scale and the Modified Dental Anxiety Scale

Statistical analysis

Data were analysed by SPSS for Windows v12™. Frequencies and means were calculated on variables where appropriate. Pearson product-moment correlation coefficients and linear regression were performed on the total scale scores of both anxiety assessments. Confidence intervals were calculated (Gardner and Altman, 1989). Two tailed tests and an alpha level of .05 were applied, unless multiple testing was performed, in which case bonferroni adjustment was adopted.

Results

Of the 1,028 patients who were approached, 24 refused. Respondents refused due to lack of interest ($n=6$), non-possession of glasses ($n=7$), insufficient time ($n=4$), or other miscellaneous reasons ($n=6$). The response rate was 98 per cent. Drop-out analysis revealed no gender difference between respondents and refusers ($\chi^2=0.05$, $df=1$, $p=0.83$), however the refusers were older (mean years(SD): refusers=52(19) vs respondents=41(16), $t=3.09$, $df=1$, $p=.002$).

Complete data were obtained from 1004 respondents. Their mean (SD) age was 41 (16) years; 649 (65%) were female. Sixty seven percent ($n=673$) claimed to visit the dentist at least every 6 months, and 47% (473) expected to receive a check up rather than dental treatment.

The internal consistency (Cronbach alpha) of the scales was 0.89 (CI95%: 0.83 to 0.95) and 0.91 (CI95%: 0.85 to 0.97) for the CDAS and MDAS respectively (Cronbach, 1970; Streiner and Norman, 1995). The correlation between the two scales was 0.89, $p<.001$. The means (SDs; and CI95%) were 8.79 (3.42; 8.58 to 9.01) and 10.68 (4.43; 10.41 to 10.96) for the CDAS and MDAS respectively. The recommended cut-offs are 15 and 19 (Corah *et al.*, 1978; Humphris *et al.*, 1995). This resulted in 7.7% and 6.1% of respondents scoring at or above the respective cut-offs. Almost identical respondents were identified as dentally anxious as shown by the high level of agreement (96%; kappa=0.66). The regression equations to predict either of the scales are presented in Table 1. The top row of the table shows the

results when the MDAS measure acted as the dependent measure (that is regressed onto the CDAS scores). The constant, unstandardised B coefficient and its standard error are included. Figure 2 presents the scatter plot and regression line fitted with 95% CI's. The regression results (constant and slope) were adopted to construct the conversion tables displayed in Tables 2a and b.

Discussion

Both scales gave means, standard deviations and indices of reliability similar to those reported in previously published reports. The original CDAS normative population of 1,232 participants gave a mean (SD) score of 8.89 (2.99). The CDAS has been collected from a representative UK sample of 1,800 participants (McGrath and Bedi, 2004). The mean (SD) equalled 9.3 (3.7) which is approximately an eighth of a standard deviation greater. Moreover a secondary analysis of CDAS data over eight surveys conducted in the USA demonstrate similar levels (aggregate mean=8.87) (Smith and Heaton, 2003). The MDAS normative data published for general practice attenders was mean (SD) = 10.79 (4.63) and the internal consistency was 0.89 (Humphris *et al.*, 1995). The age profile of the sample closely approximated that of the patients registered in Northern Ireland. The similarity of the data obtained from the current study assists the claim that for primary care attenders these tables are reasonably generalisable.

An example can illustrate the use of the regression equation to convert the original CDAS to the MDAS. A score of 10 obtained on the CDAS should be multiplied by the B coefficient (1.15) and the constant term (0.56) added; so for this example the predicted MDAS = $0.56 + (1.15 \times 10) = 12$. The confidence interval is the standard deviation of scores around the regression line (Figure 2). This therefore gives an index of error in the prediction. The confidence interval (95%) can be calculated by multiplying the SE (0.019) by 1.96. Hence the MDAS score of 12 could vary between 11.96 and 12.04 in 95% of cases.

Table 1. Regression equations for calculating conversion scores (a) all adults aged 16 to 82 years (b) for separate age groups

Dependent	Constant	B coefficient	Standard error	Confidence interval (95%)	
				Lower	Upper
<i>(a) all adults aged 16 to 82 years</i>					
MDAS	0.56	1.15	0.019	1.11	1.19
CDAS	1.49	0.68	0.011	0.66	0.71
<i>(b) for separate age groups</i>					
MDAS 16-40 yrs	0.95	1.14	0.028	1.08	1.19
MDAS 41-82 yrs	0.24	1.16	0.026	1.11	1.21
CDAS 16-40 yrs	1.35	0.68	.017	0.65	0.72
CDAS 41-82 yrs	1.50	0.70	.015	0.66	0.73

