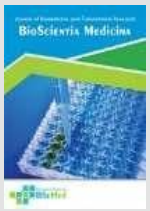
eISSN (Online): 2598-0580



Bioscientia Medicina: Journal of Biomedicine & Translational Research

Journal Homepage: www.bioscmed.com

The Relationship between Metabolic Control Status and Microalbuminuria in Pediatric Diabetes Mellitus Patients at Dr. M. Djamil General Hospital, Padang, Indonesia

Fatmah Sindi[1*], Aumas Pabuti[1], Eka Agustia Rini[1]

[1]Department of Pediatrics, Faculty of Medicine, Universitas Andalas/Dr. M. Djamil General Hospital, Padang, Indonesia

ARTICLE INFO

Keywords:
Children
Diabetes mellitus
HbA1c
Diabetic ketoacidosis
Microalbuminuria

***Corresponding author:**
Fatmah Sindi

E-mail address:
1750304301_fatmah@student.unand.ac.id

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/bsm.v7i1.757

A B S T R A C T

Background: Diabetes mellitus (DM) is a complex metabolic disorder that can cause many complications. HbA1c measurement can help monitor long-term serum glucose regulation. Microalbuminuria in DM patients is a risk factor for these complications, so evaluation of risk factors for prevention is necessary. This study aimed to determine the relationship between metabolic control status and microalbuminuria in pediatric diabetes mellitus patients at Dr. M. Djamil General Hospital, Padang, Indonesia. **Methods:** This study is an analytic observational study with a cross-sectional approach. A total of 34 children with DM aged 1-18 years participated in this study. Sampling was carried out using the consecutive sampling method at the pediatric polyclinic of Dr. M. Djamil General Hospital, Padang, Indonesia, from November 2021-April 2022. Metabolic control status was assessed by measuring HbA1C levels and microalbuminuria by measuring the urine albumin-creatinine ratio. Data analysis used the Chi-square test, with a p-value <0.05. **Results:** The average respondent was 13.2 ± 3.3 years old with a duration of suffering from DM 2.5 ± 2 years. Most of the respondents were male (52.9%), suffered from type 1 DM (94.1%), had uncontrolled metabolic control status (82.3%), had a normal creatine albumin ratio (82.4%), never had diabetic ketoacidosis (79.4%), had no family history of DM (85.3%) and had normal blood pressure (94.1%). It is known that the average urea and creatinine are within normal limits. The average HbA1c value is 11.9 ± 3.39%. The median urine creatine albumin ratio was 7.98 (0-255.74) ug/mg. Microalbuminuria in uncontrolled metabolic control status was found in as much as 17.6%, whereas in controlled metabolic control status, no microalbuminuria was found. Statistically, there is no significant relationship (p>0.05). **Conclusion:** There is no relationship between metabolic control status and microalbuminuria in pediatric diabetes mellitus patients at Dr. M. Djamil General Hospital, Padang, Indonesia.

1. Introduction

Diabetes mellitus describes a complex metabolic disorder characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Approximately 8.8% of the adult population worldwide has diabetes. Of all diabetics, only 10-15% suffer from type 1 DM (DMT1), and type 2 diabetes mellitus (DMT2) is the most common. Type 1 diabetes mellitus is the most common type of diabetes in children (<15 years), and > 500,000 children are currently living with this condition. One of the initial screenings in cases of diabetes mellitus is by examining the level of glycated hemoglobin or HbA1C. HbA1C examination has several advantages compared to fasting plasma glucose and OGTT examinations, such as in terms of convenience because it does not require fasting and stability of the pre-analysis sample.[1-4]

Evaluation of risk factors and early screening for microvascular complications in children and

adolescents with DM is very important to assist in the implementation of prevention strategies. Screening should be performed annually with three albumin/creatinine ratio samples from first-morning urine collected over a 3–6 months period and considered positive if two of the three samples are affected. Screening for albuminuria should start from the age of 11 years or after diabetes is diagnosed 2–5 years. Microalbuminuria in DM patients is a risk factor for diabetic nephropathy and cardiovascular disease and increases mortality. The prevalence of microalbuminuria in children and young adults with type 1 diabetes mellitus varies between 3 – 30%. The very wide prevalence in various studies may be caused by several genetic factors in different ethnic groups, as well as being related to the duration of suffering from DM.[5-9] This study aimed to determine the relationship between metabolic control status and microalbuminuria in pediatric diabetes mellitus patients at Dr. M. Djamil General Hospital, Padang, Indonesia.

