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Factors Associated with Adherence to Insulin Self-Administration among Children and Adolescents with Type 1 DM in Iraq [#]

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Abstract

Adolescents and children with type 1 diabetes have been reported to have challenges regarding adherence to treatment regimens compared with other age groups with diabetes. The study aimed to determine the level of commitment and investigate the effects of different factors on insulin adherence in type 1 diabetes patients in Iraq. This cross-sectional study included face-to-face interview questionnaires with caregivers of children and adolescents. Interviews were conducted in the Specialized Center of Endocrinology and Diabetes in Nasiriyah City, Iraq, from October 4, 2022, to March 30, 2023. The adherence questionnaire consisted of two sections; each consisted of five questions, including insulin and blood glucose recommendations. Blood samples were obtained from the patient to determine fasting blood glucose (FBG) and glycated hemoglobin (HBA1c)—results**:** 180 patients (86 males and 94 females) with type 1 DM. The mean age, weight, and disease duration were 10.75 (4.36) years, 36.30 (16.41) kg, and 6.24 (3.70) years, respectively. They had uncontrolled blood glucose (208.42 95.0 mg/dl) and HBA1c (9.90 2.85%). The patients (52.2%) were girls with primary school qualifications (43.3%). Most of the caregivers (parents and guardians) were either illiterate (30.6%) or had completed primary school (33.9%). In addition, the patient's families (43.9%) had low income (0.5 million ID cards). Therefore, most patients (60%) did not visit a doctor regularly or check their blood glucose. Adherence in the studied population could be higher. Focusing on raising their patients' awareness is pivotal to enhancing their medication adherence to reduce their short- and long-term diabetic complications, improve blood glucose control, and improve clinical outcomes.

Keywords: Diabetes, Adherence, Insulin self-medication, Iraqi patients.

العوامل المرتبطة بالالتزام بالحقن الذاتي للأنسولين بين الأطفال والمراهقين المصابين بداء السكري من النوع الأول في العراق [#]

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#المؤتمر العلمي الثاني لطلبة الدراسات العليا

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الخلاصة

لقد تم الإبلاغ عن وجود صعوبات لدى المراهقين والأطفال المصابين بالسكري من النوع الأول في الالتزام بنظام العلاج بالمقارنة مع فئات الأعمار الأخرى المصابة بالسكري. الهدف من هذه الدراسة هو تحديد مستوى الالتزام واستكشاف تأثيرات العوامل المختلفة على الالتزام بالأنسولين في حالات السكري من النوع الأول في العراق. كانت هذه دراسة شاملة تتضمن استبيان المقابلات وجهًا لوجه مع مقدم الرعاية للأطفال والمراهقين. تمت هذه المقابلات في المركز المتخصص لأمراض الغدد الصماء والسكري في مدينة الناصرية في العراق في الفترة من ٤ أكتوبر ٢٠٢٢ إلى ٣٠ مارس ٢٠٢٣. يتكون استبيان الالتزام من قسمين، حيث يحتوي كل قسم على خمسة أسئلة تتضمن توصية بالأنسولين وتوصية بالسكر في الدم. وقد تم الحصول على عينة دم من مريض لتحديد نسبة السكر في الدم الصائم (FBG) والهيموغلوبين السكري (HBA1c). إجمالاً، كان هناك ١٨٠ مريضًا (٨٦ ذكرًا و٩٤ أنثى) مصابين بالسكري من النوع الأول. بلغت الأعمار المتوسطة للمرضى والوزن ومدة المرض ١٠.٧٥ (±٤.٣٦) سنة و٣٦.٣٠ (±١٦.٤١) كجم و٦.٢٤ (±٣.٧٠) سنوات. كان لديهم جلوكوز الدم غير المنضبط (٢٠٨.٤٢ ± ٩٥.٠ مجم / ديسيلتر) والسكر التراكمي (٩.٩٠+٢.٨٥%)، وكان (٥٢.٢٪) من المرضى من الفتيات الحاصلات على مؤهلات المدرسة الابتدائية (٤٣.٣٪). وكان معظم مقدمي الرعاية (الآباء والأوصياء) إما أميين (٣٠.٦ %) أو أكملوا التعليم الابتدائي (٣٣.٩%). بالإضافة إلى ذلك، كان لدى (٤٣.٩٪) من عائلات المرضى دخل منخفض (أقل من ٠.٥ مليون). لذلك، فإن معظم المرضى (٦٠٪) لم يزوروا الطبيب بانتظام ولم يفحصوا نسبة الجلوكوز في الدم. الالتزام في المجتمع المدروس منخفض بشكل عام. لذا يعد التركيز على زيادة وعي مرضاهم أمرًا محوريًا لتعزيز التزامهم بالعلاج لتقليل مضاعفات مرض السكري على المدى القصير والطويل والتحكم في نسبة الجلوكوز في الدم وتحسين النتائج السريرية.

