RESEARCH PAPER

Factors affecting Diabetic control in a Cohort of children with type 1 diabetes Mellitus in Sulaimanyah City

Tara H. Tayeb[1]

CABP, Sulaimanyah University, Collage of Medicine, Pediatric Department

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Abstract

Background / Aims: Diabetic control is generally measured by HbA1C, the recent ADA (American Diabetic Association) guideline has put a target of < 7.5%. The aim of this study is to assess the diabetic control in the study sample, based on their HbA1c, and to analyze the factors that may affect diabetic control.

Subjects and Methods: This is a prospective questionnaire based cross sectional study. Parents / patients or both filled in the questionnaire, which included demographic characteristics, parents' educational level, insulin regimen and delivering device, duration of diabetes, number of injections, blood sugar monitoring / day, and hospital admissions related to diabetes, and the last the HbA1c.

Statistical analysis was done by SPSS version 24; ANOVA was used to asses correlation of HbA1c with different parameters, Chi-square tests were used to compare the categorical data between different groups of patients.

Results: A total of 163 patients were included in the study, 47.9% male and 51.2% female. The mean HbA1c was 10.3. Forty-eight-point eight percent of the sample had a HbA1c ≥10, 11% had a HbA1c of < 7.5. The HbA1c increased with age (P < 0.001), and decreased with higher levels of mother's education(P; 0.03), and more blood sugar monitoring {F (3,156) = 4.8, P = 0.003}. Gender, residency, duration of diabetes, insulin regimen, number of injections /days, and hospital admissions had no significant affect.

Conclusion: Enhancing parent's education and emphasizing on monitoring of the blood sugar, through reinforcing the role of diabetic educators, has a major impact on diabetic control

Keywords: type 1 Diabetes mellitus, HbA1C, diabetic control

Correspondent author: Tara Hussein Tayeb

Email: tara.tyib@univsul.edu.iq
Email: tarahus73@yahoo.com

Tel: + 0647701503577

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Introduction

Achieving good diabetic control has been proved to decrease the incidence of micro and macro vascular complications in diabetic patients.[1] HbA1c is a marker of diabetic control, reflecting the average blood sugar levels within the previous 3 months. Technological advancements in the field of diabetes, particularly the development of CGM (continuous glucose monitors), has led to the emergence of a new concept in diabetic control which is Time in Range (TIR), this is the percentage of time that the blood sugar is within target range). TIR is correlated with the HbA1c, but it also shows the variability in the blood sugar levels, and not just the average, like

HbA1c it has been associated with micro and macrovascular complications.[2] In this study we will only use HbA1c as a marker of diabetic control, because of the limited use of CGM devises in the setting of which this research has been conducted. According to ISPAD (International Society of Pediatric and Adolescent Diabetes) guidelines 2014 the target of good control for children and adolescents with type 1 diabetes throughout age groups was HbA1c of < 7.5, this target had then been further refined in 2018 ISPAD guidelines to < 7, while the ADA (American Diabetic Association) still recommends a target HbA1c of < 7.5.[3-5] In this research a target HbA1c < 7.5 has been used as a cut off point for good diabetic control, because this seemed more realistic and truer to the clinical practice of the center that the research was conducted in. There are multiple aspects involved in type 1 diabetes management; types of insulin and insulin regimens, delivery devices, dietary, social, financial, educational and technological aspects, so having a full picture with in the context of a single research would be impossible. This study aims to highlight some of the factors that have an effect on diabetic control, to help understand and implement practical steps towards achieving better diabetic management in general.

Methods

This is a cross sectional, questioner based prospective study, done in the Diabetic clinic of Dr. Jamal Ahmad Rasheed Pediatric Teaching hospital in Sulaimanyah city / Iraq. This is the main Pediatric diabetic clinic in the city, the overwhelming majority of the patients have type 1 diabetes. The questioner was clearly explained to the patients and their caretaker while waiting to be seen by the doctor in the clinic. Informed consent was taken, and the questionnaire was then filled by the patient, the care taker or both depending on the degree of mental maturity of the child, and to whether, whom was mainly responsible for the child's management. Factors studied were; the age, sex, duration of the disease, residency (rural or in the city), the insulin regimens, number of injections / day, numbers of blood sugar monitoring / day, number of previous hospital admissions related to diabetes, and the HbA1c level in the last 3 months. Statistical analysis was performed by SPSS program, version 24 (IBM SPSS Statistical Package for the Social Sciences). Compliance of quantitative random variables with Gaussian curve (normal distribution) was analyzed using Kolmogorov-smirnov test. The variables which shown to be normally distributed quantitative continuous variables where described by mean and SD (standard deviation). The data presented in tabular forms showing the frequency and relative frequency distribution of different variables of the study. The statistical significance of difference among variable groups (based on HbA1C levels for sugar control) was assessed using ANOVA,

