

Oral Health Knowledge, Attitudes, and Behaviors Among University Students in Jeddah, Saudi Arabia

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Purpose: This study aimed to evaluate oral health knowledge, attitudes, and behaviors among a sample of senior students at King Abdulaziz University (KAU), and to assess differences among these factors between genders.

Methods: A total of 1177 senior university students at KAU were included in this cross-sectional study. Participants were selected by stratified random sampling. KAU has three main streams categorized by field of study. One faculty was randomly selected from each stream. Information regarding oral health knowledge, attitudes, and behaviors was collected with a validated self-administered questionnaire. A knowledge score was calculated, and predictors of oral health knowledge were assessed by linear regression.

Results: In general, the mean oral health knowledge score of females (8.1 ± 1.8) was significantly higher than that of males (7.2 ± 2.1) out of 13. Relative to males, females reported a greater frequency of teeth cleaning and of using a toothbrush with proper technique ($p < 0.001$). Females were also more likely to have ever visited a dentist than males (95% and 86%, respectively). The linear regression model revealed that students in non-medical faculties and those who were not shown how to brush their teeth by a dentist had lower oral health knowledge scores, than their counterparts. Students older than 22 years and females were more likely to have higher oral health knowledge scores than were their counterparts.

Conclusion: Oral health knowledge was relatively low among the university students, but females showed better oral health knowledge and behaviors than males did.

Keywords: oral health, attitudes, behaviors, university students

Introduction

Oral health is an essential component of individuals' general health and overall well-being, which is related to individuals' oral health knowledge and healthy oral hygiene habits.¹ Abstract knowledge of oral health practices alone does not ensure a subsequent change in individuals' attitudes and behaviors, however, as they are usually acquired after conceptualizing oral health practices. Neglect of oral health, on the other hand, can lead to pain and suffering, which can affect individuals' quality of life and hinder productivity at the workplace.²

According to the World Health Organization (WHO), oral health problems are still not well controlled globally despite the considerable improvements in oral health measures among populations. This state of oral health might be related to the rapid development of oral diseases following lifestyle changes such as consumption

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of a sugar-rich diet, lack of water fluoridation, and other socio-environmental factors.^{3,4} The high incidence and prevalence of oral diseases globally qualifies oral health as a serious public health issue. In addition, oral disease treatments are considered to be the fourth most expensive disease treatments in most industrial countries.^{3,4} That makes oral health a huge burden at both the individual and the community level. In 2003, the Fédération Dentaire Internationale World Dental Federation (FDI), WHO, and the International Association for Dental Research issued the document “Global Goals for Oral Health 2020,” which contains proposals for new goals, objectives, and targets for global oral health of increasing detail and complexity. That proposal aimed to provide an instrument for local and national health care planners to determine realistic goals and standards for oral health.³ Establishing a baseline of detailed information regarding oral health knowledge and healthy oral hygiene habits will help policymakers set attainable goals and track changes. Moreover, this baseline information will strengthen oral health programs through the implementation of effective prevention measures.

Studies on oral health knowledge, attitudes, and practices have been conducted among university students in different countries. In 2014, Peltzer and Pengpid investigated oral health behavior and associated factors among undergraduate university students from various disciplines in 26 low, middle-, and high-income countries. This study confirmed low rates of tooth brushing and dental attendance among university students in different cultures across Africa, Asia, and the Americas.⁵ In Nigeria, a study was conducted to compare oral health knowledge, attitudes, and behavior of medical, pharmacy, and nursing university students. The investigators found that students’ oral health knowledge, attitudes, and behavior were inadequate and needed to be improved.⁶ In 2017, Kumar et al studied and compared oral health knowledge, attitudes, and practices among dental and medical students at a university in Eastern India. They reported that oral health knowledge and practices among females was better than that in males.⁷

