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Original Article

Prevalence of Dyslipidemia in Children with Type-1 Diabetes Mellitus at a Tertiary Childcare Hospital of South Punjab, Pakistan

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ABSTRACT

Objective: To determine the prevalence of dyslipidemia in children with type-1 diabetes mellitus (T1DM) at a tertiary childcare hospital of South Punjab, Pakistan.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Pediatric Endocrinology, Children's Hospital and Institute of Child Health Multan, Pakistan, from Jan to Jul 2024.

Methodology: Children of either gender, aged between 3-18 years, and diagnosed cases of type-1 DM were analyzed. The frequency of dyslipidemia was noted. Dyslipidemia was defined as serum total cholesterol levels > 200 mg/dL, triglyceride > 150 mg/dL, low-density lipoprotein > 130 mg/dL, or high-density lipoprotein below 40 mg/dL.

Results: In a total of 121 children with T1DM, 63(52.1%) were male. The median age at presentation, and duration of T1DM were 10.0(8.0-13.5) years, and 6.0(3.0-9.0) years, respectively. Dyslipidemia was identified in 39(32.2%) children. The mean HbA1c level was 9.2% (8.0-10.2). Relatively older age (p=0.006), age at the time of diagnosis (p=0.033), and low monthly family income (p=0.031) were significantly associated with poor glycemic control (PGC). PGC had significant association with dyslipidemia (36.8% vs. 15.4%, p=0.038). Dyslipidemia was found to have significant association with age (p=0.001), duration of T1DM (p<0.001), obesity (p=0.018), HbA1c (p=0.015), and poor glycemic control (89.7% vs. 73.2%, p=0.038).

Conclusion: Our study highlighted a significant prevalence of dyslipidemia among children with T1DM in South Punjab, Pakistan, with strong associations with age, duration of T1DM, obesity, HbA1c levels, and PGC.

Keywords: Dyslipidemia, Glycemic Control, Hba1c, Obesity, Type-1 Diabetes Mellitus.

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INTRODUCTION

Dyslipidemia represents a significant yet modifiable risk factor for the development of various cardiovascular diseases (CVDs).[1] Approximately one-third of myocardial infarction (MI) cases can be linked to elevated cholesterol levels.[2] Worldwide, increased levels of low-density lipoprotein cholesterol (LDL-C) is a major contributor to health complications, leading towards 4.3 million mortality.[3]

Dyslipidemia is highly prevalent among individuals with type 1 diabetes mellitus (T1DM), elevating their CVD risk by 4 to 10 times.[4,5] Patients with T1DM often display a range of atherogenic lipoprotein abnormalities, with dyslipidemia affecting approximately 72.5% of this population, thereby heightening their susceptibility to vascular complications.[6,7] Studies have indicated a positive correlation between dyslipidemia and poor glycemic control (PGC).[7] Assessing dyslipidemia, particularly in diabetic populations, is vital for implementing preventive measures, especially for those at high risk of CVD.[8]

Research indicates that poor glycemic control (PGC) and elevated HbA1c levels in T1DM patients are linked to increased lipid peroxidation and increased risk of atherosclerosis.[9,10]

There is a need to address the growing concern of dyslipidemia as a significant cardiovascular risk factor in children with T1DM. Despite the well-established link between diabetes and lipid abnormalities, there is limited data on the prevalence of dyslipidemia in pediatric T1DM patients, especially in Pakistan. Understanding the burden of dyslipidemia in this population can help in early identification and management, potentially reducing long-term cardiovascular complications in these children. This study was designed to evaluate the prevalence of dyslipidemia in children with T1DM.

METHODOLOGY

This cross-sectional study was conducted at the Department of Pediatric Endocrinology, Children's Hospital and Institute of Child Health, Multan, Pakistan, from Jan to Jul 2024. Approval from

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Institutional Ethical Committee was acquired (letter number: 1927, dated 18-10/2023).

