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The Influences of Multiple Daily Insulin Regimen and Conventional Insulin Regimen on Level of HbA1C in Type 1 Diabetes in Children

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ABSTRACT

Introduction:
Type 1 diabetes (T1DM), as a chronic endocrine disorder associated with insulin deficiency and accompanied by hyperglycemia. This study aims to compare the effect of multiple daily insulin regimen (MDI) and conventional insulin regimen (CIR) on HbA1C levels in children with T1DM in terms of glycemic control, complications, and quality of life.

Materials and Methods:
The proposed study was a retrospective cohort study conducted on 84 children aged between 2-18 years and who attended a hospital in Sulaymaniyah, Iraq, in the first half year of 2025. A structured questionnaire collected data on socio-economic status, and health history. The hospital records were used to collect the data required for the study. HbA1C levels, insulin regimen details, frequency/severity of glycemic events, incidence of complications, and adherence and quality of life scores were collected. Statistical significance was set at $P<0.05$.

Results:
Although children on MDI showed higher mean HbA1c levels over 12–24 months (74.3% with HbA1c > 9% vs. 63.3% in the CIR group), a larger proportion of MDI users (20% vs. 2%) reported a noticeable decrease in HbA1c after switching to this regimen. Blood glucose monitoring frequency was higher in the MDI group ($P<0.001$), yet hypoglycemia and hyperglycemia rates were comparable between groups ($P>0.703$ and $P>0.061$), respectively. Notably, dietary adherence was suboptimal in both cohorts, and most participants expressed uncertainty regarding regimen ease of use.

Conclusion:
The current study found that the MDI regimen compared to the CIR regimen was linked to high levels of HbA1c level among young patients with T1DM, therefore, inhibiting the expected superiority of MDI in attaining high-quality glycemic regulation.

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Introduction

Type 1 diabetes (T1DM), as a chronic disease an endocrine disorder associated with insulin deficiency due to loss of pancreatic β cells and accompanied by hyperglycemia, is also known as autoimmune diabetes (1). T1DM is the third most common chronic disorder in children (2). Before the introduction of insulin, T1DM was considered a fatal disease, associated with rapid death from complications such as ketoacidosis within a few months or 1 to 2 years (3).

The incidence of T1DM varies significantly across countries. More than 1.6 million people in the United States are likely to have T1DM (4). The gradual annual worldwide increase in the incidence of T1DM over the past 30 years is a significant reported problem. The reasons for this increase are not precisely known, however it is possible that dietary changes and environmental factors could be contributing factors to this increase in incidence (5).

The onset of T1DM symptoms usually occurs in childhood or adolescence, although in some cases symptoms may appear at an older age (1). Symptoms can include polydipsia, polyuria, and weight loss. Diabetic ketoacidosis is an acute complication of the disease and requires immediate intervention. Microvascular and macrovascular disease are long-term complications of T1DM (6). Microvascular (nephropathy, retinopathy, and neuropathy) and macrovascular (cardiovascular disease, peripheral arterial disease) complications associated with diabetes contribute to the morbidity and mortality associated with T1DM. Tight glycemic control can be associated with the prevention of diabetes-related complications and is the main focus of clinical care in the management of T1DM, but since diabetic complications occur years or decades after the onset of T1DM, glycemic management is challenging (4).

T1DM management should focus on optimizing blood glucose levels control with the aim of reducing acute and long-term complications of the disease (6). Current treatment for T1DM focuses on exogenous insulin, diet, daily activities such as exercise, and sleep. Newer insulin formulations and diabetes-related technologies, including methods for insulin delivery and glucose monitoring, have made significant advances (7,8). Significant advances in insulin formulations and insulin delivery devices and continuous glucose monitoring (CGM) have significantly improved the clinical care and daily lives of people with T1DM (4).

To achieve adequate glycemic control, treatment options for patients with T1DM include basal bolus therapy with multiple daily injections (MDI). MDIs provide basal insulin as long- or intermediate-acting insulin analogs, while bolus injections of rapid-acting insulin analogs provide better diet-related glucose control. Current treatments do not match the endogenous insulin profile of β cells, and risks such as suboptimal glycemic control, hypoglycemia, and ketosis in children and adolescents should be considered. The safety and success of insulin regimens require self-monitoring of blood glucose and/or a continuous glucose monitoring system to prevent critical hypoglycemia and control glucose variability (9). On the other hand, the conventional insulin regimen (CIR), which is still used in some areas, is a rigid regimen that requires injection timing, precise meal times, and specific meal and snack sizes to prevent hypoglycemia (10). Intensive treatment of T1DM significantly delays and slows the onset and progression of microvascular and macrovascular complications of the disease (11).

