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Effects of anxiety on dental students' noncognitive performance in their first objective structured clinical examination

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Abstract

Patient-dentist discourse is a core nonoperational competency in dental education. The skills of querying patients and responding to questions are noncognitive attributes, and their evaluation by the standardized patient objective structured clinical examination (OSCE) is particularly necessary. However, it is not clear whether students' test anxiety affects these attributes. This study aims to examine the relationship between dental students' state-trait anxiety, noncognitive performance, and examination results during their first OSCE. A single dental school cohort (n = 226) of 5 year students attending their first clinical examination from 2014 to 2017 was studied. Participants completed the Chinese Mandarin Version State-Trait Anxiety Inventory Y form before taking the OSCE. The difference between state and trait anxiety levels was compared by paired *t* test. Gender differences and the effect of age group in these anxiety levels were analyzed using multivariate analysis of variance. Moreover, gender, age group, state anxiety, and trait anxiety scores were compared with the OSCE items of noncognitive performance using a chi-square test. Students showed significantly higher state anxiety than trait anxiety levels; moreover, women showed significantly higher state anxiety than men. Furthermore, gender, age group, state anxiety, and trait anxiety had no association with the noncognitive performance examination results. Most participants showed moderate state and trait anxiety levels during their first OSCE. Further, the state-trait anxiety had no significant effect on their noncognitive performance. However, 26.5% of participants did not pass the examination; therefore, dental educators should increase communication skill training courses during clerkship training to improve students' noncognitive attributes.

KEYWORDS

dental education, noncognitive performance, OSCE, state-trait anxiety

1 | INTRODUCTION

Many assessments have evaluated dental students' knowledge, understanding, and clinical skills. In 1975, Harden et al¹ developed and introduced the objective structured clinical examination (OSCE) in a Scottish medical school to assess the clinical competence of students. Today, dental educators are required to develop OSCEs that objectively assess their students' essential dental knowledge, skills, and attitudes pertaining to clinical competence.² OSCEs were implemented in Kaohsiung Medical University medical programs in 2003.³ It is also essential to have an OSCE program that has been developed and implemented successfully in the Kaohsiung Medical University dental school. To this end, in 2011, the program's dental educators established a dental OSCE committee responsible for writing cases, training on simulated patients (SPs), training raters, administering the OSCEs, and gathering feedback from dental students. Since 2012, the OSCEs have been used to assessing fifth and sixth year dental students' learning outcomes, including communication skills and practical procedures. The committee evaluates the effectiveness of the OSCEs and makes recommendations for future improvements.

Many assessment methods are suitable for the evaluation of dental operational skills; however, there is a lack of appropriate assessment methods for nonoperational skills. It is particularly necessary to evaluate students' nonoperational competencies with respect to communication and interaction for standardized patient OSCE, which requires students to show not only their cognitive attributes but also their noncognitive personal qualities.⁴ The concept of "noncognitive skills" is an extensively researched topic and covers numerous phenomena. Its scope includes self-perception, motivation, perseverance, self-control, metacognitive strategies, social competencies, resilience and coping, and creativity.⁵ Social competencies refer to one's ability to effectively manage social interactions and relationships with others, including leadership and social skills. Further, social skills are related to various positive interactions with others, including having good communication skills, showing empathy to other people, having good friends, and cooperating with other individuals. It is strongly relevant to one of the core nonoperational competencies, that is, patient-dentist discourse (querying patients and responding to questions), which has been suggested by the Association for Dental Sciences for dental graduates in Taiwan.⁶

The OSCE covers a broad range of aspects such as communication, problem-solving, decision-making, and patient management abilities.⁷ It can effectively evaluate students' essential noncognitive skills, especially through the standardized patient test. However, the assessment and examination procedures are potentially stressful and anxiety-provoking for dental students.⁸ Dental students perceive the OSCE as much more stressful than a written test.^{9,10} In addition, many other health professionals also find the OSCE to be particularly stressful.¹¹ A qualitative study clarified that "fear of the unknown" was one of the themes that affected students' anxiety regarding the OSCE.¹² The unknown and unfamiliar element of the OSCE certainly affected some students' feelings and reactions toward the assessment for the first time.

