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Validity and Reliability of the Interval Scale of Anxiety Response

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The Interval Scale of Anxiety Response (ISAR) is shown to be a valid and reliable instrument for measuring situation dental anxiety in adults. The ISAR demonstrates differences that are known or expected between various population subgroups. Thus, significantly higher scores, indicating greater levels of anxiety, are reported by women compared with men; by hospital clinic patients compared with private practice patients; by occasional compared with regular users of dental care; by those with lower educational levels; and by those patients undergoing exodontia compared with patients having other dental procedures. Younger adults also report significantly higher anxiety scores during treatment than older adults. The ISAR is also significantly associated with other measures of anxiety and pain, and with a measure of dentist-rated difficulty of extraction. Reliability is assessed favorably and present-time administration is found to improve ISAR accuracy over its retrospective use.

The Interval Scale of Anxiety Response (ISAR) is a seven-descriptor graphic rating scale for situational anxiety that appears to offer an advantage over ordinal scales by providing a more sensitive assessment. It was developed using the psychophysical method of magnitude estimation; the perceptual distance between its highest and lowest descriptor categories is 21 : 1.

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In an earlier paper,[1] we reported that the ISAR appeared to demonstrate the characteristics of a good scale—reliability, validity, and usefulness. We indicated the desirability for further investigation to assess its sensitivity in measuring differences in anxiety response by different population subgroups in a variety of clinical applications. We also suggested the need to evaluate its performance when administered to patients at different times.

This paper presents data on ISAR from a new series of studies of adult dental patients being seen for a variety of procedures and in different practice settings. We argue for the measure's validity by showing how it differentially defines the anxiety of men and women; hospital and private patients; younger and older people; symptomatic and preventive users of dental services; persons with higher and lower educational levels; and patients undergoing exodontia compared to other dental procedures. In addition, the ISAR is examined among patients undergoing extractions of varying difficulty. Finally, the ISAR's validity is judged by its relationship to previously validated measures of anxiety and pain.

We also present data here on reliability and examine when ISAR may best be administered to improve its accuracy in describing patients' feelings.

Table 1. Scale Values and Total Percent Distribution* of the ISAR

Descriptor (Scale Value)		*ISAR Before Treatment* %	*ISAR During Treatment* %
Terrified	(42)	4	4
Panicked	(33)	1	2
Very Afraid	(26)	4	2
Afraid	(18)	4	4
Tense, Upset	(13)	8	9
Little Nervous	(8)	35	33
Calm, Relaxed	(2)	45	47

* Column percent totals may not equal 100% due to rounding; N = 1004.

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Table 2. Percent Distribution* of the ISAR Before Treatment by Gender and Age

	Gender†		*Years of Age‡*				
ISAR Descriptor	*Male N = 384*	*Female N = 618*	*18–29 N = 304*	*30–39 N = 274*	*40–49 N = 154*	*50–59 N = 114*	*60+ N = 144*
Terrified	3	4	5	4	1	3	2
Panicked	1	1	1	0	2	1	0
Very Afraid	1	5	4	4	4	3	2
Afraid	2	6	4	6	4	4	2
Tense, Upset	8	8	9	9	8	8	2
Little Nervous	31	37	34	33	36	37	36
Calm, Relaxed	54	40	43	43	45	46	56

* Column percent totals may not equal 100% due to rounding; † $\chi^2 = 27.94$, $df = 6$, $P < .01$; ‡ $\chi^2 = 26.86$, $df = 24$.

METHODS

ISAR responses were collected from adult patients in two hospital outpatient dental clinics ($N = 503$) and five private practice dental offices ($N = 501$). Questionnaires were administered before treatment while patients were waiting in the reception area, and again immediately after treatment. The total number of respondents for each validating measure vary because questionnaires were changed over the course of data collection to maximize completion rates and to gather a range of validating information. A separate sample of adult patients ($N = 70$) in a university oral surgery clinic was assessed to provide an indication of ISAR's validity in the context of extractions of varying difficulty as rated by dentists.

RESULTS AND DISCUSSION

Validity

The overall distribution of ISAR scores reflects the nature of dental anxiety in the population at large; it is essentially a J-curve, with the majority of people reporting low anxiety levels. Because this type of distribution renders parametric statistics inappropriate and not particularly meaningful, total percent distributions are used to indicate dispersion.