2. Methods

This study is an analytic observational study with a cross-sectional approach. This study was conducted at the polyclinic and inpatient hospital Dr. M. Djamil General Hospital, Padang, Indonesia. clinical laboratory of Dr. M. Djamil General Hospital, Padang, Indonesia, and Prodia Padang Indonesia Laboratory. A total of 34 research subjects participated in this study, where the research subjects met the inclusion criteria. The inclusion criteria for research subjects were pediatric patients aged 1-18 years with a diagnosis of type 1 diabetes mellitus who were treated at Dr. M. Djamil General Hospital, Padang, Indonesia, and obtained parental/guardian consent to participate in this study, which was marked by the signing of an informed consent sheet. This study was approved by the medical and health research ethics committee at Dr. M. Djamil General Hospital, Padang, Indonesia (No. 416/KEPK/2021).

This study observed metabolic control status by assessing HbA1c levels using HPLC (High-Performance Liquid Chromatography). HbA1c has been declared controlled if HbA1c ≤ 8.5% in children aged 0-5 years, ≤ 8% in children aged 6-12 years, and ≤7.5% in adolescents aged 13-17 years. Microalbuminuria levels were observed using the ELISA (enzyme-linked immunosorbent assay) method. Microalbuminuria is normal if the level is <30 ug/mg. Data analysis was carried out using SPSS software version 25. Univariate analysis was performed to present the frequency distribution of data for each variable, and bivariate analysis was performed to determine the relationship between metabolic control status and microalbuminuria levels, where the value of $p<0.05$.

3. Results

Table 1 presents a baseline description of the characteristics of the respondents. The study subjects had an average age of 13.2 years, with the majority age group in the range of 13-18 years. The majority of research subjects are male. The majority of research subjects had type 1 diabetes mellitus and had suffered from diabetes mellitus for an average of 2.12 years. The majority of research subjects had a history of diabetic ketoacidosis, had no family history of diabetes mellitus, and had normal blood pressure. The research subjects had an average HbA1c level of 11.9%.

4. Discussion

The average level of urine creatine albumin ratio in respondents in this study who had a controlled metabolic control status had a level of 21.33±18.32 ug/mg, while the uncontrolled respondents obtained a median of 6.8 ug/mg with a minimum value of 0 and a maximum of 255.74. Albumin levels are known to be inversely related to HbA1c. Erythrocytes maintained at low albumin levels illustrate higher glycation of albumin and hemoglobin compared to those maintained at high albumin levels. Increased albumin glycation can increase its ability to protect

hemoglobin glycation. This was evident in the treatment of erythrocytes with N(ε)-(carboxymethyl)lysin-modified serum albumin (CMSA), which failed to maintain hemoglobin glycation; instead, it increases the glycation of the hemoglobin. CMSA's inability to reduce hemoglobin glycation is due to the lack of free lysine residues from albumin, which was confirmed by using N(ε)-(acetyl)lysin-modified serum albumin. (AcSA).[10-14]

Table 1. Baseline characteristics of respondents.

Characteristics	Frequency (%)	Mean ± SD	Median (Min-Max)
Age (years)		13,2 ± 3,3	
Age group			
0-5 years	1 (2,9%)		
6-12 years	15 (44,1%)		
13-18 years	18 (52,9 %)		
Gender			
Male	18 (52,9%)		
Female	16 (47,1%)		
DM Type			
DM type 1	32 (94,1%)		
DM type 2	2 (5,8%)		
Suffering from DM for a long time (years)		2.12 ± 2,3	1.5 (0-9)
History of diabetic ketoacidosis			
Yes	27 (79.4 %)		
No	7 (20.6 %)		
Family history of DM			
Yes	5 (14,7%)		
No	29(85,3%)		
Puberty status			
Prepubertal	15 (44,1%)		
Postpubertal	19 (55,9 %)		
Blood pressure			
Normal	32(94,1%)		
Increased blood pressure	2(5,8%)		
Hypertension	0		
Urea (mg/dl)		18,2 ± 7,99	
Creatinine (mg/dl)		0,65 ± 0,44	
HbA1c (%)		11,90 ± 3,39	
Urinary creatine albumin ratio levels (ug/mg)			7,98 (0-255.74)

Table 2 presents the relationship between metabolic control status and microalbuminuria. The results of the study showed that in the controlled metabolic status group, the majority found microalbuminuria. Likewise, in the uncontrolled metabolic status group, the majority found microalbuminuria. This shows that there is no difference in the incidence of microalbuminuria in the metabolically controlled and uncontrolled groups, p>0.05.

