

Knowledge, attitude and practice of diabetic retinopathy care and prevention among diabetic patients in Saudi Arabia: a systematic review

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Abstract

Background: In Saudi Arabia, recent studies have reported a high prevalence of diabetic retinopathy (DR) among diabetics in different regions of the country.

Objectives: To summarize available published studies about knowledge, attitude and practice of diabetic retinopathy (DR) care among the population of the Kingdom of Saudi Arabia.

Methods: The standard reporting guidelines outlined in PRISMA statement were followed for the preparation of this systematic review. In April 2020, a literature search in PubMed and Google scholar was conducted using the following key words; retinopathy and Saudi Arabia (knowledge or awareness or attitude or compliance). Results were screened, and relevant studies were involved in this review and synthesized narratively.

Results: 11 studies were included in this review. All studies (n=11) targeted the diabetic population. This systematic review reveals a huge variation of knowledge about diabetic retinopathy (25.2%-92%) in Saudi studies. This variation was accompanied by a negative attitude and poor compliance among patients in most studies.

Conclusion: The results of this systematic review reveal the importance of enhancing diabetic patients' knowledge, attitude, and practice towards diabetic retinopathy in Saudi Arabia. This highlights the major role of the general physician as frontline and the role of the ophthalmologists in providing patient education to correct their misconceptions as well as the need for considering this issue in health policy and the provision of more awareness programs.

Key words: knowledge, practice, diabetic, retinopathy Saudi, review

Introduction

Diabetic retinopathy is the most common cause of blindness in adults aged 20 - 74 years. Nearly all patients with type 1 diabetes and over 60% of patients with type 2 diabetes develop retinopathy over the first two decades of diagnosis (1).

The duration of DM is probably the strongest predictor for development and progression of retinopathy (1). Microangiopathy due to hyperglycemia in patients with diabetes mellitus results in vascular leakage, which causes capillary occlusion. Capillary occlusion then again causes retinal ischemia and increased levels of vascular endothelial growth factor (VEGF) which are responsible for the development of neovascularization and the proliferative stage of diabetic retinopathy (2).

Diabetic retinopathy can be classified as non-proliferative or proliferative. Non-proliferative can then be further classified by severity ranging from mild to moderate and severe. Non-proliferative diabetic retinopathy (NPDR) is characterized by the presence of microaneurysms, hard exudates, cotton-wool spots, and/or retinal hemorrhages. Pre-proliferative diabetic retinopathy changes include vasculopathies such as intraretinal microvascular abnormality (IRMA), whereas proliferative diabetic retinopathy is defined by the presence of neovascularization or vitreous hemorrhage or pre-retinal hemorrhage (3).

A recent large meta-analysis of 35 studies carried out between 1982 and 2008 reported an estimated worldwide prevalence for any DR at 35.4% (4).

Locally, in Saudi Arabia, recent studies have reported a high prevalence of DR among diabetics in different regions of the country. A recent population-based study in Taif, in the Western region of KSA reported that 33% of all diabetics have some form of DR (5); while another hospital-based study in the Madinah region reported the same estimate at 36%(6). A more recent study in the Jazan district, Southern Saudi Arabia reports a lower prevalence of diabetic retinopathy of 27.8% (7).

Due to population growth, aging, urbanization and increased prevalence of obesity and physical inactivity, the number of people with diabetes is increasing (8). In 2019, there were 351.7 million working-age people (20-64 years) with diagnosed or undiagnosed diabetes worldwide. In 2030 this number is expected to increase to 417.3 million, and by 2045 to 486.1 million. The biggest change would arise in areas where populations shift from low-to middle-income status (9).

According to the World Health Organization (WHO), Saudi Arabia ranks second highest in the Middle East and is seventh in the world for diabetes. About 7 million people are known to be diabetic and about 3 million have pre-diabetes(10).

Patients with DM should be encouraged to optimize their control of the disease to prevent the development and progression of diabetic retinopathy. Overall, screening of DR is required to detect patients with visually threatening DR, as they need timely treatment before developing potentially irreversible vision loss.

From the literature review of Saudi studies, we conclude that there is a wide variation in the level of knowledge regarding DR among Saudi Arabian city populations. However, compliance with the best medical practice for monitoring eye disease in diabetic patients through regular eye examination is poor in Saudi Arabia. To the best of our knowledge, there is no previous study that summarizes the knowledge, attitude, and practice of patients with diabetes regarding diabetic retinopathy in Saudi Arabia and from the studies done in Saudi Arabia there is a variation in the knowledge and the practice of patients with this eye complication. Hence, this reflects the importance of our study which aims to summarize the level of knowledge, attitude, and practice of diabetic retinopathy care among diabetic patients in Saudi Arabia.

Review Methodology

The preparation of this systematic review strictly followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement.

The strategy of the Literature search: A systematic literature search was carried out in the following two databases: firstly PubMed and secondly Google scholar throughout April 2020 and the keywords used in the search were diabetic retinopathy AND Saudi Arabia (knowledge OR awareness OR attitude OR practice), which applies to the subject region and were the most suitable terms for the review. The results of the search from these databases were restricted to the English language, Boolean operators, peer-reviewed, research articles and using (allintitle) advanced Google scholar search operators with no time frame limit.

Method of Study selection: All researchers independently screened the literature search results for relevant studies. Initially, a computerized search was done on the first database; results showed 40 potential studies. The second database showed 16 potential studies. The titles and abstracts of a Total 56 studies were screened to detect relevant studies which excluded (42) non-relevant studies keeping only (14) possible studies. Finally, the researchers reviewed the full text of all studies selected during the previous step in detail which resulted in excluding 3 studies targeting the non-diabetic population. There was no disagreement between researchers about the relevance of any study. After this review process, 11 studies were selected to be relevant and were included in the systematic review.

Eligibility criteria: All studies fulfilled the following inclusion criteria: 1) studies that were described as cross-sectional studies, 2) Studies that were done among Saudi Arabia population 3) studies that explored the knowledge, Awareness, Attitude, or practice of the diabetic patient about diabetic retinopathy and were included in this review. All studies that were 1) Not done in Saudi Arabia, and 2) the Non-diabetic population were excluded.

Data extraction: Data were extracted autonomously by the researchers to a uniform data extraction sheet. The extracted data involved 1) characteristics of the study design, 2) data of the study outcomes.

Synthesis of results: Included studies were arranged depending on the following:

1) studies assessed the level of knowledge or awareness, 2) studies assessed the attitude, and 3) studies assessed the practice. Extracted data from each study were arranged and tabulated narratively.

Results

Characteristics of included studies: The search strategy in the systematic review retrieved 56 published articles. 11 articles fulfilled the eligibility criteria for systematic review. Diabetic patients were the only study populations in all studies (n=11). The flow diagram of the study selection process is shown in Figure 1.

Knowledge regarding diabetic Retinopathy:

The Saudi studies showed a huge variation (25.2% - 92%) in the level of knowledge among diabetic patients regarding diabetic eye disease.

Al-Asbali et al found that only 45% of diabetic patients' knowledge regarding DR was graded as excellent and interestingly this level of knowledge was higher among diabetic patients attending eye clinics than those attending diabetic clinics (11). Albalawi et al conducted a cross-sectional study on 382 Type 2 Diabetes mellitus patients who visited the PHC at King Salman Armed Forces Hospital, Tabuk and they found only 25.2% of the participants had good knowledge about diabetic retinopathy where almost half of the patients had poor level of knowledge (around 47.1%) (12). In another cross-sectional study conducted by Alzahrani et al targeting PHC visitors in Jeddah, they found a poor level of knowledge as around 36% of participants reported that they didn't receive any information about DR from their doctors (13). AlHargan et al conducted a study targeting patients with diabetes in two primary health centers in Riyadh, and found a high level of knowledge among 88% of the patients who were aware of the effect of diabetes on the retina; 76% were aware that controlling blood sugar can reduce the risk of DR, while only 66% of them were aware that DR can lead to blindness and there was a significant association between formal education and the awareness about DM and retinopathy (14). In Al hasa there were two studies. The first one was conducted on a large number of patients

with type 2 diabetes by Khan et al and they found more than 92% of participants know the importance of annual eye examination and more than 73% knew about retinal eye disease of diabetics (15). Whereas 66% of patient in Neama et al's study had heard about DR. Almost half of them were able to define DR as a complication of diabetes correctly, but 42.6% didn't know that with age the risk of DR increases. Interestingly they found that a poor level of knowledge was associated with sociodemographic factors like aging and female patients (16). A good awareness level was graded in 75.62% of diabetic patients by Al Zarea et al (17) in the endocrine clinic at King Abdelaziz Specialized Hospital in Taif where 64% of screened Type 2 Diabetes mellitus patients had good knowledge (18). The knowledgeable group was significantly more likely to have higher school educational level, a longer duration of DM, and low risk factors that may affect their HgA1c control (18). Nevertheless around 50% were not aware of the recommendation for DR annual screening and thought there is no need for it unless symptomatic (18).