In Iraqi children and adolescents with T1DM, MDI was shown to provide approximately similar glycemic control as measured by HbA1c compared with CIR. MDI did not increase the number of hypoglycemic episodes, but was associated with more diabetic ketoacidosis (2).

Because adolescent and pediatric patients may have difficulty adhering to regular insulin injections, frequent blood sugar monitoring, and a regular diet, and during treatment periods they have higher HbA1c levels and a higher rate of severe hypoglycemic events than adults, therefore, there is a clear need for an intensive insulin regimen that is appropriate for these age groups and allows for close glycemic control without increasing the risk of severe hypoglycemic complications. It is unclear whether intensive insulin regimens in the clinical management of pediatric diabetes lead to improvements in HbA1c levels (12).

Studies have shown that HbA1c levels are inappropriately high in adolescents. Also, 70% of these patients have reported HbA1c levels above 7.5% regardless of insulin regimen. While these results provide important information about insulin regimens and HbA1c outcomes, gaps in the body of knowledge limit the provision of evidence-based guidelines, and further studies are needed to determine how different insulin regimens best affect patients with diverse resources and conditions over time (13).

However most of the relevant research has been conducted in high-income countries (14), and local data in the pediatric population is limited. This study aims to compare the effect of multiple daily insulin regimen and conventional insulin regimen on HbA1C levels in children with T1DM in terms of glycemic control, complications, and quality of life.

Materials and Methods

Study design

A retrospective cohort study design was employed to compare the effect of multiple daily insulin regimen and conventional insulin regimen on HbA1C levels in children with T1DM in terms of glycemic control, complications, and quality of life. This design was chosen to capture point-prevalence data and identify correlations between and socio-economic, demographic, and dietary variables.

Study setting

The study was conducted at Dr. Jamal Ahmad Rashid Pediatric Teaching Hospital – Endocrine Department, Sulaimani City, Iraq. The target population comprised children aged 2-18 years admitted to the Dr. Jamal Ahmad Rashid Pediatric Teaching Hospital – Endocrine Department. The sample size was determined based on precedents from prior studies investigating T1DM treatment regimes in pediatric populations. Using a confidence level of 95% and a margin of error of 5%, the estimated sample size was approximately xxx children. All eligible children with complete medical records during the past two years before the study were enrolled to the study using the census method.

Participants were included if they met the following criteria: Age 2–18 years, diagnosis of T1DM, on MDIR or CIR for at least 12 months, and complete hospital record documentation. Children were excluded if: type 2 or secondary diabetes, severe comorbidities interfering with study outcomes, and incomplete or missing medical records.

Data collection

A structured questionnaire, completed by the child's primary caregivers during clinic visits, collected information on socio-economic factors (parental education, income, household size), medical history (previous infections, frequency of hospitalizations), and perceived adherence to insulin therapy and dietary recommendations. Hospital records were reviewed to obtain clinical data, including mean HbA1c levels (averaged over 12–24 months), detailed insulin regimen classification (multiple daily injections [MDI] or conventional insulin regimen [CIR]), and whether the regimen incorporated correction doses. In this study, the conventional insulin regimen (CIR) comprised either premixed biphasic insulin (Mixtard 30/70) administered twice daily or a combination of regular human insulin and NPH insulin given two to three times per day, as per local prescribing practices.

In this study, a correction dose is defined as the administration of additional rapid-acting insulin outside scheduled mealtime doses to correct elevated blood glucose levels, as prescribed by the treating endocrinologist. Additional variables included the frequency and severity of glycemic events, occurrence of diabetes-related complications (e.g., diabetic ketoacidosis, retinopathy), and indicators of quality of life.

