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Awareness of Diabetes Complications among Diabetes Patients in Northern Border Region in Saudi Arabia

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Abstract **Background:** Diabetes mellitus (DM) is a chronic common illness leading to various complications, significantly impacting health outcomes and the quality of life of affected individuals. In Saudi Arabia's Northern Border Region, understanding the awareness of diabetes-related complications among patients is critical for effective health management and educational outreach. **Objective:** This study aimed to assess the level of awareness regarding diabetic complications among diabetes patients in the Northern Border region of Saudi Arabia. **Methods:** A quantitative, cross-sectional design was employed, utilizing convenience sampling to select 385 participants from the Northern Border region. Data were collected through a self-administered online questionnaire, which included demographic information and questions regarding diabetes knowledge. Statistical analysis involves descriptive and inferential statistics. **Results:** The findings revealed a diverse demographic; most participants were Saudi nationals (355, 92.2%), predominantly male (247, 64.2%) and largely educated (300, 77.9% with university degrees). A significant portion (262, 68.1%) had diabetes for 1 to 5 years. Awareness levels varied: while 304 (79.0%) recognized the risk of blindness due to retinopathy and 296 (76.9%) understood the potential for kidney failure, only 234 (60.8%) were aware of diabetes-related stroke risks. Notably, 270 (70.1%) of participants displayed sufficient knowledge of diabetic complications, yet 294 (76.4%) indicated a lack of adequate educational resources. **Conclusion:** The study highlights a commendable degree of knowledge about diabetes complications among patients in the Northern Border region. However, significant gaps remain, particularly concerning specific complications like skin disease and recurrent infections. The correlation between awareness and age suggests a need for targeted educational initiatives to enhance understanding, especially among older patients.

Key Words DM, diabetes complications, awareness, Northern Border region, Saudi Arabia

INTRODUCTION

Background

In the twenty-first century, diabetes mellitus (DM) is one of the most difficult chronic health issues [1]. DM is a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin production, insulin action, or both. Despite advances in DM diagnosis and management, the incidence of DM-related complications remains high [2].

It is becoming more clear that treating the major consequences of diabetes, in addition to curing the current global epidemic, is necessary in the majority of individuals with both type 1 and type 2 diabetes [3]. DM will be a leading cause of morbidity and mortality in the future, the goal of treatment for DM is to prevent mortality and complications by normalizing blood glucose levels. However, blood glucose levels might be increased despite appropriate therapy resulting in complications, such as disturbances in fat metabolism, nerve damage and eye disease [4].

Common complications of diabetes include dysfunctions in the kidney, retina, cardiovascular system, neurons and liver; once again, there are no effective treatments to restore organ damage [5].

Saudi Arabia has the fourth highest incidence of Type 1 Diabetes Mellitus (T1DM) in the world and the highest DM incidence in the Middle East and North Africa (MENA) area, with a prevalence rate of 17.7 percent [6]. The main goals of

primary care are to stop diabetic ketoacidosis from getting worse and to reduce the chance of cerebral edema, a rare but potentially fatal complication. The pathogenesis of diabetic ketoacidosis has recently been discussed, including the role of insulin insufficiency, altered glucose metabolism and acid-base abnormalities, severe diabetic ketoacidosis therapy is not without difficulties [7]. Technological developments and monitoring methods have also made it possible to regulate fluid and electrolyte imbalances, insulin therapy and other adjuvant medications more precisely [8].

Since 2017, the charity has been conducting an annual assessment of the general public's understanding of DM and physical activity. The emphasis on learning about physical activity in conjunction with DM stems from the significance of physical activity in managing and preventing DM and the government's prioritization of physical activity in interventional initiatives [9].

Rationale and Knowledge Gap

The knowledge about diabetes complications by diabetic patients helps to manage stressful situations. This has been found to lessen diabetic complications. Given the evidence that persons with diabetes frequently lack sufficient understanding regarding the disease's related complications, health education is seen as a crucial element in enhancing knowledge and altering behavior.

Objective

Consequently, the primary aim of this study is to know to what extent diabetic patients are aware and perceptive of diabetes complications in the Northern Border region, Saudi Arabia.

Hypothesis

- **Null hypothesis:** Diabetic patients have knowledge and awareness about diabetes complications.
- **Alternative hypothesis:** Diabetic patients don't have knowledge and awareness about diabetes complications

METHODS

Study Design and Participants

A quantitative cross-sectional study was conducted in the Northern Border region, Saudi Arabia including adult diabetic patients above 18 years of both genders living in Northern Border region Saudi Arabia, who agreed to complete the survey, were selected through convenient sampling. While the exclusion criteria were living outside the Northern Border region and refusing to complete the survey. The study lasted 7 months.

Using social media sites, a questionnaire was distributed anonymously through an online survey tool [1]. It was developed in Arabic and delivered following the reading and acceptance of informed permission. Pilot was studied and applied by the investigators. The questionnaire covered the following data: patients' socio-demographic characteristics like age, gender, nationality, education, occupation and family history of diabetes. The second section covered the parameters related to clinical characteristics of participants like the type of diabetes, duration of diabetes, in addition to, the management of blood sugar level. The third one covered participants' awareness toward diabetic complications in Northern Border region Saudi Arabia such as retinopathy, renal failure and neuropathy.

There was no risk to the participants because it was a descriptive study that helped to determine the awareness of diabetic complications among general population in Northern Border region Saudi Arabia. There is no direct benefit for the patients. However, it might have an indirect benefit for them.

Ethics Approval of Research

Before the study began, ethical clearance was requested from the College of Medicine's Ethical Committee (HAP-09-A-043) and issued by Northern Border University's decision no. (26-24-H), dated on 18/3/2024.

Sample Size and Data Analysis

Using the Raosoft® calculator, we calculated a sample size of 385 participants with a 50% expected response distribution, a 5% margin of error, a 95% confidence level and a significance level of 5% [10]. To determine the feasibility, applicability and clarity of the tool, a pilot research was carried out on 10% of the collected sample. No changes were made to the study. Data analysis was done using SPSS (version 26) and remained anonymous because the questionnaire does not include any personal information that may be used to identify a participant, such as a name, ID number, or other specific information. The Chi Square test was used to examine the connection. Qualitative variables are represented in the figures as percentages and numerical values (mean, frequency, etc.). Every test utilized in the study had a significance level of 0.05.

RESULTS

Table 1 displays various demographic parameters of the participants with a total number of 385. The age distribution reveals a predominantly older demographic, with 145 (37.7%) of participants over 40 years old, contrasted by a younger segment of 108 (28.1%) aged 18-25. This suggests a potential focus on the health concerns relevant to an aging population. Gender representation skews significantly towards males, comprising 247 (64.2%) of the sample, which may indicate a need for targeted health interventions that take into account male-specific factors. Nationally, most participants identified as Saudi (355, 92.2%), which highlights cultural and regional considerations that may influence health outcomes. Marital status indicates a well-established population, with 287 (74.5%) of participants being married, which could impact the perceived social support structures related to health management. Educational attainment demonstrates a high level of education, as 300 (77.9%) have obtained a university degree or higher, suggesting that the findings may reflect the health literacy levels associated with this educational

Table 1: Sociodemographic characteristics of participants (n = 385)

Parameter	N	Percentage
Age		
18-25	108	28.1
26-35	71	18.4
36-40	61	15.8
More than 40	145	37.7
Gender		
Male	247	64.2
Female	138	35.8
Nationality		
Saudi	355	92.2
Non-Saudi	30	7.8
Marital state		
Single	87	22.6
Married	287	74.5
Divorced	8	2.1
Widowed	3	.8
Educational status		
University or higher	300	77.9
Secondary school	68	17.7
Preparatory school	10	2.6
Primary school	5	1.3
Illiterate	2	.5
Occupation		
An employee of a government company	247	64.2
Employee of a private work	46	11.9
Not working	92	23.9
City		
Arar	164	42.6
Rafha	156	40.5
Turaif	10	2.6
Al uwayqilah	5	1.3
Other	50	13.0
Is there a family history of Diabetes?		
Yes	247	64.2
No	138	35.8

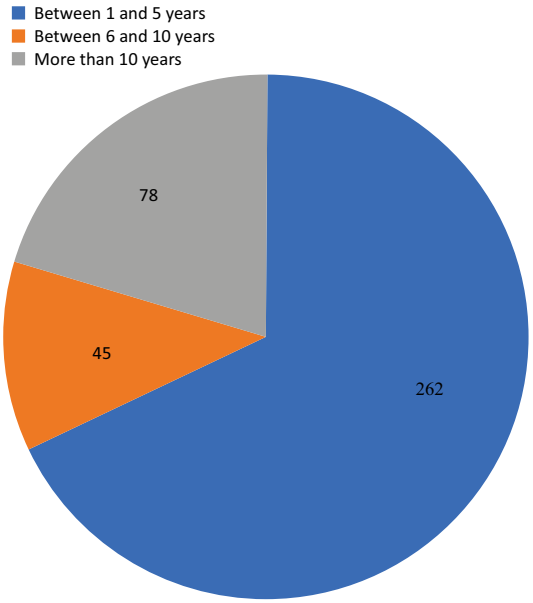

Figure 1: Illustrates the duration of diabetes among participants

background. Employment status reveals a strong inclination towards government work, with 247 (64.2%) employed in government roles, potentially linking economic stability to

Table 2: Parameters related to clinical characteristics of participants (n = 385)

Parameter	N	Percentage
Type of diabetes		
Type 1	255	66.2
Type 2	130	33.8
Duration of diabetes		
Between 1 and 5 years	262	68.1
Between 6 and 10 years	45	11.7
More than 10 years	78	20.3
Do you measure your blood sugar regularly?		
Yes 216	56.1	
No 169	43.9	
How long have you had an HbA1C test?		
Every 3 months	180	46.8
Every 6 months	91	23.6
Annually	60	15.6
Others	54	14.0
Do you use a continuous glucose monitor (a small sensor that alerts you when your blood sugar levels are suddenly high or low) at home?		
Yes 190	49.4	
No 195	50.6	
Is a blood glucose meter in your home?		
Yes 232	60.3	
No 153	39.7	
Do you take your medications regularly as directed by your physician?		
Yes 270	70.1	
No 115	29.9	
How long do you visit your doctor?		
Monthly	2	.5
Every 3 months	186	48.3
Every 6 months	98	25.5
Others	99	25.7
Having good information about diabetic complications?		
Yes 270	70.1	
No 115	29.9	
Do you follow a healthy balanced diet?		
Yes 231	60.0	
No 154	40.0	
Do you exercise regularly?		
30 min daily	162	42.1
Twice per week	65	16.9
3 times per week	63	16.4
Others	17	4.4
No 78	20.3	
In your opinion, is there a lack of education for diabetic patients about diabetic complication in Saudi Arabia?		
Yes 294	76.4	
No 91	23.6	

health access and outcomes. Geographically, most participants reside in Arar and Rafha, accounting for a combined (320, 83.1%), which may reflect regional health trends and accessibility to healthcare resources. Notably, 247 (64.2%) reported a family history of diabetes, emphasizing the importance of understanding genetic factors in health research, particularly in a region where lifestyle diseases are increasingly prevalent.