People commonly experience elevated state anxiety during test situations.¹³ Spielberger¹⁴ introduced the two complementary concepts of state and trait anxiety; the former refers to a transient emotional state related to a specific situation, while the latter refers to a relatively persistent personality trait. It has been noted that anxiety is a personal self-perception. It is a feeling of worry, nervousness, or unease, typically about an imminent event or something that has an uncertain outcome. Anxiety easily causes people to feel uncomfortable and have bad thoughts, and it can reduce individuals' standards of cognitive performance.¹⁵ In a competitive society, approximately 30% to 50% of students are bothered by test anxiety.¹⁶ Many studies have found that test anxiety and academic performance have a significant negative association.^{17,18} State anxiety was found to be elevated during the OSCE, written test, and preclinical preparation test, and the OSCE was revealed to be the most anxiety-provoking assessment method.⁹ Moreover, lower levels of state and trait anxiety have been identified as factors that improve OSCE performance.¹⁹

Strictly speaking, the checklist of a standardized patient test includes both cognitive items (such as professional knowledge and decision-making skills) and noncognitive items (social skills). Previous studies examining the effect of test anxiety on OSCE performance have adopted an overall score as the outcome variable; no existing study has explored the effect of anxiety on noncognitive performance during a standardized patient test. Although the relationship between anxiety and cognitive performance has been confirmed,¹⁵ it is not yet clear how facing the OSCE and standardized patient test for the first time affect students' anxiety levels and noncognitive performance. Therefore, this study aimed to examine the level of anxiety experienced by dental university students on facing their first OSCE as well as the effects of this anxiety on their noncognitive OSCE performance.

2 | MATERIALS AND METHODS

This study was approved by the Institutional Review Board of Kaohsiung Medical University Hospital (Letter No. KMHIRB20130100).

2.1 | Study design

A single dental school cohort of 5 year students taking their first clinical examination during the years 2014, 2016, and 2017 was studied. Five-year students who had just finished clerkship training (for 12 weeks) at the hospital and take the OSCE assessment before their internship course commences in June of the same year. The OSCE was a formative assessment, and the examiner offered immediate feedback at the end of the examination. The OSCE score was included as 10% of the clerkship performance. All students took the examination on the same day under secure conditions. A test staff member who did not belong to the dental OSCE committee or have dental background was responsible for organizing the sequence of OSCE stations according to the students' clerkship groups (the students self-determine their group before starting the clerkship training) ordered

by student ID numbers. The students were informed of the sequence of stations and OSCE scenarios only at the time of the examinations. Students' personal belongings such as mobile phones cannot be brought into the test room.

The 2014 OSCE comprised three stations: one communication examination conducted using trained SPs, and two examinations on skills required in standard situations. The 2014 OSCE scenarios included information giving, suturing, and image interpretation. In 2015, a national dental OSCE was conducted as a trial in Taiwan. However, those students had just begun their clerkships when they appeared for the trial version examination. Therefore, they have been excluded from this study to avoid potential bias that might be caused by insufficient training hours.

The 2016 OSCE comprised six stations: two communication examinations conducted using trained SPs, and four examinations on skills required in standard situations. The 2016 OSCE scenarios included oral hygiene instruction, history taking (periodontology), aseptic procedure, impressions, tooth root planning, and rubber dam isolation. The 2017 OSCE comprised three stations: one communication examination conducted using trained SPs, and two examinations on skills required in standard situations. The 2017 OSCE scenarios included history taking (oral and maxillofacial surgery), rubber dam isolation, and image interpretation. Different OSCE stations were adopted for different academic years to avoid the influence of revealing examination questions. There was only one examiner in all stations, and all voluntary SPs were female.

2.2 | Procedure

The students were required to take the OSCE; however, answering the questionnaire was optional. Among the total of 238 students who were invited to participate in this study, 226 students (95.0%) agreed and completed the State-Trait Anxiety Inventory Y form questionnaires, and informed consent was obtained from these students.

The OSCE check listings include cognitive and noncognitive performance. In this study, we consider the noncognitive items alone. These items have two parts: one is the establishment of rapport (self-introduction, patient identification, explanation of the purpose of the visit, and patient's expectation), and the other comprises communication skills (listening, organization, speaking clearly, and expressing empathy). A test station has two to three noncognitive items. Each item was scored in the range 0 to 3, where 0 = did not meet the requirements, 1 = partially met the requirements, and 2 = met the requirements. The sum of raw scores was scaled according to the formula: raw score/total score \times 100. A student had to obtain 75 points (out of a total of 100 points) to pass each station of noncognitive items.

