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Structural equation modeling to assess gender differences in the relationship between psychological symptoms and dental visits after dental check-ups for university students

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Abstract

Objective. Some studies have shown a relationship between psychological symptoms and oral health behaviors. However, it is unknown whether gender differences affect the relationship between psychological symptoms and oral health behaviors. In addition, gender differences in the relationship between dental anxiety and dental visits for treatment or regular check-up are unclear. The objective of the present study was to explain the relationships among gender differences, psychological symptoms, oral health behaviors, dental anxiety and 'expectation of dental visit', evaluated as 'dental visits when treatments are recommended' in university students. ***Materials and methods.*** A total of 607 students (311 males, 296 females) aged 18–38 years old were examined. The information was collected via questionnaire regarding gender, psychological symptoms and oral health behaviors. Psychological symptoms were assessed using the Hopkins Symptom Checklist. Structural equation modeling was used to test pathways from these factors to 'expectation of dental visit'. Multiple-group modeling was also conducted to test for gender differences. ***Results.*** Psychological symptoms were related to low expectation of dental visit in females, but there was no such relationship in males. Oral health behaviors were related to expectation of dental visit in both genders. ***Conclusions.*** Psychological symptoms were directly related to expectation of dental visit in females and oral health behaviors were related to expectation of dental visit in both genders. To promote dental visits after dental check-ups at school, it might be necessary to improve oral health behaviors in both genders and to evaluate psychological symptoms, especially in females.

Key Words: *psychological symptoms, behavioral science, structural equation modeling, cross-sectional studies, university students*

Introduction

Oral health behaviors are associated with various factors, including gender [1–3], stress [4,5], anxiety symptoms [6], knowledge [7], attitude [7], lifestyle [8] and socioeconomic status [9]. For instance, females brush their teeth, use extra cleaning devices and visit the dentist for regular check-ups more frequently than do males [1,2].

Previous studies have described the effects of psychological condition or anxiety about dental treatment on dental expectations, which meant the possibility of dental visit. Bernson et al. [10] reported that levels of dental and general anxiety and of depression were higher among irregular attendees than regular attendees. Okoro et al. [11] reported that adults with current depression had a higher prevalence of non-use of oral health services than those without depression. Another study revealed that dental anxiety resulted in avoidance of dental treatment [12]. In contrast, Marques-Vidal and Milagre [13] reported that participants with anxiety or depression reported a higher dentist attendance than normal participants and Anttila et al. [6] found that anxiety symptoms were not related to frequency of dental visits. Therefore, the relationships among psychological conditions, dental anxiety and dental attitude are inconsistent.

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Previous research has shown that depression and stress levels were higher in females than males [14]. In addition, dental anxiety was reported to be more severe among females than among males [15]. These previous findings suggest that it is possible for gender difference to affect the relationship between psychological symptoms and oral health behaviors.

We hypothesized that psychological symptoms, including anxiety and depression, and oral health behaviors relate to visiting the dental office after a dental check-up at school or university and that such a relationship differs between genders. The aims of the present study were to examine the interactions among psychological symptoms, oral health behaviors and dental anxiety by structural equation modeling and to clarify the gender differences in the effects of psychological symptoms, oral health behaviors and dental anxiety on dental visits following dental checkups (expectation of dental visit) in university students.

Materials and methods

Study population

A total of 2374 first-year students underwent a general health examination in April 2009 at the Health Service Center of Okayama University, Okayama, Japan. The general health examination is mandatory for all first-year students. Of these students, 641 (18.8 ± 1.7 years; mean ± SD) volunteered to participate in the study. The study was approved by the Ethics Committee of Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences. Verbal consent was obtained. We excluded 34 participants who had provided incomplete data in their questionnaires. As a result, data from 607 students (311 males and 296 females) aged 18–38 years old were analyzed. The response rates were 27.0% initially and 25.6% after excluding cases. The numbers of analyzed students aged 18, 19, 20–29 and 30–38 years old were 473 (77.9%), 82 (13.5%), 50 (8.2%) and 2 (0.3%), respectively.