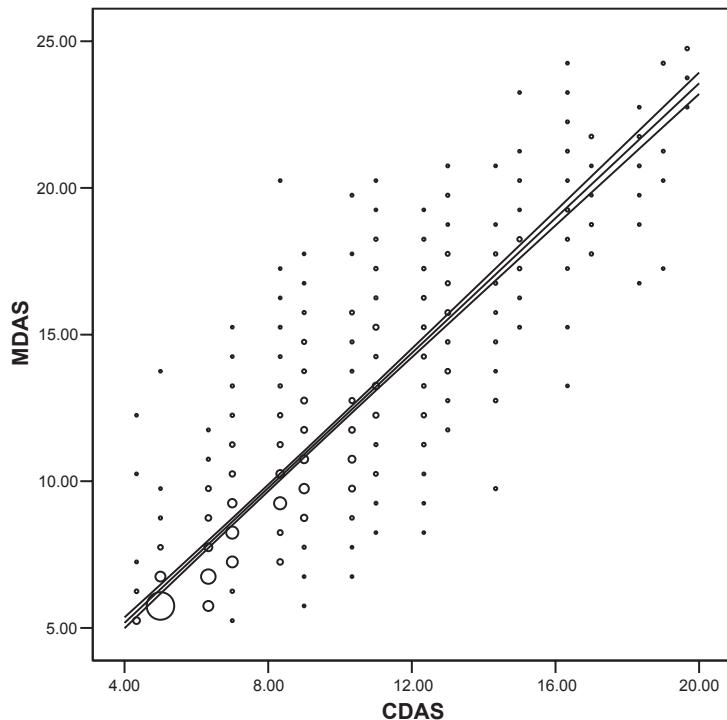


Figure 2. Scatterplot of CDAS (x axis) against MDAS (y axis) showing linear regression line and 95% confidence intervals. Size of markers scaled according to number of overlapping points.

To determine the robustness of these conversion tables further analyses were investigated. First we inspected the association between the two measures for each sample ($n=18$) that attended separate practices. The range of associations was small (0.77 to 0.97) with the mean and median an identical 0.88 confirming that the correlation coefficients approximated closely a normal distribution (Kolgomivov-Smirnoff test for normality = 0.14, $df=18$, $p=.02$). In addition the variance of scores was not explained by practice for either scale. Secondly, two important demographic factors (gender and age) were investigated. Age was dichotomised using a median split (16-40 and 41 to 82 years). The regression equations were reanalysed introducing gender ($p>.05$) and age group ($p<.001$). The relationship of the two scales with either MDAS or CDAS as dependent variables was varied according to age group. We therefore have supplied extra columns for the investigator to use if they wish to adjust their conversion by taking into account the age of the respondent. The current tables are based upon a single, albeit relatively large sample. Some caution should be applied to using these tables too rigidly. The reader will observe that the adoption of the age related conversion will assist accuracy and are therefore recommended, however the adoption of the full sample tables will not introduce substantial differences in estimation of dental anxiety. The investigator can recode their raw data version of the dental anxiety questionnaire into the desired version using the appropriate SPSS commands (Appendix).

The advantage of adopting a regression approach to convert scores as opposed to simple prorating is apparent when considering the ‘regression to the mean’ effect. When assessing a construct with measurement error it is known that more extreme scores will possess

greater error. Simple prorating from one scale to another would not take this into account. An illustration would be that a maximum score of 20 for the CDAS would result in a score of 24 on the MDAS and not the actual maximum of 25.

Both scales gave virtually identical proportions (difference less than 2%) of those achieving their respective cut-offs. On closer inspection the proportion of respondents identified by both scales was 4.7% indicating that 95.3% were not dentally anxious. Hence 44 (4.4%) patients were not consistently selected by both measures. The level of agreement as indicated by per cent agreement was high although the kappa coefficient was somewhat less in magnitude, probably due to the high proportion of participants scoring below the cut off and likely to agree purely by chance. This phenomenon has been recognised previously (Locker *et al.*, 1996). Fortunately the level of discrepancy between the two scales was less than that described by Locker and colleagues when they studied three dental anxiety scales.

In conclusion this study enables the researcher to convert scores between the two brief scales of dental anxiety. This facility will assist dental researchers interested in this psychological construct to compare levels of dental anxiety where these two scales have been separately employed.

Acknowledgements

We would like to thank Aoibheann McGahan and Lisa Hall for their assistance with the data collection and data entry. We would also like to acknowledge the dental practitioners and their patients who participated in the study. Funding received from the SHSSB Northern Ireland and work conducted within its geographical boundaries.