A simple change score can be calculated by subtracting the ISAR score reported for anxiety during treatment from the score reported while waiting for treatment. This change score approximates a normal distribution. Although the distribution for our sample is highly leptokurtic, with a majority of patients reporting no change in anxiety, this distribution ($\bar{x} = .02$, $SD = 8.17$) may allow the appropriate use of parametric statistical analyses.

The distributions reported here represent a first step in establishing general norms for the ISAR as a measure of adult situational dental anxiety. Our sample size is large, but all data was collected from hospital clinics and from largely middle-class private dental practices in the Buffalo, New York area. ISAR distribution for the total sample is shown in Table 1. The data shows that the ISAR discriminates between the anxiety responses of all the various subgroups examined and in the ways the previous literature would anticipate.[2–4]

Table 3. Percent Distribution* of the ISAR During Treatment by Gender and Age

	Gender†		*Years of Age‡*				
ISAR Descriptor	*Male N = 384*	*Female N = 618*	*18–29 N = 304*	*30–39 N = 274*	*40–49 N = 154*	*50–59 N = 114*	*60+ N = 144*
Terrified	3	5	6	4	3	4	1
Panicked	1	2	3	2	0	2	0
Very Afraid	1	2	3	2	3	0	1
Afraid	1	5	4	5	6	0	0
Tense, Upset	9	9	12	11	7	11	2
Little Nervous	31	34	29	38	33	28	32
Calm, Relaxed	53	43	43	39	49	55	64

* Column percent totals may not equal 100% due to rounding; † $\chi^2 = 18.76$, $df = 6$, $P < .01$; ‡ $\chi^2 = 65.13$, $df = 24$, $P < .01$.

Table 4. Percent Distribution* of the ISAR Before Treatment by Site and Education

	Site†		*Years of Education*‡			
ISAR Descriptor	*Hospital N = 503*	*Private N = 501*	*<12 N = 157*	*12 N = 332*	*13–15 N = 177*	*16+ N = 338*
Terrified	5	2	4	5	5	2
Panicked	1	1	2	1	0	1
Very Afraid	5	2	4	5	4	2
Afraid	5	3	3	4	6	4
Tense, Upset	10	6	11	9	9	5
Little Nervous	36	33	41	32	37	33
Calm, Relaxed	38	53	35	45	40	54

* Column percent totals may not equal 100% due to rounding; † $\chi^2 = 38.77$, $df = 6$, $P < .01$; ‡ $\chi^2 = 36.54$, $df = 18$, $P < .05$.

As shown in Table 2, while waiting before treatment, women were less likely to be "calm, relaxed" (40%) than men (54%). A significant gender difference was demonstrated by χ^2 analysis. Patient age is also expected to affect anxiety level, with older persons reporting less anxiety than younger,[5] and the data show movement in the expected direction (before treatment: $r = -0.11$, $P = .001$; during treatment: $r = -0.18$, $P < .001$). While waiting for treatment, the percentage of people rating themselves as "calm, relaxed" rises from the 18–29 age group (43%) to the 60+ group (56%). However, a statistically significant difference between age groups is found only for the "during treatment in chair" ISAR scores (Table 3).

Table 4 shows that in the waiting room and before treatment, hospital patients were less likely to be "calm, relaxed" (38%) than their private practice counterparts (53%). Those with less education were generally less likely to be "calm, relaxed" before treatment (<12 yr: 35%; 16+ yr: 54%) and education was significantly associated with anxiety (before treatment: $r = -0.13$, $P < .001$; during treatment: $r = -0.19$, $P < .001$). These apparent differences are statistically significant and are also present in the ISAR scores taken to measure anxiety during treatment (Table 5). These results are all consistent with expectations based on previous socioeconomic status indexes.[2,4]

As shown in Table 6, while waiting for treatment, patients who visited the dentist symptomatically were significantly less likely to be "calm, relaxed" (28%) than people who visit the dentist regularly (49%).[6,7] In addition, dental procedures themselves have an impact on anxiety[8] and this was significantly demonstrated by the ISAR. The ISAR scores of patients while waiting for treatment reflect the nature of the treatment procedure: patients waiting before extractions were least likely to be "calm, relaxed" (24%), followed by those having restorations—crowns, fillings, and root canal procedures (44%), and the patients having their teeth cleaned (66%). Again, the statistical significance of the differences between subgroups is retained for the "during treatment in chair" ISAR scores (Table 7).

