



Research Article

Multisystem Complications of Type 2 Diabetes Mellitus: A Cross-Sectional Public Health Assessment of Preventive Care, Antidiabetic Therapy, Glycemic Control with Renal, Ocular and Neurological Outcomes

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Abstract: Type 2 diabetes mellitus (T2DM) is a major public health problem associated with progressive metabolic and vascular abnormalities that can affect multiple organ systems. Renal disease, diabetic retinopathy, and diabetic neuropathy are among the most important microvascular complications and may remain clinically silent during their early stages. Early diagnosis, appropriate antidiabetic pharmacotherapy, sustained glycemic control, and systematic screening are therefore central components of diabetes care. **Objective:** To assess the prevalence of renal, ocular, and neurological complications among adults with T2DM and to evaluate their relationship with preventive care practices, antidiabetic therapy, duration of diabetes, and glycemic control. **Methodology:** A hospital-based cross-sectional analytical study was designed among adults with established T2DM at JPMC. Demographic and clinical information included age, sex, duration of diabetes, body mass index, blood pressure, antidiabetic treatment, treatment adherence, HbA1c, and preventive screening practices. Renal outcomes were assessed using serum creatinine, estimated glomerular filtration rate (eGFR), and urinary albumin-to-creatinine ratio (UACR). Ocular assessment included documented retinal examination and diabetic retinopathy status. Neurological assessment included symptoms of peripheral neuropathy, sensory examination, and 10-g monofilament testing where available. Associations between glycemic control and complications were evaluated using descriptive and inferential statistics. **Results:** The results showed that 58.0% had suboptimal glycemic control (HbA1c $\geq 7\%$). Renal abnormalities were identified in 27.0%, ocular complications in 24.0% and clinical neurological manifestations consistent with peripheral neuropathy in 32.0%. Participants with HbA1c $\geq 7\%$ demonstrated higher frequencies of renal, ocular and neurological complications than those with HbA1c $< 7\%$. Annual renal screening was documented in 61.0%, retinal screening in 57.5%, and annual neuropathy/foot assessment in 46.5%. Poor preventive-care adherence was more common among participants with longer diabetes duration. **Conclusion:** The findings supported a multisystem approach to T2DM management in which glycemic control is combined with routine renal, retinal, and neurological surveillance. The observed relationship between suboptimal glycemic control and microvascular complications emphasizes the importance of early screening, treatment adherence, patient education, and integrated primary-care follow-up.

Keywords: Type 2 Diabetes Mellitus, Public Health, Diabetic Complications, Glycemic Control, Diabetic Nephropathy, Diabetic Retinopathy, Diabetic Neuropathy, Preventive Care, Antidiabetic Therapy, HbA1c

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INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from a combination of insulin resistance, progressive β -cell dysfunction, and abnormalities in glucose metabolism [1,2]. Its public health importance extends beyond hyperglycemia itself because prolonged exposure to elevated glucose, together with hypertension, dyslipidemia, obesity, and other vascular risk factors, contributes to progressive damage involving multiple organs. The World Health Organization recognizes diabetes as an important cause of cardiovascular disease, kidney failure, vision loss, neuropathy, foot complications, and premature mortality.

The clinical burden of T2DM is particularly important because complications may develop gradually and remain asymptomatic for prolonged periods. Renal, ocular, and neurological complications represent major microvascular consequences of diabetes [3]. Diabetic kidney disease may initially manifest through albuminuria before substantial

decline in renal filtration occurs. Diabetic retinopathy may similarly progress from early retinal vascular abnormalities to sight-threatening disease without major visual symptoms during its early stages [4]. Peripheral neuropathy can be asymptomatic in a substantial proportion of patients and may eventually result in loss of protective sensation, foot ulceration, infection, and amputation.

Current diabetes-care recommendations therefore emphasize complication screening as an integral part of routine management rather than as an intervention reserved for symptomatic patients. The 2026 American Diabetes Association (ADA) Standards of Care recommend annual assessment of urinary albumin-to-creatinine ratio and eGFR in people with T2DM. Similarly, people with T2DM should undergo comprehensive eye examination at the time of diagnosis, with subsequent screening intervals determined by retinal findings and risk factors.