Level of education, source of information and area of residency were all significantly associated with level of awareness about eye complications ($p=0.05$) as reported in Fallatah et al's survey (19). Regarding Saudi diabetic patients they had overall an acceptable knowledge, (80.8%) and (82.8% %) as shown in Abdulaal et al and Alsaidan et al's studies respectively (20,21).

Attitude Regarding Diabetic Retinopathy:

Positive attitude regarding this eye complication of diabetes mellitus among diabetic patients attending a private hospital in Riyadh was only 20% (11). In AlJouf and Hail Province a study conducted by Al Zarea showed a bad attitude among participants as 61.50% were answering that there was no need to go for an eye checkup with controlled blood glucose (17) and 29.7% of the poorly controlled group, think there is a need to screen the eye with good controlled blood sugar in Abdulaal et al's survey (20). This attitude was also found in more than 77% of patients with diabetes in Khan et al's study as they think that there is no need for regular eye checkups if there were no symptoms (15). However the study conducted by Albalawi et al reported good attitude among 71.7% of the participants as they believed eye checkups are still necessary (12). More than 75% believed that diabetes type 2 could cause Diabetic Retinopathy, which may lead to loss of vision (18).

Practice Regarding Diabetic Retinopathy:

Most studies in Saudi Arabia scored low regarding annual eye examination of diabetic patients. In Riyadh, annual eye examination was followed only by one quarter of diabetic patients in Al-Asbali et al's study (11). AlHargan et al found that only 48% of the Diabetic population followed Annual eye examination guidelines where 45% did not have an eye examination (14). This study also showed that 91% of patients who had awareness were adhering to their current DM treatment and 72% were measuring their

