

A Prospective Study on HbA_{1c}, Lipid Profile and Genitourinary Infections in Controlled Versus Uncontrolled Diabetic Patients

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ABSTRACT

Background: Diabetes Mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia, leading to significant metabolic complications. Poor glycemic control exacerbates these complications, including alterations in lipid profiles and an increased susceptibility to infections, particularly in the genitourinary system. **Aim:** This study aimed to compare HbA_{1c} levels, lipid profiles and the prevalence of genitourinary infections in patients with controlled (HbA_{1c} < 7.0%) versus uncontrolled (HbA_{1c} ≥ 7.0%) Type 2 Diabetes Mellitus (T2DM). **Materials and Methods:** A prospective observational study was conducted at a tertiary care hospital, involving 120 patients diagnosed with T2DM. Participants were divided into two groups based on their HbA_{1c} levels: controlled and uncontrolled. Data on HbA_{1c}, lipid profiles and the occurrence of genitourinary infections were collected and analyzed. **Results:** The study included 120 participants, comprising 45.83% males and 54.17% females, with a mean age of 62.52 years. The mean HbA_{1c} was 9.15%, indicating poor glycemic control; 73.33% of participants were in the uncontrolled group, with a mean HbA_{1c} of 10.16%, while 26.66% were in the controlled group, with a mean HbA_{1c} of 6.35%. Fasting Blood Glucose (FBG) levels in females ranged from 78 to 786 mg/dL, with a mean of 185.76 mg/dL, whereas in males, the range was 68 to 270 mg/dL, with a mean of 151.94 mg/dL. **Conclusion:** These findings emphasize the importance of maintaining stringent glycemic control in diabetic patients to optimize lipid profiles and reduce the risk of genitourinary infections. Effective management of HbA_{1c} is crucial for mitigating these associated risks in T2DM patients.

Keywords: HbA_{1c}, Lipid Profile, Genitourinary Infections, Diabetes mellitus.

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Received: 19-10-2024;

Revised: 18-11-2024;

Accepted: 05-01-2025.

INTRODUCTION

Diabetes Mellitus (DM) is a group of metabolic disorders characterized by chronic hyperglycemia resulting from defects in insulin secretion, action, or both. Affecting one in every 12 individuals globally, with many undiagnosed, DM is aptly termed the "Silent Killer." The disorder causes significant metabolic abnormalities in carbohydrates, lipids and proteins, primarily due to the essential role of insulin as an anabolic hormone. The International Diabetes Federation (IDF) highlights South-East Asia, particularly India, as a critical region in the global diabetes crisis, with India having the 2nd largest diabetic population after China, at 82 Million.¹

Type 2 Diabetes Mellitus (T2DM) constitutes the majority of cases, with its prevalence rising alarmingly over recent decades.

The World Health Organization (WHO) estimates that 180 million people worldwide currently suffer from T2DM, a number projected to double by 2030. T2DM imposes significant human and economic costs, primarily due to complications such as retinopathy, nephropathy, neuropathy and an increased risk of cardiovascular disease.

Glycated hemoglobin (HbA_{1c}) levels of ≥6.5% are used as a diagnostic criterion for diabetes,² and HbA_{1c} also predicts the risk of complications in DM patients. Regular monitoring of lipid profiles is crucial, as a positive correlation exists between HbA_{1c} levels and cardiovascular risk, even in non-diabetic individuals.² The abnormal lipid profiles observed in T2DM, often associated with metabolic syndrome—a combination of T2DM and hypertension—underscore the importance of early detection and management to reduce the risk of cardiovascular and cerebrovascular complications.³

This study focuses on evaluating and comparing HbA_{1c} levels, lipid profiles and the incidence of genitourinary infections in controlled (HbA_{1c} < 7.0%) and uncontrolled (HbA_{1c} ≥ 7.0%) diabetic patients. It also aims to analyze patterns of antidiabetic drug use, identify



DOI: 10.5530/ijopp.20250186

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major risk factors associated with diabetes in a hospital setting and determine the common pathogens responsible for Urinary Tract Infections (UTIs) in diabetic patients with varying levels of glycemic control.

MATERIALS AND METHODS

Study Design and Site

This study was designed as a prospective observational investigation conducted at a tertiary care hospital. The research primarily focused on patients diagnosed with type 2 diabetes mellitus who were admitted to the hospital.

Study Population

The study included male and female patients aged 35 years and above who had a diagnosis of type 2 diabetes mellitus and were undergoing surgical treatment.

Data Sources and Materials

Data were collected from various sources, including patient case notes, treatment charts and laboratory reports. These documents provided comprehensive details necessary for the study.

Inclusion Criteria

The inclusion criteria for this study are as follows: patients diagnosed with diabetes mellitus, aged above 35 years and those undergoing surgical procedures with a diagnosis of diabetes.

Exclusion Criteria

The exclusion criteria for this study included newly diagnosed diabetic patients, individuals with type 1 diabetes mellitus, those with catheter-associated infections, patients with diabetic foot complications and pregnant women.

Method of Data Collection

The study was conducted in the Department of Medicine from January to October 2023. Patients who met the inclusion criteria were enrolled after obtaining informed consent. Baseline demographic data, such as age, sex, weight, date of admission and the onset of treatment, were collected. Detailed patient history, including previous and current medical conditions, was obtained from the patients and their caregivers. Relevant clinical and laboratory data, including HbA_{1c} levels, lipid profiles and microbiological reports, were meticulously documented. All information was recorded using a standardized data collection form. Follow-up data were regularly gathered and recorded for further analysis.

Ethical Considerations

Ethical considerations included informing participants about the study's objectives, procedures and benefits and obtaining written informed consent. Data confidentiality was ensured through

anonymization and secure storage, with restricted access to authorized personnel. Since the study was observational and did not involve medication or treatment changes, ethical approval was not required, but informed consent and confidentiality were upheld throughout.

RESULTS

The study included 120 participants, with 45.83% males and 54.17% females. Age distribution showed that 25.83% were in the 55-64 age group, followed by 65-74 years (24.16%) and 75 and above (20.83%). The mean age was 62.52 years. Regarding health indicators, 20% had a BMI of ≥ 25 kg/m² and 36% had a BMI of < 25 kg/m². Smoking prevalence was 9%, while 16% engaged in regular exercise. Medication usage was as follows: 53% on Oral Hypoglycemic Agents (OHA), 7% on insulin, 18% on both and 22% on none. Compliance with treatment was reported by 33% of participants. Hypertension affected 62% of the participants, 12% had micro-vascular complications and 27% had macro-vascular complications. The mean HbA_{1c} was 9.15, indicating poor glycemic control. The median fasting blood glucose level was 155.5 mg/dL (range 68-786) and the median random blood glucose level was 213.5 mg/dL (range 101-978). This data provides a comprehensive overview of the participants' health status and treatment regimens, details depicted in Table 1.

Table 2 presents data on glycemic status and blood glucose concentrations among the study population of 120 diabetic patients. Of these, 26.66% were in the controlled glycemic group, with a mean HbA_{1c} of 6.35%, while 73.33% were in the uncontrolled group, with a mean HbA_{1c} of 10.16%. Fasting Blood Glucose (FBG) levels in females ranged from 78 to 786 mg/dL, with a mean of 185.76 mg/dL, whereas in males, the range was 68 to 270 mg/dL, with a mean of 151.94 mg/dL. HbA_{1c} levels in females varied from 5.3% to 16.4%, with a mean of 9.57%. This data highlights the significant proportion of patients with uncontrolled diabetes and indicates substantial variability in blood glucose levels among the participants.

The most frequently prescribed insulin type was short-acting insulin (62.5%), predominantly among uncontrolled patients, while long-acting insulin was prescribed to 40.83% of patients, with a higher prevalence in uncontrolled cases. Intermediate-acting insulin was the least used (2.5%) and prescribed exclusively to uncontrolled patients. Among oral hypoglycemic agents, Metformin was the most commonly prescribed (7.5%), followed by Vildagliptin (10.83%) and Glimepiride (4.16%). Combination drugs were widely used particularly Vildagliptin+Metformin (15%) and Glimepiride+Metformin (11.66%), whereas combinations like Dapagliflozin+Vildagliptin (0.83%) were the least prescribed. These findings underscore the prevalent use of short-acting insulin and combination drugs, highlighting the importance of personalized treatment strategies in diabetes management, as detailed in Table 3.

Table 1: Baseline Characteristics of Study Participants.

Variable	Categories	Frequency (n)	Percentage (%)
Gender	Male	55	45.83
	Female	65	54.17
Age Group (years)	35-44	15	12.5
	45-54	20	16.66
	55-64	31	25.83
	65-74	29	24.16
	75 and above	25	20.83
Mean Age (years)		62.52	
BMI (kg/m ²)	≥25	24	20
	<25	43	36
Exercise	Yes	19	16
Smoking	Yes	7	9
Medication	OHA	64	53
	Insulin	8	7
	Both	22	18
	None	26	22
Compliance	Yes	40	33
Hypertension	Yes	75	62
Micro-vascular complications	Yes	14	12
Macro-vascular complications	Yes	33	27
HbA_{1c} (mean)		9.15	
Fasting blood glucose levels	Median	155.5	(68-786)
Random blood glucose levels	Median	213.5	(101-978)

