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## The correlation between duration of illness and hemoglobin A1c levels with quality of life in children with type 1 diabetes mellitus

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(RESEARCH ARTICLE)



## The correlation between duration of illness and hemoglobin A1c levels with quality of life in children with type 1 diabetes mellitus

Garindra Wicaksono <sup>1,2</sup>, Ahmad Suryawan <sup>1,2,\*</sup>, Anang Endaryanto <sup>1,2</sup>, Nur Rochmah <sup>1,2</sup> and Muhammad Faizi <sup>1,2</sup>

<sup>1</sup> Department of Pediatric, Faculty of Medicine Universitas Airlangga 60132, Surabaya, East Java, Indonesia.

<sup>2</sup> Dr. Soetomo General Hospital 60286, Surabaya, East Java, Indonesia.

International Journal of Frontiers in Medicine and Surgery Research, 2021, 01(01), 019–024

Publication history: Received on 25 March 2021; revised on 27 April 2021; accepted on 30 April 2021

Article DOI: <https://doi.org/10.53294/ijfmsr.2021.1.1.0062>

### Abstract

Children with type 1 diabetes mellitus (T1DM) are in a chronic condition that requires daily care throughout life and interferes the quality of life. This research was an analytical observational study with a cross-sectional design at the Pediatric Endocrinology Outpatient Clinic in Dr. Soetomo General Hospital, Surabaya. The sample size of this study was 29 subjects. Data were accumulated through interviews, questionnaires, and medical records. To determine whether there is a relationship among the duration of illness, HbA1c levels, and the quality of life in children with T1DM, a correlation test with Pearson will be conducted. The Multiple Linear Regression test was carried out to determine how big the influence of the relationship. The results showed that from a total sample of 34 subjects, the average duration of illness was 21.24 ( $\pm 14.82$ ) months, the highest HbA1c level was 9 (6-13) %. The analysis results with the independent sample T-test were obtained with a value of  $p=0.877$  ( $p < 0.05$ ), means that there was no notable difference between children and parents reports. The relationship among duration of illness, HbA1c, and quality of life were analyzed by Pearson Correlation test and Multiple Linear Regression test. The correlation results for length of illness and HbA1c sequentially  $r= 0.743$ ,  $r= -0.857$  with  $R^2$  value: 78.4% and  $p=0.001$  ( $p < 0.05$ ). From this study, it was also found that there was a positive relation between duration of illness and quality of life along with a negative correlation between HbA1c and quality of life.

**Keywords:** Duration of illness; HbA1c; Quality of Life; Type 1 Diabetes Mellitus

### 1. Introduction

Type 1 diabetes mellitus type 1 (T1DM) is one of the most prevalent chronic diseases in childhood. T1DM occurs due to deficiency of insulin levels caused by damage to pancreatic beta cells resulting in the disruption of insulin production [1]. As a result, children with T1DM depend on insulin injections to meet their daily metabolic needs. In addition, they also receive a variety of treatment programs, ranging from daily blood sugar control, carbohydrate calculation, diet planning and physical activity [2]. Children with T1DM are requires daily care throughout life and harms the quality of life [3]. The children quality of life with T1DM is influenced by factors of age at diagnosis, sex, parents' views on T1DM disease, glycemic control achievement and lifestyle of the T1DM children themselves [4]. Various factors can also affect a child's quality of life, such as, severity and complications of disease, length of treatment, family, the environment, education, and socioeconomics [5]. In addition, high emotional levels in children with T1DM are associated with psychosocial and behavioral factors such as social support and low quality of life, as well as difficulties in managing diabetes [6].

\* Corresponding author: Ahmad Suryawan

Department of Pediatric, Faculty of Medicine Universitas Airlangga 60132, Surabaya, East Java, Indonesia.

Therefore, this study was conducted with the aim of identifying the relationship between duration of illness, HbA1c concentrations and quality of life in children with T1DM. Identifying the relationship is expected as an input for the information on parental perceptions of children with T1DM which can be used as capital for comprehensive child care with long-term treatment.

