Research Article

Awareness among Medical and Dental Students Regarding the Relationship between Periodontal and Systemic Conditions

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ABSTRACT

Aim: The main aim of the study was to assess the awareness of medical and dental students regarding the bidirectional relationships between periodontal and systemic conditions.

Methods: The study involved a cross-sectional survey of dental, medical, pharmacology, and nursing students conducted in 2014 in five colleges in the western region of Saudi Arabia. Along with information on demographic characteristics, data were collected on awareness of (i.e., agreement with questionnaire items regarding) the interrelationships between periodontal disease and diabetes, pregnancy issues, osteoporosis, cardiovascular disease, rheumatoid arthritis, and respiratory diseases (using a 5-point Likert scale, with 4 and 5 representing "agree" and "strongly agree," respectively).

Results: A total of 726 students completed the questionnaire. The majority of the respondents were aware of the interrelationships between periodontal disease and diabetes (85.0%), pregnancy issues (71.0%), osteoporosis (67.1%), and cardiovascular disease (60.5%), while fewer were aware of the associations between periodontal disease and rheumatoid arthritis (44.9%) and respiratory diseases (39.6%). Overall levels of awareness regarding the interrelationships were not found to differ between students who attended government (65.0%) and private (64.2%) schools (p=0.31).

Conclusions: While many students were aware about the evidence linking periodontal disease to diabetes, pregnancy issues, osteoporosis, and cardiovascular disease, they were less knowledgeable about the evidence linking periodontal disease to rheumatoid arthritis and respiratory diseases.

Key words: *periodontal disease, systemic conditions, awareness, interrelationship*

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INTRODUCTION

Periodontal diseases consist of a diverse range of infections involving local oral bacteria.[1–6] Periodontitis is defined as the loss of the periodontal apparatus with gingival inflammation.[7] The association between periodontal disease and overall health has been reported in several studies.[8,9] In addition, the effect of uncontrolled systemic conditions on periodontitis has been observed in many reports.[10,11] Patients with uncontrolled type 1 and 2 diabetes mellitus (DM) were found to be susceptible to periodontal diseases, while patients with well-controlled hemoglobin A1c (HbA1c) levels exhibited better outcomes after periodontitis treatment.[12] Pregnancy is another systemic condition that has been reported to have an impact on oral health. Hormonal alterations in female patients have been linked to periodontal factors.[13] On the other hand, the effect of periodontitis on systemic conditions has been the focus of many clinical studies.[14,15] Periodontitis may also actively alter glycemic control in DM, as treatment of periodontitis may result in improvement in the HbA1c level.[16,17] Clinical studies have also investigated the possible adverse effect of periodontal infection on pregnancy and cardiovascular disease (CVD).[18,19] In fact, periodontal disease has been linked to an increased risk of non-hemorrhagic stroke and cerebral ischemia.[20]

There are limited data on the knowledge and awareness of the associations between oral and systemic conditions among medical and dental students in Jeddah, Saudi Arabia. Therefore, the aim of our survey was to assess the knowledge of medical and dental students regarding the bidirectional relationship between periodontal and systemic conditions and to compare levels of awareness between students from private and government schools.

MATERIALS AND METHODS

Study population
The study involved dental, medical, pharmacology, and nursing students at dental and medical colleges in the western region of Saudi Arabia.

Data collection
The study is a cross-sectional survey-based study of students in five colleges in the western region of Saudi Arabia. Data were collected over 4 months during the 2014 academic year. Ethics approval was obtained from the Ethics Committee of the Faculty of Dentistry, King Abdul-Aziz University, before commencement of the project. Informed consent was obtained from all participants prior to their participation. To maintain anonymity, each questionnaire was identified using an anonymous numerical code, and the participants were instructed not to include any personal data.

For the survey, we designed a 27-item questionnaire and distributed it to all the subjects. The first part of the questionnaire collected information on the demographic characteristics of the participants, including age, gender, subject, academic year, and institute. The second part of the questionnaire assessed the level of awareness regarding the bidirectional relationships between periodontal disease and systemic conditions (DM, CVD, pregnancy, respiratory diseases, osteoporosis, and rheumatoid arthritis). This involved assessing agreement with questionnaire items using a 5-point Likert scale, with 4 and 5 representing "agree" and "strongly agree," respectively. There is no evidence that systemic lupus erythematosus (SLE) has any relationship with periodontal disease. Therefore, for the sole purpose of specifically assessing the participants' knowledge, we added a domain on SLE as a "trick" question domain. Thus, in total, the second part of the questionnaire was divided into eight domains: overview of relationships between periodontal and systemic conditions, DM, CVD, pregnancy, respiratory diseases, osteoporosis, rheumatoid arthritis, and SLE. The questionnaires were collected immediately after the participants filled them in.

Statistical analysis
The statistical package used for our study was SPSS v22 (IBM Corp., Armonk, NY, USA). To present the demographic variables, we used simple descriptive statistics, i.e., frequencies and percentages along with the mean and standard deviation (SD) for the age variable. For the majority of the variables based on the second part of the questionnaire, a frequency distribution was used to show the individual responses (from "strongly agree" to "strongly disagree") to each item.
To test the respondents' overall and domain-specific internal consistency, we used Cronbach's alpha as a reliability test. To measure the overall and domain-specific mean level of agreement with the questionnaire items, we used an additive method. The scores were converted from a 1–5-point scale to a 0–100-point scale (for ease of interpretation), and then the mean scores (wherein 0 represents strong disagreement and 100 represents strong agreement) and SDs were calculated. Furthermore, to determine whether demographics influence the agreement scores, we used independent t-tests and one-way analyses of variance (ANOVAs), under the assumption of normality. P-values <0.05 were considered statistically significant.

RESULTS
A total of 726 students completed the survey. The response rate was 54.2% for dental students, 28.4% for medical students, 10.9% for pharmacology students, and 6.5% for nursing students. Respondents were predominantly female (67.6%). The mean age (±SD) of the sample was 22.7±1.99. 51.3% of the respondents attended private colleges, while 48.7% attended governmental colleges. Table 1 presents the demographic characteristics of the participants.

Table 2 presents the percentages of respondents who were aware of the existence of relationships between periodontal disease and DM, CVD, pregnancy issues, respiratory diseases, osteoporosis, rheumatoid arthritis, and SLE. A high percentage of the respondents (76.9%) identified bone and tooth loss as a consequence of untreated periodontitis. The majority of the respondents were aware of the interrelationship between periodontal disease and DM (85.0%), pregnancy issues (71.0%), and osteoporosis (67.1%). On the other hand, only 60.5% reported being aware of the association between periodontal disease and CVD. Regarding the association between periodontal disease and respiratory diseases, rheumatoid arthritis, and SLE, the most common response was "neutral" (i.e., neither agree nor disagree).

Table 3 presents the respondents' detailed opinions on the strength of the evidence linking periodontal disease to DM. The majority of the respondents (76.4%) agreed that DM further complicates periodontal disease. Similarly, 63.7% of participants reported that periodontal disease contributes to poor metabolic control in diabetic patients. In contrast, only 40.8% of the respondents acknowledged the high risk of death from diabetic nephropathy in patients with severe periodontitis. Only 56.3% agreed that the treatment of periodontitis results in improvement of metabolic control.

Table 4 presents the respondents' detailed opinions on the strength of the link between periodontal disease and CVD. Among the respondents, 54.1% were aware that patients with periodontal disease have an increased prevalence and incidence of coronary heart disease. Similarly, 52.9% of the respondents reported the role of oral bacteria in initiation and progression of atherosclerosis. Also, 55.6% of the participants believed that myocardial infarction is associated with increased oral bacteria load.

