Evidence-based dentistry: analysis of dental anxiety scales for children

A. Al-Namankany,[1] M. de Souza[2] and P. Ashley[3]

VERIFIABLE CPD PAPER

IN BRIEF

- Reviews dental anxiety measures for children and assesses their statistical qualities and clinical implications.
- Reliability is necessary but not sufficient for validity – unawareness by some dentists resulted in the use of non-validated scales.
- Understanding the level of anxiety before treatment will allow the dentist to provide better anxiety management and a more positive experience.

PRACTICE

Objectives To review paediatric dental anxiety measures (DAMs) and assess the statistical methods used for validation and their clinical implications. **Method** A search of four computerised databases between 1960 and January 2011 associated with DAMs, using pre-specified search terms, to assess the method of validation including the reliability as intra-observer agreement 'repeatability or stability' and inter-observer agreement 'reproducibility' and all types of validity. **Results** Fourteen paediatric DAMs were predominantly validated in schools and not in the clinical setting while five of the DAMs were not validated at all. The DAMs that were validated were done so against other paediatric DAMs which may not have been validated previously. Reliability was not assessed in four of the DAMs. However, all of the validated studies assessed reliability which was usually 'good' or 'acceptable'. None of the current DAMs used a formal sample size technique. Diversity was seen between the studies ranging from a few simple pictograms to lists of questions reported by either the individual or an observer. **Conclusion** To date there is no scale that can be considered as a gold standard, and there is a need to further develop an anxiety scale with a cognitive component for children and adolescents.

INTRODUCTION

Dental anxiety (DA) is a multi-system response to a believed threat or danger. It is an individual, subjective experience which varies among people. DA is a widespread phenomenon which ranks fifth among the most commonly feared situations for individuals. It can have a serious impact on daily life and is a significant barrier to seeking and receiving dental care. It has been estimated that the anxious patient requires approximately 20% more chair time than the non-anxious patient,[1] which has an impact on cost. DA is seen in both children and adults, with child anxiety often manifesting as inappropriate or disruptive behaviour. Unfortunately, many general dental practitioners are not willing to provide care for preschool children who display disruptive behaviour, especially when more than simple treatment is required.[2] In addition, the use of dental anxiety measures (DAMs) by dentists is lower than it could be.[3]

Measurement of dental anxiety in children is important not just for delivery of high quality clinical care but also for research. Understanding the level of anxiety before treatment and the factors responsible for it will allow the dentist to identify the anxious child in order to provide better anxiety management and a more positive experience. Hence, behavioural science is an important component within dentistry to study and quantify the behaviour of patients toward dental treatment.[4] Studies have proved and validated most of the dental anxiety measurements, however, there is a debate about which is the best measure to use for clinical and research purposes to determine dental anxiety in children. Usually scales are preferred over single-item measures because they contain data that are suitable for statistical calculations using summed and weighted scores.[5] In 2000 some of these anxiety measures were reviewed,[6] however, this review looked at measures for anxiety/pain and children/adults together and did not include the entire available DAMs by that date, nor attempt to determine which scale was most suitable for children. This study has involved the analysis of all available dental anxiety measures for children.

In order to consider any paediatric dental anxiety measurement as a gold standard measure, the scale should cover the following criteria: all types of reliability and validity; a relatively bias-free method independent of procedural bias or patient/investigator response biases;[3] a versatile method that is applicable for both clinical and non-clinical use, which is practical in a variety of different dental settings;[3] a method that should yield numbers on an identifiable number scale (nominal, ordinal, interval, or ratio) so that the appropriate statistical analyses can be conducted;[3] short in length to maximise response from the children and minimise time for administration;[7] include items which are most relevant to the child dental experience;[7] easily hold the attention of the child;[7] and be simple to score and interpret.[7]

For self reported measures, the scale must be: age-appropriate and cover the cognitive status of the child; demonstrate reliability in scoring and test-retest reliability; be valid with respect to correlating with other indices such as behaviour during treatment, dentists' ratings of cooperation and mothers' expectations of

[1*-3]Department of Paediatric Dentistry, UCL Eastman Dental Institute, 256 Gray's Inn Road, London, WC1 X8LD
*Correspondence to: Dr Abeer Al-Namankany
Email: a.alnamankany@yahoo.com

Refereed Paper
Accepted 8 December 2011
DOI: 10.1038/sj.bdj.2012.174
©British Dental Journal 2012; 212: 219-222

