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The Effect of Diabetes on Lipid Profile in Patients with Type 1 Diabetes

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ABSTRACT

Background and Objective: Type 1 diabetes mellitus and its associated comorbidities are regarded as significant health issues. The present research aims to assess the impact of glycemic control on lipid profile of hospitalized patients with type 1 diabetes mellitus and for early diagnosis of dyslipidemia in cases with type 1 diabetes mellitus.

Methods: This cross-sectional was conducted at the Pediatric Department of Al-Imamain Al-Kadhmain Medical City from March 2018 to July 2019. Information about the gender and age of the patient, the age of diagnosis and duration of diabetes, insulin therapy: 2-3 times a day, regular blood sugar checking (daily) were collected using a questionnaire. Using American Diabetes Association criteria, cases were separated into excellent and poor glycemic control groups, and lipid profile anomalies were compared.

Findings: Out of the total of 128 people present in this study, 86 people (67%) had poor control. Increasing age of patients was associated with poor blood sugar control, so that between the ages of 13 and 18, 47 cases (54.7%) had poor control. It also increased the duration of poorly controlled diabetes. An increase in triglyceride level was evident in 76 people (88.4%), cholesterol in 52 people (60.5%) and low-density lipoprotein in 12 people (14%) among patients with poor control.

Conclusion: The results of the present study showed that increasing age and duration of the disease and high levels of triglycerides, cholesterol and low-density lipoprotein are predictors of poor glycemic control in children with type 1 diabetes.

Keywords: *Glycemic Control, Lipid, Mellitus, Type 1 Diabetes, Insulin-Dependent.*

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Introduction

The main types of diabetes are distinguished by insulin reduction and resistance; type 1 diabetes mellitus (T1DM) results from a lack of insulin secretion due to damage to the pancreatic beta-cells; type 2 diabetes mellitus (T2DM) is caused by insulin resistance at the level of skeletal muscle, liver, and adipose tissue (1). DM is a common chronic metabolic disease that is characterized by chronic hyperglycemia, formerly known as insulin-dependent, which often appears during childhood and adolescence, and is defined by reduction in insulin synthesis and necessitates the lifetime administration of insulin injections (2). Type 1 diabetes is one of the most prevalent chronic illnesses of children, with peaks in presentation occurring between 5-7 years of age or around puberty (3). Type 1 diabetes may happen at any age. Its incidence varies depending on the season and the month of birth. Being born in spring is linked to a greater risk of type 1 diabetes, and more cases are identified in the fall and winter (4, 5). Their current pathology's incidence rates are rising, and over the next ten years, the worldwide incidence might double (6, 7). The genetic propensity that leads to type 1 diabetes appears to be less of an influence today than it was in the past (8). The main contribution of the present research is to identify the variables such as age, gender, duration of diabetes, insulin regimen, frequency of random blood sugar testing, and follow-up that impact the condition of glycemic control to assess the impact of glycemic management on the lipid profile in type 1 DM patients.

Methods

This cross-sectional study was performed from the first of March 2018 to the first of July 2019 at the pediatric department of Al-Imamain Al-Kadhmain Medical City. 128 individuals with type 1 diabetes with a known case were included in the research population. All patients who were in the outpatient endocrine clinic, the ward, or the emergency room between the ages of 2 and 18 during this period were chosen.

There were three conditions for the inclusion criteria as: 1) Confirmed T1DM diagnosis, 2) The youngsters between the ages of 2 and 18, 3) Diabetes must have existed for at least a year in order to reduce the possible effects of leftover insulin production. Also, recently diagnosed cases and cases who used drugs other than insulin, as well as underlying liver, renal, thyroid, and gastrointestinal (celiac disease) diseases are excluded which, 22 people were excluded from this trial.

Direct questionnaires were used to get information from each patient's parents or caregivers, which included the following information: The patients' age and gender, diagnosis age, the duration of diabetes, insulin treatment regimen were recorded: Regimen 1: (2 shots each day) (2 injections per day) and Regimen 2: (3 injections of insulin per day) (3 injections of insulin per day), and Regular (daily), and rare (weekly, monthly) RBS assessment frequency, and infrequent monthly follow-up visits. The patients were assigned into 2 groups by HbA1C measurement based on ADA criteria (9).