Ethical consideration

Ethical approval was secured from the Institutional Review Board (IRB) of the College of Medicine, University of Sulaimani (Reference 3172). Data were anonymized, with identifiers removed during analysis. Patient identifiers were removed and replaced with coded data**.**

Statistical analysis

Data were analyzed using SPSS v28.0. Descriptive statistics (means, frequencies) summarized socio-demographic and anthropometric data. Chi-square tests assessed associations between categorical variables (e.g., socio-economic status and complications). Independent t-test or ANOVA for treatment regimens and HbA1C levels. Statistical significance was set at $p < 0.05$.

Results

Demographic characteristics of children with T1DM who were in the MDI and CIR) study groups are presented in Table 4.1.

In the MDI group, 18 (51.4%) children were in the 11–15-year age group, and 10 (28.6%) children were in the 16–18-year age group. In the CI group, 30 (61.2%) children were in the 11–15-year age group, and 6 (12.2%) children were in the 16–18-year age group and there was no statistically significant difference in age group between the two groups (p=0.224). In the MDI group, 13 (37.1%) children were boys and 22 (62.9%) children were girls, and in the CI group, 23 (46.9%) children were boys and 26 (53.1%) children were girls and there was no statistically significant difference in gender between the two groups (p=0.503). The duration of diagnosis of type I diabetes in the MDI group was between 1-3 years in 7 (20%) children, between 3-5 years in 15 (42.9%) children, and more than 5 years in 13 (37.1%) children. The duration of diagnosis of type I diabetes in the CI group was between 1-3 years in 10 (20.4%) children, between 3-5 years in 15 (30.6%) children, and more than 5 years in 24 (49%) children and there was no statistically significant difference in gender between the two groups (p=0.466).

Table 1: Demographics characteristics in tow group

Variable		**Multiple Daily Insulin (MDI) group (n=35)**	**Conventional insulin (CI) (n=49)**	**P-value***
Age group (year)	0-5	0	1 (2%)	0.224
	6-10	7 (20%)	12 (24.5%)	
	11-15	18 (51.4%)	30 (61.2%)	
	16-18	10 (28.6%)	6 (12.2%)	
Gender	Male	13 (37.1%)	23 (46.9%)	0.503
	Female	22 (62.9%)	26 (53.1%)	
Duration of type 1 diabetes diagnosis (year)	1-3	7 (20%)	10 (20.4%)	0.466
	3-5	15 (42.9%)	15 (30.6%)	
	Mor than 5 years	13 (37.1%)	24 (49%)	
*P-value based on Chi-square				

In the MDI group, the current insulin regimen was MDI with correction in 12 (34.3%) children and MDI without correction in 23 (65.7%). In the CI group, the current insulin regimen was Conventional insulin with correction in 30 (61.2%) children and Conventional insulin without correction in 19 (38.8%). (Table 2)

Table 2: Specific method of two treatment regimens Multiple Daily Insulin (MDI) group and Conventional insulin (CIR) group in tow group

Current insulin regimen		**No.**	**%**
Multiple Daily Insulin (MDI) group	Multiple Daily Insulin (MDI) with correction	12	34.3%
	Multiple Daily Insulin (MDI) without correction	23	65.7%
Conventional insulin (CIR) group	Conventional insulin with correction	31	61.2%
	Conventional insulin without correction	18	38.8%

The insulin usage patterns of children with T1DM in both groups are presented in Table 3. In the MDI group, 26 (74.3%) children injected insulin 4 times a day and 9 (25.7%)

children injected insulin 5 or more times a day. In the CI group, 18 (36.7%) children injected insulin 2 times a day, 24 (49%) children injected insulin 3 times a day and 7 (14.3%) children injected insulin 4 or more times a day, and there was a statistically significant difference in the number of insulin injections between the two groups (P ≤ 0.001). The use of the insulin/carbohydrate ratio before each meal or snack was used in 1 (2.9%) child in the MDI group, while no patients used this ratio in CIR.

In the MDI group, the type of insulin used in all 35 (100%) patients was Rapid acting insulin + Long-acting insulin, while in the CI group, the insulin used in 18 (36.7%) patients was Mixtard insulin and in 31 (57.1%) patients was Rapid acting insulin + Mixtard insulin, and the type of insulin used between the two groups had a statistically significant difference (P ≤ 0.001). The time for adjusting the insulin dose in all children in both groups was when needed and when the blood glucose level was not within the target range.