الكلمات المفتاحية: السكري، الالتزام، الحقن الذاتي للأنسولين، المرضى العراقيين.

Introduction

Diabetes mellitus (DM) is a group of chronic metabolic disorders that affect almost half a billion people worldwide [(1)], and around 10% of them have type 1 diabetes (T1D) [(2)].

T1DM is also known as one of the most common endocrine disorders occurring in childhood, and (70–90%) of patients lose β-cells function [(3)].

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The annual worldwide incidence of type 1 diabetes mellitus is estimated to be 79,000, and the prevalence is 500,000 among children younger than 15 [4]. In Iraq, the majority of T1DM increased from 7.8 in 1995 to 14.2/100000 in 2000 and 24.7/100000 in 2014 under 15 years old children [5]. The prevalence of type 1 diabetes mellitus in primary school children in Baghdad City was 159 per 100,000, approximately the majority in Saudi Arabia, less than that in Al-Kuwait, but higher than that in Turkey. The percentage of underweight and obese was lower in the people with diabetes, while the overweight rate was slightly higher than the non-diabetics [6]. The cause of T1D has been unknown despite many investigations dealing with T1D; studies clarified that many factors have a role in this disease, like genetic susceptibility, environmental factors, and dietary deficiencies are known to contribute to the condition [7]. In Iraq, the healthcare system has been disrupted by wars and conflicts that affect health services involving the glycemic control of children with diabetes [8]. The World Health Organization defines adherence as "the extent to which a person's behavior-taking medication, following a diet, and executing lifestyle changes, corresponds with agreed recommendations from a healthcare provider [9]. Management options for patients with chronic illnesses such as diabetes are growing more complicated, which may result in a therapeutic burden for patients [10]. Insulin from an outside source is indispensable for the survival of T1DM patients [11]. Poor adherence can aggravate the situation once insulin therapy has been initiated. The World Health Organization (WHO) estimates that adherence to long-term treatments for chronic illnesses is as low as 50% in the developed world and is far lower in less developed countries [12]. The most critical determinants for excellent and poor glucose control are moderate caregiver involvement and the mother`s involvement in the all-task diabetes management of their children [13]. Effective management of diabetes requires consistent and timely administration of insulin, along with regular monitoring of blood sugar levels, a healthy diet, and physical activity. Some studies assessed adherence to blood glucose monitoring alone [14]. At the same time, others set diet adherence discretely [15].

Aim

The present study aimed to measure the level of adherence and investigate the effects of different factors on insulin self-administration in type 1 diabetes patients in Iraq**.**

Materials and Methods

Study Setting: The study was conducted in the outpatient clinic of the diabetes center in Nasiriya City, Iraq, from October 4, 2022, to March 30, 2023.

Study Design

Cross-sectional field-based study.

Inclusion criteria

1. Patients were diagnosed with type 1 diabetes at least one year before this study, and patients aged equal to or less than 18 years received insulin for at least three months.
2. Patients without comorbidities

Exclusion criteria

The exclusion criteria for the current study are:

1.The caregiver with the patient had hearing, speech, or cognitive deficits that would impair understanding of the questions.

2.All patients with type 2 diabetes and gestational diabetes were excluded from the study.

