

Impact of Medication Adherence on Glycemic Control among Pediatric Patients with Type 1 Diabetes Mellitus: A Cross-Sectional Design

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ABSTRACT

Type 1 diabetes mellitus is an autoimmune disorder that requires lifelong insulin therapy to achieve and maintain adequate glycemic control. Suboptimal adherence to insulin therapy remains a major challenge that negatively affects effective diabetes management and glycemic outcomes. This study aimed to examine the association between medication adherence and glycemic control among pediatric patients with type 1 diabetes mellitus. A descriptive cross-sectional design was employed in Karbala Governorate, Iraq, to investigate the relationship between medication adherence and glycemic control among pediatric patients with type 1 diabetes mellitus. A convenience sample of 100 participants was enrolled. Data were obtained through a structured self-administered questionnaire that captured participants' sociodemographic characteristics and medication adherence. Descriptive and inferential statistical analyses were performed to summarize the data and identify statistically significant associations between the study variables. A total of 100 pediatric patients diagnosed with type 1 diabetes mellitus participated in the study. The participants had fair adherence to their medications, whereas poor glycemic control was recorded for most of the patients. A statistically significant association was observed between medication adherence and glycemic control ($p < 0.05$), with higher adherence levels being associated with more favorable glycemic outcomes, the better their glycemic results were. In addition, there were significant relationships between the adherence and demographic variables. The findings indicate that many pediatric patients attending Al-Imam Al-Hassan Center for Endocrinology demonstrated suboptimal adherence to their prescribed treatment regimens. Medication adherence was significantly associated with glycemic control as well as selected clinical characteristics, including age, duration of diabetes, presence of comorbid conditions, and concomitant medication use.

Keywords: Type 1 Diabetes Mellitus, Medication Adherence, Glycemic Control, and child.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by impaired insulin-mediated glucose metabolism resulting from either insufficient insulin production or reduced cellular responsiveness to insulin¹. Diabetes mellitus (DM) is classified into two major types: type I diabetes mellitus (T1DM) and type II diabetes mellitus (T2DM). Diabetes Mellitus Type 1 (DMT1), commonly known as type 1 diabetes mellitus, is an autoimmune condition that lasts a lifetime, which results from the destruction of the pancreatic beta cells that cause absolute lack of insulin. DMT1 requires constant supply of insulin throughout life, both for the individual's survival and to control their blood sugar levels. This condition continues to be one of the biggest challenges worldwide due to its rising prevalence rate^{2,3}.

Adherence to prescribed insulin therapy remains a fundamental determinant of successful diabetes management in children with type

1 diabetes mellitus. Consistent insulin administration contributes to maintaining optimal glycated hemoglobin levels and reducing glycemic variability, thereby minimizing the risk of diabetes-related complications. On the other hand, drug adherence among children and adolescents tends to be limited due to various developmental, psychological, behavioral, and familial factors that have the potential to affect treatment outcomes adversely. Research findings suggest that poor adherence correlates with suboptimal glycosylated hemoglobin levels and complications development⁴.

Effective diabetes management in pediatric populations extends beyond the child and depends largely on active family support, caregiver engagement, and continuous communication with healthcare professionals. Studies show that parent supervision and medication adherence result in positive glycemic control while family disagreements, lack of diabetes education, and poor medication

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adherence lead to bad metabolic results. Therefore, adherence to diabetes management cannot be viewed without considering the broader perspective⁵. There is emerging evidence from systematic reviews showing that intervention models that incorporate structured educational programs, behavioral strategies, follow-up appointments, and the use of technology are linked with enhanced adherence to diabetes management among children.

However, the effectiveness of such intervention models differs based on different health systems. Many children are unable to attain their target glycemic levels despite the presence of such interventions. Therefore, further investigation is warranted to identify context-specific factors that may influence medication adherence among children living with type 1 diabetes mellitus⁶. In spite of the increasing amount of evidence from other countries around the world, there is very little information on how medication compliance relates to the levels of glycemia in young patients with T1DM in Iraq. Differences in healthcare systems, accessibility to diabetes education, social, economic, and familial background can affect patient adherence and metabolic results. In this regard, studying this association in the local healthcare system is vital because it will help understand the determinants of low adherence rates and develop evidence-based strategies for improving glycemia levels in these patients⁷. Lifelong insulin therapy remains the cornerstone of type 1 diabetes management, as regular insulin administration is essential for maintaining glycemic stability and preventing both acute and long-term complications. The importance of medication adherence is being widely acknowledged as a complex behavior which involves various patient-related, treatment-related, and healthcare-related issues. While there have been numerous improvements in terms of insulin administration and glucose monitoring devices, it has been reported that medication adherence remains suboptimal⁸.