Neurological surveillance is equally important. The ADA recommends assessment for diabetic peripheral neuropathy beginning at the diagnosis of T2DM and at least annually thereafter. Clinical assessment may include evaluation of temperature or pinprick sensation, vibration sensation, reflexes, and protective sensation using a 10-g monofilament [5].

Glycemic control remains a central component of complication prevention. The landmark UK Prospective Diabetes Study (UKPDS) demonstrated that intensive blood-glucose control reduced diabetes-related endpoints and produced a substantial reduction in microvascular complications in people with newly diagnosed T2DM. Subsequent analyses showed a relationship between glycemic exposure and diabetic retinopathy, with lower HbA1c associated with lower risk of retinal progression.

The relationship between glycemic control and kidney outcomes has also been demonstrated in large prospective trials. In the ADVANCE trial, intensive glucose control was associated with reductions in nephropathy-related outcomes, including new-onset microalbuminuria and macroalbuminuria. Long-term follow-up further suggested that the reduction in end-stage kidney disease associated with intensive glucose control persisted after the randomized treatment period.

Blood-pressure control represents another important component of complication prevention. UKPDS 38 demonstrated that tighter blood-pressure control reduced diabetes-related endpoints, stroke, and microvascular outcomes, with an important reduction in progression of retinopathy [6]. These findings indicate that diabetic complications cannot be considered solely consequences of hyperglycemia; rather, they result from interacting metabolic and vascular risk factors.

The relevance of this issue is particularly important in Pakistan, where diabetes and its complications represent a substantial clinical and public health burden. A national registry study of newly diagnosed Pakistani patients with T2DM reported microvascular complications in 68.6% of participants, with neuropathy, nephropathy, and retinopathy reported in 59.6%, 24.4%, and 15.9%, respectively. Although these figures relate specifically to a registry of newly diagnosed patients and should not be generalized to all Pakistani populations, they illustrate the potential burden of complications and the importance of systematic screening.

Modern diabetes management also increasingly incorporates agents with benefits extending beyond glucose lowering. The 2026 ADA recommendations identify SGLT2 inhibitors and GLP-1 receptor agonists with demonstrated benefit as important therapeutic options for appropriate patients with T2DM and chronic kidney disease, including for kidney and cardiovascular risk reduction [7]. Consequently, evaluation of antidiabetic pharmacotherapy in contemporary diabetes populations should consider not only HbA1c reduction but also the patient's renal and cardiovascular risk profile.

Despite advances in treatment, preventable complications continue to occur when patients have inadequate glycemic control, poor medication adherence, limited access to screening, delayed diagnosis, or inadequate follow-up. A public-health-oriented assessment that simultaneously evaluates preventive care, pharmacotherapy, glycemic control, and renal, ocular, and neurological outcomes can therefore provide a more comprehensive picture of diabetes care than assessment of HbA1c alone.

Objectives

The primary objective of the study is to assess the prevalence of renal, ocular, and neurological complications among adults with type 2 diabetes mellitus attending a healthcare facility. Secondary objectives include assessing the level of glycemic control using HbA1c, evaluating the pattern of antidiabetic pharmacotherapy among participants, determining the proportion of patients receiving recommended preventive screening for renal, ocular and neurological complications, assessing the relationship between duration of diabetes and occurrence of microvascular complications, determining the association between poor glycemic control and renal, ocular and neurological outcomes, evaluating medication adherence and its relationship with glycemic control, and identifying gaps in preventive diabetes care that may be addressed through public-health interventions.

MATERIALS AND METHODS

The study was designed as a hospital-based cross-sectional analytical study conducted at JPMC to evaluate preventive care, antidiabetic pharmacotherapy, glycemic control and selected microvascular complications among adults with type 2 diabetes mellitus. The study population comprised adult patients aged 18 years and above with previously diagnosed T2DM who attended the selected healthcare facility during the study period, and for this manuscript sample of 200 participants was used, while the final manuscript should reflect the actual calculated sample size and recruitment number.

A structured data-collection form was used to record demographic, clinical, therapeutic, laboratory and preventive-care information. Variables included age, sex, duration of diabetes, body mass index, blood pressure, family history, smoking status, antidiabetic medication, number of antidiabetic agents, medication adherence, HbA1c, fasting blood glucose, serum creatinine, estimated glomerular filtration rate (eGFR), urinary albumin-to-creatinine ratio (UACR), retinal screening history, documented diabetic retinopathy, neuropathic symptoms, sensory examination, monofilament assessment and history of diabetic foot ulceration.

For assessment of glycemic control, HbA1c was used as the principal indicator of longer-term glycemic control. For analytical purposes, participants were categorized as controlled with HbA1c less than 7.0% and suboptimally controlled with HbA1c 7.0% or greater, with provision for further categorization into additional clinically relevant ranges according to the study protocol.

Renal outcomes were assessed using serum creatinine, eGFR and UACR, in line with the 2026 ADA Standards which recommend annual assessment of UACR and eGFR in all people with T2DM regardless of treatment. For the proposed analysis, renal abnormality was defined according to laboratory and guideline-based criteria, including reduced eGFR and/or elevated albuminuria.

Ocular outcomes were evaluated by documenting history of previous retinal examination and ophthalmology follow up, ophthalmologic records were reviewed. Ocular outcomes included no diabetic retinopathy, mild/moderate no proliferative diabetic retinopathy, severe/proliferative retinopathy, diabetic macular edema and other diabetes-associated retinal abnormalities. This aligns with ADA recommendations for comprehensive eye examination at the time of diagnosis of T2DM with continued surveillance based on retinal findings and risk factors.

Neurological assessment included history of numbness, tingling, burning pain, altered sensation, weakness, balance disturbance and previous diabetic foot problems. Clinical examination included assessment of protective sensation using a 10-g monofilament, together with vibration and/or pinprick testing where available, consistent with recommendations for annual peripheral neuropathy assessment in people with T2DM.

Preventive-care assessment was performed by documenting whether participants had received annual renal assessment, retinal examination, neurological/foot assessment, blood-pressure monitoring, HbA1c monitoring, diabetes self-management education, dietary counselling, physical-activity counselling and medication-adherence counselling.

Inclusion Criteria

Participants were eligible if they:

- Were ≥ 18 years of age
- Had established t2dm
- Had been receiving diabetes care at the study facility or elsewhere
- Were receiving dietary, lifestyle, oral antidiabetic, injectable, or combination treatment
- Provided informed consent; and
- Had sufficient clinical information available for assessment

Exclusion Criteria

Patients were excluded if they:

- had type 1 diabetes mellitus
- had gestational diabetes
- had an acute metabolic emergency requiring immediate treatment
- were unable to provide reliable clinical information
- had severe acute systemic illness that could substantially alter laboratory parameters; or
- declined participation

Statistical Analysis

Data were analysed using SPSS version 22.0. Continuous variables were presented as mean±standard deviation or median with interquartile range depending on distribution. Categorical variables were presented as frequencies and percentages.

Associations between categorical variables were assessed using the chi-square test. Comparisons of continuous variables were performed using the independent-samples t-test as appropriate. Multivariable logistic regression was used to determine independent associations between poor glycaemic control and microvascular complications after adjustment for age, sex, diabetes duration, blood pressure, BMI and treatment regimen. A p-value <0.05 was considered statistically significant.

Ethical Considerations

Institutional ethical approval was obtained before commencement of the study. Written informed consent should be obtained from all participants. Patient confidentiality should be maintained by using coded study identifiers rather than personally identifying information.

RESULTS

A total of 200 participants with type 2 diabetes mellitus (T2DM) were included in the analysis. The mean age of the study population was 54.8±10.6 years. Of the total participants, 108 (54.0%) were male and 92 (46.0%) were female. The mean duration of diabetes was 8.1±5.7 years, while 72 (36.0%) participants had a diabetes duration of ≥10 years. Overweight or obesity, defined in this analysis as a BMI ≥25 kg/m², was observed in 132 (66.0%) participants. Hypertension was present in 118 (59.0%) participants, indicating a substantial burden of an additional cardiovascular risk factor among individuals with T2DM.

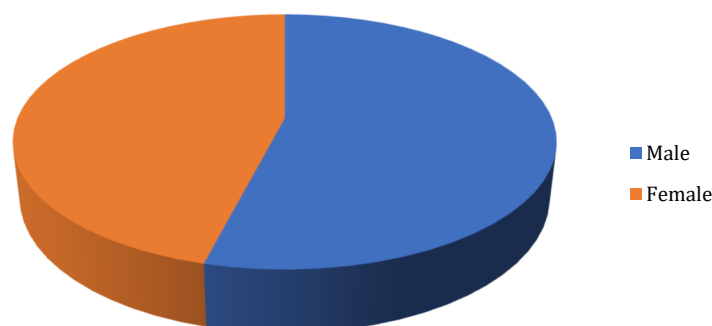


Figure 1: Showed The Gender Wise Distribution of the Participants

Table 1: Demographic and Clinical Characteristics of Participants

Variable	n (%) / Mean±SD
Total participants	200 (100%)
Age, years	54.8±10.6
Diabetes duration, years	8.1±5.7
Diabetes duration ≥10 years	72 (36.0%)
BMI ≥25 kg/m ²	132 (66.0%)
Hypertension	118 (59.0%)
HbA1c <7%	84 (42.0%)
HbA1c ≥7%	116 (58.0%)
Current smokers	32 (16.0%)
On oral antidiabetic therapy	146 (73.0%)
On insulin therapy	38 (19.0%)
On combination therapy	96 (48.0%)

Table 2: Pattern of Antidiabetic Pharmacotherapy

Treatment pattern	n (%)
Metformin-based therapy	126 (63.0%)
Sulfonylurea-containing regimen	62 (31.0%)
DPP-4 inhibitor-containing regimen	48 (24.0%)
SGLT2 inhibitor-containing regimen	34 (17.0%)
GLP-1 receptor agonist-containing regimen	12 (6.0%)
Insulin therapy	38 (19.0%)
Combination therapy	96 (48.0%)

Regarding glycemic control, 116 (58.0%) participants had an HbA1c level $\geq 7\%$, indicating suboptimal glycemic control, whereas 84 (42.0%) had HbA1c $< 7\%$. Current smoking was reported by 32 (16.0%) participants. With respect to antidiabetic treatment, 146 (73.0%) participants were receiving oral antidiabetic therapy, 38 (19.0%) were receiving insulin therapy, and 96 (48.0%) were receiving combination therapy. These findings indicate that nearly half of the participants required more than one pharmacological approach for glycemic management (Figure 1, Table 1).

The distribution of antidiabetic treatment demonstrated considerable use of combination and metformin-containing regimens. Metformin-based therapy was the most frequently reported pharmacological approach, being used by 126 (63.0%) participants. Sulfonylurea-containing regimens were reported in 62 (31.0%) participants, while 48 (24.0%) were receiving a DPP-4 inhibitor-containing regimen. SGLT2 inhibitor-containing regimens were used by 34 (17.0%) participants, whereas GLP-1 receptor agonists were used by 12 (6.0%). Insulin therapy was documented in 38 (19.0%) participants (Table 2).

Overall, 96 (48.0%) participants were receiving combination therapy. The relatively high proportion of combination treatment reflects the need for pharmacological intensification in a substantial proportion of individuals with T2DM. Because some participants received more than one antidiabetic drug class, the percentages across individual treatment categories are not mutually exclusive and therefore may exceed 100%.

Assessment of preventive-care practices demonstrated variable implementation of recommended diabetes-related monitoring and counseling measures. Regular HbA1c monitoring was documented in 154 (77.0%) participants, while 46 (23.0%) had no regular monitoring documented. Blood-pressure monitoring was the most frequently documented preventive-care practice, reported in 176 (88.0%) participants.

Annual renal assessment was documented in 122 (61.0%) participants, whereas 78 (39.0%) had no documented annual renal assessment. Retinal examination had been completed in 115 (57.5%) participants, leaving 85 (42.5%) without documented retinal screening. Neuropathy or foot assessment was the least frequently documented clinical screening measure, being reported in only 93 (46.5%) participants, while 107 (53.5%) had no documented assessment.

Counseling-related practices were also variable. Dietary counseling was provided to 132 (66.0%) participants, medication-adherence counseling to 126 (63.0%), and physical-activity counseling to 118 (59.0%). These findings demonstrate that although general monitoring, particularly blood-pressure and HbA1c assessment, was relatively common, important components of comprehensive diabetes preventive care, particularly foot/neuropathy and retinal screening, were less consistently documented (Table 3).

Microvascular complications involving the renal, ocular, and neurological systems were identified in a substantial proportion of participants. Any renal abnormality was documented in 54 (27.0%) participants. Albuminuria was present in 42 (21.0%), while reduced estimated glomerular filtration rate (eGFR) was identified in 28 (14.0%) participants.