Questionnaire

A self-administered questionnaire was filled out at the health examination. Besides gender, age, general condition and smoking status, the questionnaire included the following items:

- *Psychological symptoms*. A Japanese version of the Hopkins Symptom Checklist (HSCL) [16,17] was used to measure psychological symptoms. The HSCL consists of a set of symptoms taken from the Cornell Medical Index and is widely regarded as a reliable and valid measure [16,18]. The Japanese version of the HSCL employed in this study uses 54 items from the original inventory and the same response format (4-point scale of distress) [17]. It is scored on five underlying symptom dimensions: somatization (14 items), obsessive-compulsive (9 items), interpersonal sensitivity (10 items), anxiety (8 items) and depression (13 items). The Cronbach's alpha for five underlying symptom dimensions was 0.925 in our study. The Japanese HSCL has been widely used and is a standard assessment in Japan [17,19].
- *Oral health behaviors*. The participants reported tooth-brushing frequency, use of dental floss and whether they had visited a dental clinic for a regular check-up during the past year [20]. The participants were asked whether they would visit a dental clinic when they experienced pain in the teeth or gingiva ('Dental visit with pain') [21].
- *Anxiety about dental treatment*. The participants were asked if they would be anxious about dental treatment if they were told they would receive dental treatment tomorrow.
- *Expectation of dental visit*. It was represented by the question: 'Will you certainly go for treatment when dental treatments are recommended at a dental checkup?' [21].

Statistical analyses

The participants were then divided into two groups (male and female). Independent *t*-tests or chi-square tests were used to compare parameters between groups. A p-value < 0.05 was considered to be significant. A statistical program (SPSS version 20.0; IBM, Tokyo, Japan) was used for data analysis.

Structural equation modeling (SEM) was used to examine the hypothesis. Relationships between the constructs were assessed using Mplus version 6 (Muthén & Muthén, Los Angeles, CA). Our data included continuous variables, several dichotomous variables and variables with three categories. Therefore, SEM was performed using weighted least-squares parameter estimates (WLSMV). WLSMV uses a diagonal weight matrix with robust standard errors and mean- and variance-adjusted chi-square test statistics. For the global fit indices, a non-significant chi-square indicates that the data does not significantly differ from the hypotheses represented by the model; for comparative fit index (CFI) and Tucker-Lewis index (TLI), fit indices of above 0.90 (preferably above 0.95) are the criteria utilized to indicate a well-fitting model [22]. For root mean square error of approximation (RMSEA), a fit of <0.05 indicates a well-fitting model [23]. Finally, requiring parsimony leads to the retention of a model with the fewest parameters that still meet the other criteria. The effect size was also assessed using correlation coefficients or standardized coefficients corresponding to r [24]. Effect size is an indicator of the meaningfulness of a change in a health status

measure. The small, medium and large effect sizes are 0.10, 0.30 and 0.50 [24].

First, based on our hypothesis, we searched for a well-fitting model without separating groups by gender. Then, multiple-group modeling was conducted to test for gender differences in the obtained model.

Results

The prevalence of HSCL scores is shown in the Table I. Table II shows the gender differences in HSCL scores, oral health behaviors and expectation of dental visit. Females had significantly higher levels of somatization ($p < 0.001$) and depression ($p < 0.05$) than males. Females visited the dentist more regularly, brushed their teeth more frequently, used dental floss more often and showed higher expectation of dental visit than males. There were no significant differences in anxiety about dental treatment in between males and females; however, approximately half of the participants answered 'No anxiety'. For 'Dental visit with pain', 52.1% of males and 45.9% of females answered 'No dental visit and tolerate the pain'.

We estimated an initial model with all hypothesized pathways using SEM. Since the factor loading of 'Tooth brushing frequency' for 'Oral health behaviors' was small, we excluded the factor in the final model. A multiple-group analysis was used to test for gender differences in the structural model (Figures 1 and 2). Due to our large sample size, the value of chi-square was significant ($\chi^2 = 109.4$, df = 73, $p < 0.01$). CFI, TLI and RMSEA values indicated good model-data fit (0.968, 0.960 and 0.041, respectively). This model showed that (i) while 'Psychological symptoms' were related to low 'Expectation of dental visit' in females, there was no such relationship in males; (ii) good oral health behaviors were related to high 'Expectation of dental visit' in both males and females, although the effect size of the path in males was greater; (iii) males who had 'Psychological symptoms' felt more anxiety about dental treatment; and (iv) there was no relationship between 'Anxiety about dental treatment' and 'Expectation of dental visit'.

Table I. Prevalence of Hopkins symptom checklist score.

