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Knowledge, Attitudes, Beliefs, and Eye-Screening Practices Regarding Diabetic Retinopathy among Adults with Diabetes in Palestine: A Cross-Sectional Study

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Abstract

Background

Diabetic retinopathy (DR) is a major cause of preventable vision loss among adults with diabetes. Despite the importance of early detection, evidence regarding patients' knowledge, attitudes, and eye-care practices in Palestine remains limited. This study aimed to assess these factors and identify factors associated with an eye examination within the previous year among adults with diabetes in the West Bank.

Methods

A cross-sectional study was conducted between March and August 2026 among 389 adults with diabetes recruited through convenience sampling in the West Bank, Palestine. Data were collected using a structured questionnaire assessing sociodemographic characteristics, DR knowledge, attitudes, and eye-care practices. Multivariable regression analyses were performed to identify factors associated with knowledge scores and self-reported eye examination within the previous year.

Results

The mean knowledge score was 7.96 ± 3.06 out of 12. Although 88.4% of participants recognized that diabetes could affect the retina, only 38.8% knew that DR could develop without symptoms. Most participants (94.1%) recognized the importance of regular eye examinations; however, only 51.7% reported undergoing an eye examination within the previous year, while 20.8% had never undergone one. Higher knowledge scores (adjusted odds ratio [aOR] 1.117, 95% CI 1.029–1.212) and physician referral (aOR 2.947, 95% CI 1.807–4.807) were independently associated with reporting an eye examination within the previous year. Men (aOR 0.530, 95% CI 0.305–0.922) and village residents (aOR 0.529, 95% CI 0.323–0.866) had lower adjusted odds of reporting an eye examination within the previous year. Attitudes and beliefs were not independently associated with recent eye examination after adjustment.

Conclusion

Despite widespread recognition of the importance of preventive eye care, substantial gaps in disease-specific knowledge and eye-examination practices persist among adults with diabetes in the West Bank. The observed associations between knowledge, physician referral, and recent eye examination, together with differences by sex and place of residence, support further investigation of strategies combining targeted education, consistent referral and follow-up and improved access to retinal assessment.

Trial registration

Not applicable

Introduction

Diabetes mellitus (DM) is one of the most prevalent chronic diseases worldwide and represents a major public health challenge due to its increasing incidence and long-term complications. Data from the International Diabetes Federation (IDF) indicate that 589 million adults aged 20–79 currently live with diabetes worldwide, a number projected to reach 853 million by 2050 [1]. The continuing expansion of the diabetic population increases the number of individuals at risk of developing chronic microvascular complications, including diabetic retinopathy (DR), nephropathy, and neuropathy, which contribute substantially to morbidity and reduced quality of life among people with diabetes [2]. DR is of particular concern because vision-threatening disease may remain asymptomatic, allowing retinal damage to progress before patients notice any changes in vision [3].

Diabetic retinopathy (DR) is a leading cause of preventable vision loss among working-age adults globally [4]. It is characterized by retinal microvascular abnormalities that may progress from non-proliferative to proliferative diabetic retinopathy and may be accompanied by diabetic macular edema [5]. Among individuals with diabetes, the global prevalence of any DR is estimated at 22.27%, while vision-threatening DR (VTDR) and clinically significant macular edema (CSME) affect 6.17% and 4.07%, respectively [4]. Furthermore, by 2045, the number of adults worldwide with DR is projected to increase to 160.50 million, reflecting the growing burden of DR alongside the expanding global diabetes epidemic [4]. Longer duration of diabetes, poor glycemic control, and hypertension have been associated with the development and progression of DR [3, 6]. The clinical importance of DR lies not only in its potential to cause irreversible visual impairment but also in the opportunity to prevent vision loss. The International Council of Ophthalmology (ICO) emphasizes that vision loss from DR can be prevented through appropriate screening, timely referral, and treatment of vision-threatening disease [7].

Patients' knowledge, attitudes, beliefs, and health practices play an important role in the prevention and early detection of diabetic retinopathy (DR), as patients' understanding of the disease and perceptions of its severity and preventability may influence their engagement with recommended eye screening. These factors are closely related, yet they represent distinct dimensions of health behavior, and adequate knowledge does not necessarily translate into appropriate screening practices. For example, a study among patients with diabetes in Riyadh found good overall awareness of DR, but only 45% had undergone an eye examination within the preceding year, suggesting a gap between awareness and preventive practice [8]. Similarly, among patients attending an ophthalmology clinic in Jordan, 93.8% recognized that diabetes could affect the eyes, whereas only 4.5% knew that DR could occur without symptoms, illustrating that general awareness may not reflect disease-specific knowledge [9]. In addition to patient-related factors, practical and healthcare-system barriers may influence screening behavior; a qualitative study from southern India identified absence of symptoms, difficulties in doctor–patient communication, financial concerns, and the burden of follow-up care as important barriers to diabetic retinopathy screening [10]. Therefore, examining knowledge, attitudes, beliefs, and practices together

may provide a more comprehensive understanding of the factors associated with engagement in DR screening than assessing general awareness alone.