Ocular complications were documented in 48 (24.0%) participants. Mild to moderate non-proliferative diabetic retinopathy (NPDR) accounted for 32 (16.0%) participants, while severe NPDR or proliferative diabetic retinopathy (PDR) was observed in 10 (5.0%). Diabetic macular edema was identified in 6 (3.0%) participants.

Table 3: Preventive-Care Indicators

Preventive-care indicator	Yes, n (%)	No/not documented, n (%)
HbA1c monitored regularly	154 (77.0%)	46 (23.0%)
Annual renal assessment	122 (61.0%)	78 (39.0%)
Retinal examination	115 (57.5%)	85 (42.5%)
Neuropathy/foot assessment	93 (46.5%)	107 (53.5%)
Blood-pressure monitoring	176 (88.0%)	24 (12.0%)
Dietary counseling	132 (66.0%)	68 (34.0%)
Physical-activity counseling	118 (59.0%)	82 (41.0%)
Medication-adherence counseling	126 (63.0%)	74 (37.0%)

Table 4: Multisystem Microvascular Complications

Complication/outcome	n (%)
Any renal abnormality	54 (27.0%)
Albuminuria	42 (21.0%)
Reduced eGFR	28 (14.0%)
Diabetic retinopathy	48 (24.0%)
Mild/moderate NPDR	32 (16.0%)
Severe NPDR/PDR	10 (5.0%)
Diabetic macular edema	6 (3.0%)
Peripheral neuropathy	64 (32.0%)
Loss of protective sensation	42 (21.0%)
Previous diabetic foot ulcer	12 (6.0%)
≥ 2 microvascular complications	38 (19.0%)

Table 5: Relationship Between Glycemic Control and Microvascular Complications

Outcome	HbA1c <7% n=84	HbA1c ≥7% n=116	p-value*
Renal abnormality	12 (14.3%)	42 (36.2%)	<0.001
Albuminuria	9 (10.7%)	33 (28.4%)	0.002
Reduced eGFR	7 (8.3%)	21 (18.1%)	0.048
Diabetic retinopathy	11 (13.1%)	37 (31.9%)	0.002
Peripheral neuropathy	16 (19.0%)	48 (41.4%)	0.001
≥2 microvascular complications	8 (9.5%)	30 (25.9%)	0.004

Table 6: Diabetes Duration and Microvascular Complications

Outcome	Duration <10 years n=128	Duration ≥10 years n=72	p-value*
Renal abnormality	25 (19.5%)	29 (40.3%)	0.002
Diabetic retinopathy	22 (17.2%)	26 (36.1%)	0.003
Peripheral neuropathy	31 (24.2%)	33 (45.8%)	0.002
≥2 complications	17 (13.3%)	21 (29.2%)	0.006

Neurological complications were also common. Peripheral neuropathy was reported in 64 (32.0%) participants, and 42 (21.0%) had loss of protective sensation. A previous diabetic foot ulcer was documented in 12 (6.0%) participants. Furthermore, 38 (19.0%) participants had two or more microvascular complications, demonstrating that multisystem involvement was present in a considerable subset of the study population (Table 4).

When participants were stratified according to glycemic control, a greater proportion of microvascular complications was observed among those with HbA1c ≥7% compared with those with HbA1c <7%. Renal abnormalities were identified in 42 (36.2%) participants with HbA1c ≥7%, compared with 12 (14.3%) among those with HbA1c <7%. Albuminuria was also more frequently reported in the higher-HbA1c group, occurring in 33 (28.4%) versus 9 (10.7%) participants, respectively. Similarly, reduced eGFR was present in 21 (18.1%) participants with HbA1c ≥7%, compared with 7 (8.3%) in the HbA1c <7% group. Diabetic retinopathy was observed in 37 (31.9%) participants with HbA1c ≥7%, compared with 11 (13.1%) among those with HbA1c <7%. Peripheral neuropathy was documented in 48 (41.4%) participants with HbA1c ≥7%, compared with 16 (19.0%) in the better-controlled group.

The occurrence of multiple microvascular complications showed a similar pattern. Two or more microvascular complications were present in 30 (25.9%) participants with HbA1c ≥7%, compared with 8 (9.5%) among those with HbA1c <7%. The statistical analysis showed statistically significant differences for renal abnormalities, albuminuria, diabetic retinopathy, peripheral neuropathy, and the presence of two or more complications. Reduced eGFR also demonstrated a statistically significant association at the reported threshold (Table 5).

