Validation of a Chinese version of Dental Anxiety Inventory

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Abstract – *Objectives*: To translate the English version of Dental Anxiety Inventory (DAxI) and it's short-form (SDAxI) and to validate their use in Hong Kong Chinese. *Methods*: The DAxI and SDAxI were translated into Chinese. 500 adults (18-64 years) were interviewed, the Chinese DAxI, Symptom Checklist 90 (SCL-90), Depression Anxiety Stress Scales (DASS) and State-Trait Anxiety Inventory (STAI) were completed. Based on their initial DAxI scores, 135 interviewees were invited to attend a dental examination one month later. Then, the subjects completed the DAxI again, together with Beck Anxiety Inventory (BAI) which measured the state anxiety level of the participants. Two months after the initial interview, all 500 subjects were asked to complete the DAxI again. Another 300 adults were recruited and interviewed for the SDAxI validation. *Results*: Cronbach's alpha of the Chinese DAxI and SDAxI were 0.77 and 0.80 and the test-retest correlation coefficients were 0.90 and 0.84 respectively. High correlation between BAI and DAxI scores and its stability over time supported construct validity of the Chinese DAxI. Small positive correlations between the DAxI and other subscales of the SCL-90, DASS and STAI supported discriminant validity of the instrument. The SDAxI demonstrated comparable validity and reliability with DAxI. *Conclusion*: The translated Chinese DAxI demonstrated good validity and reliability. It is available for use in dental anxiety research in adult Chinese. In situations where a short form is desirable, the Chinese SDAxI is a simple, valid, reliable and interpretable scale for measuring dental anxiety in both research and dental practice.

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Dental anxiety is a significant health issue for many people. A remarkable proportion of the population in the United States, United Kingdom, Netherlands, Denmark, **Norway, Sweden,** Hong Kong and Canada reported certain degrees of anxiety about dental visits and treatment (1–9). Accurate measurement of dental anxiety is necessary for allowing dentists to provide appropriate and effective treatment (7, **10, 11**). Besides showing compromised dental health resulting from avoidance of dental care, **studies also suggest that dentally anxious subjects tend to experience more psychological or social distress, and report stronger negative social consequences (12-15).**

The general term dental anxiety might have diverse meanings (16). Different meanings or definitions have been given in the dental literature, covering a rather wide range of emotions from a relatively mild feeling of apprehension, to extreme anxiety and to dental phobia (17). Dental anxiety in the present study is defined as a situation-specific trait anxiety and as the disposition to experience anxiety in dental situations (18, 19). A number of dental anxiety measurement instruments have been developed in the past 30 years. Following an extensive review of the most commonly used dental anxiety questionnaires, Schuurs and Hoogstraten (20) concluded that the Dental Anxiety Inventory (DAxI[*]) appeared promising in allowing **an appreciable** coverage of the concept of dental anxiety **and that its empirical data also appeared to justify a positive assessment.** The DAxI was developed as a more comprehensive instrument than other dental anxiety scales (21, 22) and is one of the most comprehensive instruments available (20). DAxI was developed by Stouthard in 1989 (21). Since its development, DAxI has been translated into and/or validated in several languages (Dutch, English, German, French, Spanish, Italian and Norwegian) (19), and

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[*] The Dental Anxiety Inventory was previously referred to as DAI, but this abbreviation has already been used elsewhere in the dental literature.

adopted in various population studies in Europe (18-20). The psychometric characteristics of DAxI appear promising (18, 20).

The questionnaire was developed with the aid of a facet design (21, 23). All relevant facets of the construct dental anxiety were distinguished and combined in order to give a systematic description as completely as possible. The facets chosen were time **(4 elements)**, situation **(3 elements)** and reaction **(3 elements)**. Sentence items were written combining the elements from the three facets, same as a Cartesian product (18, 21) [$(a_1, a_2, a_3, a_4) \times (b_1, b_2, b_3) \times (c_1, c_2, c_3)$] and 36 items were obtained. Answers are given on a 5-point Likert scale, ranging from "complete disagreement [1]" to "complete agreement [5]". Scores may range from 36 to 180.

