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Growth Profile in Pediatric Patients with Diabetes Mellitus at Dr. M. Djamil General Hospital, Padang

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ABSTRACT

Background: Diabetes mellitus (DM) is a glucose metabolism disorder characterized by chronic hyperglycemia that often occurs and is a major health problem. During puberty, increased Growth Hormone (GH) secretion results in increased insulin resistance. This study aimed to describe the growth profile of pediatric patients with diabetes mellitus at Dr. M. Djamil General Hospital. **Methods:** A descriptive retrospective study with conducted by collecting data on body height, HbA1C level, and status of puberty from medical records at the pediatric ward of Dr. M. Djamil General Hospital from January 2019 - December 2020. **Results:** The sample was 67 (63 T1DM, 2 T2DM, and 2 double DM). Ten of them with short stature (8 with poor metabolic control). **Conclusion:** Children with DM may experience growth disturbance.

1. Introduction

Diabetes mellitus (DM) is a glucose metabolism disorder characterized by chronic hyperglycemia that often occurs and is a major health problem. DM is divided into two types, namely DM type-1 and DM type-2.¹ DM is caused by damage to pancreatic beta cells resulting in reduced or even absent insulin secretion. Type 2 DM is caused by insulin resistance in skeletal muscle, liver, and adipose tissue.^{2,3} Type-1 DM is the most common type in children.² Based on data from the Indonesian Pediatrician Association (IDAI) in 2018, there were 1220 children with type-1 DM in Indonesia. The incidence of type-1 diabetes in

children and adolescents increased by about seven times from 3.88 per 100 million population in 2000 to 28.19 per 100 million population in 2010.¹ Diabetes mellitus in children can be diagnosed when the patient has high blood glucose levels. fasting ≥ 126 mg/dL (7.0 mmol/L), 2-hour blood glucose in 75-g oral glucose tolerance test (75g-OGTT) ≥ 200 mg/dL (11.1 mmol/L), or HbA1c $\geq 6.5\%$ according to the American Diabetes Association.⁴ HbA1c (glycosylated hemoglobin) is the standard test that describes the variation in fasting and postprandial blood glucose over a 3-month period.³

Puberty is a fundamental event in growth, where there is a marked increase in several changes.² There are five specific changes that occur at puberty, namely rapid height gain (stimulating growth), secondary sex development, reproductive organ development, changes in body composition, and changes in the circulatory and respiratory systems related to body strength and stamina.^{6,7} During puberty, an increase in GH secretion results in an increase in insulin resistance, so many studies have reported a decrease in velocity during puberty in adolescents with type-1 diabetes.^{2,8} Children with DM can experience delayed puberty and eventually have a lower height than their genetic potential both at puberty and before puberty.^{7,8} Linear growth in children is a complex physiological process that is influenced by many factors, such as endocrinological, nutritional, and psychological. The effect of type-1 diabetes on growth is unclear and is still being debated. Preliminary studies suggest that chronic hyperglycemia may impair linear growth.^{2,9} Impaired linear growth will result in short stature. Short stature (*short stature*) was defined as a height <P3 or <-2 SD curve that applies according to age and sex. In dealing with children with short stature, a good and directed examination is needed. The initial criteria for diagnosing a child with short stature are (1) height <P3; (2) growth speed <P25; and (3) estimated final height below the potential genetic height.⁹ Short stature can also be caused by variants of normal growth, such as short familial stature and constitutional growth retardation, or pathological causes due to poor metabolic control.⁹ Normal growth is one of the goals in the management of children with DM. Well-controlled diabetes mellitus will provide normal growth, while uncontrolled diabetes will cause stunted growth. Adequate insulin treatment can

prevent stunted growth in children with diabetes.²

This study is an attempt to explore primary data to determine the profile of growth disorders that may be experienced by pediatric patients with type 1 diabetes mellitus.

2. Methods

This study is an observational study to explore the profile of growth disorders in children with type 1 diabetes mellitus at Dr. M Djamil General Hospital Padang from January 2019-December 2020. A total of 67 research samples participated in this study with inclusion criteria: patients aged 0-18 years with diabetes mellitus and having exclusion: samples with incomplete medical record data. This study has been approved by the ethics and research committee of Dr. M. Djamil General Hospital, Padang Indonesia. Informed consent was obtained through a cellphone. The data taken for this study were gender, age, height profile, pubertal status, metabolic control, and nutritional status of the patient. Data analysis was carried out with the help of SPSS version 25 software. Univariate analysis was carried out to present the frequency distribution of each data. Data is presented in the form of Mean±SD or in the form of Median and percentage.

3. Results

Table 1 shows that of the 67 children studied, 63 people (94.0%) had type 1 diabetes, two (3%) had type 2 diabetes, and two others (3%) had type 1 diabetes and 2. Of all patients, 28 (41.8%) were male, and 39 (58.2%) were female. Children were grouped by age, namely infants (0-2 years), children (2-12 years), and adolescents (12-17 years), with the following distribution, 2 infants (3%), 22 children (32.8 %), and 43 adolescents (64.2%).