In Palestine, diabetes represents an important and growing public health concern, with a substantial number of adults affected by diabetes and its complications. According to the International Diabetes Federation (IDF), the age-standardized prevalence of diabetes among adults in Palestine was approximately 15.5% in 2024, corresponding to an estimated 315,000 adults living with diabetes, with the burden expected to increase in the coming decades [11]. This growing burden underscores the need for effective prevention and early detection of diabetes-related complications, including diabetic retinopathy. In Palestine, diabetic retinopathy screening may be affected by patient-level and healthcare-related barriers, including financial constraints, transportation difficulties, limited access to screening services, and inadequate physician referral for eye examinations [12]. Although Palestinian research has examined aspects of diabetic retinopathy awareness, knowledge, attitudes, and screening practices, the available evidence remains limited and heterogeneous in terms of study settings, participant populations, and assessment tools. A recent Palestinian study found high general awareness of diabetes-related eye complications but identified important gaps in DR-specific knowledge and comprehensive eyescreening practices [13]. However, further assessment of knowledge, attitudes, beliefs, and eyescreening practices is needed to provide a more comprehensive understanding of these domains among adults with diabetes in Palestine. Such evidence may help identify areas for patient education and inform strategies to improve appropriate diabetic retinopathy screening and early detection. Accordingly, the present study aims to assess knowledge, attitudes, beliefs, and eye-screening practices regarding diabetic retinopathy among adults with diabetes in Palestine.

Methodology

Study Design and population

A cross-sectional study was conducted between March-August 2026 in the West Bank to study the knowledge, attitudes, beliefs and eye-screening practices regarding diabetic retinopathy among adults with diabetes in the West-Bank, Palestine. The study included adults ≥ 18 years old, currently residing in Palestine, diagnosed with Diabetes (type 1 or 2), and willing to provide informed consent. Participants who were younger than 18 years old, were not diagnosed with diabetes, did not provide informed consent, or who had not completed scales items in the questionnaire were excluded.

Sample size calculations

Sample size was calculated using Rosoft sample size calculator REF for single population proportion estimation, which is widely applied in cross-sectional epidemiological studies. The standard formula n = Z2·p(1-p)/d2 was used, where n represents the minimum required sample size, Z is the standard normal

deviate corresponding to a 95% confidence level (1.96), p is the estimated anticipated proportion for the primary proportion estimate, and d is the margin of error set at 5% to ensure adequate precision.

Given the lack of a single robust estimate applicable to the study's primary outcomes in the target population, a conservative prevalence estimate of 50% (p = 0.5) was adopted to maximize sample size under maximum variability conditions. Based on these assumptions, the minimum required sample size was calculated to be approximately 385 participants. A total of 389 participants were successfully recruited and included in the final analysis.

Sampling technique and data collection

All the data were collected via a structured questionnaire using a non-probability convenience sampling technique through both social media platforms and in-person interviews. The questionnaire items were assembled from different valid resources (REF, REF, REF, REF, REF, REF), and revised by experts in the field. It consisted of 4 sections; the first was sociodemographic and clinical characteristics, such as age, gender, occupational status, educational level, source of information about diabetic retinopathy, type of diagnosed diabetes, duration since diagnosis, diagnosis of hypertension or cholesterol, and family history of diabetes. The second consisted of 12 knowledge items; one correct answer for each item, each correct answer was given 1 point and incorrect answers were given 0 points. The third consisted of 6 items about attitudes and beliefs regarding diabetic retinopathy, the answers were scored according to a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The fourth section was regarding health behaviors and eye-care practices, such as adherence to diabetes medications, smoking status, frequency of blood glucose monitoring, previous diagnosis of diabetic retinopathy, physician referral for retinal examination, adherence to scheduled eye examinations, time since the last eye examination, adherence to physician advice regarding retinal examination, and reasons for not undergoing an eye examination. The English-language version of the questionnaire is provided in Supplementary File 1.

Validity and reliability

A pilot study (n = 20) was conducted to assess clarity and feasibility. Minor adjustments were made based on participant's feedback to improve the structure and ensure ease of understanding and access to accurate and reliable information. The pilot participants were excluded from final analysis.

Internal consistency was subsequently assessed using Cronbach's alpha yielding coefficients of 0.819 for the 12-item knowledge scale, and 0.772 for the 6-item attitudes and beliefs scale.

Ethical approval

The study was approved by the Institutional Review Board (IRB) of An-Najah National University (IRB Reference #: Med/Mar. 2026/35). This was an observational study, and no clinical trial interventions were involved. The research was conducted in compliance with the Declaration of Helsinki.

The participants were informed about the purpose of the study, and written consent was obtained before their participation. Confidentiality and privacy were maintained throughout the study, with access to participants' data restricted to the research team.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) version 27 was used to analyze the data. Descriptive statistics were used to summarize the study variables; categorical variables are presented as frequencies and percentages, whereas continuous variables are presented as medians, interquartile ranges (IQRs) and, where appropriate, mean and standard deviations (SD).