Hopkins symptom checklist	Range		*n* (%)
Somatization	14–38	High (≥30)	19 (3.1)
		Middle (24–29)	58 (9.6)
		Low (≤23)	530 (87.3)
Obsessive-compulsive	9–33	High (≥28)	27 (4.4)
		Middle (23–27)	85 (14.0)
		Low (≤22)	495 (81.5)
Inter-personal sensitivity	10–36	High (≥22)	96 (15.8)
		Middle (18–21)	126 (20.8)
		Low (≤17)	385 (63.4)
Anxiety	7–30	High (≥21)	25 (4.1)
		Middle (17–20)	44 (7.2)
		Low (≤16)	538 (88.6)
Depression	13–44	High (≥31)	30 (4.9)
		Middle (25–30)	90 (14.8)
		Low (≤24)	487 (80.2)

Discussion

This is the first study to assess and explain the gender differences in the relationships among psychological symptoms, anxiety about dental treatment, oral health behaviors and expectation of dental visit, evaluated as 'dental visits when treatments are recommended'. The results revealed that psychological symptoms were related to low expectation of dental visit in females, but there was no such relationship in males. Stress [4], depression [4], anxiety about dental treatment [12] and gender [1–3] have been reported as factors that affect oral health behaviors. However, few studies have reported the relationships among these factors in a comprehensive way. Our study examined the interaction among these factors by structural equation modeling and clarified the gender differences.

The present study showed that scores on the Hopkins Symptom Checklist (HSCL) were higher in females than males, with statistically significant differences in somatization and depression. Although the method for evaluation of psychological symptoms was different, the results were similar to previous studies [25,26]. In addition, our study revealed that psychological symptoms were directly related to low expectation of dental visit in females, but not in males. Previous studies in female college students reported that drinking habits were positively correlated with higher perceived stress [27] and emotional and avoidant coping were positively associated with stress and binge eating [28]. Their results suggest that female students might take unhealthy actions under stressful situations, which might support our result that psychological symptoms were related to low expectation of dental visit. On the other hand, the pathway from 'Oral health behaviors' to 'Expectation of dental visit' was significant in both genders. In males, this pathway was the only significant pathway that was related to expectation of dental visit. Thus, it might be important to evaluate their oral health behaviors to predict expectation of dental visit. In females, the effect size of this pathway was almost as large as that of the pathway from 'Psychological symptoms' to 'Expectation of dental visit'. Therefore, it is possible that, in females, both improving oral health behaviors and controlling psychological symptoms are useful to promote dental visits after check-ups.

Table II. Characteristics of the study participants.

	Males (n = 311)	Females (n = 296)	p-value
Age, $M \pm$ SD	18.4 ± 1.4	18.5 ± 1.4	0.235[a]
Hopkins Symptom Checklist score, $M \pm$ SD			
Somatization	18.3 ± 3.9	19.5 ± 4.4	*< 0.001*[a]
Obsessive-compulsive	17.1 ± 5.5	17.6 ± 5.3	0.276[a]
Inter-personal sensitivity	16.0 ± 5.3	16.8 ± 5.3	0.055[a]
Anxiety	11.2 ± 3.8	11.8 ± 4.1	0.075[a]
Depression	19.1 ± 5.8	20.3 ± 6.0	*0.013*[a]
Anxiety about dental treatment, n (%)			
Strong anxiety	19 (6.1)	30 (10.1)	0.161[b]
Slight anxiety	152 (48.9)	145 (49.0)	
No anxiety	140 (45.0)	121 (40.9)	
Expectation of dental visit (Will you certainly go for treatment when dental treatments are recommended at a dental check-up?), n (%)			
Yes	151 (48.6)	175 (59.1)	*0.011*[b]
No	160 (51.4)	121 (40.9)	
Regular check-up (dental visit during a past year), n (%)			
Yes	24 (7.7)	52 (17.6)	*< 0.001*[b]
No	287 (92.3)	244 (82.4)	
Tooth brushing (daily frequency), n (%)			
3 times	23 (7.4)	36 (12.2)	*< 0.001*[b]
2 times	198 (63.7)	227 (76.7)	
1 time	89 (28.6)	33 (11.1)	
No brushing	1 (0.3)	0 (0.0)	
Dental floss (usage), n (%)			
Yes	15 (4.8)	30 (10.1)	*0.013*[b]
No	296 (95.2)	266 (89.9)	
Dental visit with pain, n (%)			
Dental visit readily	149 (47.9)	160 (54.1)	0.130[b]
No dental visit and tolerate the pain	162 (52.1)	136 (45.9)	

[a]t-test.
[b]Chi square test.
Values in italics are statistically significant.

No statistically significant relationship was observed between anxiety about dental treatment and expectation of dental visit in the present study. Previous studies reported that anxiety about dental treatment was related to dental check-up [12]. The different results may be caused by differences in target group characteristics or questionnaire items. The participants of one previous study [12] were male army soldiers and they were older (mean age = 28.3 years old) than the participants in our study (mean age = 18.5 years old). Due to their greater age, they may have previously experienced more dental treatments that might influence dental anxiety, because the most anxious situation of dental procedures was the injection of local anesthesia followed by drilling of teeth in university students [29]. Further studies are needed to investigate the dental treatment experiences that participants have received previously and to confirm how they affected dental anxiety.