Table 2. Conversion tables (a) upper panel for converting raw MDAS scores to estimated CDAS scores; (b) lower panel for converting raw CDAS scores to estimated MDAS scores

MDAS Raw score	CDAS		CDAS Estimated score (41 to 82 yrs)
	Estimated score All adults (16-82 yrs)	Estimated score (16-40 yrs)	
5	5	5	5
6	6	5	6
7	6	6	6
8	7	7	7
9	8	7	8
10	8	8	8
11	9	9	9
12	10	10	10
13	10	10	11
14	11	11	11
15	12	12	12
16	12	12	13
17	13	13	13
18	14	14	14
19	14	14	15
20	15	15	15
21	16	16	16
22	17	16	17
23	17	17	17
24	18	18	18
25	19	18	19

CDAS Raw Score	MDAS		MDAS Estimated Score (40 to 82 yrs)
	Estimated Score (all adults 16 to 82 yrs)	Estimated Score (16 to 40 yrs)	
4	5	5	5
5	6	7	6
6	7	8	7
7	9	9	8
8	10	10	10
9	11	11	11
10	12	12	12
11	13	13	13
12	14	15	14
13	16	16	15
14	17	17	17
15	18	18	18
16	19	19	19
17	20	20	20
18	21	21	21
19	22	23	22
20	24	24	24

References

- Beatty R (2004). Northern Ireland Multiple Deprivation Measure 2001-A user's guide. NISRA Occasional Paper. Belfast: Northern Ireland Statistics and Research Agency.
- Corah NL (1969). Development of a dental anxiety scale. *Journal of Dental Research* **48**(596).
- Corah NL, Gale EN, Illig SJ (1978). Assessment of a dental anxiety scale. *Journal of the American Dental Association* **97**(816-819).
- Cronbach IJ (1970). Essentials of psychological testing. 3rd ed. London: Harper and Row.
- Dailey Y, Humphris G, Lennon M (2001). The use of dental anxiety questionnaires: a survey of a group of UK dental practitioners. *British Dental Journal* **190**(8):450-453.
- Gardner M, Altman D (1989). Statistics with confidence: confidence intervals and statistical guidelines London: British Medical Journal.
- Humphris G, Freeman R, Campbell J, Tuutti H, D'Souza V (2000). Further evidence for the reliability and validity of the Modified Dental Anxiety Scale. *International Dental Journal* **50**(6):376-370.
- Humphris GM, Morrison T, Lindsay SJE (1995). The Modified Dental Anxiety Scale: UK norms and evidence for validity. *Community Dental Health* **12**(143-150).
- Kent G (1997). Dental phobias. In: Phobias-a handbook of theory, research and treatment. G Davey editor. London: John Wiley and Sons Ltd.
- Kleinknecht R, Bernstein D (1978). The assessment of dental fear. *Behaviour Therapy* **9**(626-634).

- Kvale G, Berggren U, Milgrom P (2004). Dental fear in adults: a meta-analysis of behavioural interventions. *Community Dental Oral Epidemiology* **32**(4):250-64.
- Locker D, Shapiro D, Liddell A (1996). Who is dentally anxious? Concordance between measures of dental anxiety. *Community Dentistry and Oral Epidemiology* **24**(346-350).
- McGrath C, Bedi R (2004). The association between dental anxiety and oral health-related quality of life in Britain. *Community Dentistry and Oral Epidemiology* **32**(1):67-72.
- Newton J, Buck D (2000). Anxiety and pain measures in dentistry: a guide to their quality and application. *Journal of the American Dental Association* **131**(10):1449-1457.
- Quality Assurance Agency for Higher Education (2002) Subject benchmarkstatements: Academic standards-Dentistry. QAA, Gloucester.
- Schuurs A, Hoogstraten J (1993). Appraisal of dental anxiety and fear questionnaires: a review. *Community Dentistry and Oral Epidemiology* **21**(329-339).
- Smith T, Heaton L (2003). Fear of dental care: are we making any progress. *Journal of the American Dental Association* **134**(1101-1108).
- Streiner DL, Norman GR (1995). Health measurement scales: a practical guide to their development and use. 2nd ed. New York: Oxford University Press.

Appendix

SPSS commands for conversion of total scale scores for:

- (1) all adults and
- (2) separate age groups

- (1) To convert CDAS raw total scores to estimated MDAS total scores for all adults

COMPUTE MDAS_con = (0.56) + (1.15*(CDAS)).
EXECUTE .

To convert MDAS raw total scores to estimated CDAS total scores for all adults

COMPUTE CDAS_con = (1.49) + (0.68*(MDAS)).
EXECUTE .

- (2) To convert CDAS raw total scores to estimated MDAS total scores

(i) for adults aged 16 to 40 years
COMPUTE MDAS_con = (0.95) + (1.14*(CDAS)).
EXECUTE .

(ii) for adults aged 41 to 82 years
COMPUTE MDAS_con = (0.24) + (1.16*(CDAS)).
EXECUTE .

To convert MDAS raw total scores to estimated CDAS total scores

(i) for adults aged 16 to 40 years
COMPUTE CDAS_con = (1.35) + (0.68*(MDAS)).
EXECUTE .

(ii) for adults aged 41 to 82 years
COMPUTE CDAS_con = (1.50) + (0.70*(MDAS)).
EXECUTE .