2.3 | Measures

In 1983, Spielberger et al²⁰ developed the 40-item State-Trait Anxiety Inventory Y form (STAI-Y); it has two parts for measuring state anxiety (20 items) and trait anxiety (20 items) on a 4-point Likert scale, which pertains to how the students feel at a given moment from 1 (not at all) to

4 (very much so). The state anxiety or trait anxiety can range from 20 to 80; scores 20 to 39 indicate low, 40 to 59 moderate, and 60 to 80 severe anxiety. Ma et al²¹ modified the Chinese Mandarin Version of the State-Trait Anxiety Inventory Y form (CMSTAI-Y) using a Taiwanese sample and found that the Cronbach's alpha reliabilities for the state and trait anxiety subscales were 0.91 and 0.92, respectively. In addition, the 2 week test-retest reliabilities for the state and trait anxiety subscales were found to be 0.76 and 0.91, respectively. Further, the criterion validity of the scale was supported by its high correlations with the interview version of the Chinese Hamilton Anxiety Rating Scale ($r = .69$ and $.74$ for state and trait anxieties, respectively). Finally, the scale was shown to be reliable and valid for measuring Taiwanese adults.

2.4 | Statistical analysis

Sample characteristics were presented by descriptive statistics. The difference between state and trait anxiety levels was compared using the paired t test. Age was divided into two groups (23-24 years old and over 25 years of age) for further analysis. Students above 25 years of age showed a strong desire to be a dentist, as they had taken the College Entrance Examination more than two times or even retaken the exam after earning a bachelor's degree from another college. Gender differences and the effect of age group regarding state and trait anxieties were analyzed by multivariate analysis of variance (MANOVA). Moreover, the scores of state and trait anxiety were divided into low, moderate, and severe, respectively. The chi-square test was used to compare gender, age group, state, and trait anxiety scores with the OSCE items of noncognitive performance. The statistical analyses were all conducted using the SPSS 22.0 software.

3 | RESULTS

3.1 | Sample characteristics

The sample consisted of 226 students who were taking their first OSCE. A relatively higher proportion of these students were male (61.1%). Approximately three-quarters of the total number of attending students passed the examination (73.5%). The mean age of all the participating students was 24.52 ± 2.47 years; 92% of them were 23 to 26 years old, and only 4.4% were older than 30 years. The state and trait anxiety scores both followed normal distribution, with mean scores of 51.48 and 47.28, respectively. Moreover, state anxiety was found to be statistically significantly higher than trait anxiety among students (Table 1).

TABLE 1 Comparison between state and trait anxiety levels

| Variable | Mean \pm SD | | t | P |
|---------------|------------------|------------------|-------|------|
| | State | Trait | | |
| Anxiety score | 51.48 \pm 9.71 | 47.28 \pm 8.16 | 6.689 | .000 |

Abbreviation: SD, standard deviation.

3.2 | Effects of gender and age group on anxiety

Pearson's correlation analysis revealed that state anxiety was moderately correlated with trait anxiety ($r = .454$); therefore, MANOVA was considered appropriate in this case. The Box's M test of equality

of covariance matrices was found nonsignificant ($P = .090$). As shown in Table 2, two-way MANOVA revealed no significant multivariate main effect for gender and age group; further, an interaction was not obtained for them. However, a significant univariate main effect for gender was obtained for state anxiety scores, and female

TABLE 2 Two-way multivariate analysis of variance (using gender and age groups)

| Sources of variation | Dimensions | Wilks' Λ | F | η^2 | P |
|---------------------------|---------------|------------------|-------|----------|------|
| Gender | State anxiety | 0.981 | 4.279 | 0.019 | .040 |
| | Trait anxiety | | 1.173 | 0.005 | .280 |
| Age group | State anxiety | 0.995 | 1.124 | 0.005 | .290 |
| | Trait anxiety | | 0.086 | 0.000 | .769 |
| Gender \times age group | State anxiety | 0.999 | 0.001 | 0.000 | .979 |
| | Trait anxiety | | 0.115 | 0.001 | .735 |

FIGURE 1 Mean state anxiety and trait anxiety scores according to gender and examination results