Inclusion Criteria: Children of either gender, aged between 3-18 years, and diagnosed cases of type-1 DM with a disease duration of at least 2 years were included.

Exclusion Criteria: Children taking any kinds of lipid lowering medication (as per medical record) were excluded.

The sample size calculation was done using OpenEpi online calculator, taking the proportion of dyslipidemia as 13% in children with T1DM, the sample size was calculated to be 121.[11] Non-probability consecutive sampling technique was employed, and informed consent was sought from the parents/guardians prior to data collection.

Gender, age, age at the time of diagnosis of T1DM, duration of diabetes, residence, and socio-economic status were documented. Monthly family income was termed high if above PKR 65,000, middle if between 35,000 to 65,000, or low if below 35,000.[12] A child whose readings were above the 95th percentile, based on age and gender percentile charts, were classified as hypertensive (2 repeated measurements). Each child's body weight was measured using an Electronic Body Scale. Height was measured barefoot using a stadiometer. Obesity was classified as having a BMI ≥ 95th percentile for age and gender. Blood samples were drawn following an 8-10 hour fasting period and analyzed using the Roche Modular P800 system with standardized protocols. The total cholesterol (TC), triglyceride (TG), and High-density lipoprotein cholesterol (HDL-C) were measured directly, while low-density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald formula. Dyslipidemia was defined as serum TC levels exceeding 200 mg/dL, TG levels above 150 mg/dL, LDL-C levels over 130 mg/dL, or HDL-C levels below 40 mg/dL.[13] HbA1c levels were assessed using a turbidimetric immunoassay, with results being reported as percentages. A child was labeled to have good glycemic control (GGC) if HbA1c below 8%, or PGC if HbA1c above or equal to 8%.[14]

Data analysis was performed using Statistical Package for Social Sciences (SPSS), version 26. Qualitative data like gender, residence, residential status, socio-economic status, obesity, dyslipidemia, and glycemic control were shown as frequency and percentages. Quantitative data like age, age at the time of diagnosis of T1DM, duration of T1DM, and HbA1c were non-normally distributed and represented as median and inter-quartile range (IQR).Normality distribution of the data was checked using Shapiro-Wilk test. Comparison of categorical data were made employing Chi-square test, whereas Mann-Whitney U test were used to compare quantitative data. Bivariate correlation was calculated applying Spearman's correlation between quantitative data. A *p*-value below or equal to 0.05 was taken as significant.

RESULTS

In a total of 121 children with T1DM, 63(52.1%) were boys. The median age at presentation, at the time of diagnosis, and duration of T1DM were 10.0 (8.0-13.5) years, 4.0(3.0-5.0) years, and 6.0(3.0-9.0) years, respectively. Residential affiliation of 76(62.8%) children was rural. Monthly family income status was low in 57(47.1%) children. Obesity, and hypertension were present in 25(20.7%), and 11(9.1%) children, respectively. Dyslipidemia was identified in 39(32.2%) children. The mean HbA1c level was 9.2% (8.0-10.2) whereas PGC was observed in 95(78.5%) children. Table-I shows details of demographical and clinical characteristics children with T1DM.

Table-I: Demographical and Clinical Characteristics of Participants (n=121)

Characteristics		n (%)
Gender	Boys	63 (52.1%)
	Girls	58 (47.9%)
Residence	Rural	76 (62.8%)
	Urban	45 (37.2%)
Monthly family income	Low	57 (47.1%)
	Middle	48 (39.7%)
	High	16 (13.2%)
Obesity		25 (20.7%)
Hypertension		11 (9.1%)
Dyslipidemia		39 (32.2%)
Poor glycemic control		95 (78.5%)

Stratification of study variables with respect to glycemic control, which can be seen in Table-II, revealed relatively older age (p=0.006), age at T1DM diagnosis (p=0.033), and low monthly family income (p=0.031) were significantly associated with PGC. There were 35(36.8%) patients with PGC who had dyslