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Original Research Article

Cross-Sectional Study of Microalbuminuria and Glycated Hemoglobin (HbA1c) Screening in Diabetic Patients at Tertiary Care Hospital

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Abstract:

Introduction: Diabetes mellitus is a prevalent endocrine disorder characterized by metabolic dysfunctions and long-term complications involving both microvascular and macrovascular systems. Its prevalence is rising rapidly, particularly in developing countries, posing a significant public health challenge. Diabetic nephropathy affects approximately 30% of patients with insulin-dependent diabetes mellitus and about 25% of those with non-insulin-dependent diabetes mellitus. This condition is marked by a progressive increase in proteinuria, especially albuminuria, accompanied by declining glomerular filtration rates and persistently elevated systemic blood pressure, often culminating in end-stage renal disease. This study aims to evaluate the prevalence of microalbuminuria in diabetes mellitus patients with HbA1C > 6.5% and analyze its association with age, sex, and duration of diabetes among patients attending Civil Hospital, Silvassa, DNH.

Material and Method: This cross-sectional study was conducted at Civil Hospital, Silvassa, DNH, over six months (February to July 2019) to evaluate microalbuminuria and HbA1c levels in 50 diabetic patients (cases) and 50 non-diabetic individuals (controls). Diabetic patients were diagnosed using ADA criteria, including HbA1c > 6.5%, while controls had normal glucose tolerance. Participants underwent clinical evaluations, and samples were collected for microalbumin and HbA1c analysis using a Siemens EXL-200 analyzer. Data were statistically analyzed, with $p < 0.05$ considered significant.

Result: In our study, diabetic patients (cases) had significantly higher mean microalbumin levels (36.3 ± 23.7 mg/L) and HbA1c levels (8.7 ± 1.7%) compared to non-diabetic controls (11.8 ± 5.5 mg/L and 5.9 ± 0.5%, respectively; $p < 0.0001$), indicating a strong correlation between poor glycemic control and increased microalbuminuria. Across all age groups, the majority of patients had microalbuminuria < 25 mg/L, though higher prevalence of microalbuminuria > 25 mg/L was noted in older age groups. No significant sex-based differences were observed for microalbumin or HbA1c levels ($p > 0.75$ and $p > 0.76$, respectively). The prevalence of microalbuminuria > 25 mg/L increased with longer diabetes duration, rising from 11.5% in patients with <5 years of diabetes to 80% in those with >10 years. These findings emphasize the impact of diabetes duration and glycemic control on renal function.

Conclusion: Our study concludes that microalbuminuria significantly correlates with HbA1C levels >6.5% and increases with diabetes duration. However, no correlation was found between microalbuminuria levels and the age or sex of diabetic patients.

Keywords: Diabetes mellitus, Microalbuminuria, Glycated Hemoglobin.

Introduction

Diabetes, derived from the Greek word meaning "to run through" or "siphon," was historically used to describe a condition marked by excessive urination. The term "mellitus," introduced by John Rollo, distinguished this condition from other polyuric states like diabetes insipidus, characterized by non-sweet urine. [1] Over centuries, advancements in medicine unraveled the causes, complications, and management of diabetes. Diabetes mellitus (DM) is now recognized as a group of metabolic disorders characterized by persistent hyperglycemia resulting from impaired insulin secretion, action, or both. [2] It is associated with abnormalities in carbohydrate, fat, and protein metabolism, and places patients in a state of chronic, low-grade inflammation due to elevated markers such as C-reactive protein (CRP), which correlates with endothelial dysfunction. [3] The chronic hyperglycemia in diabetes is linked to long-term damage to vital organs, including the kidneys, eyes, nerves, heart, and blood vessels. Among these, diabetic nephropathy is one of the

most serious complications. Diabetes accounts for nearly 44% of new kidney failure cases and contributes significantly to mortality rates from cardiovascular diseases and strokes. [4] In patients with diabetes and proteinuria, mortality risk increases nearly 40-fold compared to those without proteinuria. Microalbuminuria, characterized by albumin excretion rates between 30-300 mg/day, is now recognized as an early and sensitive predictor of diabetic nephropathy and cardiovascular complications. Its prevalence varies widely across populations, reported at 26-36% among Indian patients with type 2 diabetes. [5] Understanding the correlation between glycemic control and the progression from normoalbuminuria to microalbuminuria is essential to mitigate the burden of renal and cardiovascular complications in diabetic populations.