As shown in Figure 1, The data indicates that a significant proportion of participants, numbering (262,68.1%), have been living with diabetes for a duration between 1 and 5 years, which underscores a critical window for educational interventions aimed at promoting awareness of potential health risks. Conversely, the figures for individuals with diabetes spanning between 6 to 10 years (45, 11.7% participants) and more than 10 years (78, 20.3% participants) reveal a markedly diminishing representation, suggesting

Table 3: Participants' awareness towards diabetic complications in Northern Border region Saudi Arabia (n = 385)

Parameter	N	Percentage
Do you know that diabetes complications affect the retina and lead to blindness?		
Yes	304	79.0
No	41	10.6
I don't know	40	10.4
Do you know that diabetes complications affect the kidneys and lead to kidney failure?		
Yes	296	76.9
No	44	11.4
I don't know	45	11.7
Do you know that diabetes complications affect the heart and lead to its failure?		
Yes	279	72.5
No	65	16.9
I don't know	41	10.6
Do you know that one of the diabetes complications is that it causes nerve damage neuropathy?		
Yes	290	75.3
No	60	15.6
I don't know	35	9.1
Do you know about the relationship of diabetes complications to stroke?		
Yes	234	60.8
No	99	25.7
I don't know	52	13.5
Do you know about the relationship of diabetes to diabetic foot?		
Yes	286	74.3
No	66	17.1
I don't know	33	8.6
Do you know about the relationship of diabetes to skin diseases?		
Yes	216	56.1
No	114	29.6
I don't know	55	14.3
Do you know about the relationship of diabetes to fertility?		
Yes	230	59.7
No	105	27.3
I don't know	50	13.0
Do you know that recurrent infection one of complications of diabetes?		
Yes	204	53.0
No	125	32.5
I don't know	56	14.5
Do you know that gum disease is one of complications of diabetes?		
Yes	224	58.2
No	108	28.1
I don't know	53	13.8
Do you know that diabetic ketoacidosis is a life-threatening emergency complication?	Yes	26368.3
No	80	20.8
I don't know	42	10.9
From where do you know about diabetes complications?		
Your doctor	15339.7	
Awareness messages	73	19.0
Social media	138	35.8
Heath seminars affiliated with ministry of health	21	5.5

either a possible decline in the population of long-term diabetics or an alarming trend of complications arising in this demographic that warrants further investigation.

As illustrated in Table 2, the data presented provides a compelling overview of the clinical characteristics and health management behaviours of a cohort of 385 participants diagnosed with diabetes. Among those diagnosed, a significant majority (255, 66.2%) reported having Type 1 diabetes, contrasting with (130, 33.8%) who were diagnosed with Type 2 diabetes. The duration of diabetes among participants reveals that a considerable proportion, (262, 68.1%), has lived with the condition for between 1 and 5 years, which emphasizes the need for tailored educational interventions and support systems for relatively newly diagnosed patients. Moreover, the data highlight that only (216,56.1%) of participants regularly measure their blood sugar levels, which raises concerns about self-monitoring practices that are critical for effective diabetes management. Regarding HbA1C testing frequency, nearly half (180, 46.8%) of participants undergo testing every three months, a recommendation consistent with current clinical guidelines for diabetes care, while a substantial minority appears to be less compliant with testing protocols. The use of continuous glucose monitors remains evenly split, indicating a potential opportunity for increased patient education and access to such technology. Furthermore, the majority of participants (270, 70.1%) reported adherence to prescribed medication regimens, which is encouraging, yet nearly (115, 30%) do not

meet medication adherence recommendations, highlighting an area for potential improvement in patient management strategies. Regular medical visits vary, with (186, 48.3%) attending every three months, which aligns with standard care recommendations, whereas a concerning (98, 25.7%) of participants indicated less consistent visits. The findings further illustrate participants' awareness of diabetic complications, with (270, 70.1%) reporting sufficient knowledge on this issue; however, a significant majority (294, 76.4%) expressed that educational resources for diabetic patients in Saudi Arabia are lacking. This feedback underscores a critical gap in diabetes education that could be addressed through enhanced community outreach and targeted educational programs designed to empower patients in managing their condition. Lifestyle factors also play a notable role; while (231, 60.0%) of participants claim to follow a healthy diet, exercise practices are relatively varied, with only (162, 42.1%) exercising daily for 30 minutes.