Table 5 presents the respondents' detailed opinions on the strength of the evidence linking periodontal disease to both pregnancy issues and respiratory diseases. Among the study sample, only 43.4% agreed about the contribution of periodontal disease to premature delivery. Similarly, 44% of the participants were aware about the association between periodontal infection and low preterm birth weight. In addition, 47.3% of the respondents acknowledged that aspiration of an anaerobic periodontal pathogen may predispose a patient to aspiration pneumonia. Moreover, 44.7% of the sample were aware that poor oral hygiene is associated with an increased risk of chronic obstructive pulmonary disease. Only 36.4% of the respondents believed that the rate of pneumonia is reduced (by 40%) by periodontal treatment.

Table 6 presents the respondents' detailed opinions on the strength of the evidence linking periodontal disease to osteoporosis, rheumatoid arthritis, and SLE. The majority (72.3%) believed that the coexistence of severe periodontal disease and osteoporosis results in bone loss. In addition, 51.8% of the respondents acknowledged that oral and systemic osteopenia share similar risk factors. Moreover, 52.2% reported that periodontal disease and rheumatoid arthritis have common risk factors and pathologic processes. Similarly, 42.8% agreed that the periodontal bacteria *Porphyromonasgingivalis* worsens rheumatoid arthritis. Only 32.9% believed that non-surgical periodontal therapy improves rheumatoid arthritis parameters. Regarding the "trick" questions, only 37.4% of the respondents thought that severe periodontal disease and SLE share similar pathogenesis, and 36.9% thought that successful periodontal treatment minimizes the risk of SLE exacerbation.

Table 7 shows the respondents' overall and domain-specific internal consistency, Table 8 shows the overall and domain-specific level of agreement scores, and Table 9 shows the influence of demographic factors on these level of agreement scores. As shown in Table 9, overall levels of knowledge regarding the interrelationships between periodontal and systemic conditions were not found to differ between students who attended government (65.0%±11.2) and private (64.2%±11.8) schools (p=0.31). However, males (65.8%±11.6) were slightly more aware of the interrelationships between periodontal and systemic conditions compared to females (63.9%±11.4; p=0.045). Lastly, Table 10 shows the responses (by gender, school type, and year of study) to the questionnaire item on untreated gingivitis/periodontitis leading to bone and tooth loss.

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Table 1: Sample demographics

Demographic factor		Frequency	Percentage
Gender	Female	484	67.6
	Male	232	32.4
	Total	716	100
Subject	Dentistry	393	54.2
	Medicine	206	28.4
	Pharmacology	79	10.9
	Nursing	47	6.5
	Total	725	100
Year	1st	11	1.5
	2nd	52	7.2
	3rd	106	14.6
	4th	146	20.1
	5th	186	25.7
	6th	138	19
	Intern	86	11.9
	Total	725	100
Institute	IBN SINA	314	43.4
	BMC	57	7.9
	KAU	138	19.1
	UQU	162	22.4
	TaifUni	52	7.2
	Total	723	100
Institute	Government	352	48.7
	Private	371	51.3
	Total	723	100
Age	Min	Max	Mean	SD
	19	44	22.71	1.99

Note: Total n changes for each variable due to missing data.

Table 2: Respondents' opinions on the relationships between periodontal disease and systemic conditions

