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Prevalence of Microvascular Complications in Diabetes Mellitus Patients Attending Nephrology Outpatient Department at a Tertiary Care Hospital in Bangladesh

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Abstract | **Original Research Article**

Background: Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder with a rising global prevalence and represents a significant public health challenge. Persistent hyperglycemia in T2DM is closely linked to the development of microvascular complications. ***Objective:*** To assess the prevalence of microvascular complications namely- diabetic nephropathy, retinopathy, and neuropathy among patients with type 2 diabetes mellitus attending the nephrology outpatient department of a tertiary care hospital. ***Method:*** This hospital-based cross-sectional study was carried out at Bangladesh Medical University (BMU), Dhaka, Bangladesh and included 283 confirmed cases of type 2 diabetes mellitus in patients aged 20 years and above. Participants were selected consecutively from the outpatient departments. Microvascular complications were identified using clinical assessments and diagnostic investigations. ***Results:*** Of the 283 patients with type 2 diabetes mellitus, 66.4% (n = 188) had at least one microvascular complication. Diabetic neuropathy was the most prevalent, affecting 49.8% of patients, followed by diabetic retinopathy in 38.2% with 19.1% of these cases showing proliferative changes. Diabetic foot was identified in 24.7% of patients. A significantly higher prevalence of microvascular complications was seen among patients with a longer duration of diabetes ($p = 0.002$), coexisting hypertension ($p = 0.005$), and more advanced stages of chronic kidney disease ($p = 0.003$). Biochemical analyses showed that patients with microvascular complications had higher mean serum creatinine levels (3.68 ± 2.35 mg/dl versus 2.57 ± 1.41 mg/dl; $p < 0.001$) and lower estimated glomerular filtration rate (eGFR) values (23.40 ± 14.1135 ml/min/1.73 m² versus 31.22 ± 14.35 ml/min/1.73 m²; $p < 0.001$) compared to those without complications. No statistically significant associations were found with age, gender, body mass index (BMI), family history of diabetes, lipid profile, fasting blood glucose, or HbA1c levels. ***Conclusion:*** Microvascular complications are common among type 2 diabetes patients in the nephrology outpatient setting, with neuropathy being most frequent. Their strong links to longer disease duration, hypertension, and worsening kidney function highlight the need for early screening and integrated management to slow progression and improve outcomes.

Keywords: Type 2 Diabetes Mellitus (T2DM); Microvascular Complications; Diabetic Nephropathy; Diabetic Retinopathy; Diabetic Neuropathy; Chronic Kidney Disease (CKD).

1. INTRODUCTION

Diabetes mellitus (DM) is one of the most prevalent non-communicable diseases globally, with an estimated 537 million adults affected in 2021, this number is projected to rise up to 783 million by 2045 [1]. Type 2 diabetes mellitus (T2DM), a chronic metabolic condition marked by insulin resistance and persistent hyperglycemia, progressively damages multiple organ systems, particularly small blood vessels [2]. T2DM represents a growing global health challenge, largely due to its strong association with microvascular complications such as diabetic nephropathy, retinopathy, and neuropathy [2]. These complications are primarily

driven by prolonged metabolic and hemodynamic disturbances that induce oxidative stress, inflammation, and endothelial dysfunction [3].

Diabetes-related complications are generally classified as microvascular or macrovascular. Among the microvascular complications- retinopathy, nephropathy, and neuropathy are especially common and debilitating outcomes of chronic hyperglycemia, leading to capillary and small vessel damage [3]. In the United States, a comprehensive study conducted from 1988 to 2014 identified diabetic nephropathy as the leading cause of end-stage renal disease (ESRD), significantly burdening nephrology services [4]. Diabetic retinopathy continues to be a major cause of preventable blindness worldwide [5]. Diabetic neuropathy affects up to 50% of individuals with longstanding diabetes and may present as peripheral, autonomic, or focal nerve dysfunction, severely impacting quality of life [6]. It is also a major factor in the development of diabetic foot ulcers and lower limb amputations [7].