Table 1 Dental anxiety scales reported by the observer

Scale	Year of first publication	Sample size	Country of origin	Age range in years	Remark	Reliability	Validity compared to
FCRS[18]	1962	109	USA	3.5-5.	4 categories for the child's behaviour	Not assessed	Not assessed
HCRS[19]	1971	Not reported	USA	3-5	4 categories with 4 ratings each	Assessed	Not assessed
GRS[21]	1971	24	USA	3-6	4 point scale	Assessed	Not assessed
BPRS[22]	1975	44	USA	3.5-10	27 child-related behaviours; observers to score the frequency of these behaviours over 3 min interval	Assessed	CFSS-DS
VABRS[12]	1980	Not reported	UK	6-18	6 point rating scale	Not assessed	Not assessed

FCRS = Frankl Category Rating Scale; HCRS = Houpt Categorical Rating Scale; GRS = Global Rating Scale; BPRS = Behaviour Profile Rating Scale; VABRS = Venham Anxiety and Behaviour Rating Scales

Table 2 Self-reported dental anxiety scales

Scale	Year of first publication	Sample size	Country of origin	Age range in years	Remark	Reliability	Validity compared to
CFSS-DS[23]	1968	52	Sweden	4-14	15 questions with 5 ratings each	Assessed	Dental Anxiety Scale
VAS[20]	1988	45	USA	3-16	100 mm horizontal line anchored by word descriptors at each end	Assessed	Frankl and later to Houpt
VPT[11]	1979	100	UK	3-18	8 pictures/children dose not read questions or responses	Not assessed	Not assessed
CDFP[24]	1995	146	Sweden	5-12	3 subtests: 1) child to tell story about 10 different animal pictures; 2) self reported responses to each of the 5 cards; 3) child to complete 15 incomplete sentences	Assessed	CFSS-DS
FIS[14]	2002	103	UK	3-18	Row of 5 faces ranging from 1 to 5	Not assessed	VPT
DA5[15]	2002	31	UK	5	Two sets of 12 clinical pictures with 4 face responses for each picture	Assessed	VPT & CFPT
SFP[16]	2005	468	UK	4-11	5 computerised questions with 7 face responses for each question	Assessed	MCDAS
MCDAS[13]	1998	314	UK	8-15	8 questions with 5 responses for each question	Assessed	CFSS-DS
MCDASf[17]	2007	287	UK	8-12	8 questions with 5 face responses for each question	Assessed	CFSS-DS

CFSS-DS = Children's Fear Survey Schedule Dental Subscale; VAS = Visual Analogue Scale; VPT = Venham Picture Test; CDFP = Child Dental Fear Picture; FIS = Facial Image Scale; DA5 = Dental Anxiety Scale for 5-year-old children; SFP = Smiley Faces Program; MCDAS = Modified Child Dental Anxiety Scale; MCDASf = Modified Child Dental Anxiety Scale with Faces

behaviour;[8] and be numerical in order to rank dental anxiety causing items objectively and reliably.[9] Reliability is necessary but not sufficient for validity.

DAMs for children of age ≥6 years old should also assess information related to underlying beliefs and anxiety, as negative thinking patterns play a crucial role in fear evocation that could make the person apprehensive and difficult to treat,[10] and the degree of belief in negative cognitions is associated with the severity of dental anxiety. This will help dentists to understand the specific fears of patients, which in turn might help the patients to control his/her anxiety.[10] Most DAMs only provide an overall estimate of perceived discomfort without understanding the causes of this anxiety. Therefore the objective of this study was to review paediatric dental anxiety measures and assess the statistical methods that are used for validation and their clinical implications.

METHOD

A search of four computerised databases (Embase, Medline, PubMed and PsychINFO) was carried out for peer-reviewed papers published between 1960 and January 2011 associated with paediatric dental anxiety measures (DAMs) using the following search terms with appropriate abbreviations to broaden the search: paediatric/children dental anxiety, paediatric/children dental fear/phobia, dental anxiety measures and dental anxiety scales. References of studies found were then subsequently searched for any other references to dental anxiety measures. A hand search was performed for some articles which were not available electronically. The year 1960 was chosen because the first scale was published in the early 1960s, and 2011 was chosen as it was the year this study was carried out. All DAMs designed for children and adolescents in the English language were included.

After identification of the studies, data extracted included the type of scale, year of first publication, country of origin, demographic data for participants and assessment of the method of validation (if any) including the reliability as intra-observer agreement 'repeatability or stability' and inter-observer agreement 'reproducibility'. All types of validity were also checked.

RESULTS

The search of the four databases identified 14 paediatric DAMs. Seven of these scales were developed in the UK,[11–17] five in the USA[18–22] and two in Sweden.[23,24] To simplify the results, these scales were

grouped into the observer-reported scales (five scales summarised in Table 1), and the self-reported scales (nine scales summarised in Table 2). Publication dates ranged from 1962-2007, and the subjects' ages ranged from 3-18 years old.

