RESEARCH ARTICLE

Association between oral health-related quality of life and general health among dental patients: a cross-sectional study

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Keywords

Summary

Globally, the prevalence of chronic diseases is increasing significantly, causing deterioration of oral and general health and therefore quality of life. The present study was designed to assess the relationship between oral health-related quality of life and general health of dental patients. The study is part of the University's plan to achieve the United Nations Sustainable Development Goals number 1, 3, 4 and 5. Dental school students' satisfaction with their early engagement in clinical activities and research work was also evaluated. A convenience sample of 600 subjects attending dental clinics aged ≥18 years of both sexes was included in the study. Second-year dental students conducted the study under the supervision of public health staff members over two successive academic years (2015–2016 and 2016–2017). Oral health-related quality of life was assessed using the Dental Impact on Daily Living (DIDL) questionnaire. Blood pressure, random blood glucose level, body mass index, and waist circumference were measured as indicators of general health. There were statistically significant inverse correlations between DIDL scores and both mean blood pressure ($r = -0.215$, $p < 0.001$) and mean blood glucose level ($r = -0.272$, $p < 0.001$). Non-significant inverse correlations were observed between DIDL scores and both body mass index ($r = -0.062$, $p = 0.131$) and waist circumference ($r = -0.040$, $p = 0.340$). Students' satisfaction scores with research activities were high, ranging from 75.9% to 78%. Dentists must raise patients' awareness about the importance of oral health and its impact on their quality of life and general health. Participation of dental students in dental research is encouraged even in their early academic years.

Introduction

The importance of quality of life has increased lately as it became one of the outcome measures of research on chronic diseases, oral disease, and other medical conditions. The evaluation of this measure focuses on the importance of functional, social, and psychological outcomes of patients [1]. It is evident that worldwide, the global disease burden is currently shifting from communicable to non-communicable diseases (NCDs), which include cardiovascular disease, diabetes, cancer, and respiratory diseases [2]. In African nations, oral diseases were prioritized as an additional NCD because many risk factors of most common NCDs are also risk factors for oral diseases [3]. Hypertension, diabetes, and obesity are all examples of chronic medical conditions that affect oral health, in addition to their characteristic general health effects; oral conditions resulting from these diseases usually have a negative impact on patients' quality of life [1, 4]. The oral cavity is involved in many essential social functions, such as nutrition, speech, and appearance. Impairments on any level may interfere with a person's quality of life and well-being [5]. The reported shortage of measures of oral health in terms of quality of life had led to the development of the Dental Impact on Daily Living (DIDL) questionnaire by Leao and Sheiham to fill this gap [6]. The questionnaire includes items such as appearance, pain, comfort, eating restrictions, and general performance. The DIDL instrument has been confirmed to differentiate between subjective impacts on different social classes, groups, and sexes [6, 7].

Hypertension is one of the common general health conditions that have a negative impact on oral health, and this may be related to the cumulative effect of heart disease and periodontal disease, which share common risk factors [8, 9]. Common adverse effects of antihypertensive drugs are xerostomia and gingival hyperplasia [10]. The use of thiazide diuretics can result in erosions, ulcerations of buccal mucosa, and lichenoid reactions, which cause oral pain and discomfort and have a significant negative effect on oral health and hence the quality of life [11, 12]. According to the National Hypertension Project, the prevalence of hypertension has reached 35.5% among men and 34.5% among women in 2008. Globally, the number of persons affected by hypertension continues to increase as a result of aging and the increase in populations [13].

Diabetes is also one of the most common general health conditions that affect oral health, especially if poorly controlled [14]. It is expected to be the seventh leading cause of death in 2030. For instance, in Egypt, the prevalence of diabetes among adults aged 20-79 years was approximately 15.6% in 2015 [15]. The

most prevalent oral condition associated with diabetes mellitus is periodontal disease [16], which results in loss of teeth due to loss of both periodontal attachment and alveolar bone [17]. Furthermore, peripheral neuropathy that occurs in patients with diabetes negatively affects smell and taste functions [18, 19]. Those problems, together with a high caries index and reduced salivary production, significantly worsen quality of life in patients with diabetes [20-22].

The prevalence of obesity has increased internationally over the last decades, and obesity was considered by the World Health Organization as a global epidemic in the 1990s [23]. Studies have shown that poor oral health in obese people that resulted in periodontal disease, teeth loss, and inflammation might be the intermediate factor between obesity and poor dental outcomes [23-25]. Body Mass Index (BMI) is a general measure of obesity (calculated as weight in kilograms divided by height in meters squared) [26]. Increased BMI was associated with poor oral health-related quality of life in adolescents as these individuals were less proficient in performing vigorous physical and self-care activities; therefore, obesity could have an effect on oral health in everyday life [27, 28].