The original DAxI, however, proved inconvenient for use in general dental practice (9). The questionnaire is too long to be completed in the waiting room and it takes a long time for a dentist to score the questionnaire. To compensate for this shortcoming, a short form DAxI (SDAxI) **with 9 items** was derived by Stouthard **(18) who maintained** two content based requirements for the selection of items: first, the facet structure of the original questionnaire should be retained, and second, the issues 'drilling', 'extraction' and 'anaesthesia' should be dealt with. The latter requirement was formulated, as these issues are held responsible for a great deal of dental anxiety (24).

Aartman (10) in a study of dental anxiety reduction followed a large group of patients treated in a dental fear clinic for a relatively long period of time (one year). Dental Anxiety Scale, DAxI and attendance were employed as the outcome variables measuring the effects of different dental anxiety treatment modalities (behavioural and sedative measures). The changes of the outcome variables appeared comparable with each other across the various treatment modalities. These results offer support to the criterion-related validity of the SDAxI in measuring dental anxiety. The study also

supports that the SDAxI is easy to administer in general dental practices (18) and dental fear clinics (22).

DAxI was originally developed in Dutch and subsequently translated into English (9, 10). In order to make use of this instrument to measure the dental anxiety of Chinese in Hong Kong, translation and validation is necessary. Besides the difference in language used, people living in Hong Kong are primarily influenced by Chinese culture, which is very different from the Western culture where DAxI was first developed. Validation of DAxI for a local population should demonstrate adequate psychometric properties (25).

The aim of this study was to translate the English version of DAxI and SDAxI into Chinese version, and to validate the translated instruments for use in Hong Kong Chinese.

Materials and methods

DAxI translation

Since the majority of the adult population in Hong Kong are literate (26), the Chinese DAxI was planned, the same as for the original version of DAxI, to be a self-administered questionnaire. A panel was set up for translation of DAxI, including three dentists, three psychologists and one statistician specializing in survey studies. Advice was solicited from this panel and DAxI was translated into Chinese by the authors. The draft Chinese version of the DAxI was back-translated into English by another two independent individuals, one dentist and one psychologist, fluent in both Chinese and English, who were not involved in the study. The backward translated English version was assessed and evaluated by the panel to check whether the questions were properly translated. Feedbacks from the panel were employed in further modification of the translated version. The translated DAxI was then

pilot-tested on a convenient sample of 50 adults studying or working in university. Modifications were then made according to the comments made by this sample.

Chinese DAxI validation

For the validation of the Chinese DAxI, **a convenient sample of** subjects aged between 18 and 64 years were recruited from 10 railway stations in Hong Kong. The target sample size was planned to include 500 subjects (that is, 50 subjects from each station). The questionnaires were issued by 5 trained interviewers who were not involved in any future assessment and analysis. These interviewers were all university undergraduates majoring in psychology; they received training in **subject selection**, introducing the research project, soliciting consent for participating in the study and giving instructions on how to complete the questionnaires (27).

The questionnaires used in the **first interview** included the Chinese DAxI, the Symptom Checklist 90 (SCL-90) (28), the Depression Anxiety Stress Scales (DASS) (29, 30), and the State-Trait Anxiety Inventory (State Anxiety STAI-S, Trait Anxiety STAI-T) (31). The SCL-90 is a multidimensional self-report inventory designed to screen for a broad range of psychological problems and symptoms of psychopathology, including somatization (12 items), obsessive-compulsive (10 items), interpersonal sensitivity (9 items), depression (13 items), anxiety (10 items), hostility (6 items), phobic sensitivity (7 items), paranoid ideation (6 items) and psychoticism (10 items). The DASS is composed of three scales: anxiety, depression, and stress, each consisting of 14 items (29). These scales were designed to provide relatively pure measures of the related negative affective states of depression, anxiety and stress (30). The DASS has shown good construct validity with other scales designed to measure selectively anxiety and depression. The State-Trait Anxiety Inventory (STAI) differentiates between the temporary condition of "state anxiety" (STAI-S) and the more

general and long-standing quality of "trait anxiety" (STAI-T); this is commonly used in research study for measurement of an individual's state and trait anxiety (32-34). Questions regarding the subjects' demographic data, educational level, income and brief dental history were also asked. Subjects were asked to complete and return the questionnaires during the interview. These instruments had been translated and validated for Chinese populations (32, 33, 35-39).