Caution is advised in generalizing these data to other populations. Although these distributions may be good

Table 5. Percent Distribution* of the ISAR During Treatment by Site and Education

	Site†		*Years of Education*‡			
ISAR Descriptor	*Hospital N = 503*	*Private N = 501*	*<12 N = 157*	*12 N = 332*	*13–15 N = 177*	*16+ N = 338*
Terrified	8	1	6	6	3	1
Panicked	3	1	2	3	3	0
Very Afraid	3	1	6	2	1	1
Afraid	4	3	4	4	5	3
Tense, Upset	12	6	12	8	12	7
Little Nervous	35	30	34	34	31	31
Calm, Relaxed	36	59	36	44	45	57

* Column percent totals may not equal 100% due to rounding; † $\chi^2 = 87.05$, $df = 6$, $P < .01$; ‡ $\chi^2 = 53.41$, $df = 18$, $P < .01$.

Table 6. Percent Distribution* of the ISAR Before Treatment by Frequency of Dental Visits and Dental Procedure

	Dental Visits†			*Dental Procedure‡*		
ISAR Descriptor	*Regular N = 78*	*Occasional N = 62*	*Symptomatic N = 155*	*Clean N = 238*	*Restore N = 277*	*Extract N = 174*
Terrified	5	5	9	1	2	9
Panicked	0	0	1	1	0	3
Very Afraid	1	2	9	1	3	9
Afraid	3	7	7	2	4	5
Tense, Upset	4	3	14	4	7	8
Little Nervous	39	47	32	26	41	42
Calm, Relaxed	49	37	28	66	44	24

* Column totals may not equal 100% due to rounding; † $\chi^2 = 30.53$, $df = 12$, $P < .01$; $\chi^2 = 107.24$, $df = 12$, $P < .01$.

approximations, more ISAR research is needed before general population norms can be defined.

The ISAR also demonstrated significant associations with three previously validated measures of anxiety. While waiting for treatment, a group of 247 hospital and private patients, completed the Spielberger State–Trait Anxiety Inventory (STAI).[9] Patients were asked to answer the statements "to indicate how you feel right now, that is, at this moment." ISAR scores before treatment were significantly correlated with this situational measure ($r = 0.63$, $P < .001$).

The Dental Anxiety Scale (DAS)[10] was completed before treatment by 538 patients from both private and hospital sites. The DAS was significantly associated with the ISAR taken before treatment ($r = 0.59$, $P < .001$).

After receiving treatment, a group of 260 hospital and private patients completed a questionnaire designed to assess the physiological sensations they experienced during treatment in the dental chair. This questionnaire on physical feelings was an eight-item scale adapted from the Autonomic Perception Questionnaire.[11] This measure was related to the ISAR collected after treatment in which the patient was asked to describe anxiety felt "during treatment in chair" ($r = 0.52$, $P < .001$).

Reports of anticipated pain also had a significant relationship to ISAR scores. Before treatment, patients were presented a visual analogue pain scale consisting of a horizontal line anchored by "None at all" and the "Worst pain I can think of." A group of 659 patients rated the amount of pain they expected to feel during their visit. Anticipated pain was indeed associated with ISAR scores ($r = 0.53$, $P < .001$).

In an effort to evaluate ISAR's validity against an "objective" measure of pain and discomfort, we studied a separate sample of 70 oral surgery patients being seen for extractions in a university dental school clinic. This investigation provided some evidence on the validity of the ISAR as related to difficulty of extraction. Dentists rated each case on a 19-point scale, considering the number, condition, and position of teeth extracted, as well as the necessity for surgical removal. Again the association was in the expected direction, with the ISAR

Table 7. Percent Distribution* of the ISAR During Treatment by Frequency of Dental Visits and Dental Procedure

	Dental Visits†			*Dental Procedure‡*		
ISAR Descriptor	*Regular N = 78*	*Occasional N = 62*	*Symptomatic N = 155*	*Clean N = 238*	*Restore N = 277*	*Extract N = 174*
Terrified	5	7	12	1	0	10
Panicked	0	2	5	0	0	8
Very Afraid	1	3	4	1	1	5
Afraid	4	2	7	3	4	5
Tense, Upset	12	7	12	9	8	11
Little Nervous	29	42	36	28	35	39
Calm, Relaxed	50	39	25	58	52	22

* Column totals may not equal 100% due to rounding; † $\chi^2 = 24.34$, $df = 12$, $P < .05$; ‡ $\chi^2 = 115.67$, $df = 12$, $P < .01$.