Status of existing DAMs

All DAMs are open to criticism. In order to choose the right measure to use, the investigator or clinician should assess the instrument first to see whether the scale has been validated and is reliable and repeatable. Appropriateness and acceptability of the instrument for the study should also be considered.[6]

The current DAMs were predominantly validated in schools, not in the clinical setting.

Statistical assessment

Different dental anxiety studies have used different scales with different cut-off points to distinguish anxious from non-anxious patients. None of the current scales use a formal sample size technique, therefore it is not clear whether these estimates reflect the real difference between the dentally anxious and the non-anxious populations or whether they are not methodologically valid in origin. There was no published information about the validation of five of the DAMs: Frankl Category Rating Scale (FCRS);[18] Houpt Categorical Rating Scale (HCRS);[19] Global Rating Scale (GRS);[21] Venham Picture Test (VPT);[11] and Venham Anxiety and Behaviour Rating Scales (VABRS).[12] For DAMs that were validated, the gold standard used was usually other measures of paediatric DAM, which may not have been validated previously. There was no published information about the reliability of four of the DAMs: FCRS;[18] VPT;[11] VABRS;[12] and Facial Image Scale (FIS)[14] (Tables 1 and 2). The most reported scale (15 studies) was the children's fear survey schedule-dental subscale (CFSS-DS).[23] This was also the only children's scale validated in different languages.

Assessment of validity

Frankl, Houpt, Global Rating, Venham Picture Test and Venham Anxiety and Behaviour Rating Scales were not validated, therefore it is impossible to make any judgments on usability and these scales will not be considered further. The remaining DAMs were validated against each other, with the child fear survey schedule-dental subscale (CFSS-DS) most commonly used, probably because it is the oldest validated scale (1986). In addition, none of the existing DAMs has assessed the external validity or generalisability in the initial validation of the scale.

Ideally any new scale should be tested against an existing one that is as different as possible.[25] Not all of the 14 published scales have followed this guidance, for example the dental anxiety for 5-year-old children (DA5)[17] has been validated against similar scales which may affect the accuracy of the validity results. One of the scales (Visual Analogue Scale)[20] was validated against un-validated measures (Frankl and Houpt). Clearly at the very least, a gold standard should be validated itself. There are also issues in general with the use of CFSS-DS, as it includes some irrelevant items such as 'having to go to hospital' (most patients are not treated in hospitals).[16] In addition, it includes items which might be not appropriate for use in the modern day, for example people in white uniform (most of the children in the UK have never seen a dentist/doctor in white uniform). Also, in a separate study by these authors that is yet to be published, one of the reasons for parents refusing to allow their children to participate was the report that CFSS-DS includes ambiguous material for their children such as, 'strange people look at you/touch you'.

Assessment of reliability

All of the validated studies assessed reliability and this was usually classified as 'good' or 'acceptable'. Clearly inter- and intra-examiner reliability is an important measure and on the whole this was well handled by the studies assessed.

Assessment of the clinical implications

The visual analogue scale (VAS) is 'a measurement instrument that tries to determine a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured'.[26] Several studies have validated the use of VAS to measure dental anxiety.[14–16,20,27,28] It is simple to use and can reliably evaluate the responses of anxious children to treatment,[20,27] as well as being the most frequently used questionnaire for children.[3] However, it is validated primarily against self-reported scales that have not themselves been validated. Moreover, it only determines the level of anxiety in general without addressing specific issues that might help the clinician understand the cause of the anxiety.

The Behaviour Profile Rating Scale (BPRS)[22] measures the behaviour of the child in the dental situation. Observers score the frequency of 27 child-related behaviours over a 3 minute period.[29] It can be a complicated score to calculate and takes a significant amount of time, also requiring an external observer other than the treating dentist. Hence, it could be considered as impractical for daily use in dental clinics. Furthermore, it has no normative scores which could result in different scores without any interpretations. However, the BPRS could be used for children below 5 years of age. The child dental fear picture (CDFP) requires 45 to 60 minutes to complete.[24] It could be considered time consuming for the operators and complicated for the children to complete the total of 30 items across three different tests.