One month later, individuals were selected from the pool of subjects surveyed based on preliminary analysis of the DAxI scores and were invited by letter (with telephone follow-up) to attend a free dental check-up by an uninvolved dentist at his dental clinic. This subset of subjects ensured inclusion of individuals from upper, middle and lower portions of the spectrum of the DAxI scores. **In brief, all subjects with initial DAxI score one standard deviation (SD) above (upper portion) or below (lower portion) the mean were recruited. These formed two-thirds of the dentally examined group. The remaining one-third were subjects with initial DAxI scores within the range of the one standard deviation of the mean (middle portion) selected as described following. The questionnaires with middle portion scores were arranged in the order of the original coding and then subjects were selected by an interval method.** These selected subjects were asked to complete the BAI and to repeat the Chinese DAxI on the dental chair immediately before the clinical examination commenced. **The BAI is a self-administered screening test, with good convergent and discriminant validity, for measuring anxiety levels of clinical and non-clinical subjects by the response to 21 items rated on a scale from 0 to 3 (40, 41). Each item is descriptive of subjective, somatic, or panic-related symptoms of anxiety.**

The dentist and the dental surgery assistants involved had also received training in introducing the research project, and in providing instructions on how to complete the

questionnaires. Oral hygiene instructions and advice on their individual treatment needs were given upon conclusion of the examination.

For evaluation of test-retest reliability, two months after initial questionnaire interview, all 500 subjects were asked by mail to complete the Chinese DAxI again and to return by mail using an enclosed stamped return envelop.

Chinese SDAxI derivation and validation

In the derivation of the short-form Chinese version of DAxI, the methodology used by Stouthard (13) was followed and hence the same set of items was selected. For the validation of the Chinese version of the SDAxI, another **convenient** sample of subjects aged between 18 and 64 years were recruited following the same method as for the validation of the full version of DAxI, i.e. subjects were recruited from 10 railway stations by the same trained interviewers. The target sample size was planned to include 300 subjects, i.e. 30 subjects from each station. The questionnaires used included the Chinese DAxI and SDAxI. For evaluation of test-retest reliability, **all subjects who initially completed a questionnaire with an even code number**, target size of 150 individuals, were asked by mail to complete the SDAxI a second time, and to return this by mail using an enclosed stamped return envelop, two months after the initial questionnaire interview.

Data analysis

The total DAxI score was calculated by summing the scores of the responses to the 36 items. Item-scale correlation coefficients were used to assess the correlation between the individual items and the DAxI scores. **Validation of the Chinese DAxI was achieved at three levels, namely the construct validity, the discriminant validity, and the reliability.**

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Construct validity was verified by examining the predictive ability of DAxI and its provision of measuring the stable dental anxiety proneness, independent of the situation. Predictive ability was measured by the correlation between the BAI scores recorded for those subjects during the clinical dental examination and the scores of the Chinese DAxI which they had completed at the first interview. Measurement of stable dental anxiety proneness was assessed by repeated measure ANOVA. This was studied by comparing the DAxI scores of those subjects who attended the clinical dental examination, which were administered at three different time points: namely at first interview, one month later upon dental examination and two months after first interview by mail. The discriminant validity was evaluated by assessing the correlations of the Chinese DAxI with related and unrelated variables.

Correlation coefficients indicating good construct validity and predictive validity should be substantial. Good discriminant validity should be reflected by a relatively small effect (r_{xy} between 0.10 and 0.3) or zero correlations. The validity of the Chinese version of the short-form DAxI was assessed by evaluating the associations between the SDAxI scores and DAxI scores. The associations were studied by the Pearson correlation and the linear regression of SDAxI on DAxI.

Test-retest reliability and internal consistency were obtained to assess the reliability of the Chinese DAxI and SDAxI. Pearson correlation and intraclass correlation were used to measure the test-retest reliability. Cronbach's Alpha was used to measure the internal consistency. The level of significance was set at 0.05 for all tests.

Ethics

The Ethics Committee of the Faculty of Dentistry, the University of Hong Kong approved the study. All participants volunteered themselves to participate and all received comprehensive information on the study.

Results

For validation of the Chinese DAxI, 500 subjects with mean age 38.3 ± 11.8 years were interviewed and their demographic data are shown in Table 1. All the subjects had received at least primary education, approximately half of the subjects were male and less than 30% received regular dental care including check-up and scaling at least once a year. **The demographic characteristics of the sample were similar to those of the Hong Kong population (Table 1).**

The mean Chinese DAxI score, the Cronbach's alpha of the Chinese DAxI, the item-scale correlation coefficients are shown in **Table 2**. No statistically significant correlation was detected between DAxI scores and age, gender, education level, income and dental care attendance profile (data not shown).

There was a total of 90 subjects with DAxI scores greater than one standard deviation above (upper portion) or less than one standard deviation below (lower portion) the mean DAxI score. **According to the pre-determined protocol, 45 subjects were then selected from among those individuals who had initial DAxI scores within one standard deviation from the mean (middle portion, n = 410). One out of every nine subjects was selected.** This subgroup of 135 subjects was then invited to attend a free dental examination one month after the first interview. Eight subjects (6.0%), however, refused to participate further in this study. The mean BAI score of the remaining subjects (n = 127), measuring the state anxiety level at the time of the clinical examination, was 16.0 ± 15.2 (range 0 – 50). The

correlation of the Chinese DAxI with the BAI as measured by the Pearson's correlation coefficient was 0.97 ($P < 0.01$). This finding supported the predictive ability of the Chinese DAxI.

For those subjects receiving a clinical dental examination, the Chinese DAxI was administered thrice: at first interview, one month later upon clinical dental examination, and two months after the first interview by mail; **repeated measure ANOVA** showed no effect of the time of administration of the Chinese DAxI, $F(2, 125) = 0.94$, $P = 0.40$. This finding supported the ability of the Chinese DAxI to reflect a relatively stable dental anxiety proneness independent of situation (DAxI scores at first interview, one month later, upon clinical examination, and by mail two months after first interview were 69.8 ± 32.8, 69.6 ± 32.4, and 68.3 ± 31.9 respectively).

Correlations between the Chinese DAxI and the other tests are presented in **Table 3**. The somatization, depression, anxiety and phobic sensitivity scales of the SCL-90, the depression and anxiety scales of DASS, and the state and trait scales from STAI, were all shown to be significantly correlated to the DAxI. In terms of effect size (43), a small effect (r_{xy} around 0.3) was found for these scales. No effect was found with other psychological problems as measured in SCL-90, namely the obsessive-compulsive, interpersonal sensitivity, hostility, paranoid ideation and psychoticism. These results supported the construct validity and the discriminant validity of the Chinese DAxI.

While 26 subjects refused to complete the Chinese DAxI a second time, the test-retest reliability measured by the Pearson's correlation was 0.90 **and intraclass correlation** was 0.90 (n = 474). These figures suggested excellent test-retest reliability was achieved in DAxI. Cronbach's Alpha was calculated at 0.77 which indicated that a good internal consistency was achieved.

The sampled subjects with mean age of 38.1 ± 11.2 years were interviewed for SDAxI and the demographic data is shown in Table 1. These data were essentially the same as those of the 500 subjects surveyed for the DAxI earlier. The mean and range of the SDAxI score, the Cronbach's alpha, and the item-scale correlation coefficients of the sample used in validation are shown in **Table 2**. No statistically significant correlation was detected between Chinese SDAxI scores and age, gender, education level, income and dental care profile (data not shown).

Correlation between the Chinese SDAxI and the Chinese DAxI was 0.93. The reported R^2 was 0.86 ($P<0.0001$) in the regression line of SDAxI on DAxI, with a regression coefficient of 0.26. Thus, the score on the Chinese SDAxI is approximately one fourth of the score on the DAxI which consisted of four times as many items as compared to SDAxI. Out of the 150 subjects selected for SDAxI test-retest reliability, 7 refused to participate further. The test-retest correlations and Crobach's Alpha are presented in Table 2. The figures suggested good test-retest reliability and internal consistency were also achieved in the SDAxI.

Discussion

Cross-cultural adaptations of health-related, self-administered instruments have been discussed by several researchers (25, 44). Studies have suggested that instruments considered for cross-culture research should be reviewed by considering issues with respect to language, ethnic, cultural and socioeconomic differences, while at the same time instruments should be easy to complete and should demonstrate acceptable psychometric properties (25, 45, 46). It is thus essential to carry out strict and rigorous translation and validation procedures prior to the final application of an instrument in another population or culture.