Table 3: Characteristics of insulin use in two groups

Group		**Multiple Daily Insulin (MDI) group (n=35)**	**Conventional insulin (CI) (n=49)**	**P-value***
How many times per day is insulin administered?	2 times	0	18 (36.7%)	0.001
	3 times	0	24 (49%)	
	4 times	26 (74.3%)	0	
	5 time or more	9 (25.7%)	7 (14.3%)	
Do you use insulin/carb ratio before each meal or snack?	No	34 (97.1%)	49 (100%)	0.417
	Yes	1 (2.9%)	0	
What types of insulin are being used?	Mixtard insulin	0	18 (36.7%)	0.001
	Rapid acting insulin + Long acting insulin	35 (94.3%)	0	
	Rapid acting insulin+ Mixtard insulin	0	31 (57.1%)	
How often are insulin dosage adjusted?	As needed (when blood glucose levels are not within target range)	35 (100%)	49 (100%)	N/S
*P-value based on Chi square and fisher exact test				

The mean HbA1C levels over the last 1-2 years in the children in the MDI and CI group are presented in Table 4. In the MDI group mean HbA1C levels over the last 1-2 years in children with MDI with correction were 7-8% in 1 (8.3%) child, 8-9% in 3 (25%) children, and above 9% in 8 (66.7%) children, and in children with MDI without correction were 7-8% in 2 (8.7%) children, 8-9% in 3 (13%) children, and above 9% in 18 (78.3%) children. The last recorded HbA1C level in children with MDI injection with correction was Less than 7% in 1 (8.3%) child, 7-8% in 2 (16.7%) children, 8-9% in 1 (8.3%) child, and 9% or above in 8 (66.7%) children. In children with MDI injection without correction, it was 7-8% in 1 (4.3%) child, 8-9% in 4 (17.4%) child and 9% or above in 18 (78.3%) children.

In the CI group mean HbA1C levels over the last 1-2 years in children on CI are presented in Table 4.5. The mean HbA1C levels over the last 1-2 years in children on conventional insulin with correction were Less than 7% in 1 (3.3%) children, 7-8% in 3 (10%) children, 8-9% in 7 (23.3%) children, and above 9% in 19 (63.3%) children, and in children on conventional insulin without correction were Less than 7% in 1 (5.3%) children, 7-8% in 3 (10.5%) children, 8-9% in 4 (21.1%) children, and above 9% in 12 (63.2%) children. The last recorded HbA1C level in children with CI injection was 7-8% in 3 (10%) children, 8-

9% in 6 (20%) children, and above 9% in 21 (70%) children. In children with conventional insulin injection without correction, it was Less than 7% in 2 (10.5%) children, 7-8% in 1 (5.3%) child, 8-9% in 4 (21.1%) children, and above 9% in 12 (63.3%) children.

Table 4: Mean HbA1C level over the last 1-2 years and the last recorded HbA1C level in MDI and CI group

Group		Multiple Daily Insulin (MDI) with correction	Multiple Daily Insulin (MDI) without correction	P-value*
Multiple Daily Insulin (MDI) group				
The mean HbA1C level during 1-2 year?	Less than 7%	0	0	0.717
	7-8%	1 (8.3%)	2 (8.7%)	
	8-9%	3 (25%)	3 (13%)	
	Above 9%	8 (66.7%)	18 (78.3%)	
The most recent HbA1C level recorded for your child?	Less than 7%	1 (8.3%)	0	0.295
	7-8%	2 (16.7%)	1 (4.3%)	
	8-9%	1 (8.3%)	4 (17.4%)	
	9% or above	8 (66.7%)	18 (78.3%)	
Conventional insulin (CI)				
The mean HbA1C level during 1-2 year?	Less than 7%	1 (3.3%)	1 (5.3%)	0.5
	7-8%	3 (10%)	3 (10.5%)	
	8-9%	7 (23.3%)	4 (21.1%)	
	Above 9%	19 (63.3%)	12 (63.2%)	
The most recent HbA1C level recorded for your child?	Less than 7%	0	2 (10.5%)	0.441
	7-8%	3 (10%)	1 (5.3%)	
	8-9%	6 (20%)	4 (21.1%)	
	Above 9%	21 (70%)	12 (63.3%)	

*P-value based on Chi square and fisher exact test; Subgroup totals: MDI with correction (n = 12), MDI without correction (n = 23), CI with correction (n = 31), CI without correction (n = 19). All children in the MDI and CI group had a recent hemoglobin level check, all children having a normal hemoglobin level.