The burden of T2DM complications places substantial strain on global healthcare systems. However, the prevalence and presentation of these complications vary across regions, influenced by disparities in healthcare access, socioeconomic conditions, and control of risk factors [8-11]. It is quite evident that there is a wide variation in the regional dependency of microvascular complications among patients with T2DM [8-11]. These findings emphasize the global need for integrated diabetes care, including regular screening, patient education, and multidisciplinary management to reduce the burden of microvascular complications and improve patient outcomes.

Several factors are associated with the development of microvascular complications. These include poor glycemic control, long duration of diabetes, older age, presence of hypertension, obesity and dyslipidemia [12]. Even at the time of initial diagnosis, many patients already present with one or more complications, highlighting the silent and progressive nature of T2DM. Studies emphasize that early diagnosis, regular monitoring, and strict metabolic control are key strategies to prevent or delay the onset of complications [9, 10, 12].

South Asia is experiencing a disproportionately high increase in diabetes prevalence due to rapid urbanization, sedentary lifestyles, and dietary changes [13]. The prevalence of T2DM among Bangladeshi adults is estimated at 9-10%, with significant public health implications [14]. In Bangladesh, the burden of diabetic nephropathy is increasingly recognized in tertiary care settings. However, there is a paucity of local data on the concurrent prevalence of other microvascular complications among diabetic patients who present to nephrology outpatient departments (OPDs). Understanding the pattern of these complications in this high-risk group is vital, as coexisting retinopathy and neuropathy often accelerate morbidity and further compromise renal outcomes [15-16]. Early detection and integrated management of microvascular complications are key to reducing the burden of diabetes-related morbidity and mortality [17]. However, in Bangladesh, underdiagnosis and inadequate screening practices persist, particularly in patients who present with advanced renal disease. Identifying the magnitude and predictors of microvascular complications among patients attending nephrology OPDs can guide the development of comprehensive screening protocols and multidisciplinary management strategies. Evaluation of the burden and understanding the mechanisms of these complications are essential for developing early detection strategies and integrated care models to prevent irreversible damage and improve long-term outcomes in T2DM patients. Therefore, this study aims to determine the prevalence and patterns of microvascular complications among patients with type 2 diabetes mellitus attending the Nephrology OPD at a tertiary care hospital in Bangladesh. The findings will contribute to local evidence needed to strengthen clinical practice and inform targeted interventions to improve patient outcomes.

2. METHODOLOGY

This is a post-facto (retrospective, *a-posteriori*) study conducted at the Department of Nephrology of Bangladesh Medical University (BMU), Dhaka, Bangladesh, between November 01, 2021 and March 30, 2023. Participants were selected from amongst the patients who came for treatment at the Outpatient Department of Nephrology, BMU. The sample size n was calculated using

$$\boldsymbol{n = z_{\alpha/2}^2 \frac{p(1-p)}{d^2}}$$

where $\boldsymbol{z_{\alpha/2} = 1.96}$ is the two-tailed 95% confidence level

$p \approx 0.16$, the microvascular prevalence from previous studies [14, 18]

$d = 0.05$ is the error level

With these values, the sample size n was evaluated to be 283.

Therefore, the study included 283 adults (181 men and 102 women) aged 20 years and above with a confirmed diagnosis of type 2 diabetes mellitus. Patients with acute kidney injury, non-diabetic kidney diseases, or incomplete records were excluded. Data were collected through face-to-face interviews using a pre-structured questionnaire, along with a review of medical records and recent laboratory tests. Variables gathered included demographic information like age at diabetes onset, duration of the disease, comorbidities such as hypertension, and key biochemical markers like-glycated hemoglobin (HbA1c), lipid profile [total cholesterol (TC), triglyceride (TG), low-density

lipoprotein cholesterol (LDL), high-density lipoprotein cholesterol (HDL)], serum creatinine, and 24 hours-urinary protein (24h- UTP). Chronic kidney disease (CKD) stages were determined using estimated glomerular filtration rate (eGFR) derived from serum creatinine levels. Microvascular complications including- retinopathy, neuropathy, and diabetic foot were identified through clinical examination and specialist confirmation, with ophthalmologic and neurologic assessments conducted when needed. Data entry and analysis were performed using SPSS version 27. Categorical variables were analyzed with Chi-square test, while continuous variables were compared using independent t-test. A p-value of less than 0.05 was considered statistically significant.