Question	Response	Frequency	Percentage
Q1: Untreated gingivitis/periodontitis lead to bone and tooth loss.	Gingivitis	148	23.1
	Periodontitis	492	76.9
	Total	640	100
Q2A: Periodontal disease relationship with diabetes.	Strongly agree	358	50.2
	Agree	248	34.8
	Neutral	73	10.2
	Disagree	25	3.5
	Strongly disagree	9	1.3
	Total	713	100
Q2B: Periodontal disease relationship with cardiovascular disease.	Strongly agree	148	21.1
	Agree	277	39.4
	Neutral	202	28.7
	Disagree	67	9.5
	Strongly disagree	9	1.3
	Total	703	100
Q2C: Periodontal disease relationship with pregnancy issues.	Strongly agree	192	27.5
	Agree	304	43.5
	Neutral	150	21.5
	Disagree	44	6.3
	Strongly disagree	9	1.3
	Total	699	100
Q2D: Periodontal disease relationship with respiratory diseases.	Strongly agree	73	10.5
	Agree	203	29.1
	Neutral	271	38.9
	Disagree	126	18.1
	Strongly disagree	24	3.4
	Total	697	100
Q2E: Periodontal disease relationship with osteoporosis.	Strongly agree	221	31.8
	Agree	245	35.3
	Neutral	169	24.3
	Disagree	52	7.5
	Strongly disagree	8	1.2
	Total	695	100
Q2F: Periodontal disease relationship with rheumatoid arthritis.	Strongly agree	96	13.6
	Agree	221	31.3
	Neutral	278	39.4
	Disagree	90	12.7
	Strongly disagree	21	3
	Total	706	100
Q2G: Periodontal disease relationship with systemic lupus erythematosus.	Strongly agree	97	13.8
	Agree	194	27.6
	Neutral	307	43.6
	Disagree	91	12.9
	Strongly disagree	15	2.1
	Total	704	100

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Table 3: Respondents' detailed opinions on relationship between periodontal disease and diabetes.

Question	Response	Frequency	Percentage
Q3A: Periodontal disease negatively affects diabetes.	Strongly agree	215	30.6
	Agree	227	32.3
	Neutral	140	19.9
	Disagree	78	11.1
	Strongly disagree	42	6
	Total	702	100
Q3B: Diabetes further complicates periodontal disease.	Strongly agree	262	37.2
	Agree	276	39.2
	Neutral	137	19.5
	Disagree	24	3.4
	Strongly disagree	5	0.7
	Total	704	100
Q3C: Periodontal disease contributes to poor metabolic control in people with diabetes.	Strongly agree	180	25.5
	Agree	270	38.2
	Neutral	221	31.3
	Disagree	30	4.2
	Strongly disagree	5	0.7
	Total	706	100
Q3D: Patients with severe periodontal disease have 3 times the risk of death from diabetic nephropathy.	Strongly agree	96	13.6
	Agree	192	27.2
	Neutral	332	47.1
	Disagree	76	10.8
	Strongly disagree	9	1.3
	Total	705	100
Q3E: Periodontal treatment improves metabolic control.	Strongly agree	141	19.9
	Agree	257	36.4
	Neutral	245	34.7
	Disagree	53	7.5
	Strongly disagree	11	1.6
	Total	707	100

Table 4: Respondents' detailed opinions on relationship between periodontal disease and cardiovascular disease

Question	Response	Frequency	Percentage
Q4A: Patients with periodontal disease have an increased prevalence and incidence of coronary heart disease.	Strongly agree	119	17
	Agree	260	37.1
	Neutral	236	33.7
	Disagree	75	10.7
	Strongly disagree	11	1.6
	Total	701	100
Q4B: Oral bacteria play a significant role in the initiation and progression of atherosclerosis.	Strongly agree	126	17.9
	Agree	246	35
	Neutral	245	34.9
	Disagree	77	11
	Strongly disagree	9	1.3
	Total	703	100
Q4C: Increased load of oral bacteria is associated with myocardial infarction.	Strongly agree	148	21
	Agree	244	34.6
	Neutral	239	33.9
	Disagree	63	8.9
	Strongly disagree	12	1.7
	Total	706	100

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Table 5: Respondents' detailed opinions on relationships between periodontal disease and both pregnancy issues and respiratory diseases