Mann-Whitney U test and Kruskal-Wallis test were used to assess the association between non-normally distributed categorical variables and knowledge scale. When an overall Kruskal-Wallis test was significant, pairwise comparisons were conducted with Bonferroni adjustment for multiple testing. Associations between continuous variables were assessed using Spearman's rank correlation.

Factors significantly associated with knowledge score were examined using a generalized linear model with a normal probability distribution and identity link, with robust covariance estimation; adjusted estimated marginal means and Bonferroni-corrected pair wise comparisons were calculated for selected categorical predictors.

Factors associated with having undergone an eye examination within the previous year were assessed using multivariable binary logistic regression. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were reported and overall Wald tests were used to assess multicategory predictors. Logistic model fit was evaluated using the omnibus model test, Hosmer-Lemeshow goodness-of-fit test, Nagelkerke R^2, and classification accuracy. Missing data were handled using complete-case analysis for the relevant multivariable models. Statistical significance set at a confidence interval (CI) of 95% and P value < 0.05.

Results

Participant's characteristics

A total of 389 adults with diabetes were included in the final analysis. The median age of the sample was 50 years (IQR 26.25-60). The sample comprised mostly women (61.2%), bachelor degree holders (41.4%), unemployed (65.8%), and distributed similarly between cities (44.2%) and villages (42.7%). The most reported source of information about diabetic retinopathy was doctors (43.7%), while 26% reported never hearing about it. Type 2 diabetes was reported by 49.4% of participants, Type 1 was reported by 22.4%, while 28.3% did not know the type of diabetes they were diagnosed with. Oral medication was the most common treatment modality (45.2%). Family history of diabetes was reported by 75.3% of the participants. (Table 1)

Knowledge of diabetic retinopathy

The mean knowledge score was 7.96 ± 3.06 of 12, with a median of 8 (IQR 6-10) and a range of 0-12. The highest proportion of correct responses were concerning the ability of diabetes to affect the retina (88.4%), the need for regular eye examination (87.4%), the potential for uncontrolled diabetes to cause vision loss (84.8%), and the role of glycemic control in reducing risk (83.5%). While the knowledge score was lowest regarding the possibility of diabetic retinopathy occurring without symptoms (38.8%), the possibility of eye problems despite controlled diabetes (44.5%), and high cholesterol as a risk factor (44.7%). (Table 2)

Attitudes, beliefs, and eye-care practices

The attitudes and beliefs scale had a mean score of 26.06 ± 3.24 of 30, with a median of 27 (IQR 24-28.5) and a range of 13-30. Agreement or strong agreement was reported by 94.1% of participants that regular eye examinations are important for patients with diabetes, 92% that greater DR knowledge helps protect vision, 90.2% that learning more about DR is beneficial for eye health, and 90.2% that eye examinations are important even in the absence of vision problems. Overall, 70.7% agreed or strongly agreed that they were worried about vision loss due to diabetes. (Table 3)

Regarding health and eye-care practices, 72.8% reported always adhering to diabetes medications, 31.1% monitored blood glucose daily, and 28.5% were current smokers. A previous DR diagnosis was reported by 17.5%, and 47% had received a physician referral for retinal examination, and 59.9% reported adherence to physician advice regarding retinal examination. Only 34.7% reported adhering to scheduled eye examinations, 51.7% had undergone an eye examination within the previous year, whereas 20.8% had never undergone an eye examination.

Among the listed reasons for not undergoing an eye examination, absence of symptoms (16.5%), lack of awareness of its importance (13.6%), other reasons (12.6%), cost (10.8%), and difficulty accessing a doctor (5.1%) were reported, and 41.4% reported “no problems”. (Table 4)

Factors associated with diabetic retinopathy knowledge

In unadjusted analyses, knowledge score differed significantly by educational level ($p=0.019$), source of DR information ($p<0.001$), diabetes type ($p<0.001$), duration since diabetes diagnosis ($p=0.047$), and physician referral for retinal examination ($p<0.001$).

The adjusted multivariable generalized linear regression model was significant overall (likelihood-ratio $\chi^2(17) = 101.26$, $p < 0.001$). Educational level, source of DFR information, and physician referral for retinal examination remained independently associated with knowledge score. (Table 5)

In Benforreni-adjusted comparisons, participants with a bachelor’s degree had a higher adjusted knowledge score by 1.34 points more than those with secondary education (95% CI 0.45-2.22, $p < 0.001$). Participants who had never heard of DR had a lower adjusted knowledge score than those reporting the internet (mean difference -1.89, 95% CI -3.17 to -0.61, $p = 0.001$), family and friends (-1.58, 95% CI -2.77 to -0.39, $p = 0.003$), or a doctor (-1.89, 95% CI -2.96 to -0.81, $p < 0.001$) as their source of information; no significant differences were observed among the three informed groups. Participants who had not

received a physician referral had knowledge scores 1.43 points lower than those who had been referred (B = -1.431, 95% CI -2.059 to -0.803, p < 0.001). Diabetes type did not reach statistical significance as an overall factor after adjustment (p = 0.053).