As shown in Figure 2, it is evident from the results that a significant majority of respondents, totaling 304(79%), acknowledged the correlation between diabetes and retinal complications that can ultimately result in blindness. This level of recognition underscores a commendable awareness within the community regarding the serious implications of diabetic conditions. However, it is also concerning that a notable minority-41 (10.6%) individuals indicated they do not recognize this risk, while another 40 (10.4%) respondents are unaware of the complications altogether. These figures highlight critical gaps in knowledge that could potentially hinder early intervention and preventative measures for those at risk.

Table 3 reveals the participants' awareness of diabetic complications in the Northern Border region of Saudi Arabia provides insightful observations about public knowledge regarding diabetes-related health issues. Overall, the findings indicate a commendable level of awareness among the participants, with the majority recognizing critical complications such as retinopathy, nephropathy and cardiovascular issues as significant risks associated with diabetes. Specifically, a notable (304, 79.0%) of respondents acknowledged the risk of blindness related to diabetic complications affecting the retina, while (296, 76.9%) recognized the potential for kidney failure. However, the data also reveals areas of concern; for instance, only 234, (60.8%) of participants were aware of the relationship between diabetes and stroke and awareness was slightly lower regarding skin diseases (216, 56.1%) and recurrent infections (204, 53.0%). These figures suggest that while there is a broad understanding of the major complications, specific areas require enhanced educational efforts to thoroughly inform the public. Social media emerged as a prominent source of information (138, 35.8%), complemented by healthcare professionals (153, 39.7%); this underscores the importance of utilizing diverse platforms for disseminating health information.

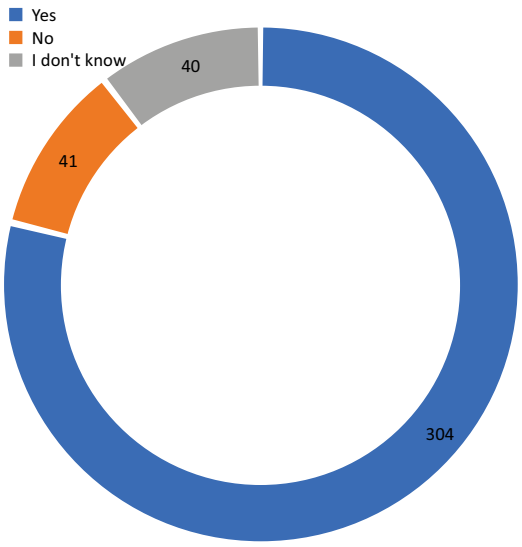

Figure 2: Illustrates if the participants know that diabetes may affect the retina and lead to blindness

Table 4 shows that having good information about diabetic complications among diabetics has a statistically significant relation to age (p value = 0.010). It also shows statistically insignificant relation to gender, nationality, marital status, educational level, occupational status, city of residence, family history of diabetes, type of diabetes and duration of diabetes.

DISCUSSION

DM can lead to various complications that affect multiple systems throughout the body. Among the most significant and chronic complications associated with DM are conditions such include coronary artery disease, nephropathy, diabetic neuropathy and retinopathy.

Each of these complications poses serious health risks and necessitates appropriate medical management and intervention [11]. For instance, research revealed that a notable 35% of individuals with DM in Saudi Arabia are affected by diabetic neuropathy. The study indicated that patients exhibiting poor adherence to their prescribed treatment regimens had a significantly higher likelihood of developing this neuropathic condition [12]. Furthermore, diabetic foot ulcers represent another critical complication of DM that not only leads to significant health problems but also imposes a considerable economic burden due to the associated healthcare costs and partial disability experienced by patients [13]. A comprehensive cross-sectional analysis involving 62,681 individuals with DM, sourced from the Saudi National Diabetes Registry (SNDR), indicated that approximately 3.3% of these patients experienced complications related to diabetic foot [14]. Several risk factors have been identified that increase the likelihood of developing diabetic foot complications, including male sex, the presence of cerebral vascular disease, inadequate

