

Does Duration of Illness Affect HbA1C Level of Type 1 DM Children?

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ABSTRACT

Background: HbA1C is average blood glucose levels for the last two or three months. The ideal level of HbA1C in diabetes sufferers is 6.5% or below. Type 1 diabetes mellitus is a non-communicable disease that is often found in children with an increasing prevalence. This disease is included in the group of metabolic diseases with the characteristic of hyperglycemia which occurs due to abnormalities in insulin secretion, insulin function, or both. **Objective:** To find out whether the duration of illness has a relationship with the HbA1C level of type 1 DM children. **Method:** This study is a cross-sectional analytical study. The study was administered on 37 Type 1 DM children who underwent control at the Pediatric Endocrinology Polyclinic of Dr. Soetomo Regional General Hospital. Data collection was done by questionnaire and interview. Data analysis was done by Pearson Product Moment correlation. **Result:** The analysis showed that there is no significant correlation between the HbA1C levels of type 1 DM children.

Keywords: HbA1C level; duration of illness; Type 1 Diabetes mellitus.

INTRODUCTION

Diabetes mellitus (DM) is a condition in which the body experiences chronic hyperglycemia. Type 1 DM (T1DM) is a disease caused by decreased insulin production mediated by an autoimmune process and requires lifelong insulin therapy (1). The incidence of T1DM globally continues to increase from year to year with the highest incidence found in the pediatric population. Early clinical manifestations of T1DM in children are also often found with acute complications in the form of diabetic ketoacidosis. Poor glycemic control in DMT1 patients can cause various microvascular and macrovascular complications with high mortality rates. Prevention of complications is carried out by evaluating glycemic control by examining the average blood sugar levels for the last 3 months with HbA1c parameters (2).

Data from the International Diabetes Federation (IDF) shows that the global incidence of DMT1 in 2022 is ±8.75 million people with an increase of

530,000 new cases compared to 2021. The dominant age range is in the 20-59 age group, which is 5.56 million people (64%). Meanwhile, there are 1.52 million people (17%) of DMT1 cases in the age group under 20 years with an increase of 201,000 new cases compared to 2021. The number of people experiencing DMT1 in 2022 is higher than before the pandemic in 2019, which was 1.11 million people in the age group under 20 years.

Based on data from the Indonesian Pediatrician Association (IDAI) in 2018, there were around 1,220 children with DMT1 with an incidence that increased sevenfold from 3.88 to 28.19 per 100 million children in a period of 10 years (3). Meanwhile, data from the International Diabetes Federation (IDF) in 2022 showed that there were 13,311 children under 20 years old with DMT1 (4). This places Indonesia as the country with the most type 1 diabetes sufferers in Southeast Asia.

Glycemic control and glucose monitoring during the COVID-19 pandemic and large-scale social restrictions (PSBB) were significantly worse compared to the pre-pandemic period, which was estimated due to the unavailability of insulin or glucostrips during the lockdown period. This was shown by a study by Verma et al in India in 2020, namely that 36.5% of T1DM patients experienced episodes of hyperglycemia and 15.3% experienced episodes of hypoglycemia (5).

Poor glycemic control during the COVID-19 pandemic was also found in Poland, with the percentage of diabetic ketoacidosis (DKA) increasing drastically by 39.5% in 2020 compared to the previous year (6). Meanwhile, Nur Rochmah's 2020 study in Indonesia showed that the compliance of DMT1 patients in using insulin was very good during the early stages of the pandemic (7). However, the tendency for poor diet and physical activity was correlated with high HbA1c levels ($\geq 7.5\%$) in the study. This is indicated by the HbA1c level of DMT1 patients before the pandemic in Indonesia of 9.20 ± 1.86 , during the COVID-19 pandemic 10.06 ± 2.49 , and in 2022 10.29 ± 2.39 , while the average HbA1c value in the pediatric population in Asia is 9.1%. These studies show a worsening of glycemic control during the pandemic in DMT1 patients in Indonesia. Poor glycemic control over the long term can increase the risk of acute (diabetic ketoacidosis and hyperosmolar hyperglycemic state) and chronic (retinopathy, neuropathy, and diabetic foot) complications due to T1DM in adolescents (8). According to the American Diabetes Association, 2022, targeted glycemic control in patients with type 1 diabetes is individualized, HbA1c $< 7\%$ (53 mmol/mol) is suitable for many children and should be reassessed from time to time (9).