Factors associated with eye examination within the previous year

201 out of 389 participants (51.7%) reported an eye examination within the previous year. The final multivariable binary logistic regression included 380 participants and was significant overall ($\chi^2(17) = 70.36$, $p < 0.001$), with a Nagelkerke R^2 of 0.225. Model calibration was acceptable (Hosmer-Lemeshow $\chi^2(8) = 3.39$, $p = 0.907$). Higher knowledge, female sex, residence, and physician referral were independently associated with having undergone an eye examination within the previous year (Table 6).

Each one-point increase in the knowledge score was associated with 11.7% higher adjusted odds of an eye examination within the previous year (aOR 1.117, 95% CI 1.029-1.212, p = 0.008). Men had lower odds than women (aOR 0.530, 95% CI 0.305-0.922, p = 0.025). Residence was significant overall (p = 0.037); participants living in villages had lower odds of recent examination than city residents (aOR 0.529, 95% CI 0.323-0.866, p = 0.011), whereas the difference between refugee-camp and city residents was not significant. Participants who had received a physician referral had nearly threefold higher odds of an eye examination within the previous year than those who had not (aOR 2.947, 95% CI 1.807-4.807, p < 0.001). Diabetes duration was not significant as an overall factor (p = 0.060), despite a significant contrast for >10 years versus <5 years (aOR 2.119, 95% CI 1.132-3.967, p = 0.019). Age, educational level, occupational status, diabetes type, and treatment type were not independently associated with recent examinations.

Attitudes/beliefs scores were higher among participants examined within the previous year in unadjusted analysis (Mann-Whitney U = 16,361, Z = −2.301, p = 0.021). However, when the attitudes/beliefs score was added to the multivariable model, it was not independently associated with recent examination (aOR 1.012 per point, 95% CI 0.932-1.097, p = 0.782), and model fit changed minimally; therefore, it was not retained in the primary model.

Discussion

This study identified a clear gap between relatively strong general awareness of diabetic retinopathy (DR), favorable preventive beliefs, and recent eye-care utilization among adults with diabetes in Palestine. Participants showed good awareness of several fundamental aspects of DR and strongly endorsed the importance of regular eye examinations; nevertheless, only 51.7% reported undergoing an eye examination within the previous year, and approximately one in five had never undergone one. In adjusted analyses, greater DR knowledge and physician referral were independently associated with recent eye examination, whereas male sex and village residence were associated with lower adjusted odds of examination. Participants who had received a physician referral had nearly threefold higher adjusted odds of reporting an eye examination within the previous year. In contrast, the association between attitudes and beliefs and recent examination observed in unadjusted analysis was no longer

evident after multivariable adjustment. Taken together, these findings suggest that favorable perceptions of preventive eye care do not necessarily correspond with recent eye-care utilization and that knowledge, interaction with healthcare providers, and contextual factors may be more closely related to examination behavior. A similar disconnect between awareness and retinal-screening practice has recently been reported in Palestine [13], although direct comparison of examination rates is limited because the previous study specifically assessed dilated fundus examination, whereas the present study assessed self-reported eye examination within the previous year.

Participants appeared to be more familiar with the general relationship between diabetes and visual damage than with the disease characteristics that make retinal assessment important before symptoms develop. Awareness that diabetes can damage the retina and threaten vision, and that glycemic control and regular eye examinations are important, was relatively strong. In contrast, understanding of asymptomatic DR and several systemic risk factors was less consistent. This distinction is clinically relevant because patients who associate diabetic eye disease primarily with visual symptoms may underestimate the importance of retinal assessment while vision remains unaffected. A comparable pattern was reported in a recent Palestinian study, in which general awareness of diabetes-related eye disease was high but knowledge of several specific DR risk factors was substantially weaker [13]. Similar findings have been reported in Jordan, although differences in study populations and knowledge instruments limit direct comparison [14]. The present findings therefore suggest that the principal knowledge deficit may lie in the depth of disease-specific understanding rather than in awareness of DR itself. Current diabetes guidance further supports the importance of this distinction, as DR may remain asymptomatic despite clinically significant retinal disease, underscoring the importance of regular screening even in the absence of visual symptoms [15]. Educational efforts may therefore benefit from explaining not only that diabetes can damage vision, but also why retinal assessment remains important in the absence of visual complaints.