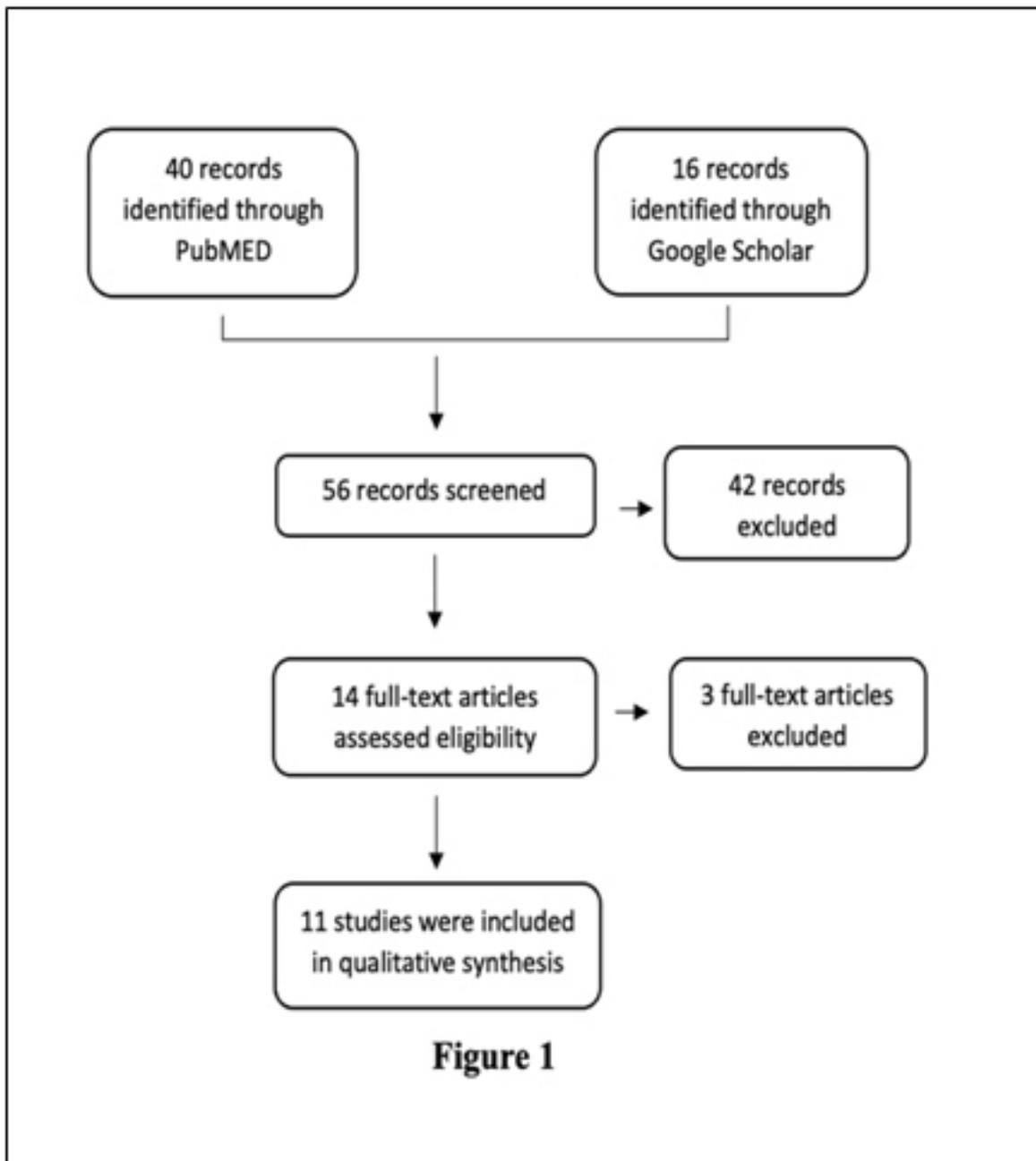


Figure 1: Review method

blood sugar at home, while 64% were adhering to their current DM treatment and 39% were measuring their blood sugar at the home of patients who didn't have awareness (14). In Jeddah, Alzahrani et al's study showed around 35% of diabetic patients didn't go for eye screening (13). 46% of patients with diabetic in Al-hasa district in regard to Khan et al's study do not follow the advice of their family doctors about the need for eye examination where 54% of participants said their ophthalmologist does not give them adequate information about this ocular complication (15). In the north of Saudi Arabia (AlJouf and Hail Province) regarding the Al Zarea survey, only 48.97% of diabetic patients went for annual eye checkups (17).

Albalawi et al found 39.5% of the participants felt that they needed to go for annual eye checkup only when vision is affected (12), with poor level of knowledge recorded among 22.5% of those who didn't visit an ophthalmology clinic (16). 28.4% of the participants in the Almalki study thought that the optometrist visit is enough for DR diagnosis and the most likely barriers that prevent patients from going to the Ophthalmologist for the recommended annual DR screening were the difficulty to get an appointment and unawareness of the possible eye complications from T2D (18).

Discussion

This review shows that diabetes is a common health problem in Saudi Arabia. Most of the studies showed moderate knowledge about diabetes mellitus and its complications. Most patient's attitudes towards DM were not too good enough. On the other hand, regarding Diabetic Retinopathy most of the patients even with good knowledge, had poor compliance. The positive attitude percentage towards Diabetic Retinopathy was very different from one study to another, and it was not shown that there was a close association between positive attitude and educational or social level.

Importance of DR education in SA

Education toward diabetes mellitus self-management is the process of teaching patients to administer their disease. The goals of this education include improving metabolic control, preventing acute and chronic complications and improving one's quality of life at reasonable costs. In a study that was conducted at University Diabetes Center in King Abdul Aziz University Hospital, Riyadh, Saudi Arabia, they found that after one year of 5-days Education Program, there was a significant improvement for all metabolic parameters in type 2 diabetes patients except in HDL (22). Other similar findings have reported that reduction in body weight and better control of blood pressure, glucose and serum lipids can be achieved by patient education on life style modification. According to our study and other results, increasing knowledge and awareness of DM in KSA will contribute to the improvement of community health results as increasing knowledge about DM will help them to improve their lifestyles, pharmacological habits, and how to deal with the longterm side effects of the disease that will finally lead to the improvement of clinical results.