METHODS

Study Design: A descriptive cross-sectional quantitative design was employed to achieve the objectives of the present study. The study was initiated from 20 October, 2025; to 1st June, 2026.

Study Sample and Sampling: A non-probability convenience sample consisting of 100 pediatric patients diagnosed with type 1 diabetes mellitus was recruited from Al-Imam Al-Hassan Center for Endocrinology in Kerbala, Iraq.

Inclusion Criteria: The sample included those meeting the following criteria:

- Child who are medically diagnosed with type I diabetes mellitus.
- Child who are found at Al-Imam Al-Hassan center for endocrinology in the holy city, kerbala.
- Child who are willing to participate in the study.
- Child who are willing to have a blood glucose level checked by a glucometer.

Study Instruments: The study instrument was developed following an extensive review of the relevant literature and adaptation of previously validated measures used to assess medication adherence and glycemic outcomes. The survey tool was specifically formulated to measure drug compliance and its association with glycemic control in pediatric cases suffering from Type 1 Diabetes Mellitus. The survey tool comprised of two major parts containing close-ended questions.

Part One: Sociodemographic and Clinical Characteristics: Sociodemographic and clinical characteristics were gathered through nine questions in the first part of the study. Variables in the first part were age, gender, years of type 1 diabetes mellitus onset, history of diabetes in the family, having other comorbidity illnesses, taking any

other medicines aside from diabetes medication, educational attainment of the care taker, and latest glucose/HbA1c measurement.

Part II: Medication Adherence Assessment: The next part of the questionnaire involved assessing the degree of medication adherence in children diagnosed with type 1 diabetes mellitus. This section of the survey comprised of 18 closed-ended questions that focused on the respondents' adherence to their insulin treatments and other suggested measures for managing their condition. These questions assessed various aspects of taking medications such as treatment adherence, punctuality in administering insulin, skipping doses, continuity of taking medication, and adherence to therapeutic instructions.

Data Collection and Intervention: Data collection was performed with the help of an organized questionnaire through systematic face-to-face interviewing of respondents. The interviews were carried out one-to-one in Al-Imam Al-Hassan Center for Endocrinology, following identical methods. This technique was employed with all respondents, reducing the effects of any interview bias on the results.

Data collection was done for a span of nine months, beginning from **October 2025 to June 2026**. Participants that were eligible for inclusion in the study and had type 1 diabetes mellitus, attending the study site within the specified time frame, were recruited to take part in the study. Data gathering took place via face-to-face interviews, which were conducted by the researcher.

Strict actions were taken in order to ensure the privacy and confidentiality of the data collected from the respondents. The objective of the research was communicated to the parents or legal guardians before proceeding with participation, and informed consent was sought. It was ensured that the information provided by each participant was kept confidential and would be used for the purpose of scientific study only. This procedure helped create an atmosphere in which participants were comfortable giving honest answers.

Ethical Considerations: Ethical approval for the study was obtained from the Research Ethics Committee of the College of Nursing, University of Karbala. The research was carried out in compliance with the code of ethics described in the Declaration of Helsinki. Participation was strictly voluntary and all the participants participated in the study after they had provided their informed consent. All participants were aware of the aims of the study and that no adverse effects would befall them should they decide to leave the study at any point. Confidentiality and anonymity were ensured at all levels of the study, and all data were used

RESULTS AND DISCUSSION

In this study, the effects of medication adherence on the level of glycemic control in children diagnosed with Type 1 Diabetes Mellitus (T1DM) have been examined. It was found that adolescents between 13 to 18 years of age formed the highest percentage in the sample. The predominance of adolescents in the study sample is noteworthy, as this developmental stage is often associated with hormonal fluctuations, psychosocial challenges, increasing autonomy, and reduced parental supervision, all of which may influence adherence behaviors (Table 1).

Previous studies have consistently reported higher rates of non-adherence among adolescents, which are frequently associated with poorer glycemic control. In accordance with Rausch et al., treatment adherence decreases at the onset of adolescence and leads to higher HbA1c levels. The same results were found by Ibrahim et al.; adolescents were defined as high-risk for poor metabolic control due to adherence problems⁹⁻¹². The prevalence of females as subjects seen

Table 1. Distribution of the study sample by their demographic data(N = 100)

No.	Variables	Comparative patterns	df	F	Sig.
1	Age	Between Groups	13	0.303	0.988
		Within Groups	36		(NS)
2	Gender	Between Groups	13	0.573	0.859
		Within Groups	36		(NS)
3	Monthly income	Between Groups	12	1.445	0.187
		Within Groups	37		(NS)
4	Duration of Type I Diabetes Mellitus	Between Groups	13	0.934	0.022
		Within Groups	36		(S)
5	Other chronic diseases	Between Groups	12	0.831	0.037
		Within Groups	37		(S)

Table 2. Distribution of Glycemic Control According to HbA1c Levels among Pediatric Patients with Type 1 Diabetes Mellitus (N = 100)

HbA1c Level	Interpretation	Frequency (n)	Percentage (%)
< 7.0%	Good glycemic control	10	10.0
7.0–9.0%	Fair glycemic control	24	24.0
> 9.0%	Poor glycemic control	66	66.0
Total		100	100.0

Table 3. Distribution Overall Impact of Medication Adherence on Glycemic Control among Pediatric Patients with Type 1 Diabetes Mellitus.