3. RESULTS AND OBSERVATIONS

This study provides valuable insights into the baseline characteristics, biochemical profile, and burden of microvascular complications among patients with type 2 diabetes mellitus (T2DM) attending the outpatient nephrology department at a tertiary care hospital in Bangladesh. The baseline characteristics of the patients in the sample are shown in Table- 1. The mean age of the study patients was 55.7 ± 10.03 years, with the majority (63.3%) in the 41-60 years age group, and a male predominance (64%, male-to-female ratio was 1.8:1). Of them 57.6% had been suffering from diabetes less than 10 years, while mean duration of diabetes was 10.5 ± 6.08 years. Almost half (44.9%) of these diabetic adults had a family history of diabetes mellitus. Hypertension as a comorbidity was observed in 70.7% of the study population. Nearly two-thirds of the patients had a normal body weight (Table- 1).

Table-1: Baseline characteristics of the study patients (N= 283)

Variables	Frequency (n)	Percentage (%)
Age group (years)		
< 40	16	5.7
41 - 60	179	63.3
> 60	88	31.1
Mean ± SD	55.7 ± 10.03	
Gender		
Male	181	64.0
Female	102	36.0
Male to female ratio	1.8: 1	
Duration of diabetes (years)		
< 10	163	57.6
10 - 20	105	37.1
> 20	15	5.3
Mean ± SD	10.5 ± 6.08	
Family history of DM	127	44.9
Hypertension	200	70.7
BMI (kg/m^2)		
Underweight	12	4.2
Normal weight	186	65.7
Overweight	79	27.9
Obese	6	2.1
Mean ± SD	23.49 ± 3.06	

Analyzing the biochemical parameters revealed a high proteinuria (mean 24h- UTP: 4.90 ± 21.05 gm/day), near normal lipid profile and slightly high mean HbA1c (7.25 ± 1.72%) among the diabetic adults. Their mean serum creatinine was 3.31 ± 2.14 gm/dl and mean eGFR was 26.03 ± 14.64 ml/min/1.73 m², (Table- 2).

Table-2: Biochemical profile of the study patients (N= 283)

Variables	Mean ± SD	Range (minimum – maximum)
24h UTP (gm/day)	4.90 ± 21.05	0.1-290.0
Serum TC (mg/dl)	169.81 ± 55.18	1.3-320.0
Serum LDL (mg/dl)	116.16 ± 47.31	28.0-288.0
Serum HDL (mg/dl)	44.20 ± 30.37	13.0-335.0
Serum TG (mg/dl)	187.96 ±99.98	10.3-777.0
FBS (mmol/L)	8.24 ± 3.62	3.3-26.7
HBA1c (%)	7.25 ± 1.72	4.0-17.0
Serum creatinine (mg/dl)	3.31 ± 2.14	1.2-13.0
eGFR (ml/min/1.73 m²)	26.03 ± 14.64	3.3-69.1

Table- 3 highlights that 66.4% of the patients had at least one microvascular complication. Diabetic neuropathy was the most prevalent (49.8%), followed by diabetic retinopathy (38.2%), including 19.1% with the proliferative form, while diabetic foot was present in 24.7% of patients.

Table- 3: Prevalence of microvascular complications among patients (N= 283)

Variables*	Frequency (n)	Percentage (%)
Diabetic retinopathy	108	38.2
Proliferative Diabetic retinopathy	54	19.1
Diabetic neuropathy	141	49.8
Diabetic foot	70	24.7
Overall microvascular complications	188	66.4

*Multiple responses

It was observed that, long duration of disease, coexisting hypertension and advance CKD stages are significantly associated with microvascular complications ($p<0.05$). Which was further supported by serum creatinine and eGFR levels ($p<0.05$) (Table- 4). These findings highlight the cumulative impact of poor glycemic and blood pressure control on the development of diabetic nephropathy and other microvascular complications.