DR knowledge was also associated with educational background and exposure to disease-specific information. Educational level remained independently associated with knowledge, consistent with recent Palestinian evidence showing a graded relationship between higher educational attainment and better DR knowledge after adjustment [13]. Similar associations have been reported among adults undergoing retinal photography screening in Bahrain [16], while a Jordanian study found that educational level was related to several domains of diabetes- and DR-related awareness [17]. Formal education, however, may not fully explain differences in knowledge. Participants who had never heard of DR had poorer knowledge than those who reported receiving information from physicians, family or friends, or the internet, while no single information source clearly outperformed the others after adjustment. Healthcare professionals remain an important source of DR information in regional studies [16–18], although digital platforms and informal social networks also contribute to patients' exposure to disease-related information [16, 18]. Physician referral was likewise associated with greater knowledge in the present study. This association may reflect opportunities for counseling during healthcare encounters, but its direction cannot be established from cross-sectional data; better-informed or more healthcare-engaged individuals may also be more likely to receive or recall referral advice. These findings support

reinforcing clear and accessible DR information across several points of contact, particularly for individuals with lower educational attainment, rather than relying on a single source of education.

A notable finding was the discrepancy between favorable attitudes toward preventive eye care and reported eye-examination practices. Although 94.1% of participants considered regular eye examinations important and 90.2% believed that they remained necessary even in the absence of visual symptoms, only 51.7% reported an eye examination within the previous year and 34.7% reported consistently attending scheduled examinations. Moreover, the attitudes and beliefs score was not independently associated with recent examination after adjustment (aOR 1.012, 95% CI 0.932–1.097). This suggests that positive perceptions alone may not be sufficient to explain whether individuals obtain recent eye care. A comparable awareness–practice gap was reported in Palestine, where 95.7% of participants believed that people with diabetes require eye screening, whereas only 30.7% reported a dilated fundus examination within the preceding year [13]. The distinction between the two studies is important because the previous study assessed a specific retinal examination, whereas the present study measured recent eye examination more broadly. In Jordan, perceived lack of need in the absence of symptoms and logistical difficulties were among the reported reasons for missed eye examinations [19], while a qualitative systematic review identified access, information sharing, service organization, referral, and follow-up as recurring influences on DR-screening attendance [20]. These observations suggest that favorable beliefs may need to be accompanied by accessible services and effective referral pathways if they are to be reflected in preventive eye-care behavior.

Physician referral was one of the factors most strongly associated with recent eye examination. Fewer than half of participants had received a referral for retinal examination, yet those who had been referred had nearly threefold higher adjusted odds of reporting an eye examination within the previous year (aOR 2.95, 95% CI 1.81–4.81). This finding is particularly relevant to the Palestinian setting, where previous qualitative research identified lack of physician recommendation as a health-system barrier among patients overdue for DR screening [12]. Although addressing physician counseling rather than referral itself, an Iranian study similarly reported substantially greater screening non-adherence among patients whose primary physicians had not explained the importance of regular ophthalmic examination [21]. The present association does not establish that referral itself caused examination attendance, because individuals who are more engaged with healthcare services may be both more likely to receive referrals and more likely to attend eye care. Nevertheless, routine diabetes consultations represent a logical point at which the need for retinal assessment can be discussed and appropriate referral arranged. The effect of more systematic referral and follow-up pathways on actual screening completion should therefore be evaluated prospectively.

Differences in recent eye-examination behavior were also observed according to sex and place of residence. After adjustment, male sex and village residence were both associated with lower odds of reporting an eye examination within the previous year. The geographic association is consistent with recent Palestinian evidence in which rural residence was independently associated with lower adherence to annual dilated fundus examination [13], although the outcome definition differed from that used in the

present study. A recent Chinese study also identified rural residence as an independent correlate of non-adherence to annual DR screening [22]. The association observed in the present study may reflect differences in access to ophthalmic services or other structural factors, but transportation, travel burden, referral pathways, and local service availability were not directly assessed and should not be assumed to explain the finding. The association with sex appears less consistent across settings. Male sex did not remain independently associated with screening behavior in the recent Palestinian study [13], while an updated systematic review found that sex differences in DR-screening attendance varied in direction across different populations [23]. The lower eye-examination uptake observed among men in the present study should therefore be viewed as a potentially context-specific disparity that merits further investigation rather than as evidence of a universal sex effect.

The reported barriers provide additional insight into the discrepancy between favorable preventive beliefs and eye-care behavior. Absence of visual symptoms was the most frequently reported specific reason for not undergoing examination in the overall sample (16.5%), followed by lack of awareness of its importance (13.6%) and cost (10.8%). These findings are particularly noteworthy because 90.2% of participants agreed that eye examinations remain important even without visual problems, whereas only 38.8% correctly recognized that DR itself may develop without symptoms. This apparent discrepancy suggests that participants may broadly accept the value of preventive eye care while still having incomplete understanding of the clinical reason retinal assessment is required before visual symptoms occur. A similar pattern has been reported in Jordan, where perceived lack of need in the absence of symptoms and limited awareness were prominent reasons for never undergoing screening [19]. Palestinian qualitative research has additionally identified financial burden, transportation difficulties, and difficulties obtaining appointments, limited screening capacity, and lack of physician recommendation as barriers to retinal examination [12]. More broadly, qualitative systematic-review evidence indicates that DR-screening attendance is influenced by the interaction of patient understanding, accessibility, service organization, and referral and follow-up processes [20]. Importantly, barrier percentages in the present study were calculated using the entire sample, including participants who reported regular examination or no difficulty, and should therefore not be interpreted as the prevalence of each barrier specifically among people who did not attend eye care.