Table 2. Relationship between metabolic control status and microalbuminuria.

Metabolic control status	Microalbuminuria		Total	p-value*
	Yes Frequency (%)	No Frequency (%)	Frequency (%)	
Controlled	6 (17,6%)	0	6 (17,6%)	0,211
Not controlled	22 (64,7 %)	6 (17,6%)	82,35 (%)	
Total	82,35 (%)	6 (17,6%)	34 (100%)	

*Fisher exact test, p>0,05.

A study showed that as many as 46 out of 409 (11.3%) children and adolescents with type 1 diabetes mellitus (DMT1) had microalbuminuria. The mean age was 12.3 ± 4.1 years. 178 were males (43.5%), 231 were females (56.5%), 128 were prepubertal (31.3%), 145 were puberty (35.5%), and 136 were postpubertal (33.3%). The average HbA1c level in the Al-Agha study group was 9.2 ± 2.4%; 315/409 (77%) had an HbA1c of 7.5%, of whom 34/315 (10.8%) had microalbuminuria while 94/409 (23%) had an HbA1c of <7.5%, of which 12/94 (12 .8%) had microalbuminuria (OR = 0.8, P = 0.6). The prevalence of microalbuminuria was higher in postpubertal children and adolescents with T1DM (23/46 - 50%) than in prepubertal children (4/46 - 8.7%) and puberty (19/46 - 41.5%). DMT1 prepubertal children who experience microalbuminuria have a duration of DMT1 >4 years. In this study, 6 (17%) microalbuminuria was found, but no association with significant metabolic control was found. This is probably a smaller number of samples (n = 34) compared to other studies.[15,16]

In another study of young people with T1DM, the prevalence of microalbuminuria was 13-26%. Several other studies have reported prevalence rates of 6-18% for microalbuminuria in children and adolescents with T1DM. In another study of 426 pediatric patients with T1DM, the researchers found a prevalence of microalbuminuria of 5.6%. Damage to the glycocalyx is common in diabetes and is associated with microalbuminuria. The early microalbuminuria observed in many T1DM patients may be due in part to tubular injury from hyperglycemia, and other metabolic factors, and the degree of tubular injury may be associated with a better microalbuminuria outcome. In another study consisting of 199 adolescents with diabetes, the prevalence of microalbuminuria was 25%, and among them, seven patients (3.5%) had macroalbuminuria (≥300 mg/L). Elevated blood pressure is associated with increased urinary albumin excretion in both adults and children. In the study population, it was found that systolic blood pressure was associated with the development of microalbuminuria. The data suggest that modifiable predictors of developing microalbuminuria are poor glycemic control, high blood pressure, and high BMI, which is consistent with findings in different studies.[17,18]

The risk of DMT1 developing into complications of kidney damage is said to be low in those under 5 years of age, but at older ages, the relationship is unclear. Although there are inconsistencies in studies regarding the effect of the duration of prepubertal diabetes on the development of microalbuminuria, it can be concluded that the duration of prepubertal diabetes contributes to the development of microalbuminuria, but the younger the age of onset or the longer the duration of prepubertal diabetes seems to prolong the development time of microalbuminuria or further kidney damage. It is likely that factors during puberty have other major effects on the development of microvascular complications.[19,20]

5. Conclusion

There is no relationship between metabolic control status and microalbuminuria in pediatric diabetes mellitus patients at Dr. M. Djamil General Hospital, Padang, Indonesia.

6. References

1. Ek AE, Samuelsson U, Jansson A, Carlsson A, Elimam A. Microalbuminuria and retinopathy in adolescents and young adults with type 1 and type 2 diabetes. Natl Diabetes Regist. 2014; 1–35.
2. Viteri B, Reid-Adam J. Hematuria and proteinuria in children. Pediatr Rev. 2018; 39(12): 573–85.
3. Diaz-Valencia PA, Bougnères P, Valleron AJ. Global epidemiology of type 1 diabetes in young adults and adults: A systematic review. BMC Public Health. 2015; 15(1).
4. Sherry NA, Tsai EB, Herold KC. Natural history of ß-cell function in type 1 diabetes. American Diabetes Association. 2005; 54: 32-9.