Table- 4: Association of microvascular complications with clinical and demographic factors among the study patients (N= 283)

Variables	Microvascular complications				p - value
	Present (n = 188)		Absent (n = 95)		
	n	%	n	%	
Age group (years)					
< 40	11	5.9	5	5.3	0.429
41 – 60	114	60.6	65	68.4	
> 60	63	33.5	25	26.3	
Gender					
Male	121	64.4	60	63.2	0.842
Female	67	35.6	35	36.8	
Duration of diabetes (years)					
< 10	95	50.5	68	71.6	0.002*
10 – 20	80	42.6	25	26.3	
> 20	13	6.9	2	2.1	
Mean ± SD					
Family history of DM	85	45.2	42	44.2	0.873
Hypertension	143	76.1	57	60.0	0.005*
BMI (kg/m^2)					
Underweight	9	4.8	3	3.2	0.656
Normal weight	126	67.0	60	63.2	
Overweight	50	26.6	29	30.5	
Obese	3	1.6	3	3.2	
CKD stage (by eGFR)					
60-89 (Stage II)	3	1.6	4	4.2	0.003*
30-59 (Stage III)	52	27.7	41	43.2	
15-29 (Stage IV)	74	39.4	37	38.9	
<15 (Stage V)	59	31.4	13	13.7	
24h UTP (gm/day)	3.85 ± 3.33		8.38 ± 43.53		0.212
Serum TC (mg/dl)	172.93 ± 56.64		163.43 ± 51.79		0.182
Serum LDL (mg/dl)	115.33 ± 50.74		117.67 ± 40.77		0.757
Serum HDL (mg/dl)	40.91 ± 14.48		50.53 ± 47.56		0.066
Serum TG (mg/dl)	191.04 ± 106.21		181.50 ± 85.73		0.468
FBS (mmol/L)	8.31 ± 3.89		8.09 ± 3.01		0.631
HBA1c (%)	7.35 ± 1.86		7.04 ± 1.39		0.161
S. Creatinine (mg/dl)	3.68 ± 2.35		2.57 ± 1.41		<0.001*
eGFR (ml/min/1.73 m^2)	23.40 ± 14.11		31.22 ± 14.35		<0 .001*

p-value obtained by Chi-square test and Unpaired t-test, *significant

4. DISCUSSION

This study revealed a high burden of microvascular complications among patients with type 2 diabetes mellitus (T2DM) attending Nephrology Outpatient Department at a Tertiary Care Hospital in Bangladesh. The majority of participants were middle-aged (mean age 55.7 ± 10.03 years), with 63.3% falling in the 41-60 years age group and a male predominance (64%) was observed in this cohort. This demographic pattern is consistent with other studies conducted in Bangladesh, which indicate that T2DM commonly affects middle-aged adults with a slight male predominance [14, 18]. Notably, over half of the patients (57.6%) had a duration of diabetes less than 10 years; yet the prevalence of hypertension was found to be as high at 70.7%, indicating an early clustering of cardiovascular risk factors. This finding is comparable with other local and regional studies showing high rates of hypertension among diabetic populations [12-14]. In this cohort, the mean BMI was 23.49 ± 3.06 kg/m², with 65.7% of patients having normal BMI, further supporting the well-established evidence that South Asians are more prone to T2DM and its complications at lower BMI thresholds due to increased visceral adiposity and insulin resistance [19]. The biochemical profile revealed a gross proteinuria reflecting overt nephropathy, mean HbA1c of 7.25 ± 1.72% indicating suboptimal glycemic control, slightly exceeding the target HbA1c of <7% recommended by the American Diabetes Association [17]. Additionally, the mean serum creatinine level was elevated at 3.31 ± 2.14 mg/dl, with a mean eGFR of 26.03 ± 14.64 ml/min/1.73 m², reflecting a substantial burden of renal impairment among these patients, which is expected in a nephrology clinic population.