Daily blood glucose monitoring in children of the two groups had a statistically significant difference (P ≤ 0.001). In 8 (22.9%) children in the MDI group, blood glucose monitoring was performed 2-3 times per day, while in 28 (57.1%) children in the CI group, blood glucose monitoring was performed 2-3 times per day. Significant change in HbA1C after insulin regimen change was also statistically significant in the two groups (P ≤ 0.001). In 45 (91.8%) children in the CI group and in 22 (62.9%) children in the MDI group, there was no significant change in HbA1C level after insulin regimen change. Regarding clinical complications, in the MDI group, 10 (28.6%) children experienced hypoglycemia once a week, 2 (5.7%) children once or twice a month, 10 (28.6%) children rarely or never, and 13 (37.1%) children several times a week. In the CI group, 10 (20.4%) children experienced hypoglycemia once a week, 2 (4.1%) children once or twice a month, 19 (38.8%) children rarely or never, and 18 (36.7%) children several times a week. In the MDI group, 4 (11.4%) children experienced hyperglycemia once a week, 2 (5.7%) children rarely or never, and 29 (82.9%) children several times a week. In children in the CI group, 1 (2%) child experienced hyperglycemia once or twice a month, 4 (8.2%) children rarely or never, and 44 (89.8%) children experienced hyperglycemia several times a week. (Table 5)

Table 5: Evaluation of blood tests and complications of blood sugar changes in two groups

Group		Multiple Daily Insulin (MDI) group (n=35)	Conventional insulin (CI) (n=49)	P-value*
Has the child's hemoglobin level HB been tested recently?	Yes, it's normal	35 (100%)	49 (100%)	N/S
How often your child's blood glucose is monitored?	2-3 times per day	8 (22.9%)	28 (57.1%)	0.001
	4 time or more per day	16 (45.7%)	10 (20.4%)	
	Continues glucose monitoring (CGM)	3 (8.6%)	1 (2%)	
	Less than 2 times per day	8 (22.9%)	10 (20.4%)	
Have there been any significant change in HbA1C since switching insulin regimen?	No change	3 (8.6%)	3 (6.1%)	0.001
	Not sure	22 (62.9%)	45 (91.8%)	
	Yes, it has decreased	7 (20%)	1 (2%)	
	Yes, it has increased	3 (8.6%)	0	
How often does your child experience hypoglycemia?	Once a week	10 (28.6%)	10 (20.4%)	0.703
	Once or twice a month	2 (5.7%)	2 (4.1%)	
	Rarely or never	10 (28.6%)	19 (38.8%)	
	Several times a week	13 (37.1%)	18 (36.7%)	
How often does your child experience hyperglycemia?	Once a week	4 (11.4%)	0	0.061
	Once or twice a month	0	1 (2%)	
	Rarely or never	2 (5.7%)	4 (8.2%)	
	Several times a week	29 (82.9%)	44 (89.8%)	
*P-value based on Chi square and fisher exact test				

Regarding the ease of use and management of the two insulin regimens, in the MDI group, 1 (2.9%) child found both MDI and CI regimens equally easy to use, 4 (11.4%) children in this group found the Conventional insulin regimen easier to use, 4 (11.4%) children in this group found the Multiple Daily insulin regimen easier to use, and 26 (74.3%) children were unsure about the ease of use and management of the MDI regimen. In the CI group, 47 (95.9%) children were unsure about the ease of use and management of the CI regimen, and 2 (4.1%) children found the CI regimen very compliant, and there was a statistically significant difference in the ease of use and management of the two insulin regimens in the two groups (P ≤ 0.001) (Figure 1).