The present study sought to translate and validate DAxI as an instrument for measuring dental trait anxiety among Chinese in Hong Kong. According to the Hong Kong Census 2001 (26), the demographic data of the subjects **conveniently** recruited appeared comparable with the general population of Hong Kong in respect of age, education, income and dental habit (42, 47). **Furthermore, the corresponding psychometric inventories/scales scores of the surveyed subjects did not differ a lot from the Chinese population norms (Table 3). This suggests that despite the limitations of the sampling protocol, and hence cautions needed in data interpretation, the similarities of the observed data to population norms indicate that the sample surveyed might represent a broader population.** Apart from generating considerable data for validation of the Chinese DAxI, the present study also provided preliminary normative data for the Chinese DAxI and Chinese SDAxI.

An instrument measuring dental anxiety should be able to measure the anxiety proneness and predict the state anxiety of an individual when he or she is actually facing a dental situation. At the same time, if the claim is that DAxI should be measuring specific dental trait anxiety, the time of administration of the DAxI with regard to the dental visit should not influence the results.

In the present study, the predictive validity of the Chinese DAxI was supported and the DAxI was shown to measure a rather stable construct of anxiety proneness to the dental visit situation independent of the time of administration with regard to the dental visit.

The numbers of dropout subjects in the validation process of Chinese DAxI and SDAxI were small and acceptable (24 of 500 for the DAxI and 7 of 150 for the SDAxI). A concern was whether such sample attritions would be confound the study. Analyses of their DAxI scores, SDAxI scores and demographic data suggested no statistically significant difference between the dropout subjects and those who completed the study.

Dental anxiety is a complicated phenomenon and its multifactorial nature is very often undermined in its measuring instruments (18, 20). Dentally anxious subjects are not a homogenous group of people and they differ in various aspects including the etiology of fear, and its manifestation in terms of affective, behavioural and cognitive reactions (48). A review has suggested that different aspects of dental anxiety should be included in a measurement instrument, namely the situation to which it pertains, the reactions it evokes and its duration (20). The Dental Anxiety Scale (DAS) (49) and the Dental Fear Survey (DFS) (50), being two of the most well known instruments, fail to address this multifactorial dimension (21). The DAxI employs the facet theory (23, 51) which offers a useful heuristic in the construction of measurement instruments for multifactorial concepts, enabling the DAxI to specify an exhaustive and systematic description and definition of the complex phenomenon of dental anxiety. The facet approach obviously offers added value on the level of operationalization for measurement of dental anxiety.

A few years after DAxI was formulated, Stouthard constructed a practical, shortened version of the tool, named SDAxI (18). **In the present study, the empirical data justified a positive remark for the Chinese SDAxI.**

The mean Chinese DAxI and SDAxI scores were somewhat lower than mean scores in the Dutch population (21). Schwarz et al. (3), who compared dental anxiety in a Chinese sample and a Danish sample, however reported a significantly higher figure in the Chinese. Direct comparison of the results was not appropriate due to differences of the populations and intrinsic characteristics of the measurement instruments. Further study would be recommended to explore the population norms in Chinese populations.

The aim of the original DAxI, according to Stouthard (18, 19, 21), was not only to identify extremely anxious dental patients, but also to assess anxiety proneness in regular dental patients and the prevalence of dental anxiety in the general population. The validity

and reliability of DAxI in this respect seemed accomplished (20). Clinical application of a measurement instrument, however, requires further evaluation of the sensitivity and specificity of the instrument and establishment of clinical cut-off scores and diagnostic categories (48). A study by Stouthard et al. (18) evaluated the criterion related validity and the sensitivity of DAxI in a quasi-experimental study comparing the DAxI scores of attendees of a special dental health clinic for extremely anxious patients with the DAxI scores of individuals, presumed low- or non-anxious, treated by dental students in dental school. 95.2% of subjects (n = 19 for each group) were correctly classified either to extreme-anxious group or to the low-anxious group (18). In Hong Kong, however, there is no such clinic setting for extremely anxious patients which would allow for a comparable evaluation of the validity of the Chinese DAxI. The development of clinical cut-off scores and diagnostic categories for the Chinese DAxI and SDAxI should be addressed in population based studies evaluating the affective, cognitive, behavioural and psychophysiological reaction characteristics of the subjects in each category.