Biochemical analyses: 5 ml venous blood sample was collected from each patient after fasting for 12 hours. Within 30 minutes, the serum was centrifuged to remove the red blood cells and determine the quantities of TC, HDL-C, LDL, and TG. The UK-based Randox original kits were used to measure these biochemical parameters using a Cecil 1021 spectrophotometer. According to age and sex percentiles, the lipid profile values in these two patient groups were classified as normal or elevated (5th-95th percentile normal, >95th percentile abnormal) (10). HbA1C: Since it was collected from a separate lab outside of the hospital, the method of collection is unknown. Parents or caregivers of every patient were orally told about the research and requested for consent to have their children participate. All identifiable data was kept private. Data were only utilized for this study's purposes. Data analysis was done employing the statistical package for social science (SPSS) software version 22. Non-parametric data was reported as a total amount, whilst parametric

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analysis was presented as Mean±SD. To compare proportions of non-parametric categorical variables, the Chi Square test was used to evaluate significance. P-values lower than 0.05 are deemed significant in all tests.

This study was done under the ethical code of ANU 12-2-2020 at Al-Nahrain University. Moreover, we used the American Diabetes Association criteria and all participants as unknown cases accpeted the agreement.

Results

128 patients were included in this study, with ages between 2 to 18 years and mean age of 10.9±3.6, including 76 (59.4%) girls and 52 (40.6%) boys. Among the patients included in this study, there were 22 (17.2%) below the age of 6 years, 50 (39.1%) from the age 6 to 12 years and 56 (43.7%) from 13 to 18 years, as shown in figure 1.

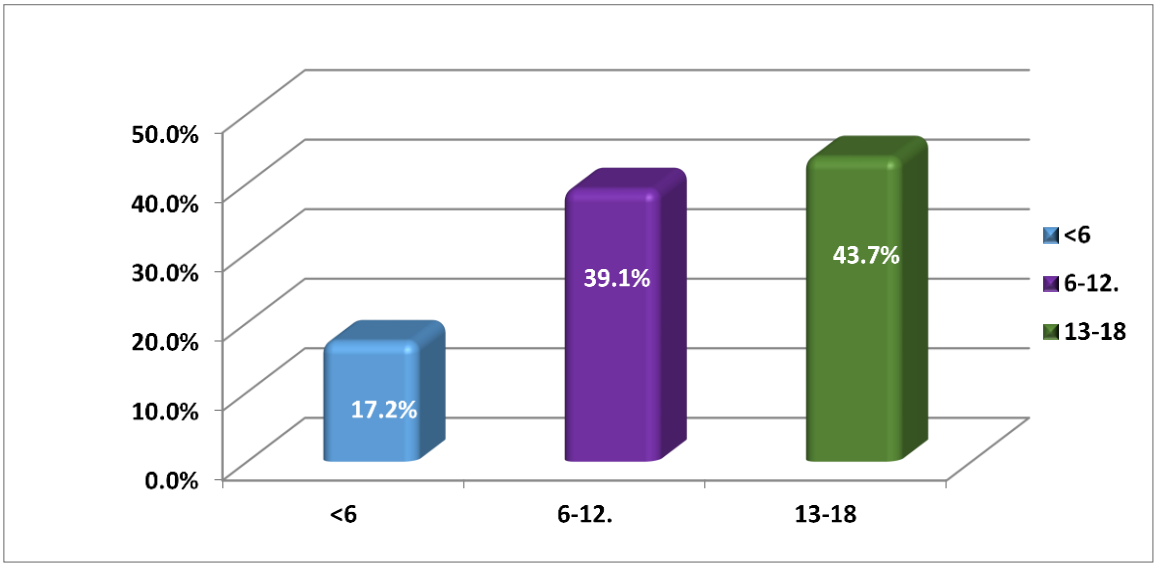

Figure 1. Age Distribution in Type-I diabetes cases

The correlation between glycemic control level and parameters such age at disease onset, diabetes duration, gender, age group, insulin regimen, RBS monitoring and follow up are presented in table 1. In T1DM cases, there was a significant correlation between older age and poor control, as those below 6 years were 12 (54.5%) good control and 10 (45.5%) poor control, as increasing the age from 6 to 12 years there are increase in the percentage of poorly controlled patients to 29 (58.0%) when compared with 21 (42.0%) good control and from 13 to 18 years were 47 (83.9%) poor control while 9 (16.1%) good control with significant p-value 0.001 as presented in table 1. Regarding the relationship between glycemic control and sexuality, most of the cases with poor control are female patients (60 [69%]) versus the male patients (26 [30.2%]), with significant p-value of 0.001, as presented in table 1.