Material and Method

This was a cross-sectional study conducted at Civil Hospital, Silvassa, DNH, over a six-month period from February 2019 to July 2019. The study aimed to evaluate microalbuminuria and glycated hemoglobin (HbA1c) levels among diabetic and non-diabetic individuals. The study included two groups: 50 diabetic patients (cases) and 50 non-diabetic individuals (controls), selected from the hospital's outpatient department. Ethical approval was obtained from the institutional ethics committee, and informed consent was secured from all participants.

Diabetic patients were diagnosed according to the American Diabetes Association (ADA) criteria, which include any of the following:[6]

1. Symptoms of diabetes mellitus (polyuria, polydipsia, weight loss) plus a random plasma glucose concentration ≥200 mg/dL (11.1 mmol/L), **or**
2. Fasting plasma glucose ≥126 mg/dL (7.0 mmol/L) after at least 8 hours of fasting, **or**
3. Two-hour postprandial plasma glucose ≥200 mg/dL (11.1 mmol/L) during an oral glucose tolerance test, **or**
4. HbA1c >6.5%.

Non-diabetic controls were selected based on normal glucose tolerance and the absence of a history of diabetes. Patients with other systemic illnesses, chronic kidney disease, or acute infections were excluded from the study.

Participants were evaluated using clinical history, physical examination, and laboratory investigations. Random urine samples were collected from all participants for microalbumin estimation, while 2 mL of venous blood was drawn into EDTA-containing vacutainers for HbA1c measurement. HbA1c analysis was performed using the Siemens EXL-200 fully automated biochemistry analyzer. All samples were processed promptly to ensure the accuracy and reliability of results.

Data were recorded systematically and analyzed using [statistical software, e.g., SPSS version 21.1. Continuous variables were presented as mean ± standard deviation, and categorical variables were expressed as frequencies and percentages. Comparisons between cases and controls were made using appropriate statistical tests, such as the chi-square test for categorical variables and the t-test for continuous variables. Correlation analysis was conducted to explore the relationship between HbA1c levels and microalbuminuria. A p-value of <0.05 was considered statistically significant. Confidentiality of participants' data was maintained throughout the study. Patients with abnormal findings, such as elevated HbA1c or microalbuminuria levels, were referred for further evaluation and management in the respective hospital departments.

Results

In our study comparing microalbuminuria and HbA1c levels between diabetic patients (cases) and non-diabetic individuals (controls), the mean microalbumin level was significantly higher in cases (36.3 ± 23.7 mg/L) compared to controls (11.8 ± 5.5 mg/L; $p < 0.0001$). Similarly, mean HbA1c levels were elevated in cases (8.7 ± 1.7%) versus controls (5.9 ± 0.5%; $p < 0.0001$), indicating a strong correlation between poor glycemic control and increased microalbuminuria in diabetic patients. (Table 1)

Table 1: Comparison of Microalbuminuria and HbA1c in Cases and Controls

Parameters	Normal Reference Value	Group 1 (Cases) (n=50) Mean ± SD	Group 2 (Controls) (n=50) Mean ± SD	Significance (p-value)
Microalbumin	< 25 mg/L	36.3 ± 23.7	11.8 ± 5.5	< 0.0001
HbA1c	< 6.5%	8.7 ± 1.7	5.9 ± 0.5	< 0.0001

In our study, among the case group, the majority of patients across all age groups had microalbumin levels < 25 mg/L, with 66.66% in both the <30 years and 30-60 years age groups, and 72.72% in the >60 years group. Microalbuminuria > 25 mg/L was observed in a smaller proportion, indicating a higher prevalence of mild microalbuminuria regardless of age. (Table 2)