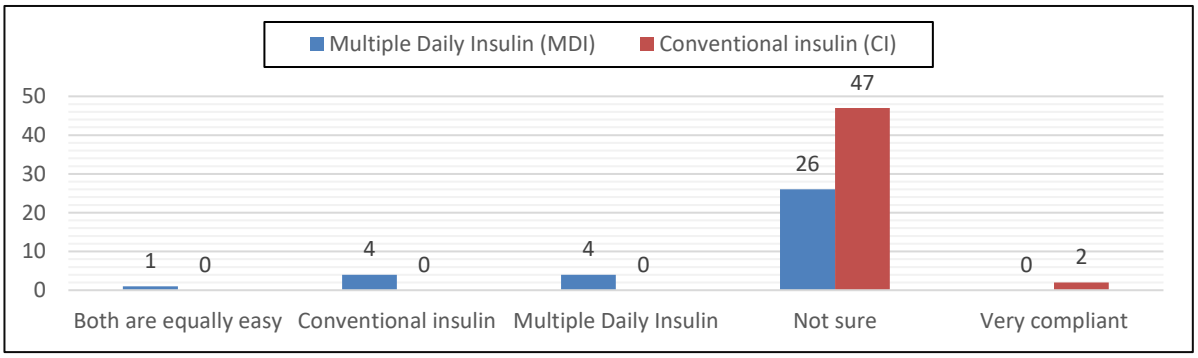

Figure 1: Comparison of daily insulin regimen management in two groups

The assessment of insulin regimen and diet compliance in children of both groups is presented in Table 6. In 2 (5.7%) children in the MDI group and in 5 (10.2%) children in the CI group, the insulin regimen was partially adhered to (missed doses, did not adhere to the schedule), and in 33 (94.3%) children in the MDI group and in 44 (89.8%) children in the CI group, the insulin regimen was fully adhered to.

In 6 (17.1%) children in the MDI group and in 10 (20.4%) children in the CI group, the diet was not adhered to. In 20 (57.1%) children in the MDI group and in 27 (55.1%) children in the CI group, the diet was partially adhered to, while in 9 (25.7%) children and in 12 (24.5%) children in the CI group, the diet was fully adhered to.

Table 6: Evaluation of insulin regimen and diet compliance in two groups of children

Group		Multiple Daily Insulin (MDI) group (n=35)	Conventional insulin (CI) (n=49)	P-value*
How compliant is the child with the insulin regimen?	Somewhat compliant (missing doses, not adhere to time schedule)	2 (5.7%)	5 (10.2%)	0.694
	Very compliant	33 (94.3%)	44 (89.8%)	
How compliant is the child with the food regimen?	Non-compliant	6 (17.1%)	10 (20.4%)	0.956
	Somewhat compliant	20 (57.1%)	27 (55.1%)	
	Very compliant	9 (25.7%)	12 (24.5%)	
*P-value based on Chi square and fisher exact test				

Discussion

In this study, the effects of MDI versus CIR on HbA1c in children with diabetes T1DM were evaluated**.** It was found that in the last 12-18 months, 74.3% of children who received MDI showed an HbA1c level above 9% compared to 63.3% of children in the CIR group. However, more recent measurements showed that there was a statistically significant difference among regimens with a higher percentage of patients using MDI having their HbA1c levels above the range of 9%**.** Therefore, the evidence suggests that adoption of an MDI strategy does not have the same effect in providing excellent glycemic regulation. However, the changes in regimens led to HbA1c improvement in 20% of children in the MDI group, which is compared to 2% in the CIR group**.** There was also a significant difference between monitoring practices with the MDI cohort having 45.7% recording capillary glucose four or more times a day compared to only 20.4% of the CIR cohort. According to the study findings, there were no statistically significant differences between the MDI and CIR groups in terms of key demographic variables. Specifically, no significant differences were observed in the distribution of age, gender, or duration of T1DM. This demographic homogeneity can be considered a methodological strength, as variables such as diabetes duration or age are well-known confounding factors that can directly influence glycemic control and the incidence of complications (15,16). The comparative evaluation of HbA1c levels in the two treatment groups showed that the mean HbA1c of the MDI arm was higher than that of the CIR group which is contrary to the initial assumptions. However, firstly, such an observation is consistent with the existing clinical dogma, according to which MDI treatment provides better glycemic control, as the current body of literature regularly identifies MDI as the standard of glycemic control in pediatric T1DM treatment (17). However, the insulin modality or dosing frequency is not the sole determinant of the therapeutic effectiveness of an intervention; other factors, such as adherence, access to special training, family support, and socioeconomic factors, also play a role (18,19). In the context of the current study, despite the frequent use of both rapid-acting and long-acting types of insulin preparations in the MDI cohort, the majority of patients in both groups had HbA1c levels above 9%, thus pointing to the fact that the population under study did not show optimal glycemic control. This observation aligns with the investigation carried out by R. Almazrouei et al. (2022) in the United Arab Emirates (20), which undertook a comparative analysis of outcomes between patients utilizing CSII and those receiving MDI. Despite the theoretical advantages attributed to CSII and the tendency of patients to attain superior glycemic regulation, empirical evidence revealed no statistically significant enhancement in HbA1c levels within either cohort. Nevertheless, the outcomes of this investigation exhibit a divergence from certain prior studies, which warrants attention. In research conducted by SW Sharef et al. (21) in Oman focusing on pediatric and adolescent populations diagnosed with T1DM, the transition from a bi-daily (BID) treatment regimen to a MDI protocol resulted in a notable decrease in HbA1c levels from 10% to 9.5% within the initial three-month period, with the