In Arab countries, several studies have been conducted to assess oral health knowledge, attitudes, and behaviors, especially among school students.^{1,8-13} Other studies assessed university dental undergraduate students and compared them with undergraduate students of other faculties. The findings of these studies are expected, as, compared with non-dental students, dental students had already received education on oral health in their undergraduate curriculum.¹⁴⁻¹⁸ Previous studies did not focus on senior students, however, which is

important because the knowledge of senior students reflects the cumulative oral health knowledge and behaviors that students acquire during their years at university.^{14,16,18-26} Moreover, most of the previous studies did not focus on gender differences in oral health knowledge, attitudes, and behaviors. The studies that did focus on gender differences assessed the knowledge of dental students and compared students from different dental academic years.^{14,26} Therefore, the present study was performed to evaluate oral health knowledge, attitudes, and behaviors among senior students of King Abdulaziz University (KAU), and to assess gender-based differences among these factors.

Methods

Study Design

In this cross-sectional study, we used a stratified random sampling technique to select a sample of senior undergraduate students attending KAU. Data were collected from March 2017 to April 2017.

Sampling Procedure

KAU is divided into three main streams: Health (Medical) Science, Sciences, and Humanities. Each stream has several faculties and departments. There were 96,459 students in all faculties during the 2016/2017 academic year. In this study, we included only those faculties in which students of both genders were enrolled (26,109 students) to allow for comparisons between genders.

The Faculties of Pharmacy and Applied Medical Sciences from the Health Sciences stream, the Faculty of Sciences from the Sciences stream, and the Faculty of Economics and Administration from the Humanities stream were randomly selected by using the stratified random sampling technique (Table 1). Two faculties were chosen from the Health Sciences stream because of the small number of senior students enrolled in them.

All senior students from each faculty were invited to participate. Ethical approval was obtained from the Research Ethics Committee of the Faculty of Dentistry (Proposal number #092-16). Written permission was obtained from the vice dean of each of the selected faculties. Participants were assured of data confidentiality, and all provided informed consent.

Questionnaire

A validated Arabic questionnaire was administered that had been developed by Farsi et al in 2003.¹¹ It consisted

Table 1 Number of Students Enrolled in KAU in the 2016/2017 Academic Year

KAU Stream	Number of Students			Faculty	Number of Students		
	Male	Female	Total		Male	Female	Total
Health Science	1822	2251	4073	Applied Medical Sciences	204	445	649
				Dentistry	374	428	802
				Medicine	988	1047	2035
				Pharmacy	256	331	587
Sciences	4960	3051	8011	Computing and Information Technology	894	730	1624
				Engineering	2734	297	3031
				Sciences	1332	2024	3356
Humanities	5761	8264	14,025	Arts and Humanities	2919	4448	7367
				Economics and Administration	1180	2374	3554
				Law	1262	1000	2262
				Communication and Media	400	442	842
Total	12,543	13,566	26,109	Total	12,543	13,566	26,109

Abbreviation: KAU, King Abdulaziz University.

of 34 questions divided into three sections. The first section elicited demographic data: faculty, gender, age, parental education level, and monthly income. The second section contained questions that assessed the participants' knowledge of oral health. The third section contained questions regarding oral health behavior and the attitudes of the participants: teeth cleaning; tooth and tongue brushing; frequency of tooth brushing; frequency of floss, miswak, and toothpick use; dental visits; and tooth brushing instructions received from a dentist.

Although the questionnaire was validated, some questions related to access to dental care were added for specific use in another study. A pilot questionnaire was administered to a sample of 20 recent KAU graduates from different specialties to ensure comprehensibility. The questionnaire was then slightly modified based on the responses, with only some words requiring modification. The questionnaire was then piloted again on another group of 20 recent graduates.

Questionnaire Distribution

Lists of all senior undergraduate male and female students were obtained from each faculty. The lists contained the number of classes, the locations of the classes, and the number of students enrolled in each class. Because classes overlapped and many were attended by the same students, a schedule was created to guarantee that the questionnaires reached all students. Graduation requisite classes were chosen, as only seniors can enroll in these classes and attendance is mandatory.