The modified child dental anxiety scale (MCDAS) consists of eight questions that assess a child's concern about specific dental procedures.[13] Each question has a five-point scale from '1' that indicates relaxed or not worried, to '5' which indicates extremely worried.[13] A new version of the modified child dental anxiety scale with faces (MCDASf) was formed by adding a five faces rating scale to the original numeric form.[17] Like all other existing scales, it includes only the most commonly feared items such as injection, drill and tooth extraction. There may be issues with how patients perceive the faces relate to their anxiety status, with evidence to suggest that face numbers 1, 2, and 3 may be seen as a relaxed response, while faces 4 and 5 an anxious response;[30] perhaps introducing bias in favour of a relaxed response when considering outcomes for MCDAS and MCDASf.

The facial image scale (FIS) was developed to assess the child's dental anxiety immediately before entering the dental clinic by using faces as an indicator of this.[14] Although it is a valid scale it is limited by the single item measure which may make it difficult to identify the construct of anxiety being measured.[17] Assessment

of dental anxiety for 5-year-old children (DA5) involves four diagrammatic picture cards denoting emotions of very happy to very sad.[15] Unfortunately, there was no mention of inter/intra-observer reliability and it was validated against very similar scales. A four item computerised smiley faces program (SFP) was introduced.[16] However, the use of it is likely to be limited by the need for access to computer equipment,[17] and the accuracy of the results could be affected by the use of seven faces as discussed earlier.

DISCUSSION

Dental anxiety is manifested in cognitive, psycho-physiological, and behavioural spheres.[1] The degree of belief in negative cognitions is associated with the severity of dental anxiety, and the cognitive/emotional responses and negative thoughts that prime distressing emotions are key in any investigation. The negative thinking patterns play a crucial role in fear evocation, possibly making the person apprehensive and difficult to treat, and making them less easily compliant with anxiety treatment techniques.[10] The highly anxious dental patient not only reports a greater number of negative thoughts, but also a stronger effort to control these thoughts as the time of the dental appointment drew closer.[31] However, current scales do not assess the cognitive aspect of the child. Hence, there is a need to develop a measure of anxiety that could include these spheres.

Most DAMs only provide an overall estimate of perceived discomfort without understanding the causes of this anxiety and reporting only the most commonly feared items (injections, extraction) without recognising other common dental procedures that could cause anxiety. Although there are many DAMs available, none of them encompass the ideal criteria for the assessment, statistically or clinically. This study confirms the findings of previous studies that there is no scale which could be regarded as the gold standard.[16] The current DAMs were predominantly validated in schools, not in the clinical setting; the child's response could be different when she/he is in a clinical sitting. The current scales also lack a report on the state of previous dental experience and the parent's expectation of the child's behaviour, which have been recommended by Melamed.[32]

The limitation of this study was the lack of reporting the number of studies that used each of these 14 scales, which could be a topic for future review. The age range from 3-18 years old was wide, but the objective of this study was to assess the quality of all current children's DAMs irrespective of age. So given these limitations which scale is the best to use? This will depend very much on what the dentist intends to do with the information. Some scales such as MCDAS and MCDASf could allow investigation into some of the reasons behind the anxiety, however, there are previously mentioned issues with how patients perceive the faces in relation to their anxiety status with evidence to suggest that face numbers 1, 2, and 3 may be seen as a relaxed response and faces 4 and 5 as an anxious response.[3] This could confuse the child as to which face to choose and introduce bias in favour of a relaxed response when considering outcomes for the scale. Use of just three faces with a neutral response at the middle may have advantages.[33] There is not one scale at present though that fulfils the required statistical assessment for validation, and the clinical implications still need future assessment studies.

CONCLUSIONS

To date there is no scale that can be considered as a gold standard, and there is a need to further develop an anxiety scale with a cognitive component for children and adolescents.