"during treatment in chair" score significantly related to the dentists' ratings of extraction difficulty ($r = 0.30$, $P < .01$).

Reliability

ISAR reliability is difficult to assess because conventional test-retest procedures do not adequately address the unique nature of situational dental anxiety. We attempted to assess reliability by asking 126 respondents to retake the ISAR after their treatment and recall how they had felt while waiting for treatment. They were able to recall their waiting room feelings with some degree of accuracy. The ISAR taken posttreatment correlated positively with the ISAR filled out earlier ($r = 0.80$, $P < .001$). Agreement between these two ISAR scores was fairly good and scores that disagreed appeared equally likely to be overestimations as underestimations of pretreatment scores ($\kappa = .57$). This level of agreement indicates that the ISAR is fairly reliable, but this agreement was expected to be stronger.

It may be that when patients were asked after treatment about their anxiety before treatment, the intervening treatment experience affected their recall. The ISAR anxiety level (reported after treatment) felt "during treatment in chair" was more strongly associated with the recalled before treatment score ($r = 0.75$, $P < .001$) than the anxiety level actually measured before treatment ($r = 0.56$, $P < .001$). This apparent influence of actual treatment on patients' recollection of their pretreatment anxiety levels may have important implications for research designs. Measuring "waiting room" anxiety while patients are indeed waiting for treatment, rather than retrospectively after treatment, can improve the ISAR's accuracy. This may be particularly critical when attempting to assess the efficacy of interventions meant to alleviate anxiety during treatment.

CONCLUSIONS

The assessment of situational anxiety is a major problem for the researcher. The ISAR scale, because of its interval nature, provides a sensitive instrument for measuring situational anxiety. In our research, we also have considered the ISAR's applicability in assessing the amount and direction of change in anxiety during the course of the dental visit. This type of application may be most useful in research focused on the assessment of specific interventions designed to reduce patient anxiety during treatment. In conclusion, the ISAR has been demonstrated to have validity, be reliable and useful in assessing adult situational dental anxiety.

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REFERENCES

1. Corah, NL, Zielezny, MA, O'Shea, RM, Thines, TJ, Mendola, P. Development of an interval scale of anxiety response. Anesth Prog 1986;33:220–224.

2. Kriesberg, L, Treiman, BR. Socio-economic status and the utilization of dentists' services. J Am Coll Dent 1960;27:147–165.

3. Corah, NL, Gale, EN, Illig, SJ. Assessment of a dental anxiety scale. J Am Dent Assoc 1978;97:816–819.

4. Richards, ND, Utilization of dental services; in Richards ND and Cohen LK (eds) *Social sciences and dentistry,* Federation Dentaire Internationale, 1971, pp 209–240.

5. Schulte, W. Pain, fear, and anesthesia as seen by the patient. Oral Res Abstr 1968;3:293.

6. Kegeles, SS. Some motives for seeking preventive dental care. J Am Dent Assoc 1963;67:90–98.

7. Schuurs, AHB, Duivenvoorden, HJ, Thoden van Velzen, SK, Eijkman, MAJ. Anxiety and dental attendance. Commun Dent Health 1985;2:203–211.

8. Corah, NL, O'Shea, RM, Bissel, GD. The dentist–patient relationship: perceptions by patients of dentist behaviors in relation to satisfaction and anxiety. J Am Dent Assoc 1985;111:443–446.

9. Spielberger, GD, Gorsuch, RL, Lushene, RE, Manual for the State-Trait Anxiety Inventory, Palo Alto, California: Consult Psychol Press, 1970.

10. Corah, NL. Development of a dental anxiety scale. J Dent Res 1969;48:596.

11. Borovec, LR, O'Brian, GT. Relation of autonomic perception and its manipulation to the maintenance and reduction of fear. J Abnorm Psychol 1977;86:163–171.