Journal of Monno Medical College
December, 2025; 11(2):86-90

Original Article

Serum Creatinine Levels in Children and Adolescents with Type-1 Diabetes Mellitus and its Relationship with Glycemic Control: An Experience from A Tertiary Level Specialized Hospital in Bangladesh

Shawana Haque[1], Thahamina Shahabuddin[2], Aniqa Tasnim[3], Md. Sahadat Hossain[4], Farzana Afroze[5], Suborna Sarker[6], Md. Mostaque Mahmud[7]

[1]Associate Professor, Department of Biochemistry, Monno Medical College, Manikganj, Bangladesh; [2]Associate Professor, Department of Biochemistry, United Medical College Hospital, Dhaka, Bangladesh; [3]Assistant Professor, Department of Biochemistry, Green Life Medical College, Dhaka, Bangladesh; [4]Lecturer, Department of Biochemistry, Chandpur Medical College, Chandpur, Bangladesh; [5]Assistant Professor, Department of Biochemistry, Monno Medical College, Manikganj, Bangladesh; [6]Senior Lecturer, Department of Biochemistry, Monno Medical College, Manikganj, Bangladesh; [7]Associate Professor, Department of Dermatology and Venereology, Bangladesh Medical University, Dhaka, Bangladesh

Abstract

Background: Type 1 Diabetes Mellitus (T1DM) is a chronic condition that can lead to multiple complications, including diabetic nephropathy. Serum creatinine is a common biomarker for assessing renal function and it is also important to understand how glycemic control influences creatinine levels in T1DM patients. ***Objective:*** This study aimed to estimate the serum creatinine level and its relationship with the glycemic control in children and adolescents with Type 1 Diabetes Mellitus. ***Methodology:*** For this study 80 type 1 diabetic children & adolescents with age range 1 to 18 years and 80 aged matched healthy controls were enrolled from the outpatient department of BIRDEM General Hospital-2, Dhaka, Bangladesh during July 2016 to June 2017. Using a cross-sectional design, we measured anthropometric parameters and serum creatinine level of all study subjects. Glycemic control was evaluated through estimation of HbA1c. ***Results:*** The mean serum creatinine levels were significantly higher in patients with type 1 DM compared to controls (1.1 ± 0.5 vs. 0.8 ± 0.2 mg/dl; $P < 0.001$). Higher levels of creatinine were found in subjects with poor glycemic control compared to good glycemic control (1.2 ± 0.5 vs. 0.9 ± 0.4 mg/dl; $P<0.05$). ***Conclusion:*** Serum creatinine level is higher in type 1 diabetic children & adolescents in comparison to its healthy counterpart and this higher creatinine level is strongly associated with poor glycemic control which may potentially contribute to the early development of diabetic complications.

Keywords: Type 1 Diabetes mellitus; glycemic control; serum creatinine
Received: 02 April 2025; Accepted: 20 May 2025; **Published:** 1 December 2025
DOI: https://doi.org/10.3329/jmomc.v11i2.90260

Correspondence: Dr. Shawana Haque, Associate Professor, Department of Biochemistry, Monno Medical College, Monno City, Gilondo, Manikganj, Bangladesh, email: drshawanahaqueofficial@gmail.com, ORCID: https://orcid.org/0009-0007-8799-0519; Cell no.: +8801760748156

How to cite this article: Haque S, Shahabuddin T, Tasnim A, Hossain MS, Afroze F, Sarker S, Mahmud MM. Serum Creatinine Levels in Children and Adolescents with Type-1 Diabetes Mellitus and its Relationship with Glycemic Control: An Experience from A Tertiary Level Specialized Hospital in Bangladesh. J Monno Med Coll. 2025 December;11(2):86-90

Introduction:

Type 1 Diabetes Mellitus (T1DM) is the most common form of diabetes in children and adolescents, characterized by autoimmune destruction of pancreatic β-cells and absolute insulin deficiency[1]. Individuals with T1DM require lifelong insulin therapy to maintain glycemic control and prevent the potentially devastating effects of hyperglycemia. Chronic hyperglycemia if not well controlled, leads to the development of a series of microvascular complications, including diabetic nephropathy, which is a leading cause of morbidity and mortality in young people with diabetes[2]. Diabetic nephropathy is a major complication of diabetes, affecting a substantial proportion of individuals with T1DM. It is characterized by damage to the small blood vessels in the kidneys, resulting in progressive renal

dysfunction. Diabetic nephropathy typically manifests clinically with microalbuminuria but the onset of structural and functional renal changes can occur much earlier often without clinical symptoms, making early detection and monitoring essential to prevent irreversible kidney damage[3,4]. The development of nephropathy in children and adolescents with T1DM presents a particular challenge, as it significantly impacts their overall health and quality of life, potentially leading to long-term kidney failure.

One of the most widely used and easily accessible biomarkers for assessing renal function is serum creatinine. In children with T1DM, an elevated serum creatinine level may serve as an early indicator of glomerular injury which could be a precursor to more severe kidney damage. Elevated creatinine levels serve as a potential marker for the early stages of diabetic nephropathy, even before more overt symptoms such as microalbuminuria appear[5,6].

Poor glycemic control reflected by elevated glycated hemoglobin (HbA1c) levels has been strongly associated with progression of microvascular complications, including nephropathy[7,8]. However, data from low- and middle-income countries, including Bangladesh, are limited. This study aimed to compare serum creatinine levels in children and adolescents with T1DM and healthy controls and to explore the relationship between serum creatinine and glycemic control.

Through these findings, we hope to highlight the importance of early detection and intervention in the prevention of renal complications in children and adolescents with T1DM, and ultimately, to improve the long-term health outcomes for this vulnerable group.

Methodology

Study Settings and Population: This cross-sectional study was conducted during July 2016 to June 2017 in the Department of Biochemistry and Molecular Biology of Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) General Hospital, Dhaka, Bangladesh, which is the largest tertiary level specialized diabetic hospital in the country. 160 participants aged 1 to 18 years through purposive sampling technique were selected from the outpatient department (OPD) of "Changing Diabetes in Children (CDIC)" Program Clinic at BIRDEM General Hospital-2, Dhaka.

Study Procedure: The participants were divided into two groups – 80 type 1 diabetic children and adolescents as cases and 80 apparently healthy participants as controls. All diabetic patients were being treated with insulin. After selection of the study subjects, the aims and objectives of the study along with procedure, risks and benefits of this study was explained to the guardian of the patient. When parents agreed for participation, written informed consents were obtained from them and structured questionnaire was filled up for each patient. Participants below 1 year and above 18 years, with any chronic illness and any medication that may influence serum creatinine level were excluded from the study. Detail personal, medical and family history of the participants were recorded. After measuring weight (in kg) and height (in meter), body mass index (BMI) was calculated.

Laboratory Procedure: Under all aseptic precautions, 4 ml venous blood sample was collected from study subjects after an overnight fasting. 3 ml was delivered in a plain test tube for estimation of serum creatinine, while remaining 1ml blood was delivered into EDTA tube for estimation of HbA1c. Then, serum creatinine was assessed by Beckman Coulter AU-480 auto-analyzer. Glycemic control was evaluated through estimation of HbA1c using a high-performance liquid chromatographic (HPLC) method in Clover A1c (HbA1c Measuring System). To define 'glycemic control', we used standard international criteria that are based on HbA1c levels – as subjects were divided into two groups (i) those with good glycemic control (normoglycemic group), defined as HbA1c levels < 7 % and (ii) those with poor glycemic control defined as HbA1c levels ≥7%.

Statistical Analysis: All data were collected, tabulated and statistically analyzed using Statistical Package for Social Science (SPSS) version 20.0 (Chicago, USA). Quantitative data was expressed as mean (±SD) and unpaired Student's 't' test was done to see the level of significance. Qualitative data were expressed as frequency & percentage and chi-square test was done to obtain the level of significance. The P-value <0.05 was considered statistically significant.