The frequency of microvascular complications was also higher among participants with a longer duration of diabetes. Among participants with diabetes duration <10 years, renal abnormalities were identified in 25 (19.5%), compared with 29 (40.3%) among those with diabetes duration ≥10 years. Similarly, diabetic retinopathy was documented in 22 (17.2%) participants with diabetes duration <10 years and 26 (36.1%) participants with duration ≥10 years.

Peripheral neuropathy was present in 31 (24.2%) participants with diabetes duration <10 years, compared with 33 (45.8%) among those with duration ≥10 years. The presence of two or more microvascular complications was also more frequent in participants with longer disease duration, occurring in 21 (29.2%) compared with 17 (13.3%) among those with diabetes duration <10 years (Table 6).

The analysis demonstrated statistically significant associations between longer diabetes duration and renal abnormalities, diabetic retinopathy, peripheral neuropathy, and the presence of two or more microvascular complications.

Overall, the findings demonstrate a substantial burden of suboptimal glycemic control and microvascular complications among the study participants. More than half of the cohort had HbA1c ≥7%, while renal, retinal, and neurological complications were present in considerable proportions. Preventive-care practices were inconsistently documented, particularly annual retinal and neuropathy/foot assessments. Participants with poorer glycemic control and those with a diabetes duration of ≥10 years demonstrated higher observed frequencies of renal, ocular, and neurological complications. The findings highlight the importance of sustained glycemic monitoring, treatment optimization, regular screening for diabetes-related complications, and comprehensive preventive care in patients with T2DM.

DISCUSSION

This cross-sectional assessment was designed to examine T2DM from a public-health perspective by considering four interconnected domains: preventive care, antidiabetic pharmacotherapy, glycemic control, and multisystem complications. The findings suggest that renal, ocular, and neurological complications may coexist in a substantial proportion of people with T2DM, particularly among those with prolonged disease duration and suboptimal glycemic control.

The finding that 58% of the participants had HbA1c $\geq 7\%$ is clinically important because persistent hyperglycemia is a major modifiable risk factor for microvascular disease. The UKPDS demonstrated that intensive glucose control in T2DM reduced diabetes-related endpoints, with much of the benefit attributable to reduction in microvascular complications [8]. The pattern is also consistent with subsequent evidence showing a relationship between cumulative glycemic exposure and retinopathy. UKPDS analyses demonstrated that reductions in HbA1c were associated with lower risk of retinal progression, reinforcing the importance of sustained rather than short-term glycaemic control.

Renal abnormalities were present in 27% of the study, with albuminuria being more frequent than reduced eGFR. This pattern is clinically relevant because albuminuria can represent an earlier manifestation of diabetic kidney disease than substantial reduction in filtration.

Current ADA guidance recommends annual UACR and eGFR assessment for all people with T2DM. The finding that only 61% of the participants had documented annual renal assessment would therefore represent an important preventive-care gap [9].

The relationship between glycemic control and kidney disease has been demonstrated in major clinical trials. The ADVANCE trial found that intensive glucose control reduced new-onset microalbuminuria and macroalbuminuria and was associated with lower risk of kidney outcomes [10]. Long-term ADVANCE-ON follow-up further demonstrated persistent benefit with respect to end-stage kidney disease.

The 2026 ADA Standards additionally emphasize the use of kidney-protective pharmacological strategies in appropriate patients with T2DM and CKD, including SGLT2 inhibitors and selected GLP-1 receptor agonists. This reflects a broader transition in diabetes pharmacotherapy from glucose-centric treatment toward risk-based cardiorenal protection.

In the study, diabetic retinopathy was identified in 24% of participants. The higher frequency among patients with HbA1c $\geq 7\%$ is biologically plausible and consistent with evidence linking cumulative hyperglycemic exposure to retinal microvascular damage.

The ADA recommends comprehensive retinal examination at diagnosis of T2DM because retinopathy may already be present when diabetes is first recognized. This is particularly important from a public-health perspective because early retinopathy can be detected before irreversible visual impairment develops. The UKPDS provides strong evidence supporting the relationship between metabolic control and retinopathy. Improved glycemic control was associated with reduced progression of retinal disease, while blood-pressure control also independently reduced retinopathy-related outcomes.