## 2. Material and methods

The population in this study were 5-18 years old children who had previously been diagnosed with T1DM and underwent outpatient treatment at the Pediatric Endocrinology Outpatient Clinic in Dr. Soetomo General Hospital from October to December 2020. The sampling method used was the consecutive random sampling. In this research, the inclusion criteria were 5-18 years old adolescents, able to communicate with the researcher and fill out PedsQL 3.2 diabetes module questionnaires. The exclusion criteria were severely ill pediatric patients and require PICU care. The independent variables were the duration of illness and HbA1c levels. The dependent variable was the quality of life. Data were collected by interviewing the parent and participant. Moreover, they were asked to fill out the PedsQL 3.2 Diabetes Module questionnaire. The informed consent was waived and signed by the participants' parents and/or legal guardian. This study was approved by Clinical Research Unit of Dr. Soetomo General Hospital Number 0123/LOE/301.4.2/IX/2020.

### 2.1. Statistical analysis

Descriptive analysis was committed to describe the duration of illness, HbA1c levels and quality of life scores refer to PedsQL. The Kolmogorov-smirnov test were used to determine the normality among the variables. We used unpaired T-independent test for measuring the different of quality of life scores PedsQL which fill out by parents and participant. Pearson correlation assessment was done to determine the correlation between the duration of illness and the quality of life. We used Spearman correlation test to see the relationship between HbA1c levels and the quality of life of the participants.

## 3. Results and discussion

The descriptive analysis in the present study was shown in Table 1.

**Table 1** Characteristics of children with T1DM

Characteristics	Children with T1DMN=34
Age (years)*	11.88 ( $\pm$ 2.86)
5-7 years old	3 (8.83)
8-12 years old	18 (52.94)
13-18 years old	13 (38.23)
<b>Sex (%)</b>	
Male	17 (50.0)
Female	17 (50.0)
BMI*	17.27 ( $\pm$ 2.74)
Duration of Illness (months)**	18 (6-60)
HbA1c (%) *	9.2 ( $\pm$ 1.87)

\*mean  $\pm$  SD, \*\*median (min-max)

The results showed that the length of illness had an intense positive connection with the quality of life of children with T1DM ( $p=0.001$ ;  $r=0.743$ ). HbA1c levels have a strong negative relationship with the quality of life of children with T1DM. Therefore, an optimal in HbA1c levels in children will make their quality of life better ( $p=0.001$ ;  $r=-0.884$ ).

**Table 2** Differences in quality of life based on participant's reports

<b>PedsQL</b>	<b>Children's Reports</b>	<b>Parents' Reports</b>	<b>p</b>
Diabetes Symptoms	74.58 (16.00)	72 (13.35)	0.472
Treatment Barriers	77.64 (16.29)	74.26 (19.50)	0.441
Treatment Adherence	84.70 (13.38)	83.73 (15.89)	0.786
Worry	54.98 (11.75)	70.08 (22.43)	0.001*
Communication	75.14 (25.17)	78.61 (20.88)	0.538

\*p&lt;0.05, the higher the value the better the quality of life

Table 2 showed the results of PedsQL analysis assessed by participants and parents in numerical data. The results showed that there are no significant different except for the wariness category.

**Table 3** The relationship between duration of illness and HbA1c with quality of life in children with T1DM

<b>Variable</b>	<b>Quality of Life</b>	
	<b>p</b>	<b>b</b>
Duration of Illness	0.004*	0.329
HbA1c	0.001*	-0.646

Multiple Linear Regression Test, \*p<0.05, R<sup>2</sup>=78.4%

Based on Table 3, the duration of illness showed a positive relationship with the quality of life of children with T1DM, along with HbA1c levels had a strong negative correlation with the quality of life of children with T1DM. From the results, the quality of life value is not much different between reports of children and reports of parents. Of the five aspects evaluated, the worry aspect has the lowest score.