1. Ayer W. *Psychology and dentistry: mental health aspects of patient care*. Haworth Press Inc, 2005.
2. Mostofsky D I, Forgione A G, Giddon D B. *Behavioural dentistry*. USA: Wiley-Blackwell, 2006.
3. Dailey Y, Humphris G, Lennon M. The use of dental anxiety questionnaires: a survey of a group of UK dental practitioners. *Br Dent J* 2001; **190:** 450–453.
4. Girdler N M, Hill C M, Wilson K. *Clinical sedation in dentistry*. Chichester: John Wiley & Sons, 2009.
5. Bowling A. *Measuring health: a review of quality of life measurement scales*. Open University Press, 1991.
6. Newton T J, Buck D J. Anxiety and pain measurements in dentistry: a guide to their quality and application. *J Am Dent Assoc* 2000; **131:** 1449–1457.
7. McGrath P A. Measurement issues in research on dental fears and anxiety. *Anesth Prog* 1986; **33:** 43–46.
8. Folayan M O, Idehen E. Factors influencing the use of behavioural management techniques during child management by dentists. *J Clin Pediatr Dent* 2004; **28:** 155–161.
9. Corah N L, Zielezny M A, O'Shea R M, Tines T J, Mendola P. Development of an interval scale of anxiety response. *Anesth Prog* 1986; **33:** 220–224.
10. De Jongh A. *Dental anxiety: a cognitive perspective*. Amsterdam: PhD Thesis, 1995.
11. Venham L. The effect of mother's presence on child's response to dental treatment. *ASCD J Dent Child* 1979; **46:** 219–225.
12. Venham L, Gaulin-Kremer E, Munster E, Bengston-Audia D, Cohan J. Interval rating scales for children's dental anxiety and uncooperative behavior. *Pediatr Dent* 1980; **2:** 195–202.
13. Wong H M, Humphris G M, Lee G T. Preliminary validation and reliability of the Modified Child Dental Anxiety Scale. *Psychol Rep* 1998; **83:** 1179–1186.
14. Buchanan H, Niven N. Validation of a facial image scale to assess child dental anxiety. *Int J Paediatr Dent* 2002; **12:** 47–52.
15. Humphris G M, Milsom K, Tickle M, Holbrook H, Blinkhorn A. A new dental anxiety scale for 5-year-old children (DA5): description and concurrent validity. *Health Educ J* 2002; **61:** 5–19.
16. Buchanan H. Development of a computerised dental anxiety scale for children: validation and reliability. *Br Dent J* 2005; **199:** 359–362.
17. Howard K E, Freeman R. Reliability and validity of a faces version of the Modified Child Dental Anxiety Scale. *Int J Paediatr Dent* 2007; **17:** 281–288.
18. Frankl S, Shiere F, Fogels H. Should the parent remain with the child in the dental operatory? *J Dent Child* 1962; **29:** 150–163.
19. Houpt M I, Sheskin R B, Koenigsberg S R, Desjardins P J, Shey Z. Assessing chloral hydrate dosage for young children. *ASCD J Dent Child* 1985; **52:** 364–369.
20. Luyk N H, Beck F M, Weaver J M. A visual analogue scale in the assessment of dental anxiety. *Anesth Prog* 1988; **35:** 121–123.
21. Chambers W L, Fields H W, Machen J B. Measuring selected disruptive behaviors of the 36- to 60-month-old patient. Part I: development and assessment of a rating scale. *Pediatr Dent* 1981; **13:** 251–256.
22. Melamed B G, Weinstein G, Hawes R R, Katin-Borland M. Reduction of fear-related dental management problems with the use of filmed modelling. *J Am Dent Assoc* 1975; **90:** 822–826.
23. Scherer M W, Nakamura C Y. A fear survey schedule for children (FSS-FC): a factor analytic comparison with manifest anxiety (CMAS). *Behav Res Ther* 1968; **6:** 173–182.
24. Klingberg G, Hwang C P. Children's dental fear picture test (CDFP): a projective test for the assessment of child dental fear. *ASDC J Dent Child* 1994; **61:** 89–96.
25. Campbell D T, Fiske D W. Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychol Bull* 1959; **56:** 81–105.
26. Gould D. Examining the validity of pressure ulcer risk assessment scales: development and using illustrated patient simulations to collect the data information point: visual analogue scale. *J Clin Nurs* 2001; **10:** 697–706.
27. Alderson P J, Lerman J. Oral premedication for paediatric ambulatory anaesthesia: a comparison of midazolam and ketamine. *Can J Anaesth* 1994; **41:** 221–226.
28. Christophorou S, Lee G T R, Humphris G M. The reliability and validity of the Modified Child Dental Anxiety Scale: a study of Greek Cypriot school children. *Eur J Paediatr Dent* 2000; **2:** 75–81.
29. Aartman I, Everdingen T, Hoogstraten J, Schuurs A. Appraisal of behavioural measurement techniques for assessing dental anxiety and fear in children: a review. *J Psychopathol Behav Assess* 1996; **18:** 153-171.
30. Tickle M, Jones C, Buchannan K, Milsom K M, Blinkhorn A S, Humphris G M. A prospective study of dental anxiety in a cohort of children followed from 5 to 9 years of age. *Int J Paediatr Dent* 2009; **19:** 225–232.
31. Kent G, Gibbons R. Self-efficacy and the control of anxious cognitions. *J Behav Ther Exp Psychiatry* 1987; **18:** 33–40.
32. Melamed B G. Methodological needs and behavioural research with child dental patients. *Anesth Prog* 1986; **33:** 34–40.
33. Streiner D, Norman G. *Health measurements scales: a practical guide to their development and use*. Oxford: Oxford University Press, 2008.