Ethical Consideration: The study was approved by the Institutional Review Board (IRB) of BIRDEM Academy, Dhaka, Bangladesh. After selection of the subjects, the aims and objectives of the study along with procedure, risks and benefits of this study were explained to the guardian of the study subjects. When their parents were agreed for participation then an informed written consent was obtained from them and a structured questionnaire was filled up for each patient.

Results

Table 1 shows that 50% of the cases were male and 50% were female, 48.8% of controls were male and rests were female. There were no statistically significant differences in age, weight, height, BMI between case and controls.

Table 1: Epidemiological and Biochemical Parameters of the Study Population (n=160)

Variables	Case (n=80)	Control n=80)	P value
Gender			
• Male	40 (50.0%)	39 (48.8%)	-
• Female	40 (50.0%)	41 (51.2%)	
Age of the respondent	14.9 ± 2.9	14.8 ± 2.9	> 0.05^{ns}
Age of onset during diagnosis (in year)	10.5 ± 3.6	-	
Duration of diabetes (in year)	4.8 ± 2.7	-	-
Weight of the respondent (in Kg)	50.5 ± 16.7	48.7 ± 13.5	
Height of the respondent (in cm)	150.8 ± 13.7	151.7 ± 12.2	
BMI of the respondent (kg/sqm)	21.5 ± 4.7	20.9 ± 3.9	> 0.05^{ns}
HbA_{1c} (%)	7.3 ± 1.1	-	

Data was expressed as mean ± SD and comparison between groups was done by Student's unpaired 't' test. n= number of subjects, p-value < 0.05 is significant, ns= not significant.

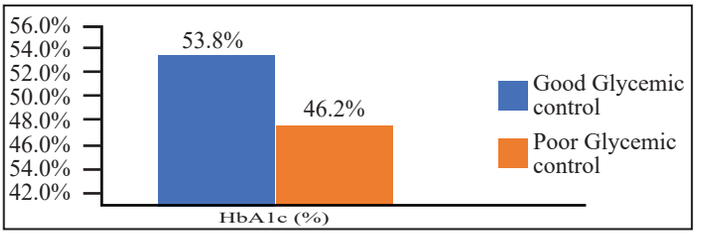

Figure I: Glycemic status of the diabetic children and adolescents

Among the total diabetic children and adolescents 53.8% had good glycemic control and 46.2% had poor glycemic control (Figure I).

Significantly higher level of serum creatinine was found (1.1 ± 0.5 vs 0.8 ± 0.2, p < 0.001) in cases with T1DM compared to controls. The serum creatinine level was significantly higher (1.2 ± 0.5 vs 0.9 ± 0.4, p<0.05) in patient with poor glycemic control compared to good glycemic control which was recorded (Table 2).

Table 2: Comparison of Serum Creatinine Level in Study Population (n=160) and Relationship of Serum Creatinine Level with Glycemic Status in Cases (n=80)

Group	Mean±SD	P value
Case	1.1 ± 0.5	<0.001
Control	0.8 ± 0.2	
In good glycemic control (HbA1c < 7)	0.9 ± 0.4	< 0.05
In poor glycemic control (HbA1c ≥ 7)	1.2 ± 0.5	

Data was expressed as mean ± SD and comparison between groups was done by Student's unpaired 't' test. n= number of subjects, p-value < 0.05 is significant, ns= not significant

The serum creatinine level in cases was significantly higher in patients who have duration of diabetes mellitus more than 5 years compared to those who have duration of diabetes mellitus less than that (Table 3).