Children with T1DM are in a chronic condition has a negative impact on quality of life [7]. The quality of life of children with T1DM is influenced by factors of age at diagnosis, sex, parents' views on T1DM disease, glycemic control achievement and lifestyle of the T1DM children themselves [4].

The average age of the T1DM children in this present study was 11.88 (SD 2.86) and the most in the sample was the age range of 8-12 years. The incidence of T1DM can occur at any age. In general, there is a steady increase at the age of 10-15 years [8]. Lifestyle and weight gain are also risk factors for T1DM [9]. Autoimmune diseases are more common in female. However, in the young T1DM population, the number of male and female is not much different [10, 11]. BMI in this study had a median mean of 17.27 (SD 2.74). Children with T1DM have a stature that tends to be thin when diagnosed. The consequences of their catabolic condition that weight loss often precedes diagnosis [12]. Immediately after receiving therapy, the weight of children with T1DM will increase as a result of the anabolic effect of insulin therapy [13]. From this study, the most duration of illness was 18 (6-60) months. Another study found that children with early-onset diabetes (0-3 years old at diagnosis, the diabetes median duration was 19.8 years) had a higher risk of generating diabetes complications than children with late-onset diabetes (9-15 years old at diagnosis, the median duration of diabetes was 19.5 years) [14]. Thus, early diabetes social impact will rise definitely, and more young patients will require sufficient health care to manage glycemic control and good quality of life [15]. In this study, the average HbA1c level was 9.2 (SD 1.87). The HbA1c target was adjusted for age, less than 8.5% for age less than 8 years, 8% for age 7-12 years, and less than 7.5% for adolescents [16]. While the International Society for Pediatric and Adolescent Diabetes (ISPAD) recommends an HbA1c target of less than 7.5% for all children and adolescents with DMT-1 regardless of age, paying attention to individual glucose targets to achieve normoglycemia, accompanied by the prevention of severe hypoglycemia [17]. The HbA1c level in this study was still above the target. Good monitoring is needed in managing T1DM, starting from insulin therapy, regulating diet and physical activity or exercise.

In this study, duration of illness has a relationship with quality of life. The longer the duration of T1DM illness, the better the quality of life. The existence of good adaptation to chronic disease plays a role in improving the quality of life. The duration of illness can lead to depression which can ultimately worsen the quality of life. Adaptation in the form of coping mechanisms plays a role in overcoming depression that occurs in chronic diseases [18]. This is in line with a study in Jordan. In a study involving 145 T1DM children, it was found that the longer the duration of T1DM illness, the

better the patient will be in managing diabetes so that glycemic control improves (decreasing HbA1c levels) and quality of life will increase [19].

HbA1c levels have a negative correlation with quality of life. HbA1c as a measure of the success of T1DM treatment, plays an important role in achieving a better quality of life [20]. This is in line with a study in the United States involving 1307 T1DM children, where the long duration of illness will cause depression so that it can worsen metabolic control conditions and has an impact on decreased quality of life [21].

The quality of life scores were not much different between the child's report and the parent's report. Intensive therapy in T1DM is very important in preventing or slowing the occurrence of complications, including impaired cognitive function, intellectual decline and neurological disorders. The occurrence of these complications will be more severe at the age of onset before the age of four or five years so that it can affect the quality of life [2]. The study in Greece, which involved 117 T1DM children and adolescents, aged between 5-8 years with a mean age of onset of 1 year, found that children with T1DM had a quality of life score of 61.07 (13.43), lower than the general population. This could be due to differences in the management of T1DM [2]. According to Al-Akour [19], older adolescents are more worried and have a lower quality of life. Adolescents are involved in the problems they face and have the ability to solve them to provide some lessons for them in dealing with problems regarding T1DM in the future. In contrast to previous investigations, other studies stated there was no significant discrepancy between the quality of life of children with T1DM and the general population, despite the repeated and often painful disturbances associated with insulin injections, blood glucose checks, and frequent snacks, adolescents with diabetes do not experience a compromised quality of life. The low number of conflicts in the family possibly plays an essential impact in handling T1DM and improve the quality of life of children with T1DM [22, 23].