The present findings have several potential implications for diabetic eye care in Palestine. First, education may need to extend beyond general messages that diabetes can affect vision and place greater emphasis on the asymptomatic nature of DR and the rationale for retinal assessment before visual symptoms develop. Second, the association between physician referral and recent eye examination suggests that consistent assessment of eye-care status and appropriate referral during routine diabetes care may be useful targets for future implementation research. The lower examination uptake among village residents also indicates that geographic accessibility should be considered when evaluating models of retinal care. Current American Diabetes Association guidance recognizes retinal photography with remote reading and FDA-approved artificial-intelligence algorithms as strategies that can improve access to DR screening when appropriate pathways for timely comprehensive eye examination are available [15]. In a recent single-site U.S. primary-care pilot, 78% of referred patients

who were overdue for eye examination completed on-site retinal photography [24]. Although the feasibility, acceptability, cost, and infrastructure requirements of such approaches have not been established in Palestine, this model illustrates how retinal assessment can potentially be incorporated more directly into diabetes-care pathways. Locally adapted implementation studies would be needed before recommending any particular model.

Overall, this study demonstrates a substantial disconnect between favorable DR awareness and preventive beliefs and recent eye-care utilization among adults with diabetes in Palestine. Greater DR knowledge and physician referral were independently associated with recent eye examination, whereas male sex and village residence were associated with lower examination uptake. Favorable attitudes and beliefs, despite being common, were not independently associated with recent examination after adjustment. These findings indicate that general awareness alone may not adequately explain eye-care behavior and support further evaluation of approaches combining disease-specific education, consistent referral and follow-up and improved accessibility to appropriate retinal assessment. Longitudinal and implementation-focused studies are needed to determine whether such approaches increase timely retinal evaluation and ultimately contribute to reducing preventable diabetes-related visual impairment.

Conclusion

This study identified gaps in diabetic retinopathy knowledge and eye-screening practices among adults with diabetes in the West Bank, Palestine. Higher DR knowledge scores and physician referral were independently associated with higher odds of reporting an eye examination within the previous year, whereas men and participants living in villages had lower odds. Attitudes and beliefs were not independently associated with recent eye examination after adjustment. These findings support the need for targeted education on diabetic retinopathy, consistent physician referral and follow-up, and efforts to address barriers to eye-screening services. Further research is needed to better understand barriers to eye screening and to evaluate strategies for improving diabetic retinopathy screening and timely eye care in Palestine.

Strength and Weakness

A key strength of this study is its patient-centered assessment of diabetic retinopathy, extending beyond knowledge to examine attitudes, beliefs, and eye-care practices. This approach provides insight into the gap between patients' recognition of the importance of diabetic retinopathy prevention and their engagement with recommended eye screening. The questionnaire also assessed important barriers to regular eye examinations, including lack of awareness, absence of visual symptoms, cost, and difficulty accessing a physician. These findings may inform patient education and future efforts to improve diabetic retinopathy screening and eye-care practices in Palestine. The use of both in-person and social-media recruitment also enabled participants to be reached through different settings.

This study has several limitations. First, its cross-sectional design precludes determination of causal relationships between the identified factors and recent eye examination. Second, the use of convenience

sampling may limit the generalizability of the findings to the broader population of adults with diabetes in Palestine. Third, information regarding eye examinations, medication adherence, smoking status, and previous diabetic retinopathy diagnosis was self-reported and may therefore be subject to recall and social desirability biases. Finally, eye examination history and previous diabetic retinopathy diagnoses were not verified using medical records or clinical documentation.

Abbreviations

aOR
Adjusted odds ratio
CI
Confidence interval
CSME
Clinically significant macular edema
DM
Diabetes mellitus
DR
Diabetic retinopathy
FDA
Food and Drug Administration
IDF
International Diabetes Federation
IQR
Interquartile range
IRB
Institutional Review Board
KAP
Knowledge, attitudes, and practices
SD
Standard deviation
SPSS
Statistical Package for the Social Sciences
VTDR
Vision—threatening diabetic retinopathy

Declarations

Human Ethics and Consent to Participate Declarations: The study was conducted in compliance with the Declaration of Helsinki. Informed consent was obtained from all participants before participation, and the study, along with its protocols, was approved by the Institutional Review Board Committee of An-Najah National University (IRB Reference #: Med/Mar. 2026/35).

Consent for publication: not applicable.

Clinical trial number: not applicable.