Table 3: Relationship between of Duration of Diabetes Mellitus (DM) and Serum Creatinine Level (n=80)

Serum Creatinine Level	Duration of DM		P value
	< 5years	≥ 5 years	
High	10(34.5%)	19(65.5%.)	
Within reference range	33(64.7%)	18 (35.3%)	< 0.05

Statistical analysis was done by Chi-square test to compare among the groups. n= number of the subjects, p-value < 0.05 is significant, ns= not significant

Discussion

This study demonstrates that Bangladeshi children and adolescents with T1DM have significantly higher serum creatinine levels compared to healthy controls and that poor glycemic control is strongly associated with elevated creatinine level. These findings suggest early renal impairment, even in the absence of overt nephropathy. It is worth noting that serum creatinine levels are not solely determined by kidney function but can also be influenced by factors such as age, sex, muscle mass, and hydration status[9].

One of the most important findings in this study is the clinically significant rise in serum creatinine levels in the poor glycemic control group. Even a mild increase in creatinine can suggest a reduction in glomerular filtration rate (GFR) in pediatric patients, a key indicator of early kidney dysfunction[10]. At this stage, kidney function may

still be preserved, but the ability of the kidneys to filter waste is already compromised. Early intervention at this stage through intensified insulin therapy, dietary counseling, and regular nephropathy screening can significantly reduce progression risk[11].

The outcome of current study is consistent with previous research by Selim et al.[12] and Latif et al.[13] as they reported that poor glycemic control is a common issue among Bangladeshi children with T1DM leading to an increased risk of complications, including kidney dysfunction. Similarly, the ISPAD (International Society for Pediatric and Adolescent Diabetes) guidelines, as outlined by Donaghue et al. [14], emphasize that poorly managed blood sugar levels accelerate renal injury in pediatric patients. Furthermore, the Diabetes Control and Complications Trial (DCCT) and the Epidemiology of Diabetes Interventions and Complications (EDIC) study strongly linked long-term hyperglycemia to the development of microvascular complications, including renal dysfunction[15].

In this study serum creatinine level was higher in patients having duration of DM ≥ 5 years. Mishra et al.[16] in his study on diabetic subjects reported that serum creatinine in diabetic patients were significantly raised with prolong duration of diabetes and thereby they had drawn an inference that prolong duration of diabetes was the risk factor for the kidney damage progression.

In the context of Bangladesh, pediatric diabetes care faces several challenges. Delayed diagnosis, poor adherence to treatment protocols, and limited access to advanced diagnostic tools, such as microalbuminuria testing, significantly hinder effective management of T1DM and the early detection of diabetic nephropathy[17]. However, serum creatinine measurement is a cost-effective and widely available tool that could serve as a valuable early indicator of renal dysfunction, particularly in resource-limited settings. Early detection of diabetic nephropathy is crucial for implementing timely interventions and preventing further deterioration of kidney function[18].

In this study estimated glomerular filtration rate (eGFR) and microalbuminuria both of which could provide a more comprehensive assessment of renal function were not estimated. Additionally, because this study is cross-sectional in design, we cannot establish causal relationships between poor glycemic control and elevated serum creatinine levels. Longitudinal studies are needed to better understand the temporal progression of kidney damage in children with T1DM and to assess the long-term impact of early interventions.

Conclusion

This study demonstrates that children and adolescents with T1DM in Bangladesh have significantly higher serum creatinine levels compared to healthy peers and poor glycemic control strongly linked to elevated serum creatinine level. Regular monitoring of serum creatinine, alongside proper glycemic control is beneficial for early detection and prevention of diabetic nephropathy.

Acknowledgement: None

Contributions to authors: Shawana Haque, Thahamina Shahabuddin, Aniqa Tasnim were involved in conceptualization, data collection and literature collection. Data analysis and manuscript writing were done by Shawana Haque and Md. Mostaque Mahmud and data are analyzed by Md. Sahadat Hossain. Manuscript revision was done by all seven authors.

Funding: This research project was not funded by any group or institution.

Conflict of Interest: We do not have any conflict of interest (financial or others).

References

1.Katsarou A, Gudbjörnsdottir S, Rawshani A, Dabelea D, Bonifacio E, Anderson BJ, et al. Type 1 diabetes mellitus. Nature reviews Disease primers. 2017 ;3(1):1-7.