Therefore, in the present study, blood pressure, blood glucose level, and BMI were measured, and the results were assessed with regard to Oral Health-Related Quality Of Life (OHR-QOL) among dental patients. In addition, second-year dental students participated in this research as part of their dental public health curriculum to obtain early experience in communication with patients.

Methods

This cross-sectional study was conducted with a convenience sample of 600 dental patients through two academic years (2015-2016 and 2016-2017). The study was conducted at the Dental Clinics Complex of the Faculty of Oral and Dental Medicine - Misr International University. Participants answered a modified Arabic version of a validated DIDL questionnaire 7 and were screened for blood pressure level, blood glucose level, and BMI.

Participants

According to a pilot study results in which the correlation between DIDL score and blood pressure was the primary outcome, the predicted minimum sample size (n) was 527 subjects. The sample size was increased to 600 subjects to ensure participation of every second-year dental student in the study. Sample size calculation was performed using IBM® SPSS® Sample Power® Release 3.0.1 (IBM Corporation, Armonk, NY, USA).

Healthy or medically compromised dental patients aged ≥ 18 years of both sexes were included. Completely edentulous subjects were excluded because the DIDL questionnaire is designed for edentulous subjects. Pregnant subjects were excluded because pregnancy may be associated with hypertension or other medical problems. Subjects with mental or psychological problems were excluded because their psychological status might affect their answers to the questionnaire.

According to the code of ethics of the World Medical Association (Declaration of Helsinki); each student provided his or her patient with a full verbal explanation of the study objectives and procedures, including how the patient would be screened for hypertension, diabetes, and BMI. Subjects then provided written consent for participation. Subjects who declined to participate in the study or who quit the study at any time were excluded without any effect on their regular treatment at the university clinics.

Questionnaire

Before the study, the questionnaire was pilot-tested by two dental public health staff members on 60 randomly selected dental patients. Face validity was evaluated to assess the understanding and completion time of the questionnaire. Three questions in the DIDL questionnaire about the association between oral health and romantic aspects of life were excluded because of cultural trends. The results of the pilot study were not included in the final results.

The questionnaire was divided into four sections. The first section was about demographics, and participants provided data about their age, sex, education level, residence, occupation, and social status. The second section concerned general health and included six questions on a nominal scale about any medications or any health problems, including hypertension, diabetes, and history of surgeries, as well as participants' attitudes toward regular measurement of blood pressure and blood glucose level. The third section concerned oral health behavior and included seven questions about tooth brushing frequency, brushing tools, types of the toothbrush, use of other oral hygiene aids, partial denture cleansing (if applicable), and frequency and reasons for visiting a dentist. The fourth section included the DIDL questionnaire, which comprised 33 questions assessing OHR-QOL in the preceding 3 months. The questionnaire has five dimensions: appearance, pain, oral comfort, general performance, and eating and chewing. Responses to the questionnaire are recorded on 3-point Likert scales. To give a weight to each dimension, the summed response of that dimension is divided by the total possible scale score; then, the dimensional weight is multiplied by the summed dimension responses to provide the dimension score. The sum of all the five weighted dimension scores is the total DIDL score. The responses are categorized as "dissatisfied," "relatively satisfied," and "satisfied" [7].

Training of students

Dental Dentistry students received training sessions during the dental public health course. The sessions included instructions on how to lead an interviewer-administered questionnaire and how to record blood pressure, blood glucose level, body weight, height, and waist circumference. Training sessions were conducted by dental public health staff members and five calibrated physicians. Cronbach's alpha values for inter-examiner reliability of the five physicians were 0.792 for systolic

blood pressure measurements and 0.771 for diastolic blood pressure measurements [29].

RECORDED MEASUREMENTS

All measurements were performed by second-year dental students, under complete supervision of the main investigators, dental public health staff members, and resident physicians.