Table 4: Relation between having good information about diabetic complications and sociodemographic characteristics

	Having information about diabetic complications				Total		
Parameters	No	Percentage	Yes	Percentage	N = 385	Percentage	p-value*
Gender							
Female	40	34.8%	98	36.3%	138	35.8%	0.777
Male	75	65.2%	172	63.7%	247	64.2%	
Age							
18-25	21	18.3%	87	32.2%	108	28.1%	0.010
26-35	18	15.7%	53	19.6%	71	18.4%	
36-40	24	20.9%	37	13.7%	61	15.8%	
More than 40	52	45.2%	93	34.4%	145	37.7%	
Nationality							
Saudi	104	90.4%	251	93.0%	355	92.2%	0.397
Non-Saudi	11	9.6%	19	7.0%	30	7.8%	
Marital status							
Single	19	16.5%	68	25.2%	87	22.6%	0.173
Married	94	81.7%	193	71.5%	287	74.5%	
Divorced	1	0.9%	7	2.6%	8	2.1%	
Widowed	1	0.9%	2	0.7%	3	0.8%	
Education level							
University or higher	84	73.0%	216	80.0%	300	77.9%	0.281
Secondary school	25	21.7%	43	15.9%	68	17.7%	
Preparatory school	2	1.7%	8	3.0%	10	2.6%	
Primary school	3	2.6%	2	0.7%	5	1.3%	
Illiterate	1	0.9%	1	0.4%	2	0.5%	
Occupation status							
An employee of a government company	68	59.1%	179	66.3%	247	64.2%	0.171
Employee of a private work	19	16.5%	27	10.0%	46	11.9%	
Not working	28	24.3%	64	23.7%	92	23.9%	
City							
Arar	42	36.5%	122	45.2%	164	42.6%	0.075
Rafha	49	42.6%	107	39.6%	156	40.5%	
Turaif	1	0.9%	9	3.3%	10	2.6%	
Al uwayqilah	1	0.9%	4	1.5%	5	1.3%	
Other	22	19.1%	28	10.4%	50	13.0%	
Is there a family history of Diabetes?							
Yes	67	58.3%	180	66.7%	247	64.2%	0.115
No	48	41.7%	90	33.3%	138	35.8%	
Type of diabetes							
Type 1	80	69.6%	175	64.8%	255	66.2%	0.367
Type 2	35	30.4%	95	35.2%	130	33.8%	
Duration of diabetes							
Between 1 and 5 years	80	69.6%	182	67.4%	262	68.1%	0.698
Between 6 and 10 years	11	9.6%	34	12.6%	45	11.7%	
More than 10 years	24	20.9%	54	20.0%	78	20.3%	

glycaemic control, use of insulin therapy and advanced age [15]. A scarcity of information is observed in the literature regarding awareness of diabetic retinopathy among the diabetic individuals in Northern Border, Saudi Arabia. Our study aims to determine the level of awareness of DM and its complications among the general population of Northern Border, Saudi Arabia.

Our study findings show a commendable level of awareness among the participants as the majority of participants (270, 70.1%) reported adherence to prescribed medication regimens, with the majority recognizing critical complications such as retinopathy, nephropathy and cardiovascular issues as significant risks associated with diabetes. Specifically, a notable (304, 79.0%) of respondents acknowledged the risk of blindness related to diabetic complications affecting the retina, while (296, 76.9%) recognized the potential for kidney failure. However, the data also reveals areas of concern; for instance, only (234, 60.8%) of participants were aware of the relationship between diabetes and stroke and awareness was slightly lower regarding skin diseases (216, 56.1%) and recurrent infections (204, 53.0%).