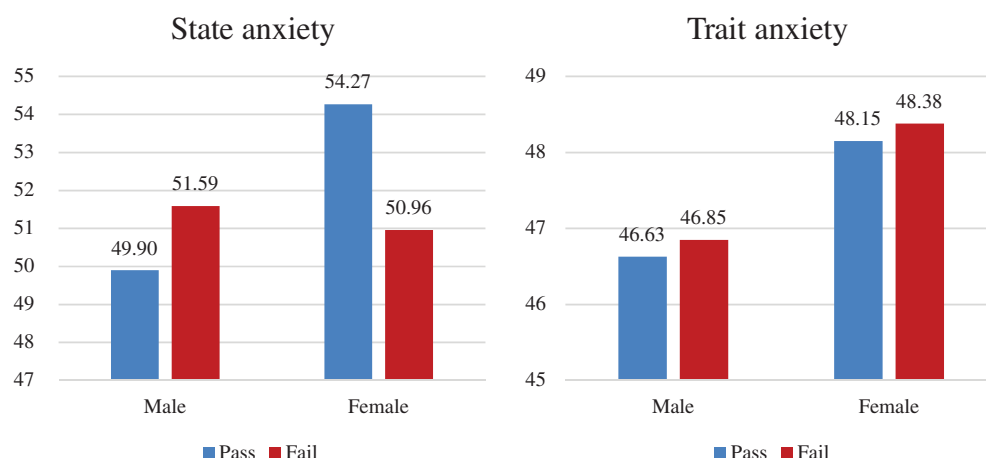


TABLE 3 Association between gender, age group, anxiety, and noncognitive performance

| Variables | Total n (%) | Examination result | | χ^2 | P |
|---------------|-------------|--------------------|------------|----------|------|
| | | Fail n (%) | Pass n (%) | | |
| Gender | | | | | |
| Male | 138 (61.1) | 34 (24.6) | 104 (75.4) | 0.664 | .415 |
| Female | 88 (38.9) | 26 (29.5) | 62 (70.5) | | |
| Age group | | | | | |
| 23–24 | 162 (71.7) | 39 (24.1) | 123 (75.9) | 1.796 | .180 |
| ≥ 25 | 64 (28.3) | 21 (32.8) | 43 (67.2) | | |
| State anxiety | | | | | |
| Low | 16 (7.1) | 3 (18.8) | 13 (81.2) | 1.901 | .387 |
| Moderate | 178 (78.8) | 51 (28.7) | 127 (71.3) | | |
| Severe | 32 (14.1) | 6 (18.8) | 26 (81.2) | | |
| Trait anxiety | | | | | |
| Low | 29 (12.8) | 5 (17.2) | 24 (82.8) | 2.764 | .251 |
| Moderate | 179 (79.2) | 52 (29.1) | 127 (70.9) | | |
| Severe | 18 (8.0) | 3 (16.7) | 15 (83.3) | | |
| Total | | 60 (26.5) | 166 (73.5) | | |

Abbreviations: N, number; %, percentage.

students showed higher state anxiety levels than male students (Figure 1).

3.3 | Association between gender, age group, anxiety, and examination results

As shown in Table 3, chi-square test revealed that gender, age group, state anxiety, and trait anxiety had no significant differences related to examination results.

4 | DISCUSSION

Most dental students who participated in this study showed moderate levels of both state and trait anxiety when facing their first OSCE (78.8% and 79.2%, respectively). Previous studies have mostly adopted only the state anxiety scale to evaluate test anxiety. Longshore,²² who conducted a study with pharmacy students, reported a mean state anxiety score of 48.0, which is slightly lower than the finding of this study (51.48). Brand and Schoonheim-Klein⁹ reported a mean state anxiety score of 54.06 among dental students for the OSCE. In addition, the mean anxiety scores reported by Marshall and Jones (59.27) and Kalantari et al (62.4) were higher than that of the current study.^{10,11} Overall, these previous studies revealed that most students show a moderate level of test anxiety for the OSCE, while our study showed a relatively lower mean score, which may be attributed to the relatively low-stakes context of this study.