Blood pressure

Blood pressure was measured in mmHg using mercurial sphygmomanometers and stethoscope (Shanghai Medical Instruments Ltd., Shanghai, China). The most recent guidelines for blood pressure reference range were used in the study: Normal blood pressure was < 120/80 mm Hg; elevated blood pressure was defined as a systolic value between 120 and 129 mm Hg and a diastolic value of < 80 mm Hg; stage 1 hypertension was defined as a systolic value between 130 and 139 mm Hgor a diastolic value between 80 and 89 mm Hg; stage 2 hypertension was defined as a systolic value of at least 140 mm Hg or a diastolic value of at least 90 mm Hg; and hypertensive crisis was defined as a systolic value of > 180 mm Hg or a diastolic value of < 120 mm Hg. Patients in hypertensive crisis were also those who needed prompt changes in medication if there were no other indications of problems or immediate hospitalization if there were signs of organ damage [30]. Blood pressure was measured in the right upper arm using a blood pressure monitor. The subject was asked to sit down for at least 5 min before blood pressure was measured [31]. The measurement was repeated after at least 5 min by the resident physician to confirm the student's reading.

Blood glucose level

To assess blood glucose level, a finger-tip blood sample was obtained with AccuChek Performa glucose meter (Roche Diabetes Care, Inc., Basel, Switzerland) in mg/dL. The reference range was a random plasma glucose level of ≥ 200 mg/dL (at any time of the day regardless of when the most recent meal was eaten) [32]. Trained nurses were assigned to perform the needle prick with disposable needles, and the students recorded the readings with the complete aseptic procedures.

Body mass index and waist circumference

To assess BMI, subjects were weighed with a lever-actuated balance to the nearest 0.1 kg (TBF-300, Tanita Corporation, Tokyo, Japan). Standing height was measured with a wall-mounted stadiometer with a range of 60-207 cm (Leicester Height Meter; Child Growth Foundation, London, UK). BMI was then calculated as the body weight in kilograms divided by the square of the height in meters [33]. Waist circumference in centimeters was measured with plastic measuring tape above the iliac crest level while the subject was at minimal respiration. Assessment of BMI and waist circumference was performed in accordance with the World Health Organization's classification of obesity [34].

Patients with critical blood pressure, blood glucose levels, or BMI values were informed about their condition and referred to the resident physician.

Oral health awareness

During the study, a brief educational session was given to the patients with the aim of increasing oral health awareness. The students also distributed oral health educational materials in the form of brochures or posters to help the patients retain the information.

MEASURING STUDENTS' SATISFACTION

At the final dental public health examination, a specially designed self-administered questionnaire in the format of 5-point Likert scales was distributed to assess the degree of the students' satisfaction with the study procedures, including the usefulness of their interview with the patients, whether participation in such a study inspired them to take part in upcoming research, and suggestions for improving future dental students' research.

Results

This study was conducted on 600 patients, of whom 379 (63.2%) were male and 221 (36.8%) were female. Their mean age was 42.6 years (standard deviation, 12.4 years); the youngest was 18 years old and the oldest was 77 years old (95% confidence interval, 41.6 to 43.6). Educational levels and occupations of the participants are depicted in Figures 1 and 2.

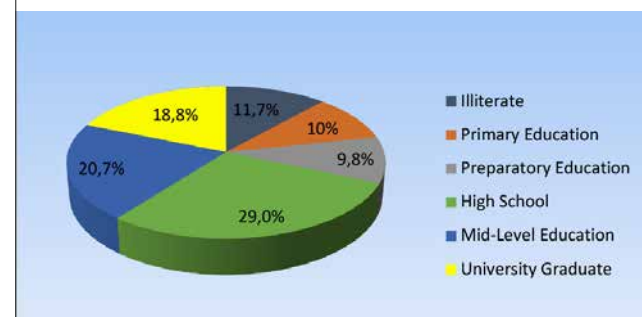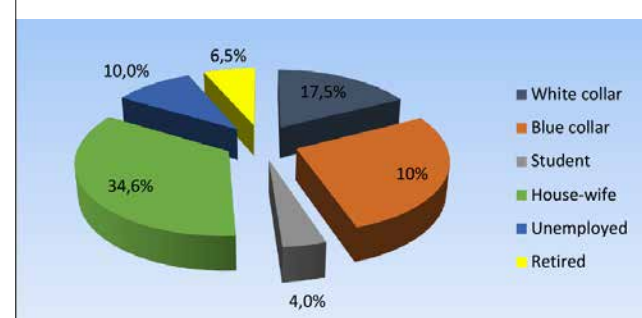**Fig. 1.** Pie chart representing distribution of educational levels of study participants.

Fig. 2. Pie chart representing distribution of occupations of study participants.