Sample size and sampling method

The formula for the single population proportion determined the sample size. Using the standard deviation corresponding to a 95% confidence interval (CI) and a 5% margin of error, the final sample size was 180.

The sample size was calculated based on the Rao soft program.

$$x = Z(c/100)2r(100-r)n$$
$$= N\,x/((N-1)E2 + x)E$$
$$= Sqrt[(N - n)x/n(N-1)]$$

N is the population size, r is the response fraction, and Z (c/100) is the critical value for the confidence level c.

Data collection

For each patient enrolled in the study, the following information was collected and recorded using a data collection sheet designed for the study: Socio-demographic characteristics: age, gender, height, weight, educational status, and monthly income Disease-related characteristics: duration of disease, history of disease, fasting blood sugar, and glycated hemoglobin test the adherence section consists of two parts of the questionnaire: Insulin recommendation Blood glucose recommendation Interviewer-administered questionnaires are used to collect information from caregivers and adolescents (self-reported adolescents (ages 12–18) when unaccompanied by a guardian). The interviews lasted an average of 30–45 minutes per participant.

Insulin adherence: we used a self-administered questionnaire about adherence [16]. All questionnaires were translated into formal Arabic. The translation steps included preparation, forward translations, back translation, review, finalization, proofreading, and the final report [17, 18]. Adherence was assessed by using five questions on recommended insulin practices given by the clinic, including taking the amount of insulin that the

healthcare-based provider prescribed, taking insulin at the correct times (taking your insulin every time you eat), adjusting the amount of insulin or food based on how much and how strenuously the child has exercised, adjusting the amount of insulin based on their blood glucose levels, and changing the amount of insulin appropriately when the child is ill. Four responses of never (1), sometimes (2), most of the time (3), and always (4) were given, and a participant who answered 1 and 2 were considered non-adherent. In contrast, those who answered 3 and 4 were considered adherents to this item.

Total adherence is calculated according to the answers (1, 2, 3, 4) and the summation of the adherence score for each of the ten questions, with the score for each question ranging from 1 to 4. The maximum score was five, and the participants who scored four or more points were regarded as adherents, while those who scored less than four points were regarded as nonadherent.

Blood sample collection and preparation

A blood sample was collected for analysis from fasting patients (which is routine in this center), and then the patients waited for the results before being seen by their doctors. During the waiting time, participants were interviewed, and each patient spent approximately 25 minutes filling out the research questionnaires. Five ml of venous blood was collected using a disposable plastic syringe of 23 g. Three parts were created from the collected blood samples: 2 ml of total drawn blood was kept in the EDTA tube for HbA1c estimation. A second part was held in plain disposable gel tubes and was allowed to separate, then separated using a centrifuge for 10 minutes at a speed of 4000 rpm. A third part was serum samples kept in a tube at -20°C until the analysis of biochemical parameters, including blood glucose and serum insulin, in fasting conditions was automatically performed using Architect (c1000) and a clinical chemistry analyzer (c4000) (Abbott Diagnostics, Abbott Park, IL, USA).

Statistical analyses

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 25 software. Descriptive statistics were conducted for all study components. Continuous variables were expressed as mean, standard deviation (SD), while categorical variables were expressed as frequencies and percentages. An independent t-test was used to compare differences in mean concordance scores between patient subcategories. A one-way ANOVA was used to measure the difference in the mean degree of agreement between patient or caregiver education and family income. A P-value of less than 0.05 was considered statistically significant.

Results and Discussion

Results

180 children and adolescents with type I DM were included in this study. Their average age was 10.75 (±4.36) years, and their average weight was 36.30(±16.41) kg. On average, they had DM type I for 6.24 (±3.70) years. They had uncontrolled fasting blood glucose (208.42 ±95.0 mg) mg/dl) and HbA1c (9.90± 2.85%) (Table 1). The patients (52.2%) were girls with primary school qualifications (43.3%). Most of the caregivers (parents and guardians) were either illiterate (30.6%) or had completed primary school (33.9%). In addition, the patient's families (43.9%) had low income (0.5 million ID cards). Therefore, most patients (60%) do not visit their doctor regularly and must check their blood glucose levels as recommended (Table 2). Eight out of ten items on insulin adherence, dose adjustment, and glycemic monitoring were above average. About three-quarters (76.7%) of the participants received the prescribed insulin dose. Most patients and caregivers (69%) admitted that they never adjusted their insulin dose based on diet, exercise, or blood glucose levels. (In other words, two items related to insulin dose adjustment were below average.).

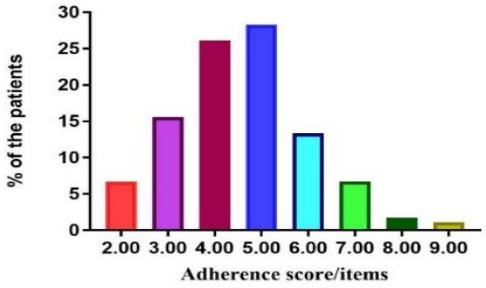

Figure 1. The percent of patients and the number of adherence items.

Table 1. Demographic characteristics of the participating patients with type I DM

Parameter	N	Minimum	Maximum	Mean	Std. Deviation
Age (years)	180	3.0	19.0	10.75	4.36
Weight (kg)	180	11.2	74.8	36.30	16.41
Height (cm)	180	84.0	179.2	139.59	23.29
HbA1c (%)	180	4.8	19.7	9.90	2.85
Duration of Type I DM (years)	180	1.0	15.0	6.24	3.70
Fasting blood glucose (mg/dl)	180	71.0	452.0	208.42	95.00

Table 2. Demographics of the participating patients and their caregivers

Characteristics	Subcategories	N	%
Gender	Male	86	47.8
	Female	94	52.2
Caregiver education level	Illiterate	55	30.6
	Primary school	61	33.9
	Secondary school	31	17.2
	University	33	18.3
Patients' education level	Below school age	40	22.2
	Primary school	78	43.3
	Secondary school	53	29.4
	University	9	5.0
Caregiver job	Employee	55	30.6
	Retired	61	33.9
	Free Business	31	17.2
	Unemployed	33	18.3
Family monthly income (Iraqi dinars)	<0.5 million	79	43.9
	0.5-1.0 million	74	41.1
	>1.0 million	24	15
Doing regular lab data	Yes	72	40
	No	108	60
Visit the doctor regularly.	Yes	72	40
	No	108	60

Table 3. The patients' adherence to insulin and blood glucose tools [15]

Adherence items Do you or your child	Never, N (%)	Sometimes, N (%)	Most of the time, N (%)	Always, N (%)	Mean	ST Dev
Take the amount of insulin that the healthcare-based provider prescribed.	9 (5)	33 (18.3)	73 (40.6)	65 (36.1)	3.08	0.86
Take insulin at the correct times, or take your insulin every time you eat?	21 (11.7)	46 (25.6)	62 (34.4)	51 (28.3)	.79	0.98
Adjust the amount of insulin or food based on how strenuously the child exercises.	100 (55.6)	25 (13.9)	32 (17.8)	23 (12.8)	1.88	1.11
Adjust the amount of insulin based on their blood glucose levels.	97 (53.9)	44 (24.4)	25 (13.9)	14 (7.8)	1.76	0.97
Adjust the amount of insulin appropriately when the child is ill.	36 (20)	71 (39.4)	42 (23.3)	31 (17.2)	2.38	0.99
Measure blood glucose before every meal.	30 (16.7)	69 (38.3)	56 (31.1)	25 (13.4)	2.42	0.93
Detect and respond to early signs of low blood glucose.	31 (17.2)	69 (38.3)	59 (32.8)	21 (11.7)	2.39	0.91
Detect and respond to early signs of high blood glucose.	38 (21.1)	64 (35.6)	56 (31.1)	22 (12.2)	2.34	0.95
Attend check-ups at the diabetes clinic every three months.	50 (27.8)	75 (41.7)	46 (25.6)	9 (5)	2.08	0.86
Keep a "diary" of the amount of insulin they take and record blood glucose measurements as required by your health care personnel.	24 (13.3)	46 (25.6)	76 (42.2)	34 (18.9)	2.67	0.93

Never=1, sometimes=2, most of the time =3, always=4.