Table 2: Relation between Age and Microalbumin in Urine in Case Group

Age Group	Microalbuminuria < 25 mg/L	Microalbuminuria > 25 mg/L	Total
< 30 years	4 (66.66%)	2 (33.33%)	6
30-60 years	22 (66.66%)	11 (33.33%)	33
> 60 years	8 (72.72%)	3 (27.27%)	11

Table 3: Sex wise distribution of Microalbumin and HbA_1C (Mean ± SD) in Cases

Parameters	Sex		Significance
	Males	Females	p value
Microalbumin (Mean ± SD)	37.9 ± 25.3	36.4 ± 23.5	0.75
HbA_1C (Mean ± SD)	8.7 ± 1.8	8.6 ± 1.5	0.76

The mean microalbumin and HbA1c levels showed no significant sex-based differences among cases, with similar values observed in males and females ($p > 0.75$ for microalbumin and $p > 0.76$ for HbA1c). (Table 3)

Table 4: Relation between Duration of Diabetes (Since Diagnosis) and Microalbuminuria in Case Group

Duration of Diabetes (since diagnosis)	Microalbuminuria > 25 mg/L	Microalbuminuria < 25 mg/L	Total
< 5 years	3 (11.5%)	23 (88.5%)	26
5-10 years	9 (64.3%)	5 (35.7%)	14
> 10 years	8 (80%)	2 (20%)	10

The prevalence of microalbuminuria > 25 mg/L increased with the duration of diabetes, observed in 11.5% of patients with <5 years, 64.3% with 5-10 years, and 80% with >10 years since diagnosis. (Table 4)

Discussion

Diabetes mellitus is characterized by widespread endothelial dysfunction, with severity linked to patient age and diabetes duration. Microalbuminuria signals early kidney dysfunction and warns of impending nephropathy. It also indicates risks of progressive nephropathy, retinopathy, neuropathy, and cardiovascular complications, including coronary artery disease and hypertension. In our study, significantly higher levels of microalbuminuria (36.3 ± 23.7 mg/L vs. 11.8 ± 5.5 mg/L) and HbA1c (8.7 ± 1.7% vs. 5.9 ± 0.5%) were observed in diabetic cases compared to controls ($p < 0.0001$), reflecting poor glycemic control's role in renal dysfunction. Similarly, Kiconco et al. [7] reported that microalbuminuria is a sensitive early marker for diabetic nephropathy, emphasizing the importance of glycemic monitoring to prevent progression to end-stage renal disease. Chowdhury et al. [8] corroborated these findings, showing a direct correlation between HbA1c levels and microalbuminuria, with microalbuminuria prevalence rising with HbA1c values above 7%.

Further, Jankar et al. [5] demonstrated a significant association between poor glycemic control (HbA1c > 7%) and increased urinary albumin levels, highlighting the utility of HbA1c and microalbumin as combined markers for early nephropathy risk assessment in diabetes. Consistent with these trends, Karki et al. [9] emphasized that tighter glycemic control significantly reduces microalbuminuria prevalence, thereby mitigating long-term complications such as diabetic nephropathy and cardiovascular disease. These studies collectively reinforce the need for regular HbA1c and microalbuminuria screening in diabetic management.

In our study, microalbuminuria > 25 mg/L was observed in 33.33% of patients aged <30 years, 33.33% in the 30-60 years group, and 27.27% in those >60 years, indicating a significant prevalence of renal involvement across all age groups. These findings are consistent with Dhonde et al. [10], who noted that advancing age correlates with an increased risk of microalbuminuria due to prolonged exposure to hyperglycemia and systemic vascular changes.

Similarly, Mir et al. [11] demonstrated a rising trend of microalbuminuria with age in newly diagnosed diabetics, highlighting age as a critical risk factor for diabetic nephropathy. Syed et al. [12] also observed that patients aged 41-60 years exhibited the highest prevalence of nephropathy markers, further supporting the role of age-related vascular changes and prolonged hyperglycemia in exacerbating renal dysfunction.