The questionnaire and a consent form were distributed by the investigation team. The consent form contained a brief description of the study, its aim, a disclaimer that their participation is optional and a data confidentiality statement. The questionnaires were distributed to 1280 students and were returned by 1177, yielding a 92% response rate. The administration and student affairs offices of the selected faculties were contacted to obtain permission to administer the questionnaire, to schedule a date, and to ask whether they preferred it to be distributed at the beginning or end of class. Most of the faculty members agreed to distribute the questionnaire in the last 7 minutes of their lecture.

Statistical Analysis

Descriptive statistics were calculated by using means and standard deviations for continuous variables and frequencies and percentages for categorical variables. The chi-square test was used to assess associations between categorical variables.

A knowledge score was calculated from the 13 knowledge questions; a score of 1 was given for correct answers and 0 for incorrect or "I don't know" answers. By adding the scores of all knowledge questions, we calculated a total knowledge score for each participant, ranging from 0 to 13. Higher scores indicated better knowledge.

Linear regression was used to determine predictors of students' knowledge scores. The predictors assessed were faculty, age, gender, mother's education, father's education, monthly income, and whether the dentist had shown the participants how to brush their teeth correctly; the outcome was the knowledge score. A forward stepwise

technique was used to select variables for inclusion in the model, with an entry level p-value of 0.05 and a removal level p-value of 0.1.

Logistic regression was used to assess the predictors of students' attitudes toward visiting the dentist. The predictors assessed were faculty, age, gender, mother's education, father's education, and monthly income; the outcome was having ever visited a dentist (never vs. ever). The same predictors were assessed in relation to the participants' oral health behavior; the outcome was brushing frequency (less than twice daily vs. twice daily or more). The data were analyzed by using statistical analysis software (SPSS version 22, IBM, Armonk, NY, USA). A p-value of < 0.05 was considered statistically significant.

Results

A total of 1177 senior undergraduate students (482 males, 695 females), with a mean age of 22.4 ± 1.7 years were included in this study. The demographic characteristics of the study participants are presented in Table 2. Female participants comprised a significantly greater proportion of participants than male students in all chosen faculties, except in the sciences. Most participants reported that their parents had education levels above high school (19.37% for fathers, 30.75% for mothers). Female students' mothers had higher education levels than did male students' mothers ($p < 0.05$). Fathers' education levels did not significantly differ between genders.

Table 3 illustrates the distribution of the participants with respect to oral health knowledge. The majority of participants of both genders agreed that tooth brushing prevents periodontal disease (94%); however, females were significantly more knowledgeable regarding the role of flossing in preventing gum problems ($p < 0.001$). A greater proportion of female students (70.2%) than male students (55.7%) ($p < 0.001$) knew that gum bleeding during brushing is a sign of early-stage inflammation. A high proportion of both genders did not exhibit an understanding of the relationship between oral disease and systemic problems; a significantly greater proportion of males (68.5%) than females (63.7%) ($p < 0.001$) exhibited a poor understanding of this relationship. Among the females, 96.8% knew that oral hygiene prevents halitosis versus 89.4% of the males ($p < 0.001$). Most male and female students knew what dental calculus is (85.6% and 96.5%, respectively; $p < 0.001$). However, the majority of both genders responded incorrectly regarding the nature of plaque. In general, the mean knowledge score (\pm SD) for

