ORIGINAL ARTICLE

Prevalence of Dyslipidemia and Hypertension in Iraqi Adolescents with Type 1 Diabetes Mellitus

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ABSTRACT

Background: Diabetes is one of the most common non-communicable diseases in the world. It is a chronic disease with multiple complications such as retinopathy, neuropathy, nephropathy, and cardiovascular disease.
Objectives: The study aimed to identify the prevalence of dyslipidemia and hypertension in type 1 diabetes mellitus (T1DM) in Iraqi adolescents.
Materials and methods: A cross-sectional retrospective study was conducted on adolescent patients with T1DM for more than two years and aged 10-18 years old. For each participant, the age, gender, onset and duration of the DM, body mass index (BMI), blood pressure, and low-density lipoprotein (LDL) level in the blood were recorded .
Results: Of 70 subjects, there were 42 (60%) girls. The duration of the DM was predominantly between 2-5 years (59%). Around half of the cases were diagnosed between 5 and 10 years. Girls had a significantly higher mean BMI than boys [21.5 kg/m2 for girls and 18.6 kg/m2 for boys (P-value 0.001)]. Seven (10%) patients were diagnosed with hypertension. LDL was high in 22 patients (31%) with the majority of them (15/22) having an LDL value of between 100-130 mg/dL. Most of the participants with a high LDL were girls (18/22) with a statistically significant gender difference (P-value = 0.018). There were significant correlations between high blood pressure and BMI (P-value = 0.004) and elevated LDL levels (P-value = 0.008).
Conclusion: The study revealed that hypertension and dyslipidemia were seen in 10% and 31% of children with T1DM respectively. The elevated LDL and BMI were significantly higher in female patients than in males. Besides, there were significant associations between high blood pressure and BMI and elevated LDL levels.
Keywords: Hypertension; Diabetes Mellitus; Dyslipidemia; Adolescents.

INTRODUCTION

Diabetes is defined by the World Health Organization (WHO) as a metabolic disorder characterized by chronic hyperglycemia with disturbances of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action, or both [1].

Diabetes mellitus (DM) is classified according to its causes into four types; Type 1 DM (T1DM), Type 2 DM, gestational diabetes, and other types: type 1 or 2 criteria with genetic syndromes, including maturity onset of diabetes of the young (MODY), neonatal diabetes (NDM), pancreatic disease, and drug therapy. T1DM occurs due to Beta cell destruction by immune-mediated or idiopathic. It is the most common endocrine-metabolic disorder in childhood and adolescence [2]. T1DM is marked by a severe lack of insulin and a need for insulin from outside the body to stay alive [3].

The morbidity and mortality of T1DM are either caused by potential acute metabolic derangements (hypoglycemia related to insulin excess or hyperglycemic ketoacidosis from insulin deficiency), or long-term complications which are related to chronic hyperglycemia and associated metabolic abnormalities on tissues and organs. This can result in microvascular diseases such as nephropathy, retinopathy, and neuropathy, or macrovascular complications such as ischemic heart dis-

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ease, cerebrovascular disease, and arterial obstruction with gangrene of the extremities [3, 4].

The definition of "normal" blood pressure (BP) in children is statistical: $< 90^{\text{th}}$ percentile for age, gender, and height. As a result, hypertension (HTN) is defined as having a systolic or diastolic blood pressure (DBP) in the 95th percentile for age, gender, and height on at least three occasions. Hypertension has two stages; stage 1 HTN: BP 95th to 99th percentile plus 5 mmHg and stage 2 HTN: BP $> 99^{\text{th}}$ percentile plus 5 mmHg [5].

The circulating level of lipoproteins is dependent on normal insulin levels and its action, which is the same as plasma glucose. In T1DM, moderate control of hyperglycemia is associated with a slight elevation of low-density lipoprotein (LDL), cholesterol, and serum triglycerides and little change in high-density lipoprotein (HDL). When hyperglycemia is corrected, lipoprotein levels become normal [6].

There is an increased risk of 2-11 times of premature cardiovascular problem in patients with T1DM and it is considered one of the most frequent reasons of death in those patients [7, 8]. Cardiovascular disease occurs even in those patients with good blood sugar control, and there are no additional cardiovascular risk factors [9]. Other risk factors might be implicated, such as lipid deregulation. Therefore, screening with a fasting lipid profile is recommended in children with T1DM to avoid the development of cardiovascular disease. So, we wanted to find out how common dyslipidemia and HTN were in Iraqi teenagers with T1DM.

