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Cross-Sectional Study

Impact of Oral Health-Related Knowledge, Attitudes, and Practices on Oral Health-Related Quality of Life in Palestinian Adults with Type 2 Diabetes: A Cross-Sectional Study

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ABSTRACT

This work set out to determine how oral-health–related knowledge, attitudes, and day-to-day practices (KAP) influence the oral-health-related quality of life (OHRQoL) of individuals diagnosed with type 2 diabetes mellitus (T2DM). Between July 2023 and July 2024, a cross-sectional investigation was carried out in primary health facilities across the West Bank. Using cluster sampling from three geographic zones, a convenience group of adults 40 years or older with confirmed T2DM was selected. Information was collected through a validated Arabic questionnaire that captured socio-demographic data, oral-health knowledge, attitudes, behaviors, and OHRQoL, using standardized tools such as the OHIP-14. Participants recorded a mean OHRQoL score of 17.84 ± 11.65 (possible range 0–50). The areas contributing most to poorer OHRQoL were psychological discomfort, social disability, and handicap. The most frequently mentioned oral problems were dry mouth (62.2%), loss of teeth (48.6%), and dental caries (46.1%). Knowledge scores averaged 6.53 ± 2.07 (range 1–10), attitudes 4.88 ± 1.65 (range 0–6), and practices 1.99 ± 1.02 (range 0–6). Spearman's correlations showed significant positive relationships: practice with knowledge ($\rho = 0.160$, $P = 0.000$), practice with attitude ($\rho = 0.171$, $P = 0.000$), and knowledge with attitude ($\rho = 0.238$, $P = 0.000$). The final regression model indicated that stable employment, higher income, and favorable attitudes predicted better OHRQoL. Declines in OHRQoL, however, were linked to visiting the dentist due to pain, discussing diabetes-related oral issues with a dentist, lower ratings of general and oral health, lower schooling, lack of diabetes history, and long delays before obtaining HbA1c tests. The findings demonstrate that attitudes play a central role in supporting higher OHRQoL among people with T2DM, whereas socioeconomic challenges and limited access to care contribute to poorer outcomes. Although many participants possessed adequate knowledge, their oral-health practices remained insufficient. Incorporating oral-care components into diabetes management, improving service availability, and addressing social barriers are essential for improving quality of life in this group.

Keywords: Type 2 diabetes, Palestinian adults, Oral health, Oral-health-related quality of life (OHRQoL)

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Introduction

Oral health and systemic health are tightly connected because they share major behavioral risk factors—including tobacco use, poor nutrition, physical inactivity, and alcohol consumption [1, 2]. Oral conditions are closely tied to the four primary non-communicable diseases: cardiovascular conditions, cancers, diabetes, and chronic respiratory disorders [1, 2]. In its 2022 Global Oral Health Status Report, the World Health Organization stressed the need to include oral-health care within NCD and Universal Health Coverage frameworks [3], recognizing that such integration broadens health impact and supports better outcomes for people with chronic diseases.

Diabetes mellitus (DM) is a long-term metabolic disorder characterized by insufficient insulin production or impaired insulin utilization [4]. Insulin maintains glucose balance [4], and both genes and environment shape susceptibility [5]. According to the American Diabetes Association, diabetes encompasses several categories, most notably type 1 (insulin deficiency) and type 2 (insulin resistance) [6]. In 2021, the International Diabetes Federation reported 537 million adults aged 20–79 living with diabetes; projections anticipate 643 million by 2030, 783 million by 2045 [7], and 1.31 billion by 2050 [8]. Globally, 90%–95% of cases are classified as T2DM [9].

For adults diagnosed with diabetes, an HbA1c level ≥7% is generally interpreted as insufficient glycaemic regulation, while readings above 9% signify very poor disease control [10]. When diabetes is not well managed, individuals face heightened risks of major complications, including kidney damage, cardiovascular problems, and ulcers of the feet [11]. Oral complications are also widespread and may present as gum inflammation, periodontal breakdown, reduced saliva flow, oral fungal infections, excessive plaque, slower healing**,** and changes in taste perception [11]. These problems largely stem from diabetes-related injury to microvascular and macrovascular systems [11]. Hyperglycaemia and periodontal disease influence each other in both directions: inadequate glycaemic control tends to aggravate periodontal conditions, whereas periodontal inflammation can interfere with stable diabetes management [12]. Routine preventive actions—brushing, flossing, dental check-ups, and quitting smoking—can help limit these problems [9, 13]. Nonetheless, many patients struggle to maintain these practices due to gaps in knowledge, financial limitations, or restricted availability of dental services, particularly in underserved communities [14].

Health-related quality of life (HRQoL) describes how illness and its treatment shape a person's physical, emotional, and social functioning [15]. Within this broader concept, oral health-related quality of life (OHRQoL) focuses specifically on the impact of oral conditions on everyday activities [16]. Most investigations report that diabetes adversely affects OHRQoL [17, 18], though several studies have found no clear association [19, 20]. Strengthening dental care and patient education remains important for lowering oral complications and improving OHRQoL.

Patients' knowledge, attitudes, and practices (KAP) toward oral care are central contributors to OHRQoL and serve as important indicators for designing preventive programs and educational initiatives [21]. A South Asian scoping review noted that enhanced oral health knowledge and more favourable attitudes can promote better oral care habits [22]. Furthermore, older individuals with lower educational attainment or poorer general health tend to exhibit worse OHRQoL [23], whereas higher education among people with diabetes is linked to stronger health-related awareness [24]. However, many diabetic patients continue to lack adequate information about oral risks and often receive limited oral-health counselling from their care providers [22]. Awareness of periodontal complications is frequently less developed than awareness of other diabetes-related problems [25], and patients tend to be better informed about systemic consequences than about oral manifestations [12].

Although work in Palestine and neighbouring countries has explored diabetes-related KAP, general HRQoL [26–28], and oral health in diabetic groups [29, 30], these themes have mainly been examined separately. No research in Palestine has yet evaluated how oral-health-related KAP influences OHRQoL among people with type 2 diabetes mellitus (T2DM)**.** Filling this gap is important because understanding these links may support more tailored health education, strengthen preventive approaches, and assist the Ministry of Health (MoH) in improving service planning.

Accordingly, this investigation aims to examine associations between oral-health-related KAP, oral hygiene behaviours, and OHRQoL among T2DM patients who attend MoH primary healthcare clinics in the West Bank. It also intends to assess how demographic and socioeconomic variables, along with accessibility to dental care, contribute to these outcomes, and to evaluate individual OHIP-14 domains in relation to overall OHRQoL.

Materials and Methods

Study design and setting

This cross-sectional study was carried out in MoH primary healthcare centers (PHCs) in the West Bank from July 2023 to July 2024**.** The area was selected due to practical considerations, including the concentration of MoH facilities and the availability of consistent patient documentation that enabled standardized data collection. Although this limits applicability to regions such as Gaza, the results are expected to be reasonably representative of the West Bank population.

Sampling strategy

To obtain coverage from all parts of the West Bank, the study relied on a cluster-based selection of governorates that reflect the three broad geographical zones: North, Central, and South**.** From these areas, the

following governorates were chosen: Jenin, Nablus, and Tulkarm in the North; Jerusalem, Ramallah, and Al-Bireh in the Central region; and Bethlehem and Hebron in the South **(Figure 1).** Within each governorate, primary healthcare centers (PHCs) were deliberately chosen based on the size of their diabetic patient lists. Clinics with the largest numbers of individuals diagnosed with type 2 diabetes mellitus (T2DM) were prioritized to ensure the sample could be recruited efficiently.

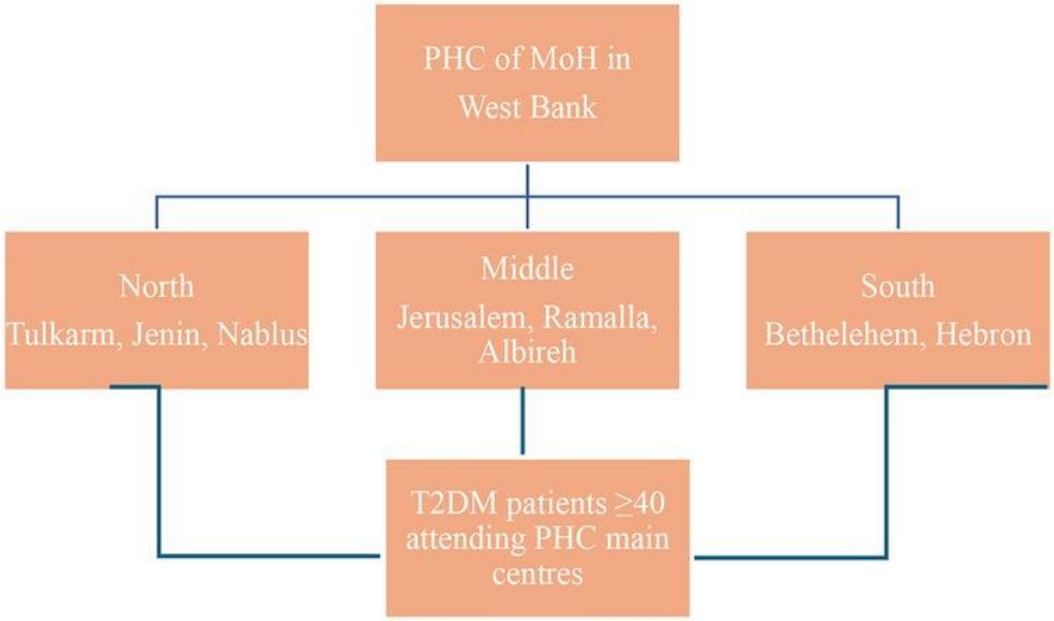

Figure 1. Flowchart of the sample technique.

The West Bank contains approximately 493 PHCs, which represent 64.3% of all healthcare facilities nationwide [31]. Among the 375 PHCs located in the included governorates, only 10 were selected because they served the highest concentrations of T2DM patients. These centers were distributed as follows:

- **North:** Jenin main PHC; Nablus main PHC and one additional Nablus PHC; Tulkarm main PHC.
- **Central:** Ramallah (Al-Bireh) main PHC; Jerusalem main PHC.
- **South:** Bethlehem main PHC; three major PHCs operating in Hebron.

Participants were enrolled consecutively. Adults were eligible if they were 40 years or older, had lived with T2DM for 6 months or more, and were able to provide informed consent. Anyone with T1DM, prediabetes, gestational diabetes, secondary diabetes, or unconfirmed diabetes was not included.

Sample size calculation

The expected prevalence of T2DM in the West Bank was set at **20%**, following estimates from a Markov model [32]. Using the reported population of 3.25 million (Palestinian Central Bureau of Statistics, 2023), the Epitools calculator was applied with a 95% confidence level and **5%** margin of error. This produced a minimum requirement of 457 participants. To compensate for a projected 10% nonresponse rate, the target sample was increased to 508**.**

Conceptual framework

The model used to guide the study **(Figure 2)** was not created specifically for this research. Instead, it was adapted from earlier frameworks that examined oral health-related quality of life (OHRQoL) alongside diabetes-related knowledge, attitudes, and practices (KAP) [33–35]. Adjustments were made only to ensure it aligned with Palestinian cultural and population characteristics. The components were taken directly from previously validated instruments.

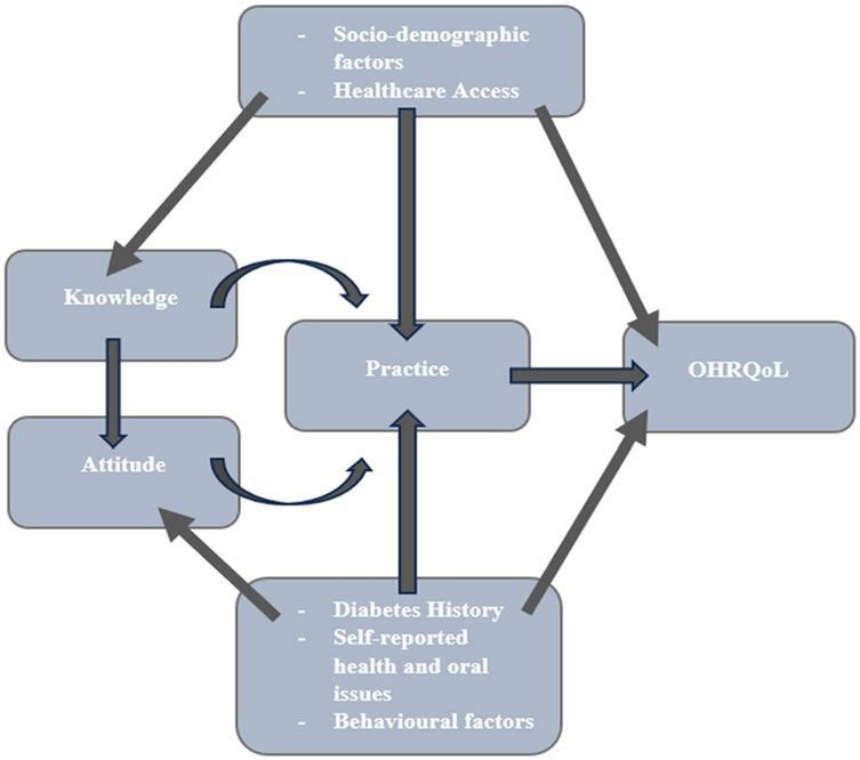

Figure 2. Conceptual framework for study variables.

Data collection and study tool

Data were gathered through structured, in-person interviews using an Arabic questionnaire delivered via Google Forms. Before beginning the interview, each participant was informed of study's aims, confidentiality protections, and general benefits, after which verbal consent was documented. Ethical clearance was approved by both the Al-Quds University Ethics Committee and the Palestinian MoH. The survey consisted of five major parts, which addressed demographic information, diabetes-related background, KAP measures, eating patterns, oral hygiene habits, complications associated with diabetes, and OHRQoL. The OHIP-14 scale—validated in Arabic in previous research [36, 37]—served as the tool for OHRQoL assessment. To ensure linguistic precision, a forward–backward translation was completed, followed by expert evaluation by two dentists, a nurse researcher, and one public health specialist. A pilot test with 45 individuals confirmed comprehensibility and internal reliability (Cronbach's $\alpha = 0.87$).

HbA1c measurement

Each participant's HbA1c value was taken directly from their PHC medical file, ensuring that the number used reflected the most recent result obtained within the preceding 3 months. This approach standardized glycaemic data across sites.

Data collector training and qualifications

Researchers responsible for data collection were chosen because they had prior involvement in health-related fieldwork, relevant academic backgrounds in medical or public health disciplines, and lived in or near the selected governorates. Training was delivered across two Zoom calibration sessions conducted by the principal investigator. After training, ongoing guidance was provided through phone calls and messaging platforms to help maintain uniform interviewing techniques, ethical communication, and adherence to the study's procedures.

Data analysis

Descriptive statistics and normality checks

Participants' demographic profiles, diabetes-related information, health indicators, and access to care were summarized using means, standard deviations, frequencies, and percentages. Normality for the KAP (Knowledge, Attitude, Practice) measures and for OHRQoL was evaluated with the Kolmogorov–Smirnov and Shapiro–Wilk tests. As both tests yielded $p < 0.05$, the distributions were considered non-normal, and non-parametric procedures were therefore used. All analyses were performed with IBM SPSS version 26.0.

Scoring procedures and formation of composite variables

- Knowledge score: Correct responses were coded as 1, incorrect as 0, creating a 0–10 range (higher scores = stronger knowledge).

- Attitude score: "Agree/Totally agree" received 1, all other responses 0, giving a 0–6 scale (higher = more favourable attitude).
- Oral hygiene practices: Brushing or flossing ≥1 time/day, correct brushing technique, brushing for 2 minutes, and use of fluoride or mouthwash were each assigned 1; the sum ranged from 0–6 (higher = better practice).
- Diet-related items: Recoding produced higher values for poorer habits (0 = good, 1 = fair, 2 = poor).
- Oral and systemic complications: Yes = 1, No/Not sure = 0, with higher totals reflecting more complications.
- OHRQoL (OHIP-14): Total scores ranged from 0–56, where larger values indicated worse OHRQoL. Each of the seven domains ranged from 0 to 8, following the same interpretation.

Bivariate analysis

Associations were assessed using Spearman's correlation, Mann–Whitney U, and Kruskal–Wallis tests.

Multivariate analysis

A stepwise multiple linear regression model was used to identify predictors of continuous OHRQoL scores. Variables that were significant in bivariate testing, along with theoretically important predictors (Knowledge, Practice, Age, Smoking, Family history, Last dental visit, and participation in education programs), were entered into the model. Categorical factors were transformed into dummy variables. In total, 51 predictors were evaluated. Forward-selection regression was used to confirm the stepwise results.

Collinearity assessment and model adequacy

Multicollinearity was not observed, with VIF < 1.21 and Tolerance > 0.82 for all predictors. Model performance was judged using adjusted R^2. Statistical significance was set at $p < 0.05$ (two-tailed).

Results and Discussion

Socio-demographic and behavioural profile of participants

The study included 510 respondents. Their mean age was 60.4 ± 9.3 years (40–85 years), and 58.2% were female. The highest share of participants came from Hebron (31.4%), reflecting the region's population size and PHC distribution **(Figure 3).** Most individuals were married (75.5%), lived in urban areas (52.7%), and had completed high-school education or above (46.5%). About 50.6% reported a monthly household income below $500. Current smokers represented 26.1%, while 40.8% consumed fruits and vegetables regularly, and 49.2% frequently consumed sugary foods **(Tables 1 and 2).**

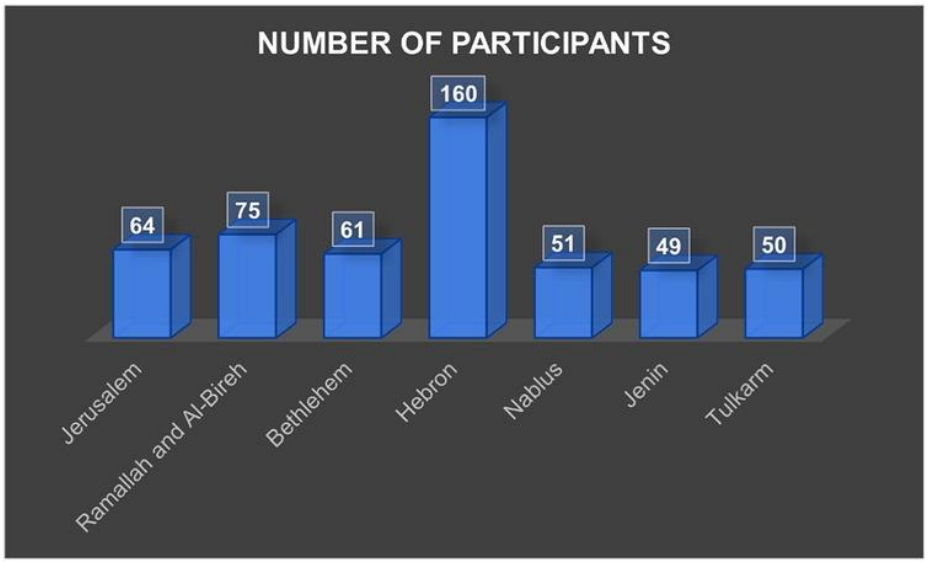

Figure 3. Number of participants in each governorate.

Table 1. Sociodemographic characteristics of the participants.

Sociodemographic Variables	Categories	Number of Participants (n)	Percentage (%)
Gender	Female	297	58.2
	Male	213	41.8
Marital Status	Single	21	4.1
	Married	385	75.5

	Widowed	86	16.9
	Divorced	18	3.5
Place of Residence	City	269	52.7
	Refugee Camp	29	5.7
	Village	212	41.6
Educational Attainment	Elementary (Grades 1–6)	88	17.3
	Secondary (Grades 7–10)	100	19.6
	High School (Grades 11–12)	131	25.7
	Two-year College/Diploma	48	9.4
	Bachelor's degree or higher	106	20.8
	No formal education	37	7.3
Monthly Household Income (USD)	Less than 250	130	25.5
	250 – 499	128	25.1
	500 – 799	126	24.7
	800 – 1,000	65	12.7
	More than 1,000	61	12.0
Employment Status	Housewife (Homemaker)	187	36.7
	Full-time employed	98	19.2
	Part-time employed	36	7.1
	Retired	75	14.7
	Unemployed	114	22.4

Notes: N = frequency; % = percentage.

Table 2. Health-related behaviours of the participants.

Health-Related Behaviours	Categories	%	n
Smoking Status	Current smoker	26.1	133
	Former smoker	15.7	80
	Never smoked	58.2	297
Duration of Smoking (among ever-smokers)	1–5 years	2.5	13
	6–10 years	5.3	27
	11–15 years	3.7	19
	More than 15 years	17.6	90
	Not applicable*	70.8	361
Type of Tobacco Used	Pipe	0.6	3
	Cigarettes	22.4	114
	Hookah (waterpipe)	7.3	37
	Electronic cigarettes	0.2	1
	More than one type	2.0	10
	Not applicable*	67.6	345
Intention to Quit Smoking (current smokers)	Yes	12.0	61
	No	16.3	83
	Not applicable*	71.8	366
Main Reason for Quitting (former smokers)	Health concerns	10.2	52
	Advice from relatives	0.8	4
	Family-related reasons	2.4	12
	Financial/economic reasons	1.8	9
	Other (personal will, self-motivation)	0.4	2
	Not applicable*	84.5	431
Time Since Quitting (former smokers)	1–5 years	7.5	38
	6–10 years	3.9	20
	11–15 years	1.8	9
	More than 15 years	2.7	14
	Not applicable*	84.1	429
Dietary Habits – Sugar and Sweets Intake	Good (rarely or occasionally)	17.8	91
	Fair (several times per week)	32.9	168
	Poor (daily or almost daily)	49.2	251
Dietary Habits – Vegetable and Fruit Intake	Good (daily or almost daily)	40.8	208

	Fair (several times per week)	34.1	174
	Poor (rarely or never)	25.1	128

Not applicable *indicates the item did not apply to certain individuals.*

Diabetes background, reported systemic conditions, and oral complications

A total of 70.2% had a first-degree family member with diabetes. The mean HbA1c was 8.12 ± 1.78, and 64.5% were classified as having uncontrolled glycaemia. Nearly all were receiving diabetes treatment (92.9%), most commonly oral hypoglycaemic agents. Frequent comorbidities included hypertension (65.9%) and hypercholesterolemia (47.6%). Oral problems were common, with xerostomia (62.2%), tooth loss (48.6%), and dental caries (46.1%) reported most often **(Tables 3 and 4).**

Table 3. Self-reported health issues.

Self-Reported Chronic Conditions or Health Problems	Yes – n (%)
Hypercholesterolemia (high cholesterol)	243 (47.6)
Hypertension (high blood pressure)	336 (65.9)
Arthritis / Rheumatism	176 (34.5)
Diabetes-related eye complications	227 (44.5)
Respiratory disease (asthma or other)	74 (14.5)
Cardiovascular disease	165 (32.4)
Stroke (cerebrovascular accident)	45 (8.8)
Other endocrine disorders	56 (11.0)

N = frequency; % = percentage.

Table 4. Self-reported oral and dental complications.

Self-Reported Oral Health Conditions	Not Sure – n (%)	No – n (%)	Yes – n (%)
Dry mouth (xerostomia)	20 (3.9)	173 (33.9)	317 (62.2)
Tooth loss	3 (0.6)	259 (50.8)	248 (48.6)
Dental caries (tooth decay)	28 (5.5)	247 (48.4)	235 (46.1)
Halitosis (bad breath)	29 (5.7)	303 (59.4)	178 (34.9)
Bleeding gums	27 (5.3)	327 (64.1)	156 (30.6)
Altered taste sensation	29 (5.7)	332 (65.1)	149 (29.2)
Oral stomatitis (inflammation or infection)	32 (6.3)	375 (73.5)	103 (20.2)
Oral candidiasis (fungal infection)	27 (5.3)	393 (77.1)	90 (17.6)
Oral ulcers, dental abscesses, or tooth sensitivity	46 (9.0)	391 (76.7)	73 (14.3)
Burning mouth syndrome	34 (6.7)	405 (79.4)	71 (13.9)

N = frequency; % = percentage.

Dental-care access and oral-health information availability

Most respondents had health insurance **(**95.9%**),** largely through public schemes. Satisfaction with services provided by PHCs was moderate at 72.2%**,** with wait times and medication availability identified as the primary issues. Only 17.6% had ever participated in diabetes education sessions, and 43.5% had discussed diabetes with their dentist **(Table 5).**

Table 5. Access to healthcare services, satisfaction, and availability of oral-health information.

Healthcare Access and Utilization Variables	Categories	%	n
Health Insurance Coverage	Yes	95.9	489
	No	1.7	9
	Don’t know	2.4	12
Type of Health Insurance	Public/Governmental	86.3	440
	Private	7.5	38
	Don’t know	5.1	26
	Other	1.2	6
Time Since Last Dental Visit	Less than 6 months	24.1	123
	6–12 months	18.0	92
	More than 1 year	38.8	198
	Never visits the dentist	19.0	97
Main Reason for Most Recent Dental Visit	Routine check-up	10.8	55

	Aesthetic/cosmetic treatment	14.5	74
	Curative/therapeutic treatment	14.7	75
	Pain relief	27.3	139
	Other treatments	13.3	68
	Never visits the dentist	19.4	99
Satisfaction with Primary Healthcare Services	Satisfied	72.2	368
	Not satisfied	17.5	89
	Refused to answer	10.4	53
Attendance at Diabetes Education Programs	Yes	17.6	90
	No	82.4	420
Discussed Diabetes with Physician	Yes	32.2	164
	No	67.8	346
Discussed Diabetes with Dentist	Yes	43.5	222
	No	56.5	288

Knowledge, attitudes, and hygiene practices (KAP)
Mean scores were **6.**53 ± 2.07 for knowledge, 4.88 ± 1.65 for attitude, and 1.99 ± 1.02 for oral hygiene practices. Higher knowledge and more positive attitudes were moderately correlated with better hygiene practices (ρ = 0.160–0.238, p < 0.001). Factors most strongly associated with improved KAP included educational attainment, income, urban residence, routine dental visits, and attending educational programs **(Tables 6–8)**.

Table 6. Distribution of correct responses to items evaluating oral-health knowledge.

Oral Health Knowledge Items (Correct vs Incorrect Responses)	Incorrect Answer n (%)	Correct Answer n (%)
Patients with diabetes are more prone to periodontal disease and supporting tissue problems	138 (27.1)	372 (72.9)
There is no association between periodontal disease and elevated blood glucose levels	192 (37.6)	318 (62.4)
Diabetes does not contribute to bad breath (halitosis)	218 (42.7)	292 (57.3)
Individuals with diabetes are more likely to experience dry mouth (xerostomia)	101 (19.8)	409 (80.2)
People with diabetes typically do not develop oral candidiasis (thrush)	217 (42.5)	293 (57.5)
Diabetes increases the risk of dental caries mainly because of reduced saliva (dry mouth)	187 (36.7)	323 (63.3)
Diabetes does not lead to tooth loss	192 (37.6)	318 (62.4)
Good blood glucose control can help prevent oral and dental complications in diabetic patients	136 (26.7)	374 (73.3)
Smoking does not increase the risk of oral and dental diseases in individuals with diabetes	151 (29.6)	359 (70.4)
Chronic periodontal inflammation is linked to cardiovascular disease in patients with diabetes	238 (46.7)	272 (53.3)

N = frequency; % = percentage.

Table 7. Summary of participants' ratings of oral-health attitude statements.

Attitude Statements (Level of Agreement)	Totally Disagree n (%)	Totally Agree n (%)	Disagree n (%)	Agree n (%)	Neutral n (%)
Oral health care is equally important as caring for other parts of the body	4 (0.8)	305 (59.8)	15 (2.9)	155 (30.4)	31 (6.1)
Teeth should be brushed every morning and before bedtime	6 (1.2)	257 (50.4)	23 (4.5)	166 (32.5)	58 (11.4)
Regular dental check-ups at least once a year are necessary	11 (2.2)	224 (43.9)	46 (9.0)	145 (28.4)	84 (16.5)
Any oral or dental problem should be addressed by consulting a dentist immediately	7 (1.4)	255 (50.0)	30 (5.9)	152 (29.8)	66 (12.9)
The diabetes care team should routinely provide information about oral health complications of diabetes	5 (1.0)	275 (53.9)	8 (1.6)	160 (31.4)	62 (12.2)

The physician managing diabetes should refer patients for regular dental examinations	25 (4.9)	237 (46.5)	26 (5.1)	158 (31.0)	64 (12.5)

N = frequency; % = percentage.

Table 8. Reported frequencies of oral-hygiene behaviours.

Oral Health Practices	n (%)	Response Categories
Frequency of tooth brushing	275 (53.9)	At least once a day
	117 (22.9)	Sometimes
	60 (11.8)	Rarely
	58 (11.4)	Never
Frequency of dental flossing	26 (5.1)	At least once a day
	54 (10.6)	Sometimes
	45 (8.8)	Rarely
	385 (75.5)	Never
Use of fluoride toothpaste	94 (18.4)	Yes
	25 (4.9)	Sometimes
	282 (55.3)	I don't know
	109 (21.4)	No
Use of mouthwash	7 (1.4)	Yes
	78 (15.3)	Sometimes
	97 (19.0)	I don't know
	328 (64.3)	No
Duration of tooth brushing per session	98 (19.2)	Exactly 2 minutes
	220 (43.1)	Less than 2 minutes
	65 (12.7)	More than 2 minutes
	127 (24.9)	I don't know / I don't brush my teeth
Demonstrated correct toothbrush angle (45° to the gumline)	176 (34.5)	Correct
	334 (65.5)	Incorrect

N = frequency; % = percentage.

Oral health–related quality of life (OHRQoL)

Participants recorded an average OHIP-14 total of **17.84 ± 11.65**, a value consistent with a moderate level of perceived burden. The domains showing the most substantial contribution to this impact were psychological discomfort, social limitation, and handicap **(Table 9).** Variations in KAP and OHIP-14 indices across governorates are depicted in **Figure 4.**

Table 9. OHIP-14 entries most commonly reported as problematic (N = 510).

OHIP-14 Domain	Item (Question)	Participants reporting "Fairly often" or "Very often"
Functional limitation	Trouble pronouncing words	9 (1.8)
	Worsened sense of taste	16 (3.1)
Physical pain	Painful aching in the mouth	18 (3.5)
	Discomfort when eating foods	24 (4.7)
Psychological discomfort	Felt self-conscious because of teeth/mouth	86 (16.9)
	Felt tense because of teeth/mouth	72 (14.1)
Physical disability	Had to interrupt meals because of problems with teeth/mouth	29 (5.7)
	Been unable to follow a satisfactory diet	18 (3.5)
Psychological disability	Found it difficult to relax because of teeth/mouth	65 (12.7)
	Felt embarrassed because of teeth/mouth	53 (10.4)
Social disability	Been irritable with other people	82 (16.1)
	Had difficulty doing usual jobs/activities	79 (15.5)
Handicap	Felt life in general was less satisfying	82 (16.1)
	Been totally unable to function	80 (15.7)

N = frequency; % = percentage.

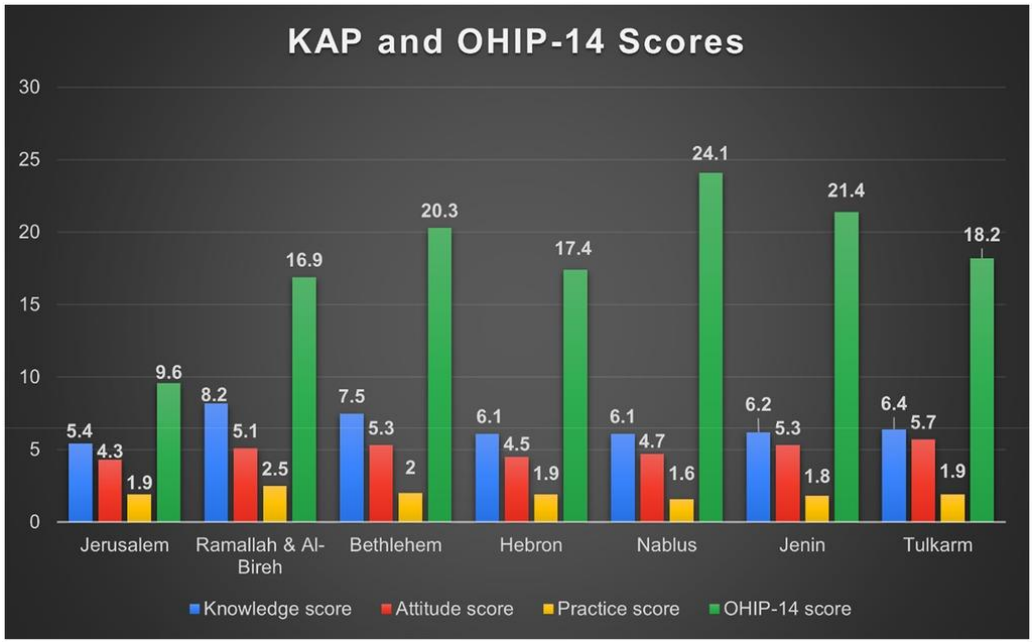

Figure 4. Geographic distribution of KAP and OHIP-14 scores.

Bivariate findings

The relationships among the KAP components demonstrated consistent, statistically significant positive correlations:

- Knowledge ↔ Practices: $\rho = 0.160$, $p < 0.001$
- Attitudes ↔ Practices: $\rho = 0.171$, $p < 0.001$
- Knowledge ↔ Attitudes: $\rho = 0.238$, $p < 0.001$

Overall, stronger knowledge and more favourable attitudes corresponded with more desirable oral-hygiene behaviours.

Factors linked with higher oral-health knowledge

Variables associated with better knowledge scores included:

- Younger age ($\rho = -0.190$, $p < 0.001$)
- Residence in urban zones ($H(2) = 11.4$, $p < 0.001$)
- More years of schooling ($\rho = 0.263$, $p < 0.001$) and higher income ($\rho = 0.121$, $p < 0.05$)
- Full-time work status ($H(4) = 12.1$, $p < 0.05$)
- Routine and preventive dental attendance ($H = 38.6–56.2$, $p < 0.001$)
- Engagement in diabetes-related education ($U = 23{,}034.5$, $p < 0.001$)
- Receiving oral-health explanations from physicians or dentists (physician: $U = 33{,}341.5$, dentist: $U = 39{,}829$, $p < 0.001$**)

Lower knowledge tended to appear among individuals with longer disease duration or those who had not visited a dentist recently.

Factors influencing positive attitudes

More favourable attitudes were found among:

- Younger adults ($\rho = -0.142$, $p < 0.001$) and women ($U = 35{,}820.5$, $p < 0.05$)
- Participants residing in cities ($H(2) = 20.9$, $p < 0.001$)
- Individuals with more education or higher income ($\rho = 0.189$; $H = 21.1–23.7$, $p < 0.001$)
- Full-time employees ($H(4) = 12.4$, $p < 0.05$)
- Those reporting healthier diets or who were non-smokers ($H = 9.48–28.3$, $p < 0.001$)
- Well-controlled blood glucose and family history of diabetes ($U = 25{,}484.5$; $H(3) = 13.59$, $p < 0.05$)
- Frequent dental care utilization and satisfaction with care ($H = 7.06–48.7$, $p < 0.05$)
- Participation in health-education activities and discussions with clinical staff ($U = 22{,}485.5–38{,}038$, $p < 0.001$)

Attitudes were poorer among those with older age, longer diabetes duration, higher HbA1c, elevated cumulative sugar results, or poorer reported general health.

Factors associated with better hygiene practices

Higher practice scores were seen among:

- Individuals with more education or greater income ($\rho = 0.188–0.282$, $p < 0.001$)
- Full-time workers ($H(4) = 34.7$, $p < 0.001$)
- Younger participants ($\rho = -0.278$, $p < 0.001$)
- Those visiting dentists regularly—whether for examinations or treatment ($H = 26.4$, $p < 0.001$)
- Participants with adequate glycaemic control ($U = 25{,}922.5$, $p < 0.05$)

Negative predictors included longer disease duration, self-reported poor health, higher cumulative sugar results, and irregular dental attendance.

Determinants of OHRQoL

Higher OHIP-14 totals (indicating poorer OHRQoL) were associated with:

- Female gender ($U = 36{,}287.5$, $p < 0.05$)
- Being unemployed ($H(4) = 25.35$, $p < 0.001$)
- Uncontrolled diabetes ($U = 34{,}421.5$, $p < 0.05$)
- Worse overall health and more oral complications related to diabetes ($\rho = 0.252–0.407$, $p < 0.001$)
- Dental visits for pain and discussions about diabetes with clinicians ($U = 32{,}919–36{,}925$; $H = 25.65$, $p < 0.05$)

Conversely, lower OHIP-14 scores (better OHRQoL) were observed in participants with higher earnings, greater educational attainment, more favourable attitudes, better hygiene practices, and controlled blood glucose.

OHIP-14 domains

Across the seven components of the OHIP-14 scale, several notable patterns emerged:

Functional Limitation & Physical Pain: Participants who had not taken part in diabetes-related educational sessions, had not spoken with healthcare professionals about their condition, or who sought dental care only when experiencing pain, showed poorer scores. Individuals who rarely or never attended dental clinics demonstrated similar trends.

Psychological Discomfort & Disability: Higher HbA1c levels, greater self-reported oral complications, and poorer overall health were all linked with increased psychological burden.

Social Disability & Handicap: Social functioning tended to be worse in those who had participated in educational sessions, had consulted providers about diabetes, or visited the dentist for pain relief. Conversely, individuals with higher education, better income, or more positive attitudes toward oral health displayed improved outcomes.

Bivariate analysis of the different domains of OHIP-14

Statistically meaningful variations ($p < 0.05$) in mean scores across all seven OHIP-14 domains were observed using Mann–Whitney and Kruskal–Wallis tests. These variations corresponded strongly with participants' involvement in diabetes education, the extent to which they discussed their condition with healthcare professionals, and the primary reason for their most recent dental appointment.

OHIP-14 domain outcomes

Detailed evaluation of each OHIP-14 domain highlighted recurring determinants influencing oral-health-related quality of life.

Functional Limitation: Scores were notably poorer among individuals who had not joined diabetes education sessions, had not spoken with providers about diabetes management, or visited dental clinics only because of pain. Elevated HbA1c, reported oral complications, and suboptimal general health further contributed to poorer outcomes. Supportive attitudes toward oral care appeared to lessen functional problems.

Physical Pain: Pain scores were higher in participants with uncontrolled blood glucose, oral complications, or poorer health status. In contrast, individuals with higher educational attainment and those who routinely sought preventive dental care experienced less pain.

Psychological Discomfort: Surprisingly, discomfort was greater in those who had attended education activities or discussed their diabetes with physicians or dentists—likely reflecting increased awareness of potential risks. Poor glycaemic control, oral issues, and inadequate health status intensified discomfort, whereas higher income and more frequent dental appointments helped reduce it.

Physical Disability: This domain was strongly influenced by high HbA1c, oral complications, and lower socioeconomic indicators. Participants with better income levels, more favorable attitudes, and stronger oral hygiene practices tended to experience fewer physical limitations.

Psychological Disability: Higher psychological disability was connected to elevated HbA1c, compromised overall health, and oral complications. However, participants with a greater educational background or higher income showed substantially lower impairment.

Social Disability: Individuals with uncontrolled diabetes, oral health problems, or lower socioeconomic status were more likely to report social difficulties. The opposite was seen in those with more education or better financial resources.

Handicap: Higher handicap scores appeared among older adults and individuals with uncontrolled glycaemia, poor general health, or oral complications. Increased education, stronger income levels, positive attitudes, and healthier oral practices played a protective role.

Overall predictors of OHRQoL

Across the assessed domains, three factors repeatedly stood out as the strongest indicators of diminished OHRQoL:

• Inadequate metabolic control (elevated HbA1c).
• Oral problems linked to diabetes.
• Lower socioeconomic standing (education and income).

On the other hand, supportive attitudes, consistent oral-care routines, and preventive dental visits appeared to enhance outcomes in several domains.

Multivariable analysis for OHRQoL (OHIP-14 scores)

Altogether, 51 candidate variables were included in a stepwise multiple linear regression, followed by confirmation using a forward-entry method. Eleven models were produced; the final model (Model 11) retained eleven predictors and achieved an R^2 of 0.306, an adjusted R^2 of 0.290, a p-value < 0.000, and an F-change of 19.95. The predictors associated with either poorer or better oral-health-related quality of life are summarized in **Table 10**.

Table 10. Multiple linear regression for OHRQoL (OHIP-14 scores), N = 510.

Independent Variables	Standardized β	p-value	t	95% Confidence Interval for Unstandardized β	
				Upper Bound	Lower Bound
(Constant)		0.000	5.802	15.115	7.468
Total number of self-reported oral health problems	0.299	<0.001	7.453	1.911	1.114
Full-time employment	−0.125	0.002	−3.169	−1.407	−6.000
Discussed diabetes with dentist	0.200	<0.001	5.049	6.514	2.864
Elementary education level	0.124	0.002	3.179	6.166	1.456
Last dental visit was for pain relief	0.139	<0.001	3.517	5.664	1.604
No family history of diabetes	0.126	0.001	3.291	6.077	1.533
Total attitude score (higher = more positive)	−0.103	0.009	−2.615	−0.182	−1.279
Monthly household income 800–1,000 USD	−0.128	0.001	−3.269	−1.787	−7.170
HbA1c test performed more than 3 months ago	0.098	0.012	2.534	4.282	0.542
Total number of self-reported chronic health conditions	0.104	0.011	2.567	1.320	0.175
Monthly household income 500–799 USD	−0.079	0.048	−1.978	−0.014	−4.246

OHRQoL = Oral Health Related Quality of Life (dependent outcome).
β = standardized beta coefficient; t = statistic based on standard error.
The final stepwise model had an adjusted R^2 of 0.290, p < 0.000.

Factors linked with poorer OHRQoL (increased OHIP-14 scores)

- Diabetes-related oral manifestations (β = 0.299, p < 0.001).
- Worse overall health perception (β = 0.104, p < 0.05).
- Reporting that diabetes was discussed with a dentist (β = 0.200, p < 0.001).
- Lower schooling level (elementary) (β = 0.124, p < 0.001).
- Consulting a dentist mainly because of pain (β = 0.139, p < 0.001).
- No family history of diabetes (β = 0.126, p < 0.001).
- HbA1c follow-up postponed beyond 3 months (β = 0.098, p < 0.05).

Factors linked with better OHRQoL (reduced OHIP-14 scores)

- Having a full-time job (β = −0.125, p < 0.05).
- More favorable oral-health attitudes (β = −0.103, p < 0.05).
- Higher monthly earnings ($500–800: β = −0.079, p < 0.05; $800–1,000: β = −0.128, p < 0.001).

These results illustrate how clinical aspects (oral and general health, metabolic monitoring), psychosocial components (attitudes, schooling level, family history), and structural determinants (employment, income, dental-care behaviors) collectively shape OHRQoL in people living with diabetes.

Figure 5 presents the updated conceptual framework built from the significant relationships identified in this study.

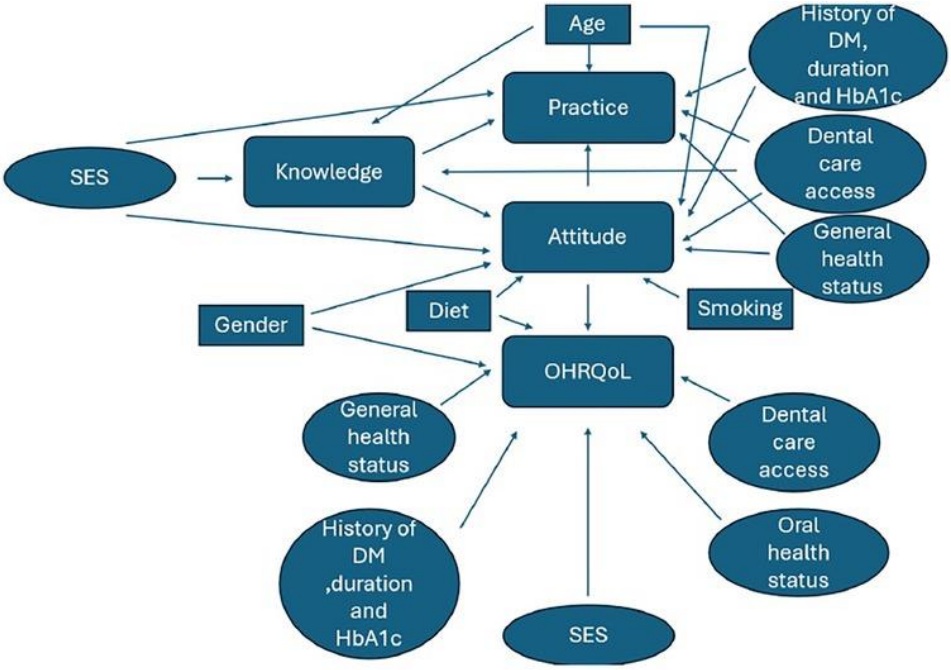

Figure 5. Revised model derived from the study. SES = socioeconomic status.

This investigation is the first to explore OHRQoL among diabetic adults in the West Bank and to analyze how it relates to knowledge, attitudes, practices, and multiple sociodemographic and health-related influences. The study used a validated instrument, standardized procedures, and a sample that reflects the national population, supporting the robustness and generalizability of the findings.

Using the Knowledge-Attitude-Practice (KAP) approach, the study examined oral health in relation to OHRQoL among diabetic patients. As reported in earlier work [38–40], although participants demonstrated moderate awareness and generally positive views toward oral health, these did not reliably result in adequate oral-care behaviors. This indicates that knowledge and attitude alone do not guarantee behavioral change. Accordingly, interventions should incorporate elements that support action—such as scheduled oral-health programs, reminder systems, and improved access to dental services. Positive attitudes were strongly tied to better OHRQoL, and more than 60% acknowledged the significance of oral health, a pattern consistent with previous reports in diabetic populations [25, 41].