The worry aspect has the lowest value. These results are in line with a cross-sectional study in Australia involving 196 children with T1DM. There is a high sense of worry in children due to the perception of the disease. Children tend to worry if they cannot be accepted by their environment, cannot be accepted by their peers because of their disease conditions and are treated differently from their friends. The existence of a pandemic condition also has an impact on children's perceptions. Children are worried about complications that occur due to the disease they are suffering from.

Duration of illness has a strong positive relationship to quality of life. The longer the duration of illness, the better the quality of life. A study in Germany, involving 629 subjects with T1DM children aged 11-17 years and the onset of illness aged 0-4 years, found that the quality of life of children with T1DM did not differ from the general population and duration of illness did not reduce the quality of life scores. This is because the patients have a good experience in managing T1DM and even have better self-esteem than the general population [24]. In contrast to this study, Northam, in their study, stated that after ten years of diagnosis, children with T1DM had experienced at least one serious event of hypoglycemia and one-third had a history of poor metabolic control [25]. This may be due to anxiety, behavioral disturbances during illness and the experience of repeated hypoglycemic events leading to poor glycemic control. Mental health services can be provided to all children, but not every child needs them. Routine screening at diagnosis with interventions specifically targeted at behavior problems, especially in high-risk children, can provide opportunities to reduce long-term morbidity. Another study states that the longer the duration of diabetes, the contribution of the family or the role of parents decreases. This can be seen where in the control group there is a decrease in family contribution scores. This decline was due to parents shifting the responsibility for managing diabetes to their children as the children grew older [26]. The existence of coping methods against chronic disease provides a good adaptation mechanism to chronic disease, so that children with a longer duration of T1DM illness will find it easier to manage their diabetes and their quality of life can improve.

HbA1c levels have a strong negative relationship to quality of life. Low HbA1c levels are associated with better quality of life in children with T1DM. This is in line with a study in Italy, involving 153 T1DM children with an average age of 14 years and a duration of illness of 6 years, it was found that the lower the HbA1c level, the better the quality of life. Researchers suggest that psychosocial factors, concerns and perceptions of children and parents about diabetes play a role in managing diabetes and metabolic control can be achieved optimally [27].

The limitation of this study is that this study is observational and the data collection is only taken once. In addition, there are variables that need to be investigated that may indirectly affect the quality of life, such as conditions during a pandemic and lockdown. Further research needs to be done with a wider population considering the different characteristics.

#### 4. Conclusion

The duration of illness has a strong positive relationship, whereas HbA1c levels have an intensive negative correlation with the quality of life of children with T1DM. The longer the duration of T1DM illness and the lower the HbA1c level, the better the quality of life for children with T1DM. There is no much difference in the quality of life scores of children with T1DM based on reports of children and parents' reports, but on the aspect of worry, there are significant differences. These findings can be taken into consideration for conducting routine quality of life screening in children with T1DM who come for treatment using the PedsQL 3.2 Diabetes Module questionnaire. Further multi-center research on the relationship between duration of illness and HbA1c levels with the quality of life in children with T1 diabetes was required.

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#### Compliance with ethical standards

##### *Acknowledgments*

We would like to express our gratitude to the fellow doctors and nurses at Department of Pediatric, Dr. Soetomo General Hospital who help and give us the support during the study.

##### *Disclosure of conflict of interest*

The authors have declared that there is no conflict of interest.

##### *Statement of informed consent*

Informed consent was obtained by all of participants' parent and/or legal guardian. This study was approved by Clinical Research Unit of Dr. Soetomo General Hospital Surabaya, Indonesia with reference number 0123/LOE/301.4.2/IX/2020.

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