One of the factors that may be related to glycemic control is the duration of the disease, which is the duration of a person's diabetes since the day the diagnosis was made, which is related to the patient's knowledge of their condition. Research by Noorani et al, 2016, stated that a shorter duration of T1DM was associated with significantly lower HbA1c levels. Children who had T1DM for less than 1 year had an average HbA1c that was 2% lower compared to those with longer duration of the disease (10).

A similar occasion was also found in the study of Mohammad et al in 2012, namely that patients who had a duration of illness of more than 10 years were mostly in the poor control group, while the group with a duration of illness of less than 5 years was more in the group with good glycemic control (11). However, the relationship between the duration of diabetes and glycemic control still has limited information. This is because there is still a lack of research that tries to link the duration of illness with glycemic control in patients with type 1 diabetes. Based on the description above, the paper will discuss whether the duration of illness correlates with Hemoglobin A1C level in Children with Type 1 Diabetes Mellitus.

METHODS

To find out the correlation between the duration of illness with the Hemoglobin A1C level in Children with Type 1 Diabetes Mellitus, the writer employs a Google form questionnaire. The questionnaire was distributed to the sufferer and/or patients' companions of Type 1 DM children to collect data on the duration of illness of the patients. The data on the HbA1C level of the patients is collected using the document technique, namely the medical record data of the patients.

The research was administered on patients of Type 1 DM children who had undergone routine check-ups at the Pediatric Endocrinology Polyclinic of Dr. Soetomo Regional General Hospital. The sample of 37 patients is selected using a consecutive random sampling technique by including the inclusive and exclusive criteria.

Inclusive criteria include that patients undergo routine check-ups at the Pediatric Endocrinology Polyclinic of Dr. Soetomo Regional General Hospital during the data collection period, patients are a maximum of 18 years old, and patients and parents or guardians are willing to participate in the study. The exclusion criteria consist of: patients experiencing acute complications and require intensive care in the pediatric intensive care unit, patients who do not have complete HbA1c level data, and who do not undergo routine check-ups.

Data analysis techniques were carried out using descriptive statistical analysis and product-moment correlation analysis.

RESULTS AND DISCUSSION

Demographic Characteristics of the Patients

Based on the distribution of questionnaires via Google form, 44 responses were obtained, consisting of 15 males and 29 females. The incoming data was then verified based on the inclusion criteria that had been set. Of the 44 data obtained, 2 subjects were eliminated because they were > 18 years old. Thus, the data that met the inclusion criteria became 42 subjects.

The further verification of 42 data showed that the complete data entry, which includes data on the duration of Type 1 DM and HbA1c levels, was 37 subject data. The study, therefore, only used 37 data as research subjects, consisting of 13 boys (35.1%) and 24 girls (64.9%).

In terms of age, the subjects were grouped into 4 age groups, namely 0-5 years, 6-10 years, 11-15 years, and > 15 years. Based on the results of the questionnaire, it can be seen that the subjects with an age range of 0-5 years were 1 person (2.7%), aged between 6-10 years 9 people (24.3%), aged between 11-15 years 18 people (48.6%), and aged > 15 years were 9 people (24.3%). Thus, most of the subjects were in the age range between 11-15 years, namely with a total of 18 people or 48.6%.

Subjects reviewed from the level of education can be grouped into 4 groups, namely pre-schooled, elementary school/equivalent, junior high school/equivalent, and high school/equivalent. The data indicates that the number of subjects who had not attended school was 1 (2.7%), subjects with elementary school/equivalent education were 16 (43.2%), subjects with junior high school/equivalent education were 13 (35.1%), and subjects with high school/equivalent education were 7 (18.9%). Therefore, based on education level, most of the subjects were elementary school/equivalent education, namely 16 (42.1%).