Descriptive Statistics

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Total adherence score	180	18.00	31.00	23.7833	2.88180

Table 4. The correlation between HbA1c and total adherence scores

Parameter		**HbA1c**	**Total adherence score**
HbA1c	Pearson Correlation	1	-.168
	P-value		.024*
	N	180	180
The correlation is significant at the 0.05 level.			

Table 5. The difference in the total adherence scores according to the patient's gender

Parameter	**gender**	**N**	**Mean**	**Std. Deviation**	**P-value**
	Male	86	23.63	2.97	.490
Total adherence score	Female	94	23.93	2.81	

non-significant (P-value 0.05) according to the independent t-test

Table 6-A. The difference in adherence to insulin and glucose monitoring according to the patient's education level

Education level	**N**	**Mean**	**Std. Deviation**	**P-value**
Below school age	40	25.75	2.76	.000*
Primary school	78	23.14	2.69	
Secondary school	53	23.21	2.60	
University	9	24.00	3.08	

Significant (P-value 0.05) according to ANOVA

Table 6-B. Post-hoc tests to measure the difference among the four subgroups

(I) Education level of the patient	**(J) Education level of the patient**	**Mean Difference (I-J)**	**Std. Error**	**P-value**
1.0	2.0	2.60897	0.52	.000*
	3.0	2.54245	0.57	.000*
	4.0	1.75000	1.00	.297
2.0	1.0	-2.60897	0.52	.000
	3.0	-.06652	0.48	.999
	4.0	-.85897	0.95	.803
3.0	1.0	-2.54245*	0.57	.000
	2.0	.06652	0.48	.999
	4.0	-.79245	0.97	.848
4.0	1.0	-1.75000	1.00	.297
	2.0	.85897	0.95	.803
	3.0	.79245	0.97	.848

Significant (P-value 0.05) according to the Tukey HSD dependent variable: Total adherence score 1 = below school age; 2 = primary school; 3 = secondary school; 4 = university

Table 7-A. The difference in adherence to insulin and glucose monitoring according to caregiver education level

Caregiver education	**N**	**Mean**	**Std. Deviation**	**P-value**
Illiterate	55	22.85	2.83	.037
Primary school	61	24.23	2.89	
Secondary school	31	24.00	2.94	
University	33	24.30	2.64	
Total	180	23.78	2.88	

Significant (P-value <0.05) according to ANOVA

Table 7-B. Multiple Comparisons to Measure the Difference Among the Four Subgroups

(I) Education level for caregivers	(J) Education level for caregivers	Mean Difference (I-J)	Std. Error	P-value.
(1) illiterate	2.0	-1.37496	0.53	.048*
	3.0	-1.14545	0.64	.278
	4.0	-1.44848	0.62	.098
(2) Primary	1.0	1.37496	0.53	.048*
	3.0	.22951	0.63	.983
	4.0	-.07352	0.61	.999
(3) Secondary	1.0	1.14545	0.64	.278
	2.0	-.22951	0.63	.983
	4.0	-.30303	0.71	.974
(4) University or higher	1.0	1.44848	0.62	.098
	2.0	.07352	0.61	.999
	3.0	.30303	0.71	.974

Significant (P-value 0.05) according to Tukey HSD Dependent Variable: Total adherence score: 1 = illiterate; 2 = primary school; 3 = secondary school; 4 = university

Table 8-A. The difference in adherence to insulin and glucose monitoring according to family income

Monthly income (IDs)	N	Mean	Std. Deviation	P-value
<0.5 million	79	24.47	3.04	.009
0.5-1.0 million	74	23.04	2.52	
>1.0 million	27	23.81	2.92	
Total	180	23.78	2.88	

Significant (P-value 0.05) according to ANOVA

Table 8-B. Post-hoc Tests to Measure the Difference Among the Four Subgroups

(I) Income	(J) Income	Mean Difference (I-J)	Std. Error	P-value
1.0	2.0	1.42781	0.46	.006*
	3.0	.65354	0.63	.553
2.0	1.0	-1.42781	0.46	.006*
	3.0	-.77427	0.63	.443
3.0	1.0	-.65354	0.63	.553
	2.0	.77427	0.63	.443