{Chi-square tests were used to compare the categorical data between different groups of patients (different HbA1c categories) in respect to different variables as age groups, sex, parent educational levels, duration of disease etc}

Results

Total number of the study participants were 163 patients, 47.9% male and 52.1% female. Age, residency educational distributions are shown in the table below.

Table 1. Demographic characteristic of the sample.

Sociodemographic	Frequency	%
Age		
Mean ± SD (Min- max)	10.6 ± 3.7 (2.4 - 16.5)	
1 - 5.9 years	20	12.3
6 - 10.9 years	53	32.5
11 - 16.9 years	90	55.2
Sex		
Male	78	47.9
Female	85	52.1
Duration		
< 5 years	112	68.7
≥ 5 years	51	31.3
Residency		
Sulaimanyah city center	92	56.3
Outside the city center	65	40.0
Other cities	6	3.7
Mothers' education		
Illiterate	39	26.5
read and write	14	9.5
primary	46	31.3
intermediate or secondary	36	24.5
Institute and Higher education	12	8.1
Fathers' education		
Illiterate	25	16.9
read and write	14	9.5
primary	52	35.1
intermediate or secondary	38	25.7
Institute and Higher education	19	12.8

The mean HbA1c of the study sample was 10.3 (5.6-18), median 9.95.

(Table-2), shows the distribution of the HbA1c and the treatment characteristics of the sample; blood sugar control was achieved in 11% of the study sample, and 48.8% of the sample had a HbA1c of 10 or above. Most where on conventional twice daily mixed insulin preparations, checked their blood sugar twice, and were on insulin pen.

Table 2. The distribution of sample according to treatment characteristics and HbA1c.

Insulin regimen	*Percent*
Mixed preparation	56.8
Basal Bolus	26.5
Basal Bolus + Mixed	16.2
Continues insulin subcutaneous infusion (insulin pump)	0.6
Total	100
Mode of delivery	***percent***
Pen only	50
Pen & syringe	45.1
Syringe only	2.5
Iport	1.9
Insulin pump	0.6
Total	100
Number of injections / days	***Percent***
1.00	0.6
2.00	50.0
3.00	21.9
4.00	25.6
5.00	1.9
Total	100.0
(HbA1c)	***Percent***
< 7.5	11.1
7.5-8.5	16.7
8.6-10	23.5
> 10	48.8
Total	100.0
Blood sugar monitoring/day	***Percent***
0-1	8.7
2	37.3
3	26.7
4	15.5
5 >	11.8

(Table-3,4); show the effects of various demographic and management characteristics on the HbA1c. Age, number of blood sugar monitoring / day and mothers' education had a significant effect on the HbA1c, which was lower with younger age, more blood sugar monitoring and maternal higher educational degree. Father's education had a favorable affect but it was not statistically significant.

Table 3. Shows the relationship of HbA1C with different variables.

	HBA1C				
	< 7.5	7.5-8.5	8.6-10	>10	P value
Age					
Mean ± SD	6.86 ± 3.13	10.83 ± 3.59	10.75 ± 2.80	12.03 ± 3.11	< 0.001**
1 – 5.9 Years	8	5	1	6	
6.0 10.9 Years	9	8	18	18	
11.0 – 16.9 years	1	14	19	55	< 0.001*
Sex					
Male	10	11	19	38	0.791*
Female	8	16	19	41	
Duration of DM					
Mean ± SD	2.98 ± 2.2	3.42 ± 2.60	3.20 ± 2.34	4.0 ± 2.972	0.464*
< 5	12	19	30	51	0.3**
≥ 5	6	8	8	28	
Mother education level					
Illiterate	1	8	8	22	0.03*
Read and write	2	2	2	6	
Primary	2	5	12	26	
intermediate or secondary	5	6	8	17	
Institute or Higher education	5	1	4	2	
Father education level					
Illiterate	1	5	2	17	0.095*
Read and write	1	2	3	7	
Primary	3	7	16	26	
intermediate or secondary	5	7	8	18	
Institute or Higher education	6	4	4	5	
Residency					
City	11	15	22	39	0.79*
Periphery	5	11	11	34	
Other Governorates	1	1	2	2	

- Chi- square test
- ** ANOVA test

Table 4. Treatment and its related characteristic in relation to the HbA1c.