Risk factors and misconceptions regarding DR

Most studies showed that many patients do not seem to understand their disease or treatment regime, although patients had a reasonable understanding of the basic risk factors for DR such as diabetes control, although they were less clear about specific risk factors such as blood pressure and lipid control. Regarding the patient's own disease, most patients attributed their DR either to poor diabetes control or to failings of the healthcare system. Some patients believed that their DR was a result of health aspects beyond their control or environmental factors, whereas others were unsure about the cause. Obviously, there is a gap between patients' knowledge and damaging beliefs about the cause and treatment of DR despite most patients having good knowledge about their state, but their knowledge isn't enough and not all patients have this knowledge. The deficiency of information about handling the DR risk factors like high blood pressure or glycemic levels has a large effect on the deterioration of the case (1). The wrong handling of the disease and the lack of knowledge leads to bad results such as the deterioration of the patient's condition and in other cases may lead to blindness, so as mentioned earlier it is important to activate the role of education about the disease and the symptoms and expected results.

Role of health care professionals

With effective diabetes management, regular eyes screening, and timely treatment great outcomes are found. Ensuring all people with diabetes have access to these important health care services requires a new approach in service provision and cross-sectoral collaboration. Primary health care workers are at the frontline of providing services to people with diabetes, and this must include screening and monitoring diabetic eye health, and timely referral to eye specialists for further examination and treatment. The first line management that can be provided in Primary health care level includes glycemic control, and blood pressure control.

Higher centers and eye specialist hospitals may be reserved for further examination and advanced treatments that include Laser Photocoagulation and, in some cases, surgical treatment is required, such as vitrectomy.

The most important issue in treating diabetic eye disease is the follow up, so the physician shouldn't forget about the great role of patient education; as mentioned above, the more the patient knows the more, the more he/ she becomes willing to cope better with their condition.

Critical appraisal of included articles:

There were some methodological limitations that were noticed in some of the included articles in this review. For instance, regarding targeting population Naif R. Almalki (18), Amal Mohammed Albalawi (12), Alsaidan et al (21) and Khan et al (15) studies were targeting only Type 2 diabetes so their result cannot be generalized for all the diabetic population. Another issue regarding the selected

population was noticed in Abdulaal et al (20) and Alsaidan et al (21) studies as they were targeting only Saudi citizens.

Study setting also showed some limitations for example Al-Asbali et al (11) were targeting the diabetic patients in two different specialty clinics (eye clinics and diabetes clinics) which might affect the overall result of knowledge, attitude, and practice. Where Fallatah et al (19) conducted their study in an eye hospital which might explain their results of the highest score of knowledge 92.4 % compared to the rest of the studies.

Regarding the data collection method Naif R. Almalki (18), Al-Asbali et al (11) and Khan et al (15) used interview techniques in the data collection method in their studies which had a potential risk of interviewer bias.

Sampling technique reveals some limitations in AlHargan et al's (14) study. They used convenience sampling rather than random sampling which may affect the generalizability of the result to their population.

Strengths and limitations of this review

Strong points of this review are that it was following PRISMA statement guidelines during the whole process and it reviewed the results of other published studies from different geographical areas with different settings in Saudi Arabia which gave better representation of awareness, attitude and practice toward DR among diabetic patients. While the limitations of this review are that the results of the study were not systematically assessed and combined to perform a Meta-Analysis and the included studies vary in quality and have several methodological limitations, which include: varying questionnaires used to assess study outcomes, limited validated questionnaires which make it difficult to do any statistical analysis or inference. Also, this review didn't look for unpublished articles and those published in other languages. These limitations need to be taken into consideration in future studies to ensure high quality evidence that is reproducible and generalizable. Implications for health policy:

The results of this review showed a variation in the level of knowledge and attitude with compliance among diabetic patients in Saudi Arabia regarding Diabetic Retinopathy. These results have several implications for primary health care providers, diabetic care providers, ophthalmologists, and policy makers. General practitioners should carry a great responsibility toward patients, families, with community education about DR risk factors and prevention, importance of regular eye screening and early detection. In addition they need to provide more information about DR treatment methods. In regard to policy makers it is really important to organize and conduct education programs about DR in a simple familiar language through mass media for the whole community in order to improve awareness level and enhance their practice as well as the creation of an appropriate and easy referral system.

Conclusions

This review shows that diabetes is a common health problem in Saudi Arabia. Most of the studies showed moderate knowledge about diabetes mellitus and its complications. Most patients' attitudes towards DM was not good enough. On the other hand, regarding Diabetic Retinopathy most patients even with good knowledge, had poor compliance. The positive attitude percentage towards Diabetic Retinopathy was very different from one study to another, and it was not proven that there was a close association between positive attitude and the educational or social domains.