RELIABILITY OF MEASUREMENTS

The agreement between blood pressure measurements obtained by the students and those obtained by the physicians was assessed using Cronbach's alpha reliability coefficient. The results showed very good agreement (Cronbach's alpha, 0.815; intra-class correlation coefficient, 0.774).

GENERAL HEALTH

Responses to questions regarding general health are presented in Table I. General health measurements performed by second-year dental students are presented in Table II. The state of blood pressure among subjects is listed in Table III. Random blood glucose levels of subjects are listed in Table IV. BMIs and waist circumferences of subjects are listed in Table V. Responses to the DIDL questionnaire are listed in Table VI.

ASSOCIATION BETWEEN DIDL SCORES AND GENERAL HEALTH MEASUREMENTS

An ordinal regression model was constructed with sociodemographic data and general health measurements as independent variables and DIDL scores as the dependent variable. Regression results revealed that none of the sociodemographic characteristics had an effect on the DIDL scores. There were statistically significant inverse correlations between DIDL scores and both mean blood pressure ($r = -0.215$, $P < 0.001$) and blood glucose level ($r = -0.272$, $P < 0.001$). There were nonsignificant inverse correlations between DIDL scores and both BMI ($r = -0.062$, $P = 0.131 = 0.131$) and waist circumference ($r = -0.040$, $P = 0.340$). Students' satisfaction scores are illustrated in Figure 3.

Tab. I. Responses to general health questions.

Question	N	%
Are you diabetic?		
Yes	45/600	7.5
No	526/600	87.7
Don't know	29/600	4.8
If yes, what type of medication do you use?		
Tablets	34/45	75.6
Insulin injection	5/45	11.1
Others	6/45	13.3
Don't know	0/45	0
If yes, do you use your medication regularly?	43/45	95.6
Are you a hypertensive patient?		
Yes	96/600	16
No	427/600	71.2
Don't know	77/600	12.8
If yes, do you use your medication regularly?	39/96	40.6
Do you assess your blood pressure and/or blood glucose level regularly?		
Yes	176/600	29.3
No	424/600	70.7
Do you use any regular medication?		
Yes	125/600	20.8
No	475/600	79.2
Do you suffer from any kidney or liver problems?		
Yes	77/600	12.8
No	484/600	80.7
Don't know	39/600	6.5
Have you undergone any surgery before?		
Yes	332/600	55.3
No	268/600	44.7

Tab. II. General health measurements performed by second-year dental students.

Measurement	Mean	SD	95% confidence interval	
			Lower limit	Upper limit
Height (cm)	165	13.7	163.8	166.2
Weight (kg)	81.9	18.6	80.3	83.6
BMI (kg/m²)	30.1	7.8	29.4	30.8
Waist circumference (cm)	105.2	24.7	103.1	107.3
Mean blood pressure (mm Hg)	104.8	14.3	103.7	106
Blood glucose level (g/dL)	108.7	43.7	105.1	112.3

BMI: body mass index; SD: standard deviation.

Tab. III. Blood pressure categories among hypertensive subjects, normotensive subjects, and subjects who did not know they had hypertension.

Blood pressure	Hypertensive patients		Normotensive patients		Patients who did not know their blood pressure status	
	N	%	N	%	N	%
Normal	11	11.5	93	21.8	14	18.2
Elevated	4	4.2	22	5.2	1	1.3
Stage 1 hypertension	29	30.2	148	34.7	28	36.4
Stage 2 hypertension	46	47.9	157	36.8	32	41.6
Hypertensive crisis	6	6.3	7	1.6	2	2.6
Total	96	16	427	71.2	77	12.8

Tab. IV. Blood glucose categories among diabetic subjects, normal subjects, and subjects who did not know they had diabetes.

Diabetes category	Normal patients		Patients with diabetes		Patients who did not know their blood glucose status	
	N	%	N	%	N	%
Normal	519	98.7	28	62.2	25	86.2
Diabetes	7	1.3	17	37.8	4	13.8
Total	526	87.7	45	7.5	29	4.8

Tab. V. Body mass index (BMI) and waist circumference of subjects.