Question	Response	Frequency	Percentage
Q5A: Periodontal disease contributes to premature delivery.	Strongly agree	104	14.8
	Agree	201	28.6
	Neutral	265	37.7
	Disagree	106	15.1
	Strongly disagree	27	3.8
	Total	703	100
Q5B: Periodontal disease has a strong association with preterm low birth weight.	Strongly agree	90	12.8
	Agree	219	31.2
	Neutral	258	36.8
	Disagree	114	16.2
	Strongly disagree	21	3
	Total	702	100
Q6A: Aspiration of anaerobic periodontal pathogens may predispose individuals to aspiration pneumonia.	Strongly agree	100	14.3
	Agree	231	33
	Neutral	310	44.2
	Disagree	49	7
	Strongly disagree	11	1.6
	Total	701	100
Q6B: Poor oral hygiene is associated with an increased risk of chronic obstructive pulmonary disease.	Strongly agree	92	13.1
	Agree	222	31.6
	Neutral	298	42.5
	Disagree	78	11.1
	Strongly disagree	12	1.7
	Total	702	100
Q6C: The rate of pneumonia is reduced by 40% by periodontal treatment.	Strongly agree	53	7.6
	Agree	202	28.8
	Neutral	361	51.5
	Disagree	74	10.6
	Strongly disagree	11	1.6
	Total	701	100

Table 6: Respondents' detailed opinions on relationships between periodontal disease and osteoporosis, rheumatoid arthritis, and systemic lupus erythematosus

Question	Response	Frequency	Percentage
Q7A: Severe periodontal disease and osteoporosis lead to bone loss.	Strongly agree	213	30.3
	Agree	295	42
	Neutral	160	22.8
	Disagree	28	4
	Strongly disagree	6	0.9
	Total	702	100
Q7B: Oral osteopenia and systemic osteopenia share similar risk factors.	Strongly agree	98	14
	Agree	265	37.8
	Neutral	286	40.8
	Disagree	45	6.4
	Strongly disagree	7	1
	Total	701	100
Q8A: Periodontal disease and rheumatoid arthritis share a number of common risk factors and pathologic processes.	Strongly agree	103	14.9
	Agree	258	37.3
	Neutral	279	40.3
	Disagree	45	6.5
	Strongly disagree	7	1
	Total	692	100
Q8B: The periodontal bacteria, *Porphyromonasgingivalis*, worsens rheumatoid arthritis.	Strongly agree	69	9.9
	Agree	228	32.9
	Neutral	344	49.6
	Disagree	48	6.9
	Strongly disagree	5	0.7
	Total	694	100
Q8C: Non-surgical periodontal therapy improves rheumatoid arthritis parameters.	Strongly agree	57	8.2
	Agree	171	24.7
	Neutral	364	52.5
	Disagree	86	12.4
	Strongly disagree	15	2.2
	Total	693	100
Q9A: Severe periodontal disease and systemic lupus erythematosus share similar pathogenesis.	Strongly agree	73	10.5
	Agree	187	26.9
	Neutral	348	50
	Disagree	78	11.2
	Strongly disagree	10	1.4
	Total	696	100
Q9B: Successful periodontal treatment minimizes the risk of systemic lupus erythematosus exacerbation.	Strongly agree	67	9.6
	Agree	190	27.3
	Neutral	359	51.5
	Disagree	67	9.6
	Strongly disagree	14	2
	Total	697	100

Table 7: Overall and domain-specific reliability based on Cronbach's Alpha

Domain	Cronbach's Alpha	Number of items
All	0.881	27
Relationships	0.697	7
Diabetes	0.631	5
CVD	0.708	3
Pregnancy	0.749	2
Respiratory diseases	0.740	3
Osteoporosis	0.666	2
Rheumatoid arthritis	0.732	3
Systemic lupus erythematosus	0.691	2

Table 8: Overall and domain-specific level of agreement scores

Domains	Min	Max	Mean	SD
All	16.67	100	64.6	11.5
Relationships	0	100	67.2	14.4
Diabetes	15	100	68.5	15.3
CVD	0	100	64.9	19.0
Pregnancy	0	100	58.8	22.6
Respiratory diseases	0	100	60.5	17.7
Osteoporosis	0	100	69.3	18.7
Rheumatoid arthritis	0	100	60.7	16.9
Systemic lupus erythematosus	0	100	58.3	18.7