Further comparison with Kavthekar et al. [13] highlights that diabetes duration significantly amplifies microalbuminuria risk, with older patients experiencing higher urinary albumin levels. This aligns with our study, where patients >60 years exhibited notable renal involvement, likely reflecting the cumulative impact of prolonged disease and aging. Puri et al. [14] also

noted a strong association between age, diabetes duration, and microvascular complications, underscoring the compounded effects of chronic hyperglycemia and vascular endothelial damage. Bhat et al. [11] corroborated this, showing that older diabetics with poor glycemic control are more prone to renal damage, reinforcing the necessity for stringent monitoring and intervention in these populations to mitigate long-term complications.

In our study, there was no statistically significant difference in microalbuminuria levels between males (37.9 ± 25.3 mg/L) and females (36.4 ± 23.5 mg/L; p = 0.75), nor in HbA1c levels (8.7 ± 1.8% vs. 8.6 ± 1.5%; p = 0.76). This aligns with findings by Mir et al. [11], who observed that microalbuminuria prevalence was comparable across genders, suggesting that sex may not independently influence renal involvement in diabetes. Similarly, Puri et al. [14] reported no significant gender differences in microalbuminuria levels, attributing renal dysfunction primarily to glycemic control and diabetes duration rather than sex-specific factors. These results challenge earlier studies, such as Dhonde et al. [10], which suggested slightly higher susceptibility in males, potentially due to behavioral and metabolic differences like higher smoking rates and delayed healthcare access.

Further supporting our findings, Kavthekar et al. [13] found no significant difference in HbA1c levels between males and females, emphasizing that glycemic control does not inherently differ by sex. Syed et al. [12] also reported similar HbA1c distributions across genders, reinforcing the notion that sex is not a primary determinant of glycemic control or related complications. However, subtle physiological differences, such as hormonal variations influencing vascular integrity in females, as noted by Mir et al. [11] (2019), may still play a role in microvascular outcomes. The overall consistency across these studies indicates that factors like duration of diabetes, lifestyle, and glycemic control are more critical in determining microalbuminuria and HbA1c outcomes than gender alone, reinforcing the need for personalized management strategies irrespective of sex.

In our study, microalbuminuria > 25 mg/L was observed in 11.5% of patients with a diabetes duration of <5 years, 64.3% with 5-10 years, and 80% with >10 years, indicating a progressive increase in renal involvement with longer disease duration. This trend is consistent with findings by Mir et al. [11], who reported a significant association between diabetes duration and the prevalence of microalbuminuria, emphasizing that prolonged hyperglycemia exacerbates renal damage. Similarly, Kavthekar et al. [13] highlighted that patients with a diabetes duration of >4 years exhibited higher rates of microalbuminuria, reflecting the cumulative effect of chronic glycemic stress on kidney function. Syed et al. [12] corroborated this pattern, noting a positive correlation between diabetes duration and nephropathy markers, reinforcing the importance of early intervention to mitigate long-term complications.

Further, Dhonde et al. [10] observed that patients with a diabetes duration exceeding 10 years had significantly elevated risks of microalbuminuria, closely aligning with the 80% prevalence observed in our study. Puri et al. [14] attributed this to persistent vascular damage and progressive glomerular dysfunction over time. The findings are also supported by Mir et al. [11], who demonstrated that diabetes duration is a critical determinant of renal outcomes, with longer durations associated with both microalbuminuria and overt nephropathy. Collectively, these studies underscore the importance of routine screening for microalbuminuria, particularly in patients with longer diabetes durations, to enable timely interventions that can slow or prevent the progression to end-stage renal disease.

The limitations of our study include a relatively small sample size, which may restrict the generalizability of the findings to larger populations. Additionally, this was a cross-sectional study, limiting the ability to establish causal relationships between microalbuminuria, HbA1c levels, and diabetes duration. Factors such as dietary habits, medication adherence, and comorbid conditions that could influence microalbuminuria were not extensively explored. Moreover, the reliance on single-time measurements of microalbumin and HbA1c may not fully capture the variability of these markers over time.