5. Koebnick C, Giuseppina MS, Elizabeth I, Stafford JM, Amy MS, et al. Progression to hypertension in youth and young adults with type 1 or type 2 diabetes: The SEARCH for Diabetes in Youth Study. J Clin Hypertens. 2020; 22(5): 1–9.
6. Parchwani D, Upadhyah A. Diabetic nephropathy: Progression and pathophysiology. Int J Med Sci Public Heal. 2012; 1(2): 59.
7. Flynn JT, Falkner BE. New clinical practice guideline for the management of high blood pressure in children and adolescents. Hypertension. 2017; 70(4): 683–6.
8. Dabelea D, Stafford JM, Mayer-Davis EJ, D'Agostino R, Dolan L, et al. Association of type 1 diabetes vs type 2 diabetes diagnosed during childhood and adolescence with complications during teenage years and young adulthood. JAMA - J Am Med Assoc. 2017; 317(8): 825–35.
9. Cherubini V, Grimsmann JM, Åkesson K, Birkebæk NH, Cinek O, et al. Temporal trends in diabetic ketoacidosis at diagnosis of paediatric type 1 diabetes between 2006 and 2016: results from 13 countries in three continents. Diabetologia. 2020; 63(8): 1530–41.
10. Castellanos L, Tuffaha M, Koren D, Levitsky LL. Management of diabetic ketoacidosis in children and adolescents with type 1 diabetes mellitus. Pediatr Drugs. 2020; 22(4): 357–67.
11. Taha Z, Eltoum Z, Washi S. Predictors of glucose control in children and adolescents with type 1 diabetes: Results of a cross-sectional study in. Maced J Med Sci. 2018; 1–5.
12. Eliadarous H. Exploring the impact of diabetes in Sudan: Out of pocket expenditure and social consequences of diabetes on patients and their families. 2017.
13. Vajravelu ME, Lee JM. Identifying prediabetes and type 2 diabetes in asymptomatyc youth: Should HbA1c be used as a diagnostic approach?. Current Diabetes Reports. 2018; 7: 1-10
14. Ramaphane T, Gezmu AM, Tefera E, Gabaitiri L, Nchingane S, et al. Prevalence and factors associated with microalbuminuria in pediatric patients with type 1 diabetes mellitus at a large tertiary-level hospital in botswana. Diabetes, Metab Syndr Obes Targets Ther. 2021; 14: 4415–22.
15. Al-agha AE, Ocheltree A, Hakeem A. Occurrence of microalbuminuria among children and adolescents with insulin-dependent diabetes melitus. Saudi J Kidney Dis Transplant. 2013; 24(6): 1180–8.
16. Schultz CJ, Konopelska-Bahu T, Dalton RN, Carroll TA, Stratton I, et al. Microalbuminuria prevalence varies with age, sex, and puberty in children with type 1 diabetes followed from diagnosis in a longitudinal study. Diabetes Care. 1999; 22(3): 495–502.
17. Ph G, Mk B, Frazer F, Ar L, Ea D, et al. Prevalence and risk factors for microalbuminuria in a population-based sample of children and adolescents with T1DM in Western Australia. Pediatr Diabetes. 2006; (15): 165–72.
18. Svensson M, Nystrom L, Schon S, Dahlquist G. Age at onset of childhood-onset type 1 diabetes and the development of end-stage renal disease: A nationwide population-based study. Diabetes Care. 2006; 29(3).
19. Vaidya VS, Niewczas MA, Ficociello LH, Johnson AC, Collings FB, et al. Regression of microalbuminuria in type 1 diabetes is associated with lower levels of urinary tubular injury biomarkers, kidney injury molecule-1, and N-acetyl-β-D-glucosaminidase. Natl Inst Heal. 2011; 79(4): 464–70.
20. Razavi Z, Momtaz HE, Sahari S. Frequency of microalbuminuria in type 1 diabetic children. Iran J Pediatr. 2009; 19(4): 404–8.