MATERIALS AND METHODS

A cross-sectional retrospective study was conducted on seventy patients who attended the Pediatric Endocrinology Clinic of the National Diabetic Center/Al-Mustansiriyah University in Baghdad city, Iraq during the period from April to October 2019. The study was conducted on the ethical principles that have their origin in the Declaration of Helsinki. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee according to document (reference number 97 on 10/4/2019) to get this approval. Owing to the retrospective nature of the study, informed consent was waived by the caregiver of the participants.

The current study included patients aged 10 to 18 years who had T1DM for more than 2 years. Any child with other chronic diseases that may affect blood pressure and lipid profile, such as congenital or acquired heart disease, thyroid disorders, renal disease, liver disease, and others, was excluded. Those patients who were not allowed to take part in this study were also left out.

Detailed information was taken from each subject concerning the age, gender, age of diabetes onset and duration of the disease, insulin dose/day, and the type of insulin regimen used (basal-bolus, conventional, or insulin pump). The height and weight were measured with a calibrated stadiometer sensitive to 0.1 cm and electronic scales sensitive to 0.1 kg, respectively. The HbA1c was registered for each participant.

The BMI was calculated by dividing the weight in kilograms by the square height in meters. Then the BMI percentile and Z-score were calculated by an anthropometric calculator depending on the Centers for Disease Control and Prevention (CDC) BMI-for-age growth chart [10], and they were considered abnormal if the value is more than -2 or +2 SD from the mean.

The blood pressure (BP) was measured with a mercury sphygmomanometer as recommended by the fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents [11], plotted on charts specific to the children's age and gender [12], and classified as normal (90th percentile for age, gender, and height) or hypertensive (more than 95% for age, gender, and height). The fasting lipid profile was measured for all patients using the KENZA BIOLAB auto analyzer device, and the total cholesterol level was calculated by the CHOD-PAP method.

The data were entered into IBM SPSS version 23 software for Windows for statistical analysis. The total number, mean, and standard deviation for each variable of the data were calculated, with an analysis of the bivariate correlation between each variable done using Pearson's correlation coefficient. In statistical analysis, the correlation between variables is considered very significant if it is equal to or less than 0.01, significant if it is 0.01-0.05, and non-significant if it is greater than 0.05.

RESULTS

Out of 70 patients, there were 42 (60%) females. The mean age of the disease onset was 8.179 ± 2.8993 years, while the mean duration of the disease was 5.240 ± 0.8374 years, and the mean insulin dose was 1.034 u/kg/day ± 0.3772. The duration of the DM was predominantly between 2-5 years (n = 41, 59%), and the least diabetic, more than 8 years (n = 12, 17%), as shown in Table 1.

In 25 (17%) of the studied cases, the first diagnosed DM was at an age more or equal to 10 years old, 33 (47%) were aged 5-10 years old, and less than 5 years old were 12 (36%).

The mean BMI was significantly higher for girls than for boys [21.5 kg/m2 for girls and 18.6 kg/m2 for boys (P-value < 0.001)]. The total BMI is 20.36. The BMI SD was significantly higher for girls than for boys (+0.517 for girls and -0.189 for boys (P-value = 0.003), while the mean BMI SD for all patients was 0.234.

Seven (10%) patients (2 males and 5 females) were diagnosed with hypertension, and 63 (90%) of patients were normal. The distribution of hypertensive patients on the duration of DM showed that 5 (71.4%) were between 2-5 years of duration with diabetes. And the distribution of hypertensive cases among those with the onset of DM showed that 4 (57.1%) of them had the onset of diabetes at ten years of age or more. In Table 2, there is no significant relationship between diabetes duration or onset with hypertension (P-value 0.526).

LDL was high (more than 100 mg/dL) in 31% (n = 22) of the patients. Seven of them had an LDL value of more than 130 mg /dL, while 15 patients had an LDL value of between 100-130 mg/dL. LDL was normal (less than 100 mg/ dL) in 69% (n = 48) of the patients. Regarding gender distribution among LDL serum levels, 4 (14%) of studied male cases (n = 28) were diagnosed with an elevated level of LDL, and from female studied cases (n = 42), 18 (43%) were diagnosed with a high level of LDL, with a P-value = 0.018, which means significant elevation among females (Table 3).

In this study, the elevated blood pressure was associated with the increment of in BMI and elevated LDL levels (Table 4).

Table 1. The number and percentage of patients according to the duration of diabetes.