Table 1. Demographic characteristics

Variables	Total	Percentage
Gender		
- Male	28	41.8%
- Female	39	58.2 %
Age		
- 0-2 years	2	3.0 %
- 2-12 years	22	32.8 %
- 12-17 years	43	64, 2 %
Nutritional Status		
- Overweight	3	4.5 %
- Good	52	77.6 %
- Less	12	17.9 %
- Bad	0	0 %
Height Profile		
- P < 3	10	14.9 %
- P ≥ 3	57	85.1 %
Type of DM		
- Type 1 DM	63	94.0 %
- DM type 2	2	3.0 %
- DM types 1 and 2	2	3.0 %
Grade Tanner		
- Tanner 1	11	16.4%
- Tanner 2	40	59.7 %
- Tanner 3	16	23, 9 %
- Tanner 4	0	0 %
- Tanner 5	0	0 %
Puberty Status		
- Prepuberty	11	16,4 %
- Puberty	56	83,6 %
Metabolic Control Status		
- Good	17	25,3 %
- Bad	50	74,7 %

Fifty-seven children are of normal height, and the remaining 10 are of short stature. Four of them (40%) with short familial stature (3 of them with poor metabolic control), and six of them (60%) with

pathological short stature (5 of them with poor metabolic control). There were no samples with delayed puberty. In this study, 83.6% were going through puberty. None had late puberty (Table 2).

Table 2. Growth profile of diabetes mellitus patients

Variable	DM Type 1		DM Type 2		DM Types 1 and 2	
	N	%	n	%	n	%
Height Profile						
- P < 3	8	12.7	1	50	1	50
- P ≥ 3	55	87.3	1	50	1	50
Grade Tanner						
- Tanner 1	11	17.5	0	0	0	0
- Tanner 2	37	58.7	1	50	2	100
- Tanner 3	5	23.8	1	50	0	0
- Tanner 4	0	0	0	0	0	0
- Tanner 5	0	0	0	0	0	0
Status Puberty						
- Prepuberty	11	16.4	0	0	0	0
- Puberty	52	83.6	2	100	2	100
Metabolic Control Status						
- Good	16	25.4	1	50	0	0
- Bad	47	74.6	1	50	2	100

Of the 10 children with short stature are in the age range is 12-17 years. The average HbA1C value in these 10 patients was above 7.5. Only two children

had HbA1C values below 7.5. Eight of these 10 children had type 1 diabetes mellitus (Tables 3,4, and 5).

Table 3. Description of Children with Height P<3

Initial	Age (In years)	HbA1C	Type Diabetes Mellitus	Height Profile
An. MF	17	9.8%	DM Type 1	Short Pathological
An. DF	16	8.1%	DM Type 1	Short Familial
An. RS	17	16.3%	DM Type 1	Short Pathological
An. DEP	14	8.0%	DM Type 1	Short Pathological
An. SN	17	6.9%	DM Type 1	Short Familial
An. RAZ	14	15.3%	Both	Short Pathological
An. MA	13	8.7%	DM Type 1	Short Familial
An. LR	15	8.7%	DM Type 1	Short Familial
An. RY	12	1.2%	DM Type 1	Short Pathological
An. B	17	16.1 %	DM Type 2	Short Pathological

Table 4. Height P < 3 in patients with diabetes mellitus

Variable	Total	Percentage
- Short Pathological	6	60 %
- Short Familial	4	40 %

Table 5. Height Profile P < 3 on the classification of types of diabetes mellitus

Variable	DM Type 1		DM Type 2		DM Types 1 and 2	
	n	%	n	%	n	%
- Short Pathological	4	50	1	100	1	100
- Short Familial	4	50	0	0	0	0

4. Discussion

Normal growth is an important indicator of good disease control in children and adolescents with DM. To date, although the available data are limited, some literature has confirmed the presence of several growth anomalies in children and adolescents with DM.¹ Growth in children and adolescents is regulated by complex hormones and is an interaction involving GH, gonadal steroids, and insulin. Puberty children with DM show insulin deficiency and impaired insulin sensitivity in peripheral tissues.⁹ In this study, 10 of 67 children experienced growth disorders (6 of whom

were pathologically short and 4 were familial). Eight of these 10 children had poor metabolic control status and HbA1C values (>7.5). This study is in line with a retrospective study conducted by Salerno et al., who found that most children with diabetes mellitus were of normal height but usually exceeded the genetic target height, and only a few had growth disorders.⁹

In this study, the average Puberty status of Tanner 1-3, none of them reached Tanner 4 and 5. In this study, 11 children (17.5%) with Tanner 1, 37 children (58.7%) with Tanner 2, and 15 children (23.8%) with Tanner 3. A study conducted by Ahmad et al. at the

Department of Paediatrics, John Radcliffe Hospital, Headington, Oxford UK found no pubertal disturbances in children with diabetes mellitus compared to the control group. Bizarri et al. suggested that although some growth abnormalities were present in some cases, modern advances in insulin therapy were able to normalize puberty and growth in children with DM.⁹

Research by Demir et al. in the Department of Pediatric Endocrinology, Dokuz Eylül University, Izmir, Turkey concluded that there was no short-term effect on growth and development parameters in children with DM. But several clinical and laboratory variables related to metabolic control were found to be correlated with growth.¹⁰ Chiarelli et al. stated that insulin therapy and especially intensive therapy have a relevant role in preventing growth disorders in children and adolescents with DM.¹¹ Khadilkar et al. also found that there was no impact of DM on child growth, especially in developed countries, associated with modern insulin therapy and better monitoring. However, in developing countries, most of which have not used modern insulin therapy and have poor medication adherence, there is less growth retardation in children with DM. Impaired growth in developing countries is associated with insulin deficiency due to the regimen used and patient non-adherence to treatment.¹²

5. Conclusion

Children with DM can experience growth disorders.

6. References

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