Subjects based on parental income were grouped into 3 groups, namely subjects with parental income <2.5 million rupiah, between 2.5 - 5 million rupiah, and > 5 million rupiah per month. The results of the study showed that the number of subjects with

parental income <Rp. 2.5 million per month was 14 (37.8%), subjects with parental income between Rp. 2.5 - Rp. 5 million were 16 (43.2%), and subjects with parental income > Rp. 5 million were 7 (18.9%). The data showed that most of the subjects came from a background of parental income between Rp. 2.5 - Rp. 5 million, namely 16 patients (42.1%).

The HbA1C Levels of the Patients

The level of hemoglobin A1c (HbA1c) in patients based on measurement results ranges from 6.90 to 13.60. The calculation results obtained an average hemoglobin A1c (HbA1c) in children with type 1 diabetes mellitus of 9.63 with a standard deviation of 1.86 and a variance of 3,457.

Data on hemoglobin A1c (HbA1c) levels in children with type 1 diabetes mellitus can be presented in the following diagram.

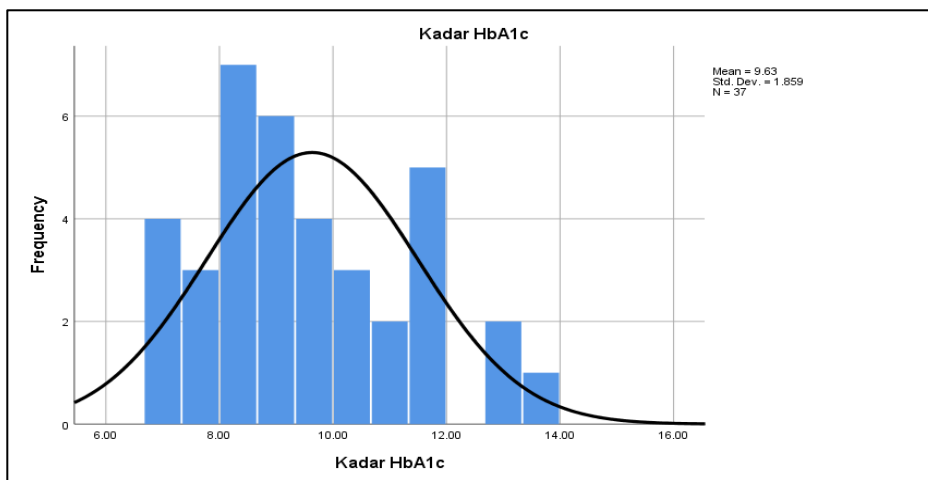


FIGURE 1: Diagram of the HbA1C of the Patients.

The Duration of Illness of the Patients

The duration of illness from type 1 Diabetes Mellitus in the research subjects varied from < 1 year, which was 6 months, to the longest which was 180 months (15) years. The calculation results showed that the average duration of illness from type 1 Diabetes Mellitus in the subjects was 50.86 months.

The standard deviation obtained was 40.529 and the variance was 1642.62.

Data on the length of time suffering from Type 1 Diabetes Mellitus in research subjects can be presented in the following diagram.