Table 2 Characteristics of Study Participants

Variable	Male N (%) (N = 482) ^a	Female N (%) (N = 695) ^a	p-value
Age, mean \pm SD	22.70 \pm 1.7	22.22 \pm 1.7	0.37 ^b
Faculty			
Applied Medical Sciences	61 (12.7)	104 (15.0)	<0.001 ^c
Pharmacy	61 (12.7)	114 (16.4)	
Economics and Administration Sciences	178 (36.9)	286 (41.2)	
Mother's education			
<High school	166 (36.2)	196 (28.9)	0.03 ^c
High school	123 (26.8)	217 (32.0)	
>High school	170 (37.0)	265 (39.1)	
Father's education			
<High school	102 (21.6)	126 (18.6)	0.23 ^c
High school	140 (29.6)	187 (27.6)	
>High school	231 (48.8)	364 (53.8)	
Monthly income (SAR)			
<10,000	171 (37.3)	243 (37.7)	0.99 ^c
10,001–20,000	160 (34.9)	223 (34.6)	
>20,000	128 (27.9)	179 (27.8)	

Notes: ^aSome numbers do not add to the total sample number because of missing data. ^bA two sample t-test was used. ^cA chi-square test was used.

Abbreviation: SAR, Saudi Arabian Riyal.

females (8.1 ± 1.8) was significantly higher than that for males (7.2 ± 2.1) ($p < 0.001$).

Oral health attitudes and behaviors among the study participants are presented in Table 4. Females visited the dentist and brushed their teeth more frequently than males did ($p < 0.001$). Furthermore, females reported a higher frequency of using a toothbrush with proper technique (outer and inner surfaces of all teeth) than males did ($p < 0.001$). A greater proportion of males reported using toothpaste during brushing rather than any other materials. Only 9.4% of females and 13% of males used electric toothbrushes.

Table 5 demonstrates the results of the linear regression model that assessed predictors of the oral health knowledge score. Students in non-medical faculties tend to have lower scores than students in medical faculties. Significant positive relationships were shown between older age (>22 years vs. ≤ 22 years) and the knowledge score (coefficient = 0.42, 95% confidence interval (CI): 0.2–0.7). Furthermore, females showed better oral health knowledge than males ($p < 0.001$). A predictor of a lower knowledge score was the

Table 3 Oral Health Knowledge Among Study Participants

Question	Male N (%) (N = 482) ^a		Female N (%) (N = 695) ^a		p-value
	Correct	Incorrect	Correct	Incorrect	
Brushing prevents gum problems	454 (94.2)	28 (5.8)	653 (94.0)	42 (6.0)	0.87 ^b
Flossing prevents gum problems	277 (57.8)	202 (42.2)	496 (71.4)	199 (28.6)	<0.001 ^b
Self-care is not related to oral health	252 (52.8)	225 (47.2)	403 (58.4)	287 (41.6)	0.05 ^b
Oral hygiene instructions do not improve oral health	258 (54.3)	217 (45.7)	372 (53.7)	321 (46.3)	0.83 ^b
Gum bleeding while brushing is a sign of early-stage inflammation	267 (55.7)	212 (44.3)	488 (70.2)	207 (29.8)	<0.001 ^b
Gingival and periodontal problems may lead to bone loss	250 (52.0)	231 (48.0)	342 (49.4)	351 (50.6)	0.38 ^b
Oral disease may cause systemic problems (eg, heart disease)	151 (31.5)	329 (68.5)	252 (36.3)	442 (63.7)	<0.001 ^b
Fluoride has a positive effect on oral health	247 (51.5)	233 (48.5)	382 (55.2)	310 (44.8)	0.206 ^b
Oral hygiene prevents halitosis	431 (89.4)	51 (10.6)	666 (96.8)	29 (4.2)	<0.001 ^b
Knowledge about calculus	409 (85.6)	69 (14.0)	669 (96.5)	24 (3.5)	<0.001 ^b
Plaque is a hard material	75 (15.6)	405 (84.4)	95 (13.7)	598 (86.3)	0.36 ^b
Dental calculus can be removed at home by brushing and flossing	373 (77.4)	109 (22.6)	518 (74.6)	176 (25.4)	0.28 ^b
Total knowledge score mean (SD)	7.2 (2.1)		8.1 (1.8)		<0.001 ^c

Notes: ^aSome numbers do not add to the total sample number because of missing data. ^bA chi-square test was used. ^cA two sample t-test was used.