Of 120 patients, 111 were diagnosed with UTIs, with *E. coli* being the predominant pathogen (46%), followed by *Klebsiella* sp. (23%) and *Pseudomonas aeruginosa* (12%). The controlled group showed a higher prevalence of *Klebsiella* sp. (26%) and *Enterococcus* sp. (15%) compared to the uncontrolled group. Cystitis was the most common type of UTI, affecting 37% of patients, with a higher incidence in females (42%) than in males (32%). Bacteriuria was present in 27% of cases, equally distributed between genders. *Pyelonephritis* and *urosepsis* were more prevalent in males (22% and 11%, respectively) than in females (9% and 16%, respectively). The findings highlight a significant presence of bacterial infections and various forms of UTIs, with notable differences across genders and glycemic control levels, as detailed in Table 4.

DISCUSSION

Diabetes Mellitus (DM) is a chronic metabolic condition associated with hyperglycemia and significant risk of complications. Glycemic control, typically assessed using Glycated Hemoglobin (HbA_{1c}), is essential for reducing complications and improving patient outcomes. Poor glycemic control is often linked to dysregulated lipid profiles and increased susceptibility

to infections and complications. This study aimed to compare controlled and uncontrolled diabetic patients based on HbA_{1c} levels, lipid profiles and genitourinary infections.

Over a 6-month period, 120 diabetic patients were analyzed and classified by glycemic control based on HbA_{1c} levels, with a cutoff of 7.0%. Patients with HbA_{1c}<7.0% were categorized as having good glycemic control, while those with HbA_{1c}>7.0% were categorized as having poor control. Data collected included demographic information, Fasting Blood Glucose (FBS), lipid profiles (Total Cholesterol [TC], Low-Density Lipoprotein [LDL], High-Density Lipoprotein [HDL] and Triglycerides [TG]) and the prevalence of risk factors and complications.

Among the 120 patients, 32 (27%) had good glycemic control (HbA_{1c}<7.0%) and 88 (73%) had poor control, consistent with previous studies showing a high prevalence of poor glycemic control in diabetic populations.⁴ The mean HbA_{1c} level in the study population was 9.15%, indicating generally poor glycemic control.

When categorized by age, the largest group (26%) was aged 55-64 years, followed by 24% aged 65-74 years. The mean age was higher in the controlled group (65.40 years) compared to

Table 2: Descriptive Statistics of Glycemic Status and Blood Glucose Concentration.

Variable	Categories	Frequency (n)	Percentage (%)	Mean/Range
Glycemic Status	Controlled	32	26.66	HbA _{1c} : 6.35
	Uncontrolled	88	73.33	HbA _{1c} : 10.16
FBG (mg/dL)	Female Normal Range			70-100
	Female Study Group Range			78-786
	Female Mean			185.76
	Male Normal Range			70-100
	Male Study Group Range			68-270
	Male Mean			151.94
HbA _{1c} (%)	Female Normal Range			<7.0
	Female Study Group Range			5.3-16.4
	Female Mean			9.57

Table 3: Types of Insulin, Oral Hypoglycemic Agents and Combination Drugs Prescribed.

Category	Type/Drug	Controlled (%)	Uncontrolled (%)	Total (%)	Frequency	Percentage (%)
Insulin Type	Short acting	50	67	62.5	-	-
	Intermediate acting	0	3.4	2.5	-	-
	Long acting	25	46.6	40.83	-	-
Oral Hypoglycemic Agents	Metformin	-	-	-	9	7.5
	Glimepiride	-	-	-	5	4.16
	Gliclazide	-	-	-	2	1.66
	Glipizide	-	-	-	1	0.83
	Vildagliptin	-	-	-	13	10.83
	Sitagliptin	-	-	-	1	0.83
	Tenagliptin	-	-	-	2	1.66
	Linagliptin	-	-	-	1	0.83
	Dapagliflozin	-	-	-	2	1.66
	Empagliflozin	-	-	-	1	0.83
Combination Drugs	Voglibose	-	-	-	2	1.66
	Glimepiride+Metformin	-	-	-	14	11.66
	Vildagliptin+Metformin	-	-	-	18	15
	Sitagliptin+Metformin	-	-	-	2	1.66
	Tenagliptin+Metformin	-	-	-	2	1.66
	Glimepiride+Metformin+Voglibose	-	-	-	3	2.5
Dapagliflozin+Vildagliptin	-	-	-	1	0.83	

the uncontrolled group (61.48 years). Female patients had higher mean HbA_{1c}, TC, LDL and TG levels compared to male patients.