Table 9: Level of agreement scores with respect to demographic factors

Domains vs Demographics		All	Relationships	Diabetes	CVD	Pregnancy	Respiratory diseases	Osteoporosis	Rheumatoid arthritis	Systemic lupus erythematosus
School type	Government	65.0 ± 11.2	68.2 ± 14.2	69.0 ± 15.2	65.1 ± 19.7	59.8 ± 23.0	60.8 ± 18.3	70.2 ± 18.1	60.0 ± 16.8	57.2 ± 17.8
	Private	64.2 ± 11.8	66.3 ± 14.5	67.9 ± 15.4	64.7 ± 18.4	57.7 ± 22.3	60.2 ± 17.1	68.5 ± 19.3	61.4 ± 17.0	59.4 ± 19.6
	P-value	0.317	0.075	0.326	0.775	0.223	0.641	0.223	0.280	0.123
Gender	Male	65.8 ± 11.6	68.7 ± 14.3	70.7 ± 15.1	66.2 ± 20.4	57.6 ± 23.6	60.3 ± 19.4	71.0 ± 19.1	61.5 ± 18.0	58.6 ± 19.7
	Female	63.9 ± 11.4	66.5 ± 14.4	67.3 ± 15.3	64.2 ± 18.4	59.2 ± 22.2	60.5 ± 16.9	68.5 ± 18.5	60.2 ± 16.4	58.2 ± 18.3
	P-value	0.045*	0.048*	0.006*	0.180	0.381	0.877	0.109	0.335	0.759
Year	1st	61.2 ± 5.7	66.9 ± 4.5	63.6 ± 7.4	58.3 ± 15.4	54.5 ± 17.9	57.6 ± 11.5	56.8 ± 11.7	62.1 ± 10.1	54.5 ± 12.8
	2nd	59.2 ± 11.6	59.4 ± 13.3	61.4 ± 13.6	57.4 ± 19.6	57.7 ± 17.2	57.8 ± 17.1	63.5 ± 19.5	56.4 ± 19.3	59.6 ± 21.0
	3rd	60.8 ± 9.7	61.9 ± 11.7	63.7 ± 14.1	59.4 ± 18.1	56.6 ± 21.2	59.8 ± 16.9	65.8 ± 18.7	58.2 ± 16.0	55.6 ± 16.4
	4th	67.7 ± 13.2	69.4 ± 16.5	70.8 ± 16.4	69.4 ± 19.5	62.9 ± 22.5	65.0 ± 18.9	74.0 ± 20.7	64.5 ± 17.9	62.3 ± 20.6
	5th	65.2 ± 11.3	68.5 ± 13.5	68.6 ± 14.2	65.2 ± 18.7	61.3 ± 21.8	61.8 ± 16.3	69.3 ± 19.6	60.2 ± 16.9	57.9 ± 18.3
	6th	65.8 ± 10.0	70.7 ± 12.8	70.2 ± 14.8	66.1 ± 18.3	56.6 ± 22.7	59.2 ± 19.1	69.9 ± 16.1	61.5 ± 15.7	59.1 ± 17.7
	Intern	64.3 ± 11.4	66.1 ± 16.4	72.3 ± 16.9	67.1 ± 18.7	53.6 ± 28.0	55.0 ± 16.7	70.2 ± 15.6	59.7 ± 16.5	54.7 ± 19.5
	P-value	0.060	0.093	<0.001*	0.017*	<0.001*	0.075	0.521	0.110	0.044*

*Significant (P<0.05)

Table 10: Responses to the questionnaire item on bone and tooth loss, with respect to demographic factors