	HBA1C				
	< 7.5	7.5-8.5	8.6-10	> 10	P value
Type of insulin Regimens					
Mixed preparation	11	13	20	47	0.42*
Basal bolus	2	8	14	18	
Mixed preparation + Basal Bolus	4	6	3	14	
No. of hospital admissions					
No. admission	3	3	8	7	0.46*
One - two admissions	11	17	18	40	
Three - four admissions	3	2	6	12	
Five or more admissions	1	5	6	20	
No. of injections / day					
One - two injections	11	15	17	39	0.89*
Three - 4 injections	7	12	19	48	
Five and more	0	0	1	2	
Blood sugar monitoring / day					
Mean ± SD	4.22 ± 2.6	3.1 ± 1.2	3.1 ± 1.37	2.64 ± 1.55	0.056*
0 - 1	0	1	2	11	0.003**
2	6	8	13	33	
3	5	9	10	18	
4	1	7	8	9	
5 and more	6	2	5	6	

- *** Chi -square test**
- **** ANOVA test**

Discussion

Type 1 diabetes Mellitus, is a disease demanding constant support, in the form of; medical personals, financial resources and the implementation of ever advancing technologies.[6,7] It has been seen generally that diabetic control is better in more advanced specialized centers with lower numbers of patients to doctors.[8] The average HbA1c in Iraqi diabetic center in AL-Mustansirya Medical collage / Baghdad was 9.18 (versus 10.3 in this study) and a research done in Children Well Fear hospital in Baghdad showed that 23.8% of the patients attending the center had good diabetic control (versus 11% of our sample).[9,10] The mean HbA1c in a study done in Saudi Arabia was 9.4, most of the patients were on intensive insulin therapy (89.7% versus 26.7% in the current study sample) 31.4% of their patients had satisfactory HbA1c < 7.5 (versus 11% in the current sample).[11] Another study from Jordan involved 2 large pediatric diabetic centers showed that about 20% of the patients had HbA1C < 7.5.[12] Comparing these findings with that of SWEET Registry which analyzed the data entered from 48 centers mainly in

Europe from 2010-2015 were the median HbA1C was 7.8 and 14 centers had a median of <7.5, in these centers > 40 % of their patients where on Insulin pumps and 4% on CGM.[13,14] A clinical study involving 17 clinics done in Yorkshire UK showed that only 14.7% of their patient had the recommended HbA1C level of < 7.5.[15] In this cohort about half of the patients were on conventional mixed Insulin vails or pens, twice daily injection and blood sugar monitoring, this indicates that the center is far away from achieving intensive insulin therapy in most of the patients. There are two main factors contributing to this; first is economic, because older types of insulins used in twice daily regimens are much cheaper than the newer insulin analogs and they are readily available to the patients in the center for free, the other cause maybe that this type of insulin regimen need's less training and is more tempting to use in patients from families with lower educational levels. Basal bolus insulin regimen as a form of intensive insulin therapy has been found to be superior to conventional mixed insulin regimen.[16-18] In this study neither regimens had a significant effect on diabetic control, most likely because the study sample had a poor diabetic control generally in both groups, an important factor in this regard is that, basal bolus insulin regimen needs high level of education and training, because the flexibility in daily insulin dosage, according to dietary intake and blood sugar parameters, is the main advantage of this regimen over the twice daily regimens, this necessitates multiple daily decision making, needing appropriate training and mathematical skills, demanding a sufficient number of diabetic educators and dietitians in every diabetic center, a factor not sufficiently available in this study setting. The importance of education resonates well with the finding that maternal education had a significant effect on diabetic control in this cohort (P-value; 0.03). This is because type 1 diabetes puts high demand on parents to learn multiple management skills, further on, basic levels of education is needed to know the importance of compliance and the consequences of poor control on long term complications, while knowing how to use more advanced technologies demands even higher skills, this finding is in coherence with other studies on the subject.[12,19-21] Also within this context, a study involving 3 pediatric diabetic center in United Kingdom, showed that social deprivation, was associated with the least likelihood of initiation or success in intensive insulin therapy, a factor likely to contribute to poor diabetic control, this seemed to be mediated through lower educational levels.[22] In agreement with other studies, this study found that diabetic control was poorer in older pediatric age groups, this could partially be due to the surges in growth and sex hormones, and the psychological difficulties in adolescence causing less compliance and increased insulin resistance.[23-25] In this study the duration of diabetes had no significant effect on diabetic control, in contrast with some other studies on the subject, this could be because most of the patients (68.7%) randomly selected in the study had a duration of diabetes of less than 5 years, and that diabetes type 1, being a progressive autoimmune disease needs time to show a significant deleterious effect on diabetic control, which could be more evident in older adolescents and young adults.[11,24] Most researches, show the advantage of increased self-glucose monitoring and the superiority of CGM (continuous glucose monitoring).[26-28] The current study also showed a favorable effect of increased blood sugar monitoring on diabetic control.