Duration of DM	Number	Percentages
2 − 5 years	41	59
> 5 − 8 years	17	24
> 8 years	12	17
Total	70	100

Table 2. The distribution of hypertensive patients based on DM duration and onset.*

Variable	Hypertensive patients	
	Number	Percentages
Duration of DM		
2 − 5years	5	71.42
> 5 − 8 years	1	14.28
> 8 years	1	14.28
Total	7	100
Onset of DM		
2 − 5 years	0	0
> 5 − 10 years	3	42.85
> 10 years	4	57.15
Total	7	100

* P-value=0.526

DISCUSSION

Adolescence is a critical period that presents different challenges and opportunities to individuals with diabetes, their families, and their doctors. Good management of T1DM reduces the risk of long-term vascular complications [13]. The main outcomes of the study were that 10% of patients were diagnosed with hypertension with a duration of between 2-5 years with diabetes (71.4%) and highly correlated with elevation of the LDL and BMI.

The mean BMI in this study sample was 20.3. These results are comparable to the study done by Garca-Garca et al. [14]. The mean BMI SD was greater in females than in males, the reverse found by Rohrer et al. [15] and Khadilkar et al. [16]. This could be because women have a better handle on their diabetes and have better nutrition or because they eat differently.

LDL level was more than 100 mg/dl in 22 patients. Only 4 of them were males (14% of total male patients) and 18 patients were females (43% of total female patients), which means clear elevation among the female sex; this result is comparable to the result found by Kim et al. in Korean adolescents and young adults with T1DM [17]. The study by Sevaliev et al. also reported that the female patients were significantly overweight compared to males and had higher LDL and cholesterol levels [18]. However, Zabeen et al, investigation found that patients with dyslipidemia had significantly lower mean BMI (18.4) vs (19.5) than patients without dyslipidemia (P-value = 0.005) [19].

The statistical analysis for the patients with high LDL showed a highly significant correlation between their LDL level and their blood pressure, the same result as Zabeen et al.'s study [19].

The blood pressure values showed a highly significant positive correlation with BMI, this result is similar to a study

Table 3. The difference in LDL levels among males and females.*

LDL level	Males	Females	Total (%)
Normal LDL			
< 100 mg/dl	24	24	48(69%)
High LDL			
100 − 130 mg/dl	3	12	15 (21%)
> 130 mg/dl	1	6	7(10%)
Total	4	18	22 (31%)
Mean LDL	89.1	105 .1	
Total mean LDL	98.70 mg/dl $\pm$ 32.033 SD		

* P-value=0.018

done by Sevaliev et al. [18]. There is no other significant relationship between LDL levels and other variables in this study.

A previous study by Guy et al. [20] showed that LDL levels in uncontrolled T1DM youth is high (mean level = 116 mg/dL) even after a short duration from the diagnosis, which was similar to our study (31% of patients had LDL more than 100 mg/dL), and similar to the study by Carneiro et al. [21]. However, the study by FAGHIH et al. [22] showed better LDL and lipid profile levels in diabetic patients as compared to controls, the cause is likely due to good nutritional control in diabetic patients who were under the study. High LDL levels are associated with an increased risk of diabetic retinopathy and the development of cardiovascular disease in diabetic children, which is greater than the risk in non-diabetic children [23]. There is a study by Dabas et al. [24] said that hyperglycemia and dyslipidemia can serve as biomarkers for cardiovascular problems in at-risk diabetic adolescents, indicating the need to define the defined measures and strategies to promote healthy eating habits and lifestyle [22].

DM is a chronic disease and carries long-term complications, especially vascular complications which require special attention by controlling blood sugar, and monitoring body weight with a BMI level within the normal range. A routine lipid profile check within one year of diabetes diagnosis for those over the age of two, with a repeat every five years if normal, and blood pressure checks every three months. All these measures, with a healthy lifestyle based on good healthy food and regular physical exercise, will decrease the risk of vascular complications.

The limitations of the study include its retrospective nature, the study performed within a short period, which didn't allow for establishing causal relationships, and its small sample size, which prevents statistical significance from being given to some associations between variables.

CONCLUSION

Hypertension and dyslipidemia were common in Iraqi teenagers with T1DM. The elevated LDL and BMI were significantly higher in girls patients than in boys. Besides, there were significant correlations between high blood pressure and BMI and elevated LDL levels.

Table 4. Correlations of hypertension with BMI and LDL.

Variable 1	Variable 2	Pearson correlation	Significance	Comment
BP percentile	BMI SD	0.341	0.004	A very significant positive correlation
BP percentile	LDL	0.315	0.008	A very significant positive correlation

ETHICAL DECLARATIONS

Acknoweldgements

None.

Ethics Approval and Consent to Participate

Written approval had been gained from the local ethics committee of the National Diabetic Center/Al-Mustansiriyah University according to document (reference number 97 on 10/4/2019), Baghdad city, Iraq. Study data/information was used for the research purpose only. Informed consent from the participants was waived owing to the retrospective nature of the study.

Consent for Publication

Not applicable (no individual personal data included).

Availability of Data and Material

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that there is no conflict of interest.

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Authors' Contributions

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