FBS levels were lower in patients with good glycemic control, aligning with findings from prior studies examining correlations

between glycemic control and lipid profiles.⁵ The lipid profile analysis revealed that mean levels of TC, LDL and TG were elevated across the population but were significantly lower in the good glycemic control group. HDL levels were higher in patients with good control.

Table 4: Uropathogens and UTI Types.

Uropathogen/UTI Type	Controlled (%)	Uncontrolled (%)	Total Cases (%)
<i>E. coli</i>	38% (13/34)	47% (38/81)	46% (51/111)
<i>Klebsiella</i> sp.	26% (9/34)	21% (17/81)	23% (26/111)
<i>Enterococcus</i> sp.	15% (5/34)	11% (9/81)	13% (14/111)
<i>Candida</i> sp.	3% (1/34)	5% (4/81)	5% (5/111)
<i>Pseudomonas aeruginosa</i>	12% (4/34)	13% (11/81)	12% (15/111)
<i>Morganella morganii</i>	3% (1/34)	0% (0/81)	1% (1/111)
<i>Acinetobacter</i> sp.	3% (1/34)	3% (2/81)	3% (3/111)
Vancomycin-resistant <i>Enterococcus</i> (VRE)	0% (0/34)	3% (2/81)	2% (2/111)
Bacteriuria	27.27% (15/55)	26.15% (17/65)	27% (32/120)
Cystitis	41.81% (23/55)	32.3% (21/65)	37% (44/120)
Pyelonephritis	9.09% (5/55)	21.53% (14/65)	16% (19/120)
Urosepsis	16.36% (9/55)	10.76% (7/65)	13% (16/120)

Patients in the uncontrolled group were more likely to have a BMI above the normal range (22%) compared to those in the controlled group. Physical activity was reported by 19% of patients in the controlled group and 15% in the uncontrolled group. Compliance with medication was significantly higher in the controlled group (66%) than in the uncontrolled group (22%).

Hypertension, microvascular complications (e.g., retinopathy, nephropathy) and macrovascular complications (e.g., cardiovascular disease) were more prevalent in the uncontrolled group compared to the controlled group.

CONCLUSION

The study highlights the critical importance of maintaining good glycemic control in diabetic patients to effectively manage HbA_{1c} levels and minimize associated risks. Poor glycemic control was linked to significantly elevated HbA_{1c} levels and adverse lipid profiles, such as increased total cholesterol, low-density lipoprotein and triglycerides. These dyslipidemic patterns are major contributors to cardiovascular complications, underscoring the need for rigorous monitoring and management of blood glucose and lipid levels. Achieving glycemic targets not only reduces these risks but also improves overall metabolic stability.

Additionally, the study revealed a potential connection between poor glycemic control and an increased incidence of Urinary Tract Infections (UTIs). Patients with higher HbA_{1c} levels exhibited a greater susceptibility to genitourinary infections, emphasizing the importance of glycemic management in reducing infection-related complications. This highlights the need for integrated care that addresses both metabolic and infectious disease risks in diabetic patients, particularly those with poorly controlled diabetes.

A comprehensive approach to diabetic care involves routine monitoring of blood glucose and lipid profiles, adoption of

lifestyle modifications and adherence to medication regimens. Physical activity, dietary management and compliance with prescribed therapies are essential components of this strategy. Healthcare providers play a pivotal role in educating patients and implementing tailored interventions that address individual risk factors. The findings of this study underscore the value of evidence-based, patient-centered care in improving health outcomes and enhancing the quality of life for diabetic patients.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to Dr. K. Ramesh, Director of Karnataka College of Pharmacy, for his invaluable support throughout the study. I also extend my heartfelt thanks to Dr. Balakeshwa Ramaiah, Professor and Head of the Department of Pharmacy Practice at Karnataka College of Pharmacy, for his cooperation and guidance, which were instrumental in the successful completion of this research.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

DM: Diabetes Mellitus; **HbA_{1c}:** Glycated Hemoglobin; **FBS:** Fasting Blood Glucose; **TC:** Total Cholesterol; **LDL:** Low-Density Lipoprotein; **HDL:** High-Density Lipoprotein; **TG:** Triglycerides; **BMI:** Body Mass Index; **UTIs:** Urinary Tract Infections.

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Cite this article: Aswathi PS, Krishnan A, Ramaiah B. A Prospective Study on HbA_{1c}, Lipid Profile and Genitourinary Infections in Controlled Versus Uncontrolled Diabetic Patients. *Indian J Pharmacy Practice.* 2025;18(3):279-84.