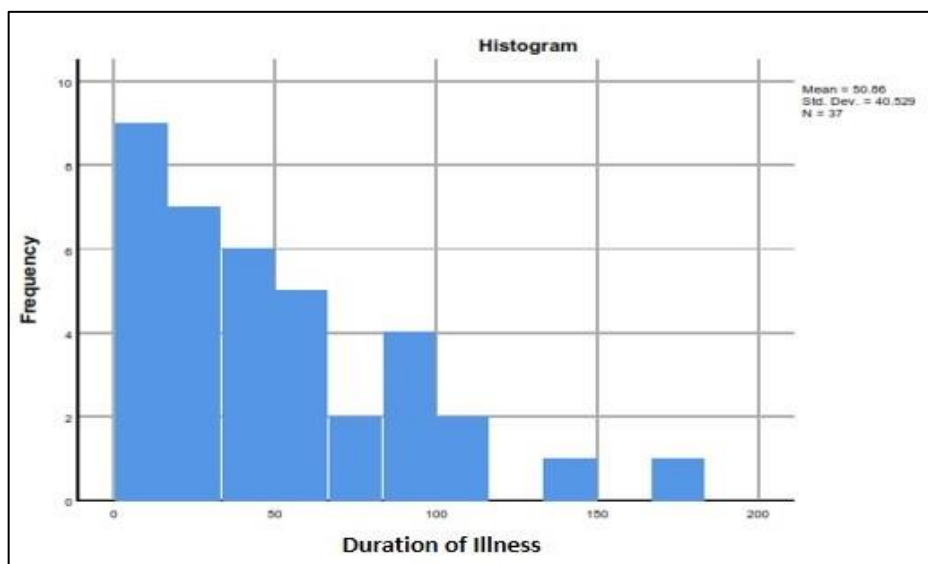


FIGURE 2: Diagram of the Duration of Illness of the Patients.

The data resulting from descriptive analysis of hemoglobin A1c (HbA1c) levels and duration of illness from Type 1 Diabetes Mellitus in research subjects can then be summarized in the following table.

TABLE 1: Descriptive Statistics Analysis.

Description	HbA1c Levels	Duration of Illness
Mean	9.6327	50.86
Median	9.05	38.00
Mode	9.00	12.00
Deviation Standard	1.859	40.529
Variance	3.457	1642.620
Minimum	6.90	6
Maximum	13.60	180
Range	6.70	174

The results of the normality test for the HbA1c Level variable obtained a Kolmogorov-Smirnov coefficient value of 0.137 with a significance of 0.079. Given the significance value of $p > 0.05$, H_0 is accepted so that it can be concluded that the distribution of HbA1c Level data is normally distributed.

of $p > 0.05$, H_0 is accepted so that it can be concluded that the distribution of data on duration of illness from Type 1 DM is normally distributed. The test results show that the distribution of data for both variables is normally distributed. Based on this, the next analysis can be carried out.

The results of the normality test for the variable of duration of suffering from Type 1 DM obtained a Kolmogorov-Smirnov coefficient value of 0.142 with a significance of 0.056. Given the significance value

Hypothesis testing is done using Pearson's Product Moment correlation test. The test results can be presented in the following table.

TABLE 2: Correlation Test Results.

		HbA1C Level	Duration of Illness
Pearson Correlation	HbA1C Level	1.000	.058
	Duration of Illness	.058	1.000
Sig (1-tailed)	HbA1C Level	.	.366
	Duration of Illness	.366	.
N	HbA1C Level	37	37
	Duration of Illness	37	37

Based on the test results, the correlation coefficient value was obtained $r = 0.058$ with a significance of $p = 0.366$. Given the significance value of $p > 0.05$, H_0 is accepted. Referring to these results, it can be concluded that there is no significant correlation between the duration of Type 1 DM and HbA1c levels in children with Type 1 Diabetes Mellitus.

Subjects who have experienced type 1 DM > 120 months are 2 people (5.4%). Thus, it can be seen that most subjects suffer from type 1 DM under 5 years (60 months) with a total of 24 people or 64.9%.

Duration of illness in children with type 1 DM is defined as how long the patient has had diabetes since the first diagnosis was made. The duration of diabetes mellitus can cause glucose accumulation in the blood which causes damage to blood vessels.

Regarding the duration of DM, the results of a study conducted by Maromi, (12) stated that out of 33 DMT1 sufferers at Dr. Soetomo Hospital, Surabaya, 17 (51.6%) sufferers experienced DMT1 within a period of 1-3 years, 10 (30.3%) experienced DMT1 with a duration of 4-6 years, while DMT1 sufferers with a duration of 7-9 years were 6 (18.1%) with an improved quality of life. However, the longer a person suffers from DM, the greater the risk of complications. This is because the length of time a patient suffers from diabetes mellitus can cause glucose accumulation in the blood which causes damage to blood vessels. This can increase the risk of complications (13).

The results of the study showed that the average duration of type 1 DM in the study subjects was 50.86 months with + 40.59. This shows that the average duration of type 1 DM in the subjects is still < 5 years (60 months).