The overall prevalence of microvascular complications in this study was 66.4%, with diabetic neuropathy (49.8%) being the most frequent, followed by retinopathy (38.2%) and diabetic foot (24.7%). These values are comparable to findings by Ali A *et al.,* who reported neuropathy in 68.5% and retinopathy in 31.4% of newly diagnosed diabetic adults [20]. Similarly, Bunza JM *et al.,* found neuropathy in 42.2% of patients in a Nigerian tertiary setting, further supporting the high frequency of nerve-related complications in diabetes [21].

The prevalence of diabetic retinopathy observed aligns with data from South Asian populations [22-23]. Rema M *et al.,* reported a 34.1% prevalence, and Agrawal RP *et al.,* found 28.9% prevalence of diabetic retinopathy in Indian cohorts [22-23]. The slightly higher rate in this study may reflect longer disease duration or the delay referral pattern of nephrology clinics. The prevalence of diabetic foot was found 24.7% which was notably higher than that reported in Chinese (12.3%) and Spanish (10.2%) populations [24-25], likely due to differences in healthcare access and patient complexity in specialty care. These findings are comparable to previous studies in Bangladesh and other low- and middle-income countries where nephropathy, neuropathy and retinopathy remain the most frequent microvascular complications in long-standing diabetes [12-13, 20-23, 26].

Key factors significantly associated with microvascular complications included longer diabetes duration, hypertension, and impaired renal function. Patients with disease duration over 10 years had a significantly higher complication rate (p=0.002), consistent with Merid F *et al.,* who reported nearly threefold increased risk after five years of diabetes [12]. Hypertension was also strongly associated (p=0.005), mirroring findings by Bunza JM *et al.,* [21] and Li C *et al.,* [27], who demonstrated elevated risk of retinopathy in hypertensive patients.

Renal function indicators were also predictive of complications. Patients with lower estimated glomerular filtration rate (eGFR) and elevated serum creatinine had significantly higher microvascular involvement (p<0.001 for both), in line with Hussein M and Menasri S [28], who reported that 80.2% of patients with complications had coexisting chronic kidney disease.

No significant associations were found with age, sex, socioeconomic status, BMI, lipid profile, fasting blood glucose, or HbA1c (p>0.05). Interestingly, BMI and most lipid parameters (TC, LDL, TG) were not significantly associated with microvascular complications. This could be due to overall suboptimal metabolic control among most patients, masking individual contributions of isolated lipid abnormalities. These findings emphasize that addressing all modifiable risk factors, including hyperglycemia, hypertension, and dyslipidemia is critical to prevent or delay microvascular damage. While some studies have shown a strong correlation between glycemic control and complications, which noted weaker association in late-stage presentations, possibly due to metabolic variability or delayed diagnosis [28]. The current study confirms a high prevalence of microvascular complications among T2DM patients in a nephrology setting, with neuropathy and retinopathy being most common. Longer disease duration, hypertension, and renal impairment were key associated factors.

The high prevalence of complications as shown in this cohort underscores the need for systematic early screening, especially for neuropathy and retinopathy, and integrated multidisciplinary care targeting tight glycemic and blood pressure control, lipid management, and renal function preservation.

5. CONCLUSION

In summary, this study demonstrates a high prevalence of microvascular complications among

T2DM patients attending Nephrology OPD at a tertiary care hospital in Bangladesh. Duration of diabetes, hypertension, and worsening renal function are significantly associated with microvascular complications. These findings underscore the need for multidisciplinary interventions focusing on early detection and comprehensive management to prevent progression and improve patient outcomes.

Limitations of the study

Limitations of this study include- its single-center design and cross-sectional nature, which restrict causal inference. However, the findings provide baseline data to guide larger, multicenter longitudinal studies exploring the burden and determinants of microvascular complications in the Bangladeshi diabetic population.