BMI categories	N	%
Underweight (< 18.5 kg/m²)	15/600	2.5
Normal (18.5 to 24.9 kg/m²)	134/600	22.3
Pre-obese Preobese (25 to 29.9 kg/m²)	174/600	29.0
Obese class 1 (30 to 34.9 kg/m²)	161/600	26.8
Obese class 2 (35 to 39.9 kg/m²)	66/600	11.0
Obese class 3 (≥ 40 kg/m²)	50/600	8.3
Waist circumference categories		
Above action level 1		
Female	53/221	24
Male	120/379	31.7
Total	173/600	28.8
Above action level 2		
Female	168/221	76
Male	259/379	68.3
Total	427/600	71.2

Waist circumference above action level 1: patients should lose weight, increase physical activity and give up smoking; waist circumference above action level 2: patients should seek advice from health professionals for weight management.

Tab. VI. Scores on Dental Impact on Daily Living (DIDL) questionnaire.

DIDL dimensions	Dissatisfied		Relatively satisfied		Satisfied	
	N	%	N	%	N	%
Appearance	301	50.2	102	17	194	32.3
Pain	433	72.2	112	18.7	194	32.3
Oral comfort	311	51.8	148	24.7	138	23
General performance	417	69.5	52	8.7	127	21.2
Eating and chewing	337	56.2	57	9.5	203	33.8

Discussion

The aims of this study were to encourage dental students to participate in research work, improve their practical skills in measuring blood pressure and blood glucose level, and improve communication skills with patients through the interviewer-led questionnaire. In addition, the results were beneficial to the participants involved in the study as each subject received educational materials regarding oral and general health and were informed about their current overall health status. We included subjects with various educational levels and occupations to increase the validity of the study. The DIDL questionnaire was used because it is simple, clear, valid, and reliable. It can be filled out in a short time by patients with various educational and social levels [7].

Blood pressure measurements recorded by the students showed good to very good interobserver agreement with those recorded by the physicians, which indicates that the training of students before the practical part of the study was efficient. Concerning the responses of the patients to the questions about general health, the results showed that 7.5% of participants were diabetic and 16% were hypertensive. Although the majority of patients with diabetes used their medications regularly, fewer than half of the hypertensive patients used their medications regularly. Moreover, only 29.3% of the participants underwent regular assessment of blood pressure and blood glucose level. Of interest was that almost half of patients who reported being hypertensive had stage 2 hypertensions, wherein only a few of patients who reported having normal blood pressure and the majority of subjects who did not know whether they were hypertensive, blood pressure categories ranged from elevated blood pressure to hypertensive crisis. Also, the results showed that 13.8% of subjects did not know whether they had diabetes although the random recordings of blood glucose levels indicated that they were elevated; 1.3% of subjects who reported having normal blood glucose levels actually had high random blood glucose levels. These findings are consistent with those of Williams et al., who mentioned that approximately 5% of dental patients have diabetes [35].