enhancement being particularly marked in the 5–11-year demographic. A comparable pattern was identified in our investigation, where 20% of children within the MDI cohort exhibited improvements following the alteration of their treatment protocol. This inconsistency may potentially be ascribed to the relatively smaller sample size in the Omani study in contrast to ours, or to sociocultural variables such as diminished adherence rates among adolescents, which posed a significant challenge in both investigations.

Various studies have determined that MDI regimen, due to its higher flexibility in dose modification, may provide better glycemic control. A T1DM systematic meta-analysis study by T.J. Dos Santos et al. (22)on pediatric patients showed that MDI, compared to CIR, reduced the levels of HbA1c and that this decrease was associated with a decreased risk of microvascular complications. The fact that said research is closely related to the current one can be traced to similar focus on pediatric groups and the paramount significance of glycemic control.

A frequency analysis of the injection frequency revealed that the participants in the MDI cohort injected insulin at a more regular basis four or more times/day, whereas those in the CIR cohort injected twice to thrice times/day. These findings coincide with the theoretical bases of MDI strategy where the goal is to reproduce physiological response of insulin secretion (23). The profile of the frequency and severity of hypoglycemic and hyperglycemic events indicated that the pattern was similar in both the groups. Hypoglycemia was reported by about 37% of children in each of the groups several times per week, whereas hyperglycemia was several times per week in over 80% of cases. This observation is in line with the results of Zucchini et al. (24), who found that intensive treatment including MDI does not enhance hypoglycemic risk but enhances the overall glycemic regulation.

With regards to the complications associated with diabetes, such as DKA and retinopathy, our study did not show any cases and all its pediatric participants had normal concentrations of hemoglobin. The results of past research have shown that intensive management regimens can slightly increase the probability of DKA as well as decrease chronic complications (25). We have not seen any complications in our cohort but it could be due to our comparatively short follow up period.

Most of the participants in the two arms were highly adherent to their insulin schedule; on the other hand, the level of adherence to dietary prescriptions was not very high. These findings are in line with the results of Azar et al. (26) who also found out that adolescent adherence is often suboptimal and correlates with high levels of HbA1c. This is in line with other studies that indicate that compliance with nutritional advice is one of the key issues in the management of T1DM in children (27,28). Finally, the paper indicates that the MDI intervention can produce small improvements in the HbA1c of some patient groups in childhood, but the overall glycemic control remains at high levels, and thus, supplementary measures should be employed, such as structured education courses and constant monitoring. Comparative studies against foreign data highlight that the advantages of MDI to continue to enjoy more consistent glycemic control are selectively evidenced in environments where their resources are well available, and, in similar situations in Iran, their socio-economic determinants play a central role.

Conclusion

The current study found that a greater proportion of children on the MDI regimen had HbA1c levels above 9% compared with those on the conventional regimen, suggesting that MDI did not confer the expected glycemic advantage in this cohort. The proportion of hypoglycemic and hyperglycemic attacks were similar in both groups but significant differences were found in comorbidity and glucose-monitoring activities. Although the level of compliance with the therapeutic protocol was high, dietary adherence was not particularly high, highlighting the importance of specific educational interventions. These results provide an

emphasis on how local factors, especially access to resources, affect the effectiveness of the treatment regimens, and indicate that the choice of a regimen is a highly specific approach that has to fit the patient situation and the degree of support available to patient.

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