Data availability statement

The data is proprietary of the hospital where the study was conducted. However, the data can be made available upon request.

Ethics statement

All patients consented to participate in the study with anonymity. The IRB of Bangabandhu Sheikh Mujib Medical University (BSMMU), predecessor of Bangladesh Medical University, BMU) waived the ethical requirement citing 'no patients were selected for the purpose of research, but rather their past medical record was used after they received regular treatment.'

Authors contributions

Ferdous Jahan: Conceptualization, data collection, data curation, formal analysis, investigation, methodology, resources, writing – original draft, review & editing of manuscript. Md. Rezaul Alam, Syed Fazlul Islam and Md. Kabir Hossain: Conceptualization, data collection, data curation, formal analysis. Md Mizanur Rahman Khan and Mahfuja Jahan: Methodology, software supervision, validation. Mst. Romena Alam, MD Harun or Rashid Mazumder and A.K.M Shahidur Rahman: Writing, review & editing of manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

REFERENCES

1. Hossain MJ, Al-Mamun M, Islam MR. Diabetes mellitus, the fastest growing global public health concern: Early detection should be focused. Health Science Reports. 2024 Mar;7(3):e2004.
2. Brownlee M. The pathobiology of diabetic complications: a unifying mechanism. diabetes. 2005 Jun 1;54(6):1615-25.
3. Forbes JM, Cooper ME. Mechanisms of diabetic complications. Physiological reviews. 2013 Jan;93(1):137-88.
4. Afkarian M, Zelnick LR, Hall YN, Heagerty PJ, Tuttle K, Weiss NS, de Boer IH. Clinical manifestations of kidney disease among US adults with diabetes, 1988-2014. Jama. 2016 Aug 9;316(6):602-10.
5. Cheung N, Mitchell P, Wong TY. Diabetic retinopathy. Lancet. 2010 Jul 10;376(9735):124-36.
6. Feldman EL, Callaghan BC, Pop-Busui R, Zochodne DW, Wright DE, Bennett DL, Bril V, Russell JW, Viswanathan V. Diabetic neuropathy. Nature reviews Disease primers. 2019 Jun 13;5(1):41.
7. Volmer-Thole M, Lobmann R. Neuropathy and diabetic foot syndrome. International journal of molecular sciences. 2016 Jun 10;17(6):917.
8. Mao W, Yip CM, Chen W. Complications of diabetes in China: health system and economic implications. BMC public health. 2019 Mar 6;19(1):269.
9. Alwin Robert A, Al Dawish MA. Microvascular complications among patients with diabetes: An emerging health problem in Saudi Arabia. Diabetes and Vascular Disease Research. 2019 May;16(3):227-35.
10. Seid MA, Akalu Y, Gela YY, Belsti Y, Diress M, Fekadu SA, Dagnew B, Getnet M. Microvascular complications and its predictors among type 2 diabetes mellitus patients at Dessie town hospitals, Ethiopia. Diabetology & Metabolic Syndrome. 2021 Aug 17;13(1):86.
11. Huang Y, Zheng Z, Chen H, Gu C. Association of socioeconomic status with diabetic microvascular complications: a UK Biobank prospective cohort study. Diabetology & Metabolic Syndrome. 2025 Jan 20;17(1):24.
12. Merid F, Getahun F, Esubalew H, Gezahegn T. Diabetic microvascular complications and associated factors in patients with type 2 diabetes in Southern Ethiopia. Frontiers in Endocrinology. 2024 Jul 4;15: 1342680.
13. Shah A, Kanaya AM. Diabetes and associated complications in the South Asian population. Current cardiology reports. 2014 May;16(5):476.
14. Hossain MB, Khan MN, Oldroyd JC, Rana J, Magliago DJ, Chowdhury EK, Karim MN, Islam RM. Prevalence of, and risk factors for, diabetes and prediabetes in Bangladesh: Evidence from the national survey using a multilevel Poisson regression model with a robust variance. PLOS Global Public Health. 2022 Jun 1;2(6):e0000461.
15. Bermejo S, González E, López-Revuelta K, Ibernon M, López D, Martín-Gómez A, Garcia-Osuna R, Linares T, Díaz M, Martín N, Barros X. The