References

1. S. Fong D, Gardner AL, Thomas W. Retinopathy in Diabetes. *Diabetes Care* 2003; 26(1):226-229.
2. Nentwich MM. Diabetic retinopathy - ocular complications of diabetes mellitus. *World J Diabetes* 2020; 11:489-499.
3. Wat N, Wong RLM, Wong IYH. Associations between diabetic retinopathy and systemic risk factors. Vol. 22, *Hong Kong Medical Journal*. Hong Kong Academy of Medicine Press. 2016: 589-599.
4. Yau JW, Rogers SL, Kawasaki R, Lamoureux EL, Kowalski JW, Bek T, et al. Global prevalence and major risk factors of diabetic retinopathy. *Diabetes Care* 2012;35(3):556-564
5. Al Ghamdi AH, Rabiou M, Hajar S, Yorston D, Kuper H, Polack S. Rapid assessment of avoidable blindness and diabetic retinopathy in Taif, Saudi Arabia. *Br J Ophthalmol* 2012;96:1168-1172.
6. El-Bab MF, Shawky N, Al-Sisi A, Akhtar M. Retinopathy and risk factors in diabetic patients from Al-Madinah Al-Munawarah in the Kingdom of Saudi Arabia. *Clin Ophthalmol* 2012; 6:269-276.
7. Hajar S, Hazmi A Al, Wasli M, Mousa A, Rabiou M. Prevalence and causes of blindness and diabetic retinopathy in southern. Saudi Arabia. *Saudi Med J* 2015; 36:449-455.
8. World Health Organization. Estimates for the year 2000 and projections for 2030. *World Health* 2004; 27:1047-1053.
9. International Diabetes Federation. IDF Diabetes Atlas Ninth. Dunia: IDF. 2019. <https://www.idf.org/e-library/epidemiology-research/diabetes-atlas/159-idf-diabetes-atlas-ninth-edition-2019.html>
10. Al Dawish MA, Robert AA, Braham R, Al Hayek AA, Al Saeed A, Ahmed RA, et al. Diabetes Mellitus in Saudi Arabia: A Review of the Recent Literature. *Curr Diabetes Rev* 2016;12(4):359-368
11. Al-Asbali T, Aldawari SA, Alzahim IA, Alalawi H, Khandekar R, Lotfy NM. Knowledge, attitude and practice regarding diabetic retinopathy screening and its management among diabetic patients at a private hospital of Riyadh. Saudi Arabia. *Saudi J Ophthalmol* 2020; 31. <https://linkinghub.elsevier.com/retrieve/pii/S1319453419300803>

Table 1: Summary of cross-sectional studies performed in the Kingdom of Saudi Arabia about knowledge, awareness, attitude and practice of diabetic retinopathy care and compliance among diabetic patients.

Reference	Study setting	Population	Sampling method	Sample size	Key Outcomes
Al-Asbali et al [11]	Private multidisciplinary hospital in central Saudi Arabia	Diabetic patients	Simple random sampling	200	45% had excellent Knowledge 20% Had positive attitude 75% had poor practice
Neama et al [12]	Primary healthcare centers at Al-ahsaa, Saudi Arabia	Diabetic patients	Simple random sampling	383	66% heard about diabetic retinopathy 54% defined DR as one of diabetes complications that lead to visual loss 42.6% didn't know that with age, the risk of DR increases 22.5% never visited ophthalmology clinic
AlHargan et al(13)	Two primary healthcare centers at Riyadh, Saudi Arabia	Diabetic patients	Convenience sampling	280	88% aware that diabetes mellitus can affect the retina; 76% aware that control of blood sugar reduces the risk of DR 66% aware that DR can lead to blindness. Formal education was significantly associated with the awareness about DM and retinopathy well controlled diabetes in 61% 48% had annual eye examination and 45% did not have eye examination
Naif R. Almalki(14)	King Abdulaziz Specialized Hospital, Division of Endocrinology, Taif city, Saudi Arabia.	Type 2 DM patients	Systematic random sampling	253	64% Had good knowledge 75% Had positive attitude 28.4% Had poor practice
Amal Mohammed Albalawi(15)	King Salman Armed Forced Hospital-Primary Health Care Centers, Tabuk	Saudi patients with type 2 DM	Simple random sampling	382	The overall awareness was among 86.9% 47.1% had poor knowledge; 25.2% had good knowledge 71.7% had good attitude 39.5% had bad practice
Al Zarea (16)	5 Ministry of Health hospitals in AlJouf and Hail Province	DM patients	Simple random sampling	439	75.62 % had a good knowledge, 61.50 % had a bad attitude as they believed in no need for eye checkup with controlled blood glucose
Alzahrani et al(17)	Primary health care centers, Jeddah	DM patients	Systematic random sampling	377	82.6% had a good awareness level while 36% had no information at all 35% did not go ever to their eye checkups.

Fallatah et al(18)	Jeddah Eye Hospital	DM patients	Simple random sampling	380	92.4 % had a good knowledge 67.2% reported health care workers as their source of information 66.9% of participants diagnosed already with diabetic retinopathy.
Abdulaal et al(19)	Saudi Arabia public facilities	Diabetic Saudi citizens	Simple random sampling	385	80.8% had a good knowledge while 25.7% had an extremely poor knowledge
Alsaidan et al(20)	Security forces hospital	Saudi patients with type 2 DM	Simple random Sampling	174	The overall awareness was among 82.8% participants, and only 17.2% had no awareness
Khan et al (21)	chronic disease clinics in Al ahsa district	type 2 diabetic patients	Multistage cluster random sample.	2016	Most of patients 92% are knowledgeable about Diabetic retinopathy. 77% think there is no need for eye checkup if asymptomatic 46% of them do not follow the recommendation of regular eye examination.

12. Neama MY, Alhashim M, Al A, Assistance O, Al-Mubarak F. knowledge and awareness of diabetic retinopathy among diabetic patients:AL-Ahsaa, Saudi Arabia. International journal of scientific research 2019; 8(3):2277-8179.

13. AlHargan MH, AlBaker KM, AlFadhel AA, AlGhamdi MA, AlMuammar SM, AlDawood HA. Awareness, knowledge, and practices related to diabetic retinopathy among diabetic patients in primary healthcare centers at Riyadh, Saudi Arabia. J Family Med Prim Care 2019;8(2):373-377

14. Almalki NR, Almalki TM, Alswat K. Diabetics retinopathy knowledge and awareness assessment among the type 2 diabetics. Open Access Maced J Med Sci 2018; 16:574-577.

15. Albalawi AM, Khalil T, Alimam RA, Albalawi AS. Awareness of diabetic retinopathy among type II diabetic patients attending at king salman armed forced hospital-primary health care, tabuk 2019. Open Access Maced J Med Sci 2019; 15:4143-4148.

16. Al Zarea BK. Knowledge, Attitude and Practice of Diabetic Retinopathy amongst the Diabetic Patients of AlJouf and Hail Province of Saudi Arabia. J Clin Diagn Res 2016;5:5-8.

17. Alzahrani SH, Bakarman MA, Alqahtani SM, Alqahtani MS, Butt NS, Salawati EM, Alkatheri A, Malik AA, Saad K. Awareness of diabetic retinopathy among people with diabetes in Jeddah, Saudi Arabia. Ther Adv Endocrinol Metab 2018;9(4):103-112.

18. R. Almalki N , M. Almalki T, Alswat K. Diabetics Retinopathy Knowledge and Awareness Assessment among the Type 2 Diabetics. Open Access Maced J Med Sci 2018; 121:1-4. https://www.researchgate.net/publication/323664778_Diabetics_Retinopathy_Knowledge_and_Awareness_Assessment_among_the_Type_2_Diabetics/fulltext/5aa2bfe845851543e63c2acc/

Diabetics-Retinopathy-Knowledge-and-Awareness-Assessment-among-the-Type-2-Diabetics.pdf

19. Fallatah MO. Knowledge, Awareness, and Eye Care-Seeking Behavior in Diabetic Retinopathy: A Cross-Sectional Study in Jeddah, Kingdom of Saudi Arabia. Ophthalmol Ther 2018;16:377-385.

20. Abdulaal AE, Alobaid OM, Alotaibi AG, et al. Diabetic patients' awareness of diabetic retinopathy symptoms and complications. J Family Med Prim Care 2019;8(1):49-53.

21. Alsaidan AA, Ghoraba M. Awareness of diabetic retinopathy among patients with type 2 diabetes mellitus in primary health care in security forces hospital Riyadh, Saudi Arabia. J Family Med Prim Care 2019;8(7):2433-2438.

22. Al-Shahrani AM, Hassan A, Al-Rubeaan KA, Al Sharqawi AH, Ahmad NA. Effects of diabetes education program on metabolic control among Saudi type 2 diabetic patients. Pakistan J Med Sci 2012; 28:925-390.