Among the cases with type 1 diabetes there is no significant difference in glycemic control in relation to the age of disease onset (p=0.127). The other parameter is duration of diabetes which are presented in table 3. Regarding the association between the diabetic duration and glycemic control, the patients below 5 years' duration 38 (44.2%) were good control and 48 (55.8%) poor control, as increasing the duration from 5 to

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10 years there are 30 (88.2%) poor control and 4 (11.8%) good control, while all of the patients above 10 years were poor control 8 (100%) with significant (p<0.0001) as presented in table 1.

Table 1. Correlation of glycemic control level with the age at disease onset, diabetes duration, Gender, age group, insulin regimen, RBS monitoring and follow up to endocrine clinic

Parameter	Total Number(%)	HbA1C		p-value
		Good control Number(%)	Poor control Number(%)	
Age of onset				
<6	52(100)	20(38.5)	32(61.5)	
6-12	64(100)	16(25.0)	48(75.0)	0.127
13-18	12(100)	6(50.0)	6(50.0)	
Duration of diabetes				
<5	86(100)	38(44.2)	48(55.8)	
5-10	34(100)	4(11.8)	30(88.2)	<0.0001
>10	8(100)	0(0)	8(100.0)	
Gender				
Male	-	26(61.9)	26(30.2)	0.001
Female	-	16(38.1)	60(69.8)	
Age Group				
<6	22(100)	12(54.5)	10(45.5)	
6-12	50(100)	21(42.0)	29(58.0)	0.001
13-18	56(100)	9(16.1)	47(83.9)	
Insulin regimen				
R1	-	38(30.6)	86(69.4)	<0.0005
R2	-	4(100.0)	0(0)	
RBS monitoring				
Regular	-	36(85.7)	22(25.6)	<0.0001
Irregular	-	6(14.3)	64(74.4)	
Follow up				
Regular	-	36(85.7)	36(41.9)	<0.0001
Irregular	-	6(14.3)	50(58.1)	

All of the patients on regimen 2 (3 injections per day) were good control 4 (100%) while most of those on regimen 1 (2 injections per day) were poor control 86 (69.4%) with significant (p=0.0005) as presented in table 1.

Most of the cases by good control are regular RBS check (daily) 36 (85.7%), while most of the patients with poor control were irregular checking (weekly to monthly) 64 (74.4%) with significant p value<0.0001. Regarding follow up to endocrine clinic, most of the patients with poor controls where irregular follow up 50 (58.1%) with significant (p<0.0001), as presented in table 1.

Among the patients with type 1 diabetes who had poor control had significant high serum TG 76 (88.4%) p-value less than 0.0001, while all the patients with high LDL 12 (14%) (p=0.011) and high total serum cholesterol 52 (60.5%) (p=0.049) were poor control as shown in table 2.

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Table 2. Correlation of lipid profiles and glycemic control level

Parameter	HbA1C		p-value
	Good control Number(%)	Poor control Number(%)	
HDL			
Normal level	42(100)	86(100)	-
Low level	0(0)	0(0)	
LDL			
Normal level	42(100)	74(86)	0.011
High level	0(0)	12(14)	
TC			
Normal level	42(100)	34(39.5)	0.049
High level	0(0)	52(60.5)	
TG			
Normal level	38(90.5)	10(11.6)	<0.0001
High level	4(9.5)	76(88.4)	