Demographic factor		Q1: Untreated gingivitis/periodontitis lead to bone and tooth loss		Total	P-value
		Gingivitis n=147	Periodontitis n=487		
Gender	Female	116 (27.2%)	310 (72.8%)	426 (100.0%)	<0.001*
	Male	31 (14.9%)	177 (85.1%)	208 (100.0%)	
School type	Government	60 (18.6%)	262 (81.4%)	322 (100.0%)	0.008*
	Private	87 (27.4%)	230 (72.6%)	317 (100.0%)	
Year	1st	5 (45.5%)	6 (54.5%)	11 (100.0%)	0.019*
	2nd	17 (38.6%)	27 (61.4%)	44 (100.0%)	
	3rd	21 (21.9%)	75 (78.1%)	96 (100.0%)	
	4th	33 (26.0%)	94 (74.0%)	127 (100.0%)	
	5th	34 (21.7%)	123 (78.3%)	157 (100.0%)	
	6th	28 (22.6%)	96 (77.4%)	124 (100.0%)	
	Intern	10 (12.3%)	71 (87.7%)	81 (100.0%)	

*Significant (P<0.05)

DISCUSSION

The results from our study suggest that a large portion of medical and dental students appear to be insightful and knowledgeable about the interrelationships between periodontal disease and major systemic conditions. In particular, the majority of the participants were aware about the evidence linking periodontal disease to DM (85.0%), pregnancy issues (71.0%), osteoporosis (67.1%),and CVD (60.5%). The questionnaire item associated with the highest level of awareness concerned the fact that having DM further complicates periodontal disease, which 76.4% of the students were aware of. In addition, overall levels of awareness regarding the interrelationships were not found to differ between students who attended government (65.0%) and private (64.2%) schools (p=0.31).

However, the data indicate that the participants were less knowledgeable about the interrelationships between periodontal disease and both rheumatoid arthritis (44.9%) and respiratory diseases (39.6%). In particular, only 36.4% of the students were aware that periodontal treatment can reduce the rate of pneumonia by 40%, which is similar to the percentages of students that responded affirmatively to the two "trick" questions on SLE (37.4% and 36.9%, respectively).

A 2011 survey of 196 medical interns in India sought to explore awareness regarding the systemic effects of periodontal disease. Unlike our study, the Indian study found that almost all of the sample were unaware of the associations between periodontal and systemic conditions. Another study, which involved a 2015 survey of 1,766 medical doctors in Turkey, investigated knowledge about the relationship between periodontal disease and systemic health.21 In contrast to the survey in India, the Turkish study found that the majority of the sample were aware about the relationship between periodontal and systemic conditions. Diabetes mellitus was the most frequent systemic disease (66.8%) that was known to be related to periodontal disease by the sample of medical doctors. However, it is difficult to directly compare the findings from these two previous studies with ours on medical and dental students, as there were multiple differences, particularly regarding the participant demographics, sample sizes, years of the surveys, questionnaires, and rating scales.

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LIMITATIONS
Our study was carried out in only three cities in the western region of Saudi Arabia, and a large percentage of students did not participate in the survey. Thus, inferences based on our findings might not be able to be made regarding other areas of the country or nationally. Moreover, our study relies on self-reported data. Lastly, while the survey collected demographic data (including each participant's subject, academic year, and institute), it did not gather data on other potentially influential factors, such as school curriculum. To obtain results that are more representative, an analogous study on a larger scale is required. It would also be useful to collect information on, and subsequently test, other potentially influential factors, e.g., to explore whether awareness differs between dental, medical, pharmacology, and nursing students who are all at the end of their courses, as this would help instructors to target specific teaching interventions to the correct groups of students.

CONCLUSION
Overall, the level of awareness among medical and dental students in the western region of Saudi Arabia in 2014 regarding the bidirectional relationships between periodontal and systemic conditions is adequate. However, to provide optimum healthcare to patients, it is necessary to enhance the awareness and knowledge among students. We recommend developing intensive courses and training for medical and dental students regarding the existence of associations between periodontal and systemic conditions.

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