Finally it would be of immense importance to have a local and national registry and also to be part of international registries, this is not only deficient in Iraq but in the middle east in general, such registries can improve the understanding of diabetes and help benefit from experiences in the area and around the world, and give the opportunity for collaborative researches[29,30] of equal importance is having family targeted educational programs, which would have a positive effect on diabetic control.[31] We recommend performing a larger collaborative research on diabetic control including multiple centers in Iraq to have a more unified picture on the problems facing diabetic management in the country.

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العوامل المؤثرة ف السيطرة على مرض السكري في مجموعة من الاطفال المصابين بداء السكري من النوع ١ في مدينة السليمانية

الخلفية / الأهداف يتم قياس التحكم في مرض السكري بشكل عام بواسطة HbA1C, وقد حددت إرشادات ADA (الرابطة الأمريكية لمرضى السكر مؤخراً هدف بنسبة .< 7.5٪

الهدف من هذه الدراسة هو تقييم السيطرة على مرض السكري في عينة الدراسة، بناء على c1HbA ،وتحليل العوامل اليت قد تؤثر على السيطرة على مرض السكري .

الموضوعات والطرق: هذه دراسة مقطعية قائمة على الاستبيان قام الآباء / لمرضى أو كالمها ملء الاستبيان، والذي تضمن الخصائص الديموغرافية، والمستوى التعليمي للوالدين، ونظام الأنسولين وجهاز التوصيل، ومدة مرض السكري، وعدد احلقن، ومراقبة نسبة السكر في الدم / اليوم، وحالات الدخول إلى المستشفى المتعلقة مبرض السكري، وآخرها ال HbA1c .ت إجراء التحليل الإحصائي باستخدام الإصدار ٢٤ من SPSS ،استخدام ANOVA لتقييم ارتباط HbA1c اختبارات مختلفة، واستخدمت اختبارات square-Chi مقارنة البيانات الفئوية بين مجموعات مختلفة من المرضى .ً

النتائج: ت اشتمال الدراسة على ١٦٣ مريضا، ٤٧,٩٪ ذكور و ٥١,٢٪ إناث. كان متوسط HbA1c 10.3.مثانية وأربعون فاصل ثمانية في المئة من العينة كان HbA1c 10، 11 ٪ كان **HbA1c <7.5** .زاد HbA1c مع تقدم العمر **(P< 0.001)**، وينخفض مع ارتفاع مستويات تعليم الأم (0.03) P، والمزيد من مراقبة نسبة السكر في الدم3}F ،4.8=(156, P= 0.003 لم يكن للجنس، والاقامة، ومدة السكري، ونظام الأنسولين، وعدد الحقن / الأيام، ودخول المستشفى أي تأثير كبير

الخلاصة: إن تعزيز تعليم الوالدين والتأكيد على مراقبة نسبة السكر في الدم، من خلال تعزيز دور معلمي مرض السكري، له أتثري كبري على السيطرة على مرض السكري