Table 4 Oral Health Attitudes and Behaviors Among Study Participants

Question	Male N (%) (N = 482)	Female N (%) (N = 695)	p-value
Have you ever visited a dentist?			
No	68 (14.1)	32 (4.6)	<0.001 ^a
Yes	413 (85.9)	663 (95.4)	
Do you clean your teeth?			
No	12 (2.5)	0 (0)	<0.001 ^b
Yes	470 (97.5)	695 (100)	
How frequently do you brush?			
<3 times per month	8 (1.7)	2 (0.3)	<0.001 ^b
Once or twice per week or once per day	273 (58.8)	185 (26.7)	
Twice or more per day	183 (39.4)	507 (73.1)	
What is your brushing technique?			
Anterior or posterior teeth only	32 (7)	10 (1.4)	<0.001 ^a
Outer surfaces of all teeth	31 (6.8)	22 (3.2)	
Outer and inner surfaces of all teeth	395 (86.2)	658 (95.4)	
Do you use toothpaste?			
No or another material	6 (1.3)	26 (3.7)	<0.001 ^a
Yes	453 (98.7)	668 (96.3)	
Do you use an electric toothbrush?			
No	402 (87)	626 (90.6)	0.06 ^a
Yes	60 (13)	65 (9.4)	

Notes: ^aA chi-square test was used. ^bFisher's exact test was used.

Table 5 Predictors of Oral Health Knowledge Score

Variable	Coefficient	Standard of Error	95% CI		p-value
			Lower	Upper	
Faculty (Ref = Medical) Non-medical	-0.58	0.14	-0.84	-0.31	< 0.001
Age (Ref = ≤22 years) >22 years	0.42	0.13	0.17	0.68	0.001
Gender (Ref = Male) Female	0.52	0.13	0.27	0.77	< 0.001
Mother's education level (Ref= Less than university) University	0.07	0.13	-0.19	0.33	0.583
Father's education level (Ref= Less than university) University	0.07	0.13	-0.18	0.32	0.588
Monthly income (SAR) (Ref = ≤10,000) >10,000	0.12	0.13	-0.15	0.38	0.385
Did the dentist show you how to brush correctly? (Ref = Yes) No	-0.36	0.12	-0.60	-0.12	0.003

Abbreviations: CI, confidence interval; Ref, reference; KAU, King Abdulaziz University, SAR, Saudi Arabian Riyal.

lack of learning about how to brush correctly from a dentist ($p = 0.003$).

Logistic regression models were used to assess predictors of the participants' attitudes toward visiting the dentist (ever vs. never visiting a dentist) ([Supplementary Table 1](#)) and another model was made to assess oral hygiene behavior (brushing less than twice daily vs brushing twice or more daily) ([Supplementary Table 2](#)). The same predictors from the previous model were assessed in these two models. The only predictor that affected dental visits and oral hygiene was gender. Females were more likely than males to brush twice daily or more (odds ratio [OR] = 4.5, 95% CI: 3.4–5.9), and were more likely to have ever visited a dentist (OR = 3.6, 95% CI: 2.2–5.8).

Discussion

This cross-sectional study assessed the oral health knowledge, attitudes, and behaviors of 1177 senior undergraduate students who were randomly selected from KAU. Results showed that female students demonstrated significantly better knowledge, attitudes, and behaviors than male students did.

Females were more knowledgeable than males with respect to bleeding as a sign of periodontal disease and the role of flossing as a preventive aid. In this study, our assessments of knowledge regarding flossing were consistent with the results of prior studies that reported that females showed

better knowledge and attitudes regarding dental floss and other interdental aids.^{14–17,27} This finding may result from greater esthetic awareness among females. Thus, they might be more proactive with respect to visiting the dentist and might tend to receive more frequent dental health care, thereby providing them with greater exposure to oral health knowledge.^{17,27} In addition, attitudes regarding oral health are influenced by one's own experiences, cultural/familial practices, religious beliefs, and other life situations. These attitudes are reflected in an individual's oral health behavior.