When people act for their health, various factors participate in it. The Health Belief Model [30] is one of the first social cognition models and remains one of the best known [31]. In the Health Belief Model, the factor 'likelihood of taking recommended preventive health action' was considered to be important when people take action. Thus, we focused on 'likelihood of taking recommended preventive health action' as a measure of expectation of dental visit and examined the factors related to it.

Psychosocial conditions lead to changes in the oral habits and behavioral responses of the host [32]. In this study, we hypothesized that the associations

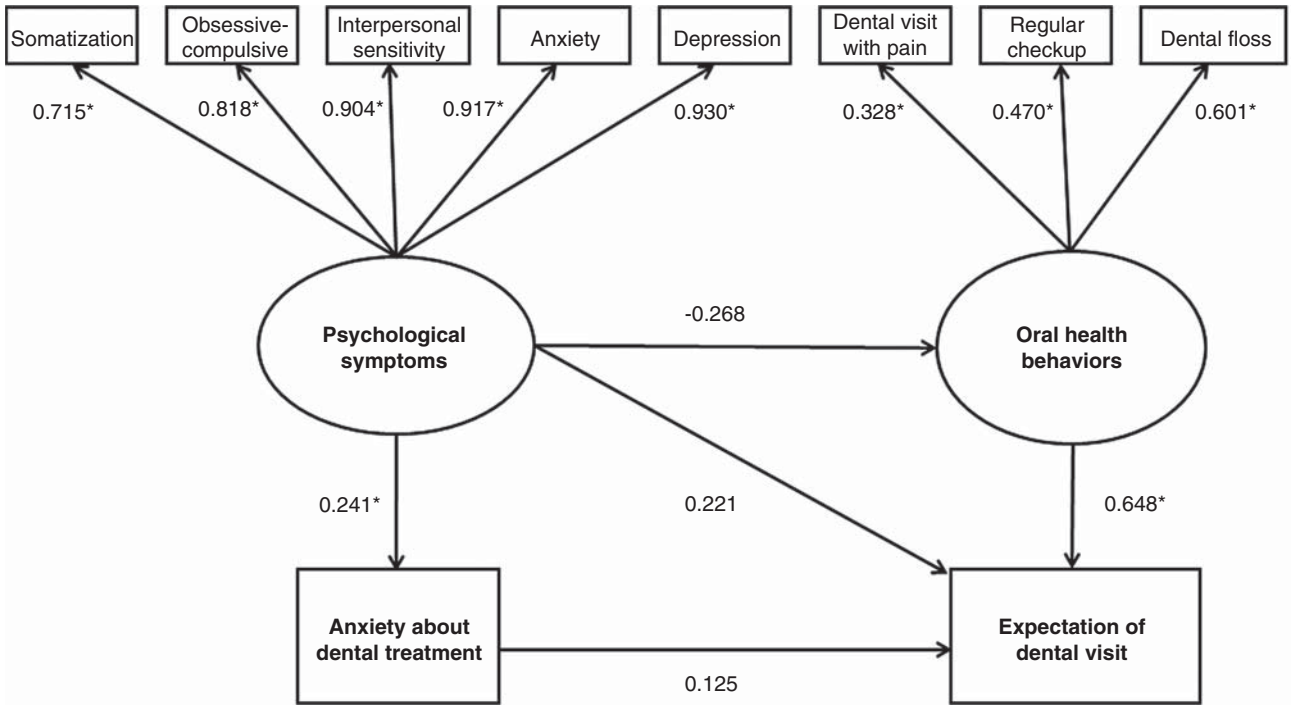

Figure 1. The final structural model for males. Significant standardized coefficients ($p < 0.05$) are indicated by asterisks. High psychological symptoms are associated with anxiety about dental treatment. Good oral health behaviors were related to high expectation of dental visit evaluated as 'dental visit when treatments are recommended' with a large effect size.

among psychological symptoms, anxiety about dental treatment, oral health behaviors, and expectation of dental visit were not only direct but also indirect. Therefore, we performed SEM analysis. In addition, we also performed multiple logistic regression analysis and confirmed that results supported the SEM analysis (data not shown).