Sociodemographic characteristics also shaped outcomes: younger age groups, individuals with higher education, and those with greater income showed better oral-health knowledge, mirroring findings from Tanzania and Pakistan [39, 42]. Employed and educated women showed more favorable attitudes, aligning with research from Saudi Arabia [43]. However, strong knowledge did not always produce good habits—likely due to burdens of diabetes management, insufficient motivation, and barriers in access to dental treatment [39, 42]. Good practices were more common among higher-income and employed individuals, consistent with international patterns [43]. Meanwhile, older adults tended to have poorer oral-care routines, which may be linked to denture wear, reduced dexterity, or cumulative oral-health challenges [44, 45].

Controlled diabetes was linked to more favorable attitudes and behaviors, reinforcing the well-established two-way interaction between diabetes and periodontal conditions. Poor glucose regulation intensifies oral inflammation, periodontal breakdown, and dry mouth, which can subsequently worsen metabolic control—an association also described by Genco *et al.* regarding infection and inflammation in periodontal and cardiovascular diseases [46]. Yet, only 43.5% had ever talked about diabetes with a dentist and just 32.2% with a medical doctor, underscoring the need for stronger collaboration between health disciplines. Evidence from both local and international studies shows that coordinated care enhances oral health and glycemic management [47, 48], lowering the likelihood of cardiovascular, renal, and other systemic outcomes [49].

Only 18% of respondents had attended diabetes-related education sessions, indicating a significant gap in community health engagement, similar to findings from Abbasi *et al.* in Malaysia [50]. Access to dental services was associated with improvements in knowledge, attitudes, and behaviors [51], while preventive or cosmetic procedures encouraged better daily care [52]. Health-promoting habits—such as

nutritious eating and smoking avoidance—were related to more positive oral health indicators, whereas active smokers showed poorer attitudes, paralleling results from Sadeghi *et al*. in Tehran [53]. These patterns suggest that public health initiatives focusing on lifestyle change, cessation of tobacco use, and nutritional counseling are essential for enhancing oral health behaviors among diabetic individuals.

In this study, diminished OHRQoL was primarily linked to psychological discomfort, functional limitations, and social disadvantages. Elevated HbA1c, compromised general and dental health, and lower socioeconomic status were linked with worse disability-related dimensions [51, 52]. Older age, weak oral health practices, and insufficient knowledge further contributed to higher disability scores. These findings emphasize the importance of addressing biological and social determinants simultaneously through educational, behavioral, and socioeconomic interventions.

Participants who had never joined educational programs or communicated with healthcare providers demonstrated poorer results across OHIP-14 dimensions [54, 55]. Interestingly, individuals who did participate in such programs reported greater psychological distress, likely due to heightened awareness of complications without adequate ongoing support—an observation also documented in earlier research [56, 57]. Visits triggered by urgent symptoms or cosmetic concerns were linked with reduced OHRQoL, reflecting reactive rather than preventive care-seeking behaviors observed both locally and worldwide [44].

Poor glucose control (high HbA1c) was consistently associated with reduced OHRQoL across all domains [47], while higher education, better income, positive attitudes, and effective practices were linked with improved outcomes [58, 59]. Socioeconomic disadvantages—older age, joblessness, low income, and limited education—were predictors of poorer OHRQoL, echoing Palestinian and international findings [23, 49, 59]. Self-reported oral problems and uncontrolled diabetes negatively influenced OHRQoL, whereas less severe, non-medicated diabetes corresponded with better scores, consistent with studies from the UAE and Kuwait [60, 61]. Notably, the absence of a family history of diabetes was associated with poorer OHRQoL—a new finding that may signal lower awareness, delayed preventive action, and missed opportunities for early guidance.

Overall, the study illustrates that oral health in individuals with diabetes is shaped by clinical status, behaviors, and social conditions. Integrating oral-health components into diabetes care, expanding educational opportunities, and reducing socioeconomic barriers are fundamental, as supported by the literature. Public health recommendations include structured diabetes-and-oral-health education programs, enhanced access to preventive dental services and hygiene tools, lifestyle interventions (healthy diet and smoking cessation), and policies that strengthen collaboration between dental and medical professionals. Implementing these strategies may improve oral-care habits, reduce complications, and uplift OHRQoL for diabetic patients, especially in low-resource settings such as Palestine.

Crucially, such recommendations must align with the capacity of the Palestinian healthcare system. Ministry of Health (MoH) primary-care clinics, which already manage most diabetes care, provide a realistic setting for integrating oral-health assessments and education. Cost-effective actions—like training diabetes educators and nurses to include brief oral-health guidance, adding oral-health checklists to routine diabetes visits, and involving community workers in rural regions—are viable within current infrastructure. Collaboration with universities and dental faculties could support preventive campaigns and patient-education initiatives. Given financial limitations, emphasizing preventive approaches, task-shifting, and interprofessional coordination represents a practical route toward improving oral-health outcomes for diabetic patients in Palestine.

Limitations and future research

Because this study used a cross-sectional approach, it cannot determine cause-and-effect relationships and only reflects patterns observed at one moment in time. The reliance on participants' own reporting may have introduced errors related to memory or the tendency to give socially acceptable answers. Furthermore, since data were collected exclusively from primary healthcare centers in the West Bank, the results may not reflect conditions in Gaza or groups with limited contact with PHC services. Future investigations should consider longitudinal designs or mixed-method approaches and include wider geographic areas and socioeconomic backgrounds to gain a more complete understanding of what shapes oral health behaviors and OHRQoL among diabetic individuals in Palestine.

Conclusion

This work sheds light on the oral-health-related quality of life of diabetic patients in the West Bank. Although many participants possessed reasonable knowledge and expressed positive attitudes, these did not reliably

translate into strong daily oral hygiene habits. Positive attitudes were linked with better OHRQoL, while poorer scores were associated with limited access to care, financial hardship, uncontrolled diabetes, and psychological strain. Improving OHRQoL will require a broad, patient-focused strategy that weaves oral health into long-term diabetes management, encourages healthy lifestyle behaviors, and addresses underlying social and structural obstacles. Interpretation of the findings should remain cautious, given the restricted generalizability and the model's modest explanatory strength, indicating that other clinical, social, and environmental elements also influence OHRQoL.

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Ethics Statement: The studies involving humans were approved by Al-Quds University School of Public Health Ethical Research Committee and AL- Quds University Graduate Studies Committee. Approval was obtained from the Ministry of Health to access the healthcare centres. For the potential participants, field researchers explained the aim of this study then verbal consent from them and finishing the questionnaire. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

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