Significant (P-value 0.05) according to the Tukey HSD dependent variable: Total adherence score: 1 = 0.5 million; 2 = 0.5–1.0 million; 3 = 1.0 million

Discussion

The study aims to measure the level of adherence and investigate the effects of different factors on insulin self-administration in type 1 diabetes patients in Iraq. This study reports a lower commitment to blood glucose monitoring recommendations at 60% compared with 76.5% by Kyokunzire C. and Matovu [16] and higher than that reported by Moström et al. at 43.9%. However, the latter study was conducted among older patients with type 1 diabetes [19]. This study says lower adherence for primary and secondary school-aged children compared with children below school (6 years old) with significantly higher adherence scores (P-value 0.05), possibly due to the parents of those children being entirely responsible for their medication administration and dosing. Parents often take a more active role in managing their child's treatment, ensuring they receive therapy and enhance adherence. Below the school, children typically have less autonomy and decision-making power compared to older children. Most patients and caregivers (> 69%) admitted that they never or rarely adjust insulin doses according to food, exercise, and blood glucose levels. Tight glycemic control has a pivotal role in reducing complications [20]. Type 1 diabetes children are still reported to have poor adherence to dietary recommendations as their diets are characterized by high proportions of saturated fat and low fruit, vegetable, and fiber content [21]. The involvement of caregivers in diet monitoring was one of the factors found to positively influence adherence to insulin self-administration in this same study as the Uganda study [15]. However, caretaker and parental involvement are widely related to better treatment outcomes [22]. There was a significant (P-value 0.05) difference in the adherence to insulin and glucose monitoring according to the caregiver education level; children with illiterate caregivers had a significantly lower commitment to insulin and glucose monitoring compared to those with

caregivers with primary school education. In another study in Iraq, the uncontrolled glycemic state of the patients were older children, and the low educational level of the parents led to poor glycemic control in around two-thirds of the patients, and about 25% of them had acute complications and problems in school achievement [23]. In another study in Iraq, diabetic educational programs should be made freely available to all diabetic patients to ensure better glycemic control, eventually decreasing the risk of diabetic complications [24]. This study reports an expected result associated with income for caregivers: low-income patients have more adherence than high-income patients. There was a significant (P-value o.o5) difference in the commitment to insulin and glucose monitoring according to the family monthly income; the children whose families had meager income (0.5 million IDs monthly) had significantly better adherence to insulin treatment compared to those whose families had income (0.5–1.0 IDs monthly). Due to financial constraints, low-income individuals may face more challenges accessing healthcare services. As a result, they may be more motivated to adhere to their prescribed insulin. A study in Iraq in Sulaymaniyah Governorate explains no significant association between glycemic control and family economic status [25]. Another study in Iraq revealed a negative relationship between parents' finances, psychological well-being, and environment, as poorer subjects rated higher scores than richer ones [26]. This study has shown that the majority of diabetic patients were always measured blood glucose only (13.4%) compared with other research that showed 89.1% of participants could correctly identify the parameters required for monitoring the patient's progress in response to the treatment plan, including monitoring of blood sugar [27].

Limitations of the study

The study was done in one center which serves residents living in Nasiriyah City, making it deficient in information regarding residents of other governorates.

Conclusion

This study reports poor adherence to insulin self-administration among type 1 diabetes children and adolescents in Iraq.

Acknowledgment

We thank the staff at the diabetes clinic in Nasiriyah City for their support during the study. The participants who took part in the survey are also appreciated.

Conflicts of Interest

None

Funding

None

Ethics Statements

1. Permissions obtained from the Ministry of Health by official letters directed to the author of the center to facilitate the researcher's task.
2. The ethical committee at The Central Scientific Committee of the University of Baghdad, College of Pharmacy had approved the conduction of the study
3. The parents of patients gave informed consent to participate after the objectives of the study were explained to them

Author Contribution

As a result, we confirm that all the figures and tables in the manuscript are ours.

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