coexistence of diabetic retinopathy and diabetic nephropathy is associated with worse kidney outcomes. Clinical Kidney Journal. 2023 Oct;16(10):1656-63.
16. Pop-Busui R, Roberts L, Pennathur S, Kretzler M, Brosius FC, Feldman EL. The management of diabetic neuropathy in CKD and dialysis patients. American journal of kidney diseases: the official journal of the National Kidney Foundation. 2009 Dec 30;55(2):365.
17. American Diabetes Association. Standards of medical care in diabetes—2014. Diabetes care. 2014 Jan 1;37(Supplement_1):S14-80.
18. Chowdhury MA, Islam M, Rahman J, Uddin MJ, Haque MR. Diabetes among adults in Bangladesh: changes in prevalence and risk factors between two cross-sectional surveys. BMJ Open. 2022 Aug 1;12(8):e055044.
19. Misra A, Shrivastava U. Obesity and dyslipidemia in South Asians. Nutrients. 2013 Jul 16;5(7):2708-33.
20. Ali A, Iqbal F, Taj A, Iqbal Z, Amin MJ, Iqbal QZ. Prevalence of microvascular complications in newly diagnosed patients with type 2 diabetes. Pakistan journal of medical sciences. 2013 Jul;29(4):899.
21. Bunza JM, Alhassan AJ, Sani MU, Gwarzo MY, Ogunwale KA, Haruna S, Ciroma FA, Dallatu MK, Yeldu MH, Jidda ML, Ngaski AA. Prevalence and Association of Microvascular Complications with some clinical Factors in Patients with Type 2 Diabetes Mellitus in Kano, Nigeria. Elite Journal of Medicine. 2024; 2(3):28-40.
22. Rema M, Ponnaiya M, Mohan V. Prevalence of retinopathy in non-insulin dependent diabetes mellitus at a diabetes centre in southern India. Diabetes research and clinical practice. 1996 Sep 1;34(1):29-36.
23. Agrawal RP, Ranka M, Beniwal R, Sharma S, Purohit VP, Kochar DK, Kothari RP. Prevalence of micro and macro vascular complications in type 2 diabetes and their risk factors. Age. 2004; 50:12-4.
24. Bui HD, Jing X, Lu R, Chen J, Ngo V, Cui Z, Liu Y, Li C, Ma J. Prevalence of and factors related to microvascular complications in patients with type 2 diabetes mellitus in Tianjin, China: a cross-sectional study. Annals of translational medicine. 2019 Jul;7(14):325.
25. Bundó M, Vlacho B, Llussà J, Puig-Treserra R, Mata-Cases M, Cos X, Jude EB, Franch-Nadal J, Mauricio D. Prevalence and risk factors of diabetic foot disease among the people with type 2 diabetes using real-world practice data from Catalonia during 2018. Frontiers in endocrinology. 2022 Oct 24;13: 1024904.
26. Afroz A, Zhang W, Loh AJ, Lee DX, Billah B. Macro-and micro-vascular complications and their determinants among people with type 2 diabetes in Bangladesh. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2019 Sep 1;13(5):2939-46.
27. Li C, Yu H, Zhu Z, Shang X, Huang Y, Sabanayagam C, Yang X, Liu L. Association of blood pressure with incident diabetic microvascular complications among diabetic patients: Longitudinal findings from the UK Biobank. Journal of Global Health. 2023 Mar 24;13: 04027.
28. Hussein M, Menasri S. Prevalence of microvascular complications in type 2 diabetics attending a primary healthcare centre in Sudan. International Journal of Diabetes and Metabolism. 2019 Dec 28;25(3-4):127-33.