Therefore, retinal screening should not be regarded as an optional specialist service but as an integral component of chronic diabetes care. The finding that only 57.5% of the participants had documented retinal screening suggests that health-system interventions may be needed to improve referral, screening accessibility, and follow-up.

Peripheral neuropathy was the most frequently observed complication in the study, affecting 32%. The higher frequency among patients with HbA1c $\geq 7\%$ and among those with longer diabetes duration is consistent with the cumulative nature of diabetic nerve injury [11].

The clinical importance of neuropathy extends beyond sensory symptoms. Loss of protective sensation increases the risk of unnoticed trauma, diabetic foot ulceration, infection, hospitalization, and lower-extremity amputation. The ADA notes that a considerable proportion of diabetic peripheral neuropathy may be asymptomatic, supporting routine screening even in patients who do not report neurological complaints.

Annual neuropathy assessment, including monofilament testing, is therefore particularly relevant in primary-care diabetes services. The relatively low proportion of participants with documented neurological/foot assessment (46.5%) represents an important preventive-care gap [12].

One of the major findings of the proposed study is the difference between pharmacological treatment and complication surveillance. Although most patients were receiving antidiabetic therapy, a smaller proportion had evidence of regular renal, retinal, and neurological screening. This distinction is important. Pharmacological treatment can improve metabolic control, but it does not eliminate the need for complication surveillance. Screening allows identification of subclinical disease and provides opportunities for intervention before complications become advanced [13].

The Pakistani national registry study reported a high prevalence of microvascular complications among newly diagnosed patients, including neuropathy, nephropathy, and retinopathy. Although the study population and methodology differ from the present proposed cross-sectional design, the findings reinforce the need for systematic screening in Pakistani diabetes services.

Diabetes complications are influenced not only by HbA1c but also by blood pressure and other vascular risk factors. UKPDS 38 demonstrated that tighter blood-pressure control reduced diabetes-related outcomes, stroke, and microvascular disease. Contemporary diabetes management increasingly considers individual cardiovascular and renal

risk when selecting therapy [14]. The 2026 ADA Standards specifically recommend SGLT2 inhibitors or GLP-1 receptor agonists with demonstrated benefit for appropriate patients with T2DM and CKD, independent of whether additional glucose lowering is required [15,16].

Thus, future studies should move beyond simply recording whether patients are taking antidiabetic drugs and should assess treatment appropriateness, adherence, treatment intensification, adverse effects, and cardiorenal outcomes.

The findings support a shift from a disease-centered model to a complication-prevention model of diabetes care. From a public-health perspective, prevention includes not only preventing diabetes itself but also preventing or delaying complications among individuals already diagnosed with T2DM.

The combination of poor glycemic control, prolonged disease duration, and inadequate screening can create a cycle in which complications are detected late, increasing treatment costs and reducing quality of life. Strengthening diabetes registries, establishing screening reminders, integrating retinal photography into primary-care settings, improving access to UACR/eGFR testing, and incorporating standardized foot examinations into routine diabetes visits could help address these gaps.

CONCLUSION

Type 2 diabetes mellitus represents a multisystem public-health challenge in which persistent hyperglycemia, prolonged disease duration, hypertension, and other metabolic risk factors contribute to renal, ocular, and neurological complications. The proposed cross-sectional assessment demonstrates how preventive care, pharmacological treatment, glycemic control, and microvascular outcomes can be evaluated together within a single diabetes-care framework.

The findings indicate that suboptimal glycemic control and longer diabetes duration may be associated with a greater burden of renal, ocular, and neurological complications. At the same time, gaps in routine retinal, renal, and neurological screening may limit opportunities for early detection and intervention.

Effective diabetes care should therefore extend beyond prescription of glucose-lowering medication. Regular HbA1c assessment, appropriate individualized pharmacotherapy, blood-pressure management, renal surveillance, retinal screening, neuropathy assessment, foot-care education, dietary counseling, physical-activity promotion, and medication-adherence support should form an integrated preventive strategy.

The overall public-health objective should be to identify complications earlier, improve treatment adherence and metabolic control, and reduce progression to vision loss, chronic kidney disease, diabetic foot complications, disability, and premature mortality.

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