Availability of data and materials: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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Tables

Table 1. Sociodemographic and clinical characteristics of participants (N = 389)

Characteristic	n (%) or summary
Age, years, median (IQR)	50.0 (26.25-60.0)
Age, years, mean ± SD	46.87 ± 18.50
Sex	
Female	238 (61.2)
Male	151 (38.8)
Educational level	
Primary	85 (21.9)
Secondary	115 (29.6)
Bachelor	161 (41.4)
Higher education	28 (7.2)
Occupational status	
Unemployed	256 (65.8)
Employed	133 (34.2)
Residence	
City	172 (44.2)
Village	166 (42.7)
Refugee camp	51 (13.1)
Source of DR information	
Never heard about it	101 (26.0)
Internet	53 (13.6)
Family and friends	65 (16.7)
Doctor	170 (43.7)
Type of diabetes	
DM-1	87 (22.4)
DM-2	192 (49.4)
Don't know	110 (28.3)
Duration of diabetes	
<5 years	171 (44.0)

5-10 years	83 (21.3)
>10 years	135 (34.7)
Treatment type	
Diet	64 (16.5)
Oral medication	176 (45.2)
Insulin injections	81 (20.8)
Combined oral and insulin	68 (17.5)
Hypertension	
No	216 (55.5)
Yes	173 (44.5)
High cholesterol	
No	224 (57.6)
Yes	165 (42.4)
Family history of diabetes	
No	96 (24.7)
Yes	293 (75.3)

Data are n (%) unless otherwise indicated. Age was available for 380 participants (9 missing). DR, diabetic retinopathy; IQR, interquartile range; SD, standard deviation.

Table 2. Knowledge of diabetic retinopathy (N = 389)

Knowledge item	Correct, n (%)
Uncontrolled diabetes can cause vision loss	330 (84.8)
Diabetes can affect the retina	344 (88.4)
Retina identified as the part of the eye affected by DR	252 (64.8)
DR can occur without symptoms	151 (38.8)
Eye problems can occur even when diabetes is controlled	173 (44.5)
Hypertension increases the risk of DR	235 (60.4)
High cholesterol increases the risk of DR	174 (44.7)
Smoking increases the risk of DR	212 (54.5)
Good blood glucose control reduces the risk of DR	325 (83.5)
Regular eye examination is necessary	340 (87.4)
Early detection allows treatment or slows progression	294 (75.6)
Correct frequency of eye examination	267 (68.6)

Total knowledge score: mean ± SD, 7.96 ± 3.06; median (IQR), 8 (6-10); range, 0-12; Cronbach's α = 0.819. Each correct response contributed one point. DR, diabetic retinopathy.

Table 3. Attitudes and beliefs regarding diabetic retinopathy (N = 389)

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Regular eye exams can prevent vision loss	3 (0.8)	13 (3.3)	32 (8.2)	164 (42.2)	177 (45.5)
Regular eye exams are important for patients with diabetes	0 (0.0)	4 (1.0)	19 (4.9)	126 (32.4)	240 (61.7)
I am worried about vision loss due to diabetes	8 (2.1)	35 (9.0)	71 (18.3)	145 (37.3)	130 (33.4)
Learning more about DR is beneficial for eye health	4 (1.0)	5 (1.3)	29 (7.5)	134 (34.4)	217 (55.8)
Eye exams are important even without vision problems	1 (0.3)	7 (1.8)	30 (7.7)	127 (32.6)	224 (57.6)
Knowing more about DR helps protect vision	1 (0.3)	4 (1.0)	26 (6.7)	152 (39.1)	206 (53.0)

Values are n (%). Total attitudes/beliefs score: mean ± SD, 26.06 ± 3.24; median (IQR), 27 (24-28.5); range, 13-30; Cronbach's α = 0.772. Higher scores indicate stronger endorsement of DR-related preventive beliefs and concern. DR, diabetic retinopathy.

Table 4. Health and eye-care practices (N = 389)

Practice/eye-care variable	n (%)
Adherence to diabetes medications	
Rarely	24 (6.2)
Sometimes	82 (21.1)
Always	283 (72.8)
Current smoking status	
No	278 (71.5)
Yes	111 (28.5)
Frequency of blood glucose monitoring	
Rarely	75 (19.3)
Monthly	92 (23.7)
Weekly	101 (26.0)
Daily	121 (31.1)
Previous diagnosis of diabetic retinopathy	
No	321 (82.5)
Yes	68 (17.5)
Referral by a physician for retinal examination	
No	206 (53.0)
Yes	183 (47.0)
Adherence to scheduled eye examinations	
Rarely	128 (32.9)
Sometimes	126 (32.4)
Always	135 (34.7)
Time since last eye examination	
Never had eye examination	81 (20.8)
>2 years ago	56 (14.4)
1-2 years ago	51 (13.1)
Within past year	201 (51.7)
Adherence to physician advice regarding retinal examination	

No	156 (40.1)
Yes	233 (59.9)
Reason for not undergoing eye examination	
Unaware of its importance	53 (13.6)
Cost	42 (10.8)
Absence of symptoms	64 (16.5)
Difficulty accessing a doctor	20 (5.1)
Other reasons	49 (12.6)
No problem / undergoes regular examinations	161 (41.4)