In the present study, females exhibited better oral health behavior than males did with respect to the frequency of brushing and visiting the dentist. Female students also showed better brushing techniques, which involved cleaning of all outer and inner surfaces of the teeth, consistent with the results of previous studies.^{14,18,25,28} The positive oral health behaviors and attitudes of females could be explained in terms of females usually having a higher concern about their appearance. Thus, they would be more likely to visit a dentist and become educated about oral health. Periodic dental checkups are important in preventing oral disease, educating patients, and encouraging them to maintain good oral hygiene habits.^{6,29–32} For example, in 2020, Covello et al found that periodic follow-ups can even prevent oral piercing complications.³³ Only a minority of our participants used electric toothbrushes, which is consistent with the results of previous studies that

showed a low frequency of electric toothbrush users among students and adults.^{11,28} A previous study found that the majority of respondents did not consider electric toothbrushes to offer any greater advantage over manual toothbrushes.¹⁸

We found that parental education did not play a critical role in determining the extent of oral hygiene knowledge and behavior among participants. It could be expected that more educated parents would be more aware of their children's oral health and more likely to supervise them while brushing. However, a previous study that assessed tooth brushing behavior in 32 countries reported that lack of parental supervision had an inconsistent effect on brushing behavior.³⁴ School and media contributions have increased awareness in recent years, thereby potentially relieving a portion of the parental burden with regard to oral hygiene. Vozza et al concluded that oral health prevention programs in schools play an important role in students' gaining knowledge and practicing skills.³⁵ In contrast, numerous studies involving children have shown that parents play a significant role in overall oral hygiene.^{8,9,12} It was reported that the development of caries can be decreased with parental supervision in addition to tooth brushing.^{36,37} Our participants were university students, and thus parental guidance probably plays less of a role than it does for younger students. In addition, the participants' monthly income did not seem to significantly contribute to oral hygiene knowledge or behavior. This result was unexpected and differs from the findings of previous studies, which have shown significant correlations between socioeconomic status and oral hygiene.^{35,36} This finding might be explained by a lack of oral health knowledge, which negatively affects participants' behaviors. Furthermore, participants who frequently brushed and flossed had better oral health knowledge. In previous studies, this improved knowledge was correlated with good oral hygiene behavior.^{28,38,39} Dentists are regarded as an important source of oral health information, along with mass media, and have a considerable impact on their patients.^{13,40} In the present study, participants showed better oral hygiene knowledge if their dentists had shown them how to properly brush their teeth.

Our study has a few limitations. First, the research was performed on the basis of self-reported data. Thus, participants may have made errors in interpreting the questions.⁴¹ We believe that any such effect would be minimal, however, as the questionnaire was validated¹¹ and piloted twice. Notably, previous studies found that self-reporting of daily flossing and annual checkups accurately predicted the incidences of plaque, calculus, gingivitis, and periodontal destruction.^{42,43} Second, a dental examination was not performed, which could have

offered an objective assessment of oral health status along with the questionnaire-based subjective assessment of participants' knowledge, attitudes, and practices.

The study also has notable strengths, in that we used an appropriate sampling strategy to select participants. We believe that the use of this sampling technique, in addition to the high response rate, minimized selection bias. A diverse group of senior students was randomly selected from the KAU, which makes the study results more generalizable to all senior students at KAU.

Conclusion

This study of a sample of senior students demonstrated that females had significantly better oral health knowledge, attitudes, and behaviors than males did. We recommend that oral health-related education be included and emphasized in university curricula with a greater focus on male students.

Data Sharing Statement

Data can be made available upon request.

Disclosure

The authors report no conflicts of interest for this work.

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