Further analysis results indicate that the number of subjects who have suffered from type 1 DM < 60 months is 24 people (64.9%). Subjects who have experienced type 1 DM between 60 months and < 120 months are 11 people (29.7%).

HbA1c (Glycolyzed Hemoglobin) is a test to measure the level of sugar associated with hemoglobin A, throughout the life of red blood cells. The higher the HbA1c in people with diabetes mellitus, the greater the risk of complications.

Normal HbA1c describes the patient's compliance with diet, exercise and medication so that blood sugar levels are controlled for the past 3 months.

The results of the study showed that the average hemoglobin A1c (HbA1c) level in children with type 1 Diabetes Mellitus was 9,633. The average HbA1c level shows that the HbA1c level in patients is relatively high. This shows that many people with DMT1 do not have HbA1c levels according to the glycemic control target by the ADA (14), namely HbA1c levels <7% (53 mmol/mol).

The finding that the average hemoglobin A1c (HbA1c) level in children with type 1 Diabetes Mellitus was an average of 9,633 supports the results of a study conducted by Rochmah et al (15) who conducted a study on DMT1 patients during the pandemic. The results of the study by Rochmah et al, found that the average HbA1C before the COVID pandemic was 9.2 ± 1.86 and HbA1C during the pandemic was 10.79 ± 2.43 . This shows that restrictions on activities during the pandemic have an effect on HbA1c levels.

The results of the study showed that there was no significant relationship between the duration of illness and hemoglobin A1c (HbA1c) levels in children with type 1 Diabetes Mellitus. This is indicated by the results of the correlation analysis where the correlation coefficient was obtained $r = 0.058$ with a significance of $p = 0.366$. Given the significance value of $p > 0.05$ then H_0 is accepted so it is concluded that there is no significant correlation between the duration of illness and hemoglobin A1c (HbA1c) levels in children with type 1 Diabetes Mellitus.

The finding that there is no significant relationship between the duration of illness and hemoglobin A1c (HbA1c) levels in children with type 1 Diabetes Mellitus is different from the results of a study conducted by Noorani et al in 2016. The results of the study by Noorani et al (16) showed that shorter duration of DMT1 disease was associated with significantly lower HbA1c levels. Children who had DMT1 for less than 1 year had an average HbA1c that was 2% lower compared to children with longer duration of illness.

The findings of this study also differ from the results of a study conducted by Mohammad et al (17) which concluded that patients who had a duration of illness of more than 10 years were mostly found in the poor control group, while the group with a duration of illness of less than 5 years was mostly found in the group with good glycemic control.

The research findings that there is no significant relationship between the duration of illness and hemoglobin A1c (HbA1c) levels in children with type 1 Diabetes Mellitus are in line with the results of studies conducted by Rahayu (18) and Koniah et al (19). The results of Rahayu's study concluded that there was no significant correlation between blood sugar control and the duration of DM. The results of

Koniah et al' study stated that there was no significant relationship between average blood sugar and the average duration of illness from DM patients.

The results of the statistical test showed no significant relationship between the duration of DM and blood sugar control, so it can be concluded that there is no difference in the proportion of controlled blood sugar in the group with a duration of DM <5 years or >5 years, meaning that both groups with a duration of DM <5 years and >5 years have the same chance of uncontrolled blood sugar. In this study, the duration of DM did not affect blood sugar control. This is because blood sugar regulation in DM patients is influenced by several factors holistically, starting from the type of insulin, level of compliance, level of knowledge, and social environment. Behavioral factors are also more dominant factors in blood sugar levels compared to the duration of DM. Although diabetics have had diabetes for a long time, if they do therapy properly, blood sugar levels will be well controlled.

CONCLUSIONS

Based on the results of research conducted on 37 children with Type 1 DM, the following conclusions can be drawn as follows: There is no significant relationship between the duration of illness and hemoglobin A1c (HbA1c) levels in children with type 1 Diabetes Mellitus. The average duration of illness in children with type 1 Diabetes Mellitus is 50.86 months or less than 5 years. The average hemoglobin A1c (HbA1c) level in children with type 1 Diabetes Mellitus is 9,633.

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