Table 5. Unadjusted and adjusted factors associated with diabetic retinopathy knowledge score

Predictor/contrast	Unadjusted p	Adjusted B (95% CI)	Adjusted overall p
Age, per year	0.417	−0.003 (−0.025 to 0.020)	0.817
Sex	0.824		0.771
Female vs male (ref)		0.098 (−0.561 to 0.756)	
Educational level	0.019		0.001
Primary vs higher education (ref)		0.093 (−1.200 to 1.386)	
Secondary vs higher education (ref)		−0.302 (−1.476 to 0.872)	
Bachelor vs higher education (ref)		1.036 (−0.093 to 2.165)	
Occupational status	0.155		0.673
Unemployed vs employed (ref)		−0.143 (−0.808 to 0.522)	
Residence	0.404		0.693
City vs refugee camp (ref)		−0.244 (−1.177 to 0.689)	
Village vs refugee camp (ref)		−0.404 (−1.370 to 0.563)	
Source of DR information	<0.001		<0.001
Never heard vs doctor (ref)		−1.885 (−2.687 to −1.084)	
Internet vs doctor (ref)		0.007 (−0.806 to 0.821)	
Family and friends vs doctor (ref)		−0.304 (−1.033 to 0.425)	
Type of diabetes	<0.001		0.053
DM-1 vs don’t know (ref)		0.935 (0.083 to 1.786)	
DM-2 vs don’t know (ref)		0.927 (0.102 to 1.751)	
Duration of diabetes	0.047		0.479
<5 years vs >10 years (ref)		−0.201 (−0.939 to 0.538)	
5-10 years vs >10 years (ref)		0.268 (−0.499 to 1.035)	
Previous DR diagnosis	0.259		0.618
No vs yes (ref)		0.212 (−0.620 to 1.044)	
Physician referral	<0.001		<0.001
No vs yes (ref)		−1.431 (−2.059 to −0.803)	

Unadjusted p values are from Spearman correlation, Mann-Whitney U, or Kruskal-Wallis tests, as appropriate. Adjusted model: generalized linear model with normal distribution, identity link, and robust covariance estimator (n = 380). Overall p values for multi-category predictors are Type III Wald tests. In Bonferroni-adjusted estimated-marginal-mean comparisons, bachelor's degree was associated with a 1.34-point higher score than secondary education (95% CI 0.45-2.22; p < 0.001). Participants who had never heard of DR scored lower than those reporting the internet (mean difference −1.89; p = 0.001), family and friends (−1.58; p = 0.003), or a doctor (−1.89; p < 0.001). DR, diabetic retinopathy; CI, confidence interval; ref, reference category.

Table 6. Multivariable factors associated with eye examination within the previous year

Predictor/contrast	Adjusted OR (95% CI)	p value
Age, per year	0.996 (0.978-1.014)	0.636
Sex		0.025
Male vs female (ref)	0.530 (0.305-0.922)	0.025
Educational level		0.236
Secondary vs primary (ref)	0.510 (0.256-1.015)	0.055
Bachelor vs primary (ref)	0.542 (0.261-1.127)	0.101
Higher education vs primary (ref)	0.767 (0.269-2.189)	0.621
Occupational status		0.953
Employed vs unemployed (ref)	1.017 (0.577-1.794)	0.953
Residence		0.037
Village vs city (ref)	0.529 (0.323-0.866)	0.011
Refugee camp vs city (ref)	0.604 (0.288-1.268)	0.183
Type of diabetes		0.522
DM-2 vs DM-1 (ref)	0.698 (0.363-1.340)	0.279
Don’t know vs DM-1 (ref)	0.896 (0.445-1.804)	0.759
Duration of diabetes		0.060
5-10 years vs <5 years (ref)	1.340 (0.700-2.565)	0.377
>10 years vs <5 years (ref)	2.119 (1.132-3.967)	0.019
Treatment type		0.356
Oral medication vs diet (ref)	0.778 (0.370-1.637)	0.509
Insulin injections vs diet (ref)	0.719 (0.307-1.681)	0.446
Combined oral and insulin vs diet (ref)	0.469 (0.193-1.141)	0.095
Physician referral		<0.001
Yes vs no (ref)	2.947 (1.807-4.807)	<0.001
Knowledge score, per point	1.117 (1.029-1.212)	0.008

Outcome event: eye examination within the previous year. Binary logistic regression, enter method; n = 380. Overall model $\chi^2(17) = 70.36$, $p < 0.001$; Nagelkerke $R^2 = 0.225$; Hosmer-Lemeshow $\chi^2(8) = 3.39$, $p = 0.907$. Overall p values are shown for multi-category predictors. In a secondary adjusted model,

attitudes/beliefs score was not independently associated with recent examinations (aOR 1.012, 95% CI 0.932-1.097; p = 0.782). OR, odds ratio; CI, confidence interval; ref, reference category.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryFile1EnglishVersionoftheQuestionnaire.docx