2. Arora MK, Singh UK. Molecular mechanisms in the pathogenesis of diabetic nephropathy: an update. Vascular pharmacology. 2013;58(4):259-71.

3. Roshan B, Stanton RC. A story of microalbuminuria and diabetic nephropathy. Journal of nephropathology. 2013;2(4):234-240.

4. Suh JS, Kim SH, Cho KS, Jung IA, Cho WK, Jeon YJ, et al. Urinary markers in the early stage of nephropathy in patients with childhood-onset type 1 diabetes. Pediatric Nephrology. 2016;31(4):623-31.

5. Nazar CM. Diabetic nephropathy; principles of diagnosis and treatment of diabetic kidney disease. Journal of nephropharmacology. 2014; 3(1):15-20.

6. Youssef DM, Fawzy FM. Value of renal resistive index as an early marker of diabetic nephropathy in children with type-1 diabetes mellitus. Saudi journal of kidney diseases and transplantation. 2012; 23(5):985-92.

7. Doshi SM, Friedman AN. Diagnosis and management of type 2 diabetic kidney disease. Clinical Journal of the American Society of Nephrology. 2017; 12(8):1366-73.

8. Fiseha T. Urinary biomarkers for early diabetic nephropathy in type 2 diabetic patients. Biomarker research. 2015;3(16):1-7.

9. Thongprayoon C, Cheungpasitporn W, Kashani K. Serum creatinine level, a surrogate of muscle mass, predicts mortality in critically ill

patients. Journal of thoracic disease. 2016;8(5):305-311.

10. Uemura O, Nagai T, Ishikura K, Ito S, Hataya H, Gotoh et al. Creatinine-based equation to estimate the glomerular filtration rate in Japanese children and adolescents with chronic kidney disease. Clinical and experimental nephrology. 2014;18(4):626-33.

11. Lee CK, Swinford RD, Cerda RD, Portman RJ, Hwang W, Furth SL. Evaluation of serum creatinine concentration–based glomerular filtration rate equations in pediatric patients with chronic kidney disease. Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy. 2012;32(7):642-8.

12. Selim S, Pathan F, Saifuddin M, Latif ZA, Karim N. The challenge of proper glycaemic control among patients with type 2 diabetes in Bangladesh. Sri Lanka Journal of Diabetes Endocrinology and Metabolism. 2016;6(2):16-20.

13. Latif ZA, Jain A, Rahman MM. Evaluation of management, control, complications and psychosocial aspects of diabetics in Bangladesh: DiabCare Bangladesh 2008. Bangladesh Medical Research Council Bulletin. 2011;37(1):11-16.

14. Donaghue KC, Wadwa RP, Dimeglio LA, Wong TY, Chiarelli F, Marcovecchio ML, et al. Microvascular and macrovascular complications in children and adolescents. Pediatric diabetes. 2014;15 (20):257-69.

15. The Writing Team for the Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Research Group. Effect of intensive therapy on the microvascular complications of type 1 diabetes mellitus. JAMA: the journal of the American Medical Association. 2002 ;287(19):2563-69.

16. Mishra KP, Mawar A, Kare PK, Verma N. Relationship between fasting blood glucose, serum urea, serum creatinine and duration of diabetes in Type-2 diabetic patients. Flora Fauna. 2015;21(1):127-32.

17. Kesavadev J, Sadikot SM, Saboo B, Shrestha D, Jawad F, Azad K, et al. Challenges in Type 1 diabetes management in South East Asia: Descriptive situational assessment. Indian journal of endocrinology and metabolism.2014;18(5):600-7.

18. Sheira G, Noreldin N, Tamer A, Saad M. Urinary biomarker N-acetyl-β-D-glucosaminidase can predict severity of renal damage in diabetic nephropathy. Journal of Diabetes and Metabolic Disorders. 2015;14(1):1-7.