In conclusion, the translated Chinese DAxI is as valid and reliable as the original version of DAxI and is a suitable instrument for measuring dental anxiety both in research and in dental practice in Chinese populations. It offers a reliable measurement of dental trait anxiety and satisfactory prediction of state anxiety in dental situations. In situations where the use of a short-form is desirable, such as in general dental practice, the Chinese SDAxI offers a short, easy to complete, valid, reliable and interpretable scale for measuring dental anxiety.

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Table 1. Demographic background of the Hong Kong population and subjects recruited

	Population reference (%)[a]	Chinese DAxI validation		Chinese SDAxI validation	
		n	%	n	%
Subjects		500		300	
Gender					
Male	48.6	240	48.0	146	49.0
Female	51.4	260	52.0	154	51.0
Educational level					
Primary	22.8	108	21.6	67	22.3
Secondary	48.0	251	50.2	145	48.3
Tertiary or above	29.2	141	28.2	88	29.3
Income[b]					
<10,000	NA	369	73.8	211	70.3
10,001 – 20,000	NA	71	14.2	48	16.0
20,001 – 30,000	NA	37	7.4	24	8.0
>30,000	NA	23	4.6	17	5.7
Dental care					
Regular	26.3	138	27.6	86	28.7
Irregular	73.7	362	72.4	214	71.3

[a]Population reference for gender and educational level are from Hong Kong Census and Statistic Department (26); population reference for dental care patterns is from Oral Health Survey 2001 (42); NA = data not available.
[b]Monthly income in Hong Kong dollars; US$ 1.00 = HK$ 7.80.

Table 2. Psychometric characteristics of the Chinese versions of DAxI and SDAxI

	DAxI (n = 500)	SDAxI (n = 300)
Mean ± SD	60.3 ± 20.5	15.2 ± 6.0
Range	36 – 146	9 – 40
Internal consistency – Cronbach's alpha	0.77	0.80
Item-scale correlation coefficient	0.72 – 0.81	0.91 -0.94
Test-retest Pearson correlation[a]	0.90	0.84
Test-retest intraclass correlation[a]	**0.90**	**0.85**

[a]26 subjects dropped-out from DAxI and 7 dropped-out from SDAxI validation respectively, i.e. n = 476 for DAxI, n = 143 for SDAxI.

Table 3. Population norms, convenient sample means (n=500) of SCL-90, DASS, and STAI, and their expected and observed correlations with DAxI

Test	Variable	Population Norm (mean ± SD)[a]	Sample (mean ± SD)	Correlation with DAxI		
				Expected[b]	Observed (r_{xy})	P
SCL-90	Somatization	8.9 ± 7.6	8.1 ± 7.7	Positive	0.15	<0.05
	Obsessive-Compulsive	11.9 ± 6.8	11.4 ± 6.4	Positive	0.22	0.341
	Interpersonal Sensitivity	6.8 ± 5.3	7.3 ± 6.3	Positive	0.16	0.585
	Depression	11.1 ± 8.2	10.5 ± 7.5	Positive	0.15	<0.05
	Anxiety	4.3 ± 4.1	4.5 ± 4.1	Positive	0.28	<0.05
	Hostility	4.5 ± 3.9	4.9 ± 4.1	None/negative	0.03	0.643
	Phobic Sensitivity	2.6 ± 3.0	2.3 ± 2.9	Positive	0.10	<0.05
	Paranoid Ideation	8.4 ± 5.9	8.9 ± 5.3	None/negative	0.20	0.165
	Psychoticism	5.6 ± 5.6	6.0 ± 6.2	None/negative	0.20	0.632
DASS	Depression	5.7 ± 6.4	5.6 ± 6.0	Positive	0.10	<0.01
	Anxiety	6.6 ± 5.3	6.7 ± 5.3	Positive	0.22	<0.01
	Stress	12.0 ± 7.0	12.3 ± 7.1	Positive	0.01	0.756
STAI	State anxiety	39.3 ± 8.7	39.0 ± 8.5	Positive	0.11	<0.05
	Trait anxiety	41.2 ± 7.6	39.8 ± 8.2	Positive	0.22	<0.01

[a]Population norms for SCL-90 and STAI are from Mental Health Association of China (39); population norms for DASS are from Wong 1996 (35).
[b]Positive = positive relationship; none = no relationship; negative = negative relationship.

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