Level of Medication Adherence	Frequency	Percent	Mean	Std. Deviation
Poor	16	16	1.71	0.36
Fair	56	56		
Good	28	28		

Table 4. Relationship between level of Medication Adherence for Type I Diabetes and Demographic data

No.	Variables	Comparative patterns	df	F	Sig.
1	Age	Between Groups	13	0.303	0.988
		Within Groups	36		(NS)
2	Gender	Between Groups	13	0.573	0.859
		Within Groups	36		(NS)
3	Monthly income	Between Groups	12	1.445	0.187
		Within Groups	37		(NS)
4	Duration of Type I Diabetes Mellitus	Between Groups	13	0.934	0.022
		Within Groups	36		(S)
5	Other chronic diseases	Between Groups	12	0.831	0.037
		Within Groups	37		(S)

in the current study (60%) has been found similarly in earlier literature conducted on adolescents having Type 1 Diabetes Mellitus (T1DM) (Table 2).

For instance, in a multi-center study done by¹³ to examine adherence behavior in adolescents with T1DM, a larger number of female participants were seen and it was noted that female adolescents have a higher participation in healthcare services and diabetes follow-up programs. This trend has been witnessed in many other studies related to pediatric diabetes and could be due to the differences in healthcare seeking behavior of female adolescents. This study has additionally shown that a number of individuals have been living with T1DM for more than five years. It is known that long disease duration can be correlated with treatment fatigue, lack of motivation, and decreased adherence (Table 3).

Nevertheless, there are inconsistent results described in the (literature. Although some research proves that the long disease duration is negative for adherence, other papers prove that with the increase of experience in disease management, people can develop self-care

skills. This study agree with study¹⁴⁻¹⁶. In addition, the most of the participants (68%) have been characterized by the absence of chronic diseases except for T1DM. The lack of several comorbidities can make treatment simpler and easier to adhere to. This study consist with^{17,18}.The findings from the current study indicated that there was a fair adherence level amongst more than half of the participants (56%). This finding is supported by the findings of¹⁹ who reported that the adherence levels of people suffering from Type 1 Diabetes were usually not optimal and the people were usually fairly adhering to the medication regimen rather than being optimally adherent. The reason for this was the difficulty in managing diabetes in the form of insulin injections and glucose monitoring. Thus, the predominance of fair adherence in the current study could be attributed to the challenges faced by children in diabetes management.

Also study supported by the population-based longitudinal research conducted by²⁰⁻²². In this study, lower and intermediate levels of adherence have been found typical for children and adolescents diagnosed with type 1 diabetes mellitus and were linked to unfavorable patterns of glycemic control. It is important to note that the researchers

stressed the variability of adherence behavior of children and adolescents and the fact that this behavior is affected by the role of caregivers, education, and family characteristics. Fair adherence can be considered a transitional behavior. In the current study, there was no statistically significant correlation between medication compliance and age, gender, and monthly income of the participants. This result is similar to the research done by²³⁻²⁵ who found out that there was no relationship between sociodemographic factors such as gender and socioeconomic measures and diabetes self-management practices in adolescents and young adults with Type 1 Diabetes Mellitus (Table 4).

The researchers hypothesized that adherence is more affected by psychological readiness and self-management abilities than by demographic factors²⁶. On the other hand, disease duration and comorbidity were strongly associated with medication adherence in this study. As was reported by^{27,28} the duration of the disease proved to be an independent factor predicting glycemic control by way of its impact on adherence to treatment regimen in the population of adolescents suffering from Type 1 Diabetes. In addition, recent studies demonstrate that the presence of multiple chronic conditions makes the process of treatment more complex and difficult for patients, thus influencing adherence. The results obtained can imply that clinical factors play a larger role in adherence compared to demographic factors.

CONCLUSION

The findings indicate that many pediatric patients attending Al-Imam Al-Hassan Center for Endocrinology demonstrated suboptimal adherence to their prescribed treatment regimens. Medication adherence was significantly associated with glycemic control as well as selected clinical characteristics, including age, duration of diabetes, presence of comorbid conditions, and concomitant medication use.

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Competing Interest: None

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