Conclusion

Our study underscores the significant association between diabetes duration and microalbuminuria, with longer durations correlating with higher prevalence rates, highlighting the cumulative impact of chronic hyperglycemia on renal function. Microalbuminuria, as the earliest indicator of diabetic nephropathy, also reflects generalized vascular damage and serves as a critical predictor of renal disease. While no significant sex or age differences in microalbuminuria levels were observed in diabetic patients with HbA1c > 6.5%, its progression is closely linked to disease duration. These findings emphasize the importance of regular screening for microalbuminuria, including at least twice-annual urinary albumin measurements, to enable early detection and timely intervention. Effective glycemic control and careful follow-up are vital to mitigating the risk of nephropathy and

other vascular complications in diabetic populations.

Bibliography

1. Alam S, Eqbal K, Patel I, Mulla I, Ansari S, Ayesha B. The history of diabetes: from olden days to discovering insulin. Int J Unani Integr Med. 2017; 1(1):25–8.
2. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2014; 37(Supplement_1):S81–90.
3. Pietzner M, Kaul A, Henning AK, Kastenmüller G, Artati A, Lerch MM, et al. Comprehensive metabolic profiling of chronic low-grade inflammation among generally healthy individuals. BMC Med. 2017; 15:1–12.
4. Martínez-Castelao A, Navarro-González JF, Górriz JL, De Alvaro F. The concept and the epidemiology of diabetic nephropathy have changed in recent years. J Clin Med. 2015; 4(6):1207–16.
5. Warjukar P, Jain P, Kute P, Anjankar A, Ghangale S. Study of microalbuminuria and uric acid in type 2 diabetes mellitus. Int J Cur Res Rev. 2020; 2020.
6. Inzucchi SE, Bergenstal RM, Buse JB, Diamant M, Ferrannini E, Nauck M, et al. Management of hyperglycemia in type 2 diabetes: a patient-centered approach: position statement of the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). Diabetes Spectr. 2012; 25(3):154–71.
7. Kiconco R, Rugera SP, Kiwanuka GN. Microalbuminuria and traditional serum biomarkers of nephropathy among diabetic patients at Mbarara regional referral Hospital in south western Uganda. J Diabetes Res. 2019; 2019(1):3534260.
8. Chowdhury SK, Datta S, Mohith MT, Roy S, Hossain MJ, Zafrin N, et al. Study of relationship between HbA1c and microalbuminuria of diabetic patients. Ann Intern Med Dent Res. 2022; 8(2):99–108.
9. Karki PK, Timalsina S, Chalise S, Yadav A, Bhattarai AK. Prevalence of microalbuminuria and its association with glycemic control in type 2 diabetic patients: A cross sectional study at Kathmandu Medical College. J Chitwan Med Coll. 2019; 9(1):2–7.
10. Dhonde S, Jagtap P, Belwalkar G, Mane V, Shilwant N, Nagane N. A study of microalbuminuria in patients with type 2 diabetes mellitus, visiting tertiary care center Sangli. Int J Clin Biochem Res. 2022; 9(1):31–7.
11. Mir SR, Bhat MH, Misgar RA, Bashir MI, Wani AI, Malik HI. Prevalence of microalbuminuria in newly diagnosed T2DM patients attending a tertiary care hospital in North India and its association with various risk factors. Int J Contemp Med Res. 2019; 6:D9-13.
12. Syed AA, Sultana W, Ameer SR, Keerthana OBS. A Study on Relationship of Glycosylated Haemoglobin (HbA1c) in Newly Diagnosed Type 2 Diabetes Mellitus with Special Reference to Diabetic Retinopathy and Diabetic Nephropathy. Eur J Cardiovasc Med. 2024; 14:488–96.
13. Kavthekar SO, Mali VT, Verma S, Kurane AB, Patil NB, Kulkarni SP. Evaluation of Microalbuminuria and Glycosylated Hemoglobin in the Assessment of Diabetes Control in Children with Type 1 Diabetes Mellitus Hospitalized with Diabetic Ketoacidosis. J Compr Pediatr. 2021; 12(2).
14. Puri D, Kaur J, Gaur N, Kodidala SR. Role of glycated hemoglobin in microvascular complications in type 2 diabetes mellitus: cross sectional study. Int J Endocrinol Ukr. 2022; 18(6):319–23.