Fig. 3. Bar chart representing comparison between satisfaction scores with Spring 2016 and Spring 2017 research activities.
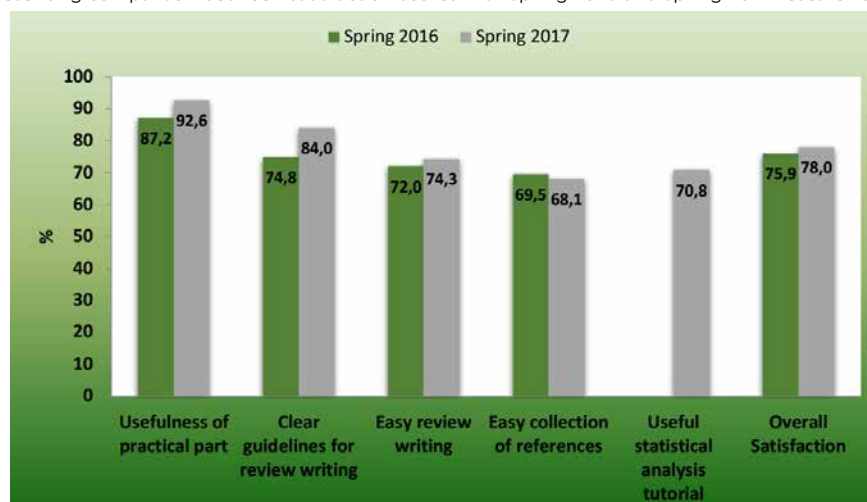
The abovementioned results revealed that many dental patients were unaware of the importance of regular assessment of their blood pressure and blood glucose level and that the dentist could be the first medical professional to discover that a patient has inadequately controlled diabetes or hypertension. Several authors reported similar results and found that patients' general condition was correlated with their oral health [7, 32]. Therefore, screening of blood pressure and blood glucose level should be included in the routine dental examination, whether in private practice or in public and governmental clinics. With regard to general health measurements and descriptive statistics for BMI categories, the results showed that the most common BMI categorization was pre-obese, followed by obese class 1 and normal weight. Obese classes 2 and 3 were less prevalent. The least prevalent BMI category was underweight, which characterized 2.5% of the study sample. With regard to waist circumference categories, the majority of subjects were categorized as action level 2. This category included a higher proportion of women than of men. In contrast, subjects categorized as action level 1 were men. Rosli et al. (2019) [36] showed that the mean BMI was 26.3 kg/m^2 (standard deviation: 4.6) in a sample in which the majority of the respondents were overweight and obese and only 3.9% were underweight. Chan et al. (2017) [24] combined overweight and obese adults into one group; they found that of 17, 261 respondents, approximately half were overweight/obese, which may be consistent with the results of this study. With regard to the DIDL questionnaire, the results showed that the dissatisfaction was high (among more than half of subjects) regarding all dimensions of the questionnaire; the area of the most dissatisfaction was pain, and satisfaction was highest for eating and chewing. This information is valuable with regard to the increased functional and emotional effects of pain from teeth and oral sores and their impact on psychological and physical functioning, as well as health behavior [34]. The statistically significant inverse correlations in the present study between DIDL scores and both blood pressure and blood glucose level mean that chronic diseases, especially hypertension and diabetes, had a negative impact on OHR-QOL as measured by the DIDL questionnaire. This may be attributed to decreased awareness of patients with diabetes and hypertension about the potential impact of poor oral health on their general health. These findings were in agreement with the results of other studies that highlighted the need of patients with high blood glucose levels to be informed about the effect of high blood glucose level on oral health [37-39]. Dentists have an important role in increasing awareness about the importance of maintaining good oral hygiene in patients with diabetes and hypertension. The statistically significant inverse correlation between DIDL scores and hypertension may be related to the cumulative effect of heart disease and periodontal disease, which share common risk factors [5]. It may also be attributed to the effect of antihypertensive drugs on gingival condition and salivary flow as such drugs may cause enlargement of gingiva, dry mouth, alteration in taste sensation, pain, and swelling in salivary glands [40]. The non-significant inverse correlation between DIDL

scores and both BMI and waist circumference may be consistent with the findings of Rosli et al. [35], who showed that the association of oral health and quality of life with impact of nutritional status is related merely to the risk of nutritional deficiency and not to the actual BMI score. In contrast to other studies' findings of a correlation between OHR-QOL and the anthropometric measurements, waist circumference and DIDL scores were significantly inversely correlated, which indicates that high waist circumference might adversely affect OHR-QOL [41]. Overall, students were satisfied with the research activities. The increase in students' satisfaction scores throughout the research period indicates success of the corrective action plan that was based upon the students' and supervisors' comments about the research in its first year.

The present study complies with the University's plan to achieve the United Nations Sustainable Development Goals (SDGs). SDG1 (No Poverty) is achieved through free of charge dental treatment for all people without discrimination. SDG3 (Good Health and Well-Being) is achieved in the present study by assessment of the general health of people and educating them regarding general and dental health. The engagement of students in research at an early stage of their education is within SDG4 (Quality Education) and finally both genders are treated and educated equally which fulfills SDG5SDG5 (Gender Equality) [42].

Limitations

The present study was cross-sectional; thus, it could not demonstrate causal relationships. The sampling method used was convenience sampling, and this enabled easy enrollment of participants; however, it did not reflect the entire population; so, the generalizability of the results is limited. The findings related to oral health knowledge, attitude, and behavior depended on self-reported data, and the rates of oral health behavior may have been biased through over- and under-reporting.

Conclusions

Within the limitations of this study, it could be concluded that patients with diabetes and hypertension have lower levels of OHR-QOL. Dentists must raise patients' awareness about the importance of oral health in their general health and quality of life. Participation of dental students in dental research should be encouraged even in their early academic years. Early contact between dental students and patients is advised to improve communication skills of students.

Ethical committee approval

Ethical approval was obtained from the Institutional Review Board (IRB #1617-031).

Data statement

The authors state that data are available when requested.

Acknowledgements

Conflicts of interest statement

The authors declare no conflict of interest.

Authors' contributions

MMF was the study director, participated in conduction of the research, wrote the introduction, methodology and discussion sections; AS sections;AS participated in conduction of the research, wrote the introduction, methodology and discussion sections; KK participated in conduction of the research, wrote the results and discussion sections.

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