Discussion

Dyslipidemia and hyperglycemia, metabolic abnormalities typical in young type 1 diabetics, causes high risks of cardiovascular disease (CVD) (11). Females constituted most of patients (59.4% versus 40.6% male), which was consistent with Turkish Demirbilek et al. (12) who found that from a total of T1DM patients, female were predominant (58.5%) while male accounted for the remaining (41.5%), nearly similar results were observed in Saudi Arabia by Abduljabbar et al. (13), who found a female predominance in more than half of the study patients (55%). However, Usher-Smith et al. (14) in UK found that males predominated. In the present research, the mean age was 10.9±3.6, between 2 and 18 years, and the most investigated cases was 13 years old and older 56 (43.7%) & from 6 to 12 years old 50 (39.1%), which agrees with Archinkova et al., (15) and Birkebaek et al., (16) in Bulgaria who found 49.6% 13-18 years and 32.5% 6-12 years. In this research, age was discovered to be a highly substantial parameter of glycemic control; by increasing age there is an increase in the incidence of patient with poor control diabetes 47 (54.7%), so adolescents usually do not have proper glycemic control than younger children with type 1 DM, due to alterations in normal physiology at puberty, such as the cessation and acceleration of somatic growth, the growth of secondary sexual features, and the development of adipose (17). Stress during puberty may also cause hyperglycemia by stimulating the nervousness (18). Vanelli et al. (19) in Italy concluded that rising age was related to a higher HbA1c (67.9%) independent of insulin regimen in children and adolescents with diabetes. Hood et al., (20) and Selvaraj et al. (21) similarly found this. However, Yazidi et al. in Tunis (22) and Mostofizadeh et al. (23) in Iran did not. Due to sadness and psychological issues, females had a higher rate of poor glycemic control than boys (26 [30.2%]). This study agrees with Setoodeh et al. (24) (71.2% female), Hashemi et al., (25) and Gerstl et al. (26), but does not agree with Mostofizadeh et al. (23) in Iran and Archinkova et al. (15), who showed no significant difference between male and female. High fat content in females decreases insulin sensitivity, making them more susceptible to poor glycemic control during adolescence. In this study, there was no major association of glycemic control based on age at disease onset, unlike other studies that show disease onset after 10 years more likely to be poor control than onset below 6 years like Svensson et al. (27) and Homaei et al (28) Muhimbili National Hospital. Yazidi et al. (22) in Tunis show the young age was linked with poor control. In this research, shorter illness duration was

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considerably better managed than longer disease duration owing to gradual beta cell function loss and the difficulty for cases to maintain control of blood glucose levels and adapt to therapy, diet, and exercise regimens. Mohammad et al., (29) in Egypt, Azad et al. (30), and McKinney et al., (31) corroborate this research, although Bulut et al., (32) in Turkey and Homaei et al. (28) in Iran disagree.

In this trial, one baseline dosage of insulin glargine and 3 insulin injections had the highest rate of satisfactory glycemic control. Sharplin et al. (33) and Alemzadeh et al. (34) observed satisfactory control in T1DM patients after switching from pre-mixed insulin to glargine. This study found that daily glucose testing improved glycemic control more than weekly or monthly testing. Daily testing helps patients identify, prevent, and manage hypo- or hyperglycemia and avoid the marked day-to-day difference in serum glucose from high to low amounts that characterize T1DM children. Haller et al. (35) in Egypt agree. A significant distinct was observed in good and poor glycemic control regarding usual visit for follow up to endocrine clinic. This agrees with Kaufman et al. (36) and Yazidi et al., (22) in Tunis, unlike Mohammad et al., (29) in Egypt who show no difference. Selvaraj et al., (21) confirmed that increase in the frequency of clinic visit lead to bad control and explain that as the frequent visit is an outcome of poor control.

Poorly managed individuals had substantially greater blood TC, TG, and LDL-cholesterol than those with excellent control. This research matches Petitti et al. (37) in the US and Mohammad et al. (29) in Egypt. Herman et al. (38) studied Egyptian children with T1DM. Mostofizadeh et al. (23) in Iran showed that hypertriglyceridemia was the most frequent dyslipidemia. Zabeen, et al. (39) conclude that poor glycemic control increased elevated LDL rates. Low glycemic group had greater rates of hypercholesterolemia, hypertriglyceridemia, and low HDL, although not significantly.

Poor glycemic control was shown to increase with patient age and diabetes duration in this research. Women are more likely to be the cause of poor self-control than men. Dyslipidemia (High TG, LDL Chol. Level) is more common in the poorly managed group.

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