Our study has some limitations. First, although we have examined the possibility of dental visit after dental check-up via a questionnaire, we did not

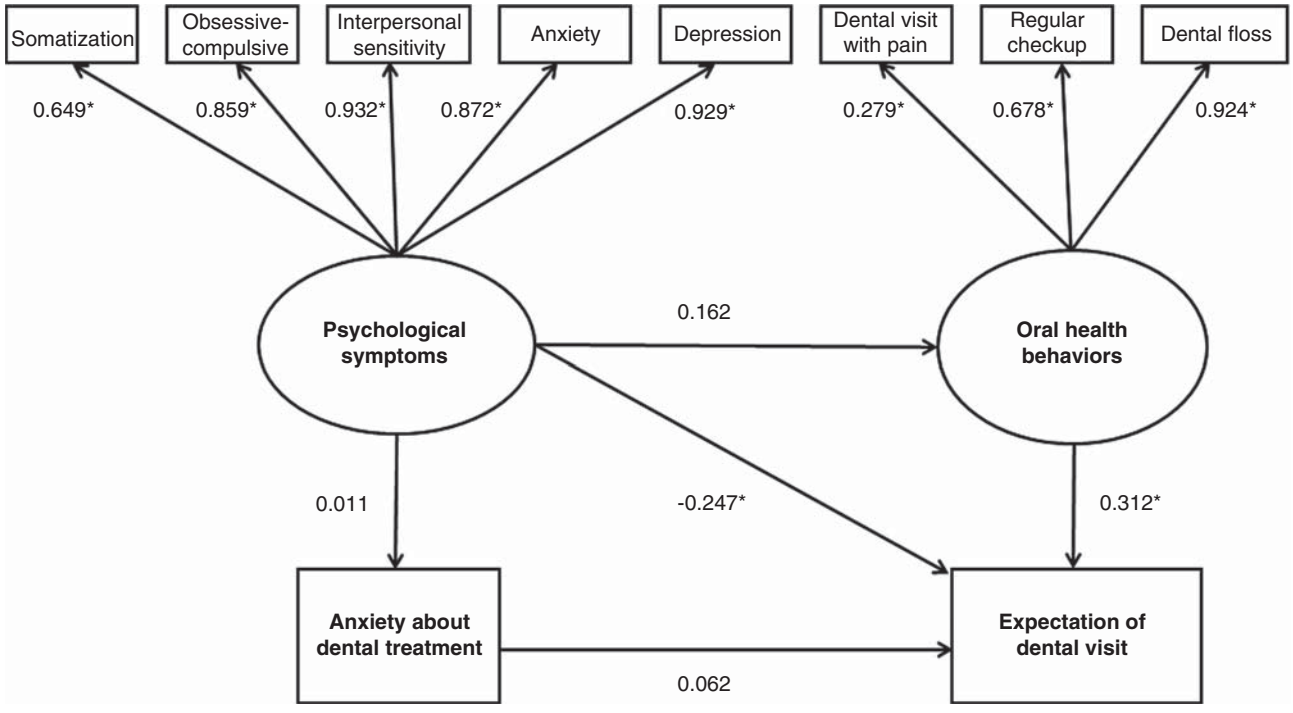

Figure 2. The final structural model for females. Significant standardized coefficients ($p < 0.05$) are indicated by asterisks. High psychological symptoms and good oral health behaviors were related to high expectation of dental visit evaluated as 'dental visit when treatments are recommended'.

examine whether they actually consulted a dentist. However, the evaluation of the possibility of taking action was meaningful because it carried an important role in the Health Belief Model [30]. Second, since this study was cross-sectional, it is still uncertain as to whether greater psychological symptoms are the primary cause of low 'Expectation of dental visit'. Prospective cohort studies may provide information beyond what we present here. Third, the low response rate of this study (27.0%) may indicate the potential for bias. For example, students who had high psychological symptoms or anxiety about dental examination might not participate in this study. Moreover, students who visit the dental clinic regularly might avoid our dental examination. Fourth, socioeconomic status may influence the preventive behaviors, represent a measure of personal drive and motivation and impact the quality of oral hygiene habits and, as such, represents a valid risk indicator [9]. In addition, the participants in our study were all Japanese. Although stress may differ in non-Japanese populations because of socioeconomic differences, we did not consider race in this study. Finally, all participants were recruited from among Okayama University students, which may limit the ability to extrapolate these findings to the general population.

Conclusions

The present study demonstrates that psychological symptoms were directly related to expectation of dental visit, evaluated as 'dental visits when treatments are recommended' in females. In addition, oral health behaviors including dental visit with pain, regular check-up and use of dental floss was also related to expectation of dental visit in both genders. Improving oral health behaviors and evaluating psychological symptoms in females may be a useful approach to promoting dental visits after dental check-ups at school in university students.

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