Further, this study also found that female students showed a higher mean test anxiety score than male students, which is similar to the results of some previous studies^{10,12,23} but inconsistent with those of some other studies.^{9,24} Brand and Schoonheim-Klein⁹ reported mean state anxiety scores of 51.14 and 54.59 for male and female dental students, respectively, with no significant difference between the two. However, Kalantari et al¹⁰ showed a significantly higher state anxiety score for female (71.4) than male (52.4) dental students. Moreover, some other studies that adopted different instruments to measure test anxiety found similar (anxiety level for female students is higher than that for male students)^{23,24} or contradictory results²⁴ compared to our findings. The inconsistency in these results may be attributed to cultural differences, student age, sample size, study design, test style, and instruments used for the respective studies.

Furthermore, this study found that although female students had higher anxiety levels, there was no gender difference in students' noncognitive performance. There are limited studies exploring the relationship between test anxiety and OSCE performance.^{9,10,12,23,24} Most of them have found that anxiety level, whether or not there is a gender difference, has no association with the overall OSCE score.^{9,12,23,24} However, Kalantari et al showed that female students have high levels of mean state anxiety, as well as higher OSCE scores, although the overall anxiety level (low, moderate, or high) has no association with the OSCE score. Interestingly, Kalantari et al also found that female students have a significantly higher preparation level than

male students.¹⁰ Many previous studies on medical education have found gender differences in psychological characteristics. For example, Blanch et al²⁵ found that female medical students reported decreased self-confidence and increased anxiety; Carson et al reported that there is an interaction between the gender of the student and that of the SP, and this interaction affects OSCE scores.²⁶ Recent studies have found that gender is associated with metacognition and worry.^{27,28} Further studies need to explore the underlying mechanism of the effect of gender on anxiety. However, from the results obtained in this study, we can conclude that similar to the overall OSCE score, noncognitive performance is not affected by test anxiety and gender. These findings indicate that test anxiety is only one among several variables that influence students' grades, and that in order to better understand students' performance, it is necessary to consider other factors such as motivational beliefs, learning strategies, and numerous cognitive processes.²⁹

In this study, the mean trait anxiety score was lower than the mean state anxiety score. The two anxiety scores also showed a moderate correlation. Moreover, trait anxiety was not associated with gender, age, and students' noncognitive performance. An individual's self-control strength may influence his or her feelings of state anxiety because emotion regulation is impaired in individuals whose self-control strength is temporarily depleted. Further, trait anxiety predicted an increase in state anxiety only in students with depleted self-control strength.¹³ Many previous studies have assumed that individuals' momentary capacity to exert self-control over their attentional processes may be an anxiety-moderating factor.¹⁵ In our study, anxiety levels showed no significant influence on noncognitive performance; this result may be attributed to the low-stakes nature of the examination. Dental OSCEs are still in the testing phase in Taiwan, and the OSCE score constitutes only 10% of the clerkship performance. In the future, it is recommended that research based on high-stake examinations should be conducted. However, the noncognitive skills considered in this study included interpersonal skills such as empathy and sociability, which are basic skills required in daily social and clinical activities. In this study, 26.5% of students did not pass the examination, indicating a necessity of remedial training before their internship. Good interpersonal communication between dentists and patients leads to better patient satisfaction, reduction of patient fear and anxiety, and improved treatment outcomes.³⁰ Therefore, dental educators should improve communication skills training courses during clerkship training. Various approaches should be applied, such as role-play simulations, web-based cases scenarios, SPs, and video interactions to aid in learning these skills instead of traditional didactic lectures.³¹

This study has some limitations. First, students from different academic years took the OSCE with different stations, making it impossible to compare their cognitive attributes; however, without being qualified in noncognitive performance, students often fail in patient-dentist discourse, because cognition is dependent on noncognitive processes.³² Second, the demographic characteristics of this study's participants were too simple, and other factors, such as school location and financial problems, have been previously associated with increase in medical students' anxiety symptoms.³³ Further study is encouraged to investigate this issue among dental students. Third, it

took place in a medical university—Kaohsiung Medical University—that recruits only one-fifth of the newly enrolled dental students every year in Taiwan. Although the effect of volunteer bias is small due to the high participation rate, future research based on multiple institutions is warranted to enhance the generalizability of this study. Overall, this study is significant in that, to the best of our knowledge, this is the first to investigate the relationship between test anxiety and noncognitive performance related to the OSCE, with a sample size larger than that of previous studies.

5 | CONCLUSIONS

Most of the dental students showed moderate state and trait anxiety levels while taking their first OSCE. Further, state-trait anxiety was not found to have any significant effect on the noncognitive performance of OSCE.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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