The findings further illustrate participants' awareness of diabetic complications, with (270, 70.1%) reporting sufficient knowledge on this issue; however, a significant majority (294, 76.4%) expressed that educational resources for diabetic patients in Saudi Arabia are lacking. Similarly, a cross-sectional study involving 439 diabetic patients in the Al Jouf and Hail regions, revealed that a significant majority (75.62%) possessed awareness regarding the ocular complications associated with diabetes [16]. As compared to other literature, our findings are marginally higher than the

findings from the study conducted in India (50%) [17], the USA (52%) [18] and Oman (72%) [19]. conversely, it was lower than the figures reported in Japan (98%) [20] and Australia (96%) [21].

In a separate cross-sectional descriptive study that focused on 45 healthcare professionals managing diabetes at a tertiary eye hospital in central Saudi Arabia, the findings indicated that, within the preceding year, merely one-third of the participants had undergone screening for diabetic retinopathy. Furthermore, only 29% demonstrated a high level of knowledge concerning diabetic retinopathy and the associated ocular complications of diabetes mellitus [22]. Similarly, another study was carried out a cross-sectional study to evaluate the understanding of DM risk factors among diabetic patients in Arar region, recruiting 702 participants using a systematic random sampling approach. Among these individuals, 12.4% attributed DM to the excessive consumption of sweets. The overall awareness regarding complications of DM was found to be insufficient, with only 24.5% recognizing the potential for retinopathy and a mere 8.3% understanding the risks of sensory loss and numbness in the extremities [23].

Our findings also show that having good information about diabetic complications among diabetics has a significant relation to age (p value = 0.010) with younger patients showing higher knowledge (18-25 years old) similar to a study in Asir region, patients between the ages of 25 and 35 had better awareness levels than patients over the age of 50, with a statistically significant difference (p = 0.049) [1], 48.5% of patients were aware of DM problems; however, elderly patients in their study had higher knowledge levels [24]. In addition, our findings show statistically insignificant relation to gender, nationality, marital status, educational level, occupational status, city of residence, family history of diabetes, type of diabetes and duration of diabetes in contrast to another study showed that a significant positive association between receiving any form of education (general or professional) and higher knowledge [25].

Future Recommendations

Given the increasing prevalence of diabetes and its complications globally, it is imperative that public health strategies in Saudi Arabia focus on improving knowledge dissemination regarding diabetes-related health risks. Implementing targeted community outreach, expanding access to educational materials and leveraging both healthcare professionals and digital platforms could significantly bolster awareness and ultimately improve health outcomes for diabetic patients. Future research should continue to explore the factors influencing awareness and compliance to generate tailored interventions that address both the needs and challenges faced by this population. Through improved education and awareness, we have the potential to mitigate the burden of diabetes complications and enhance the quality of life for individuals living with this chronic condition. In addition, these patients need to increase doctor visits, follow instructions, prescribed medications and continue assessment of their health-related consequences

CONCLUSIONS

In conclusion, this study provides crucial insights into the awareness of diabetes complications among adult diabetic patients above 18 years of both genders in the Northern Border region of Saudi Arabia. The findings indicate a commendable level of overall awareness, with a significant proportion of participants recognizing critical complications such as retinopathy, nephropathy and cardiovascular diseases. Notably, approximately (304, 79.0%) of respondents acknowledged the risk of blindness related to diabetic retinopathy, while (296, 76.9%) recognized the potential for kidney failure. However, the study also highlights important gaps in awareness, particularly regarding less recognized complications such as stroke, skin diseases and recurrent infections, which were noted by only 234, 216, 204(60.8%, 56.1% and 53.0%) of participants, respectively.

To enhance diabetes awareness, diabetes screening must be done regularly at every annual checkup, especially for those at high risk. and health care providers must take an active role in educating diabetes. Policymakers should put plans that focus on preventing diabetes, such as programs promoting healthy eating, exercise and weight management in schools and communities and can also distribute them using various media platforms. The sociodemographic distinctions between rural and urban populations may explain for some of the variations in the availability and utilization of health information sources. There can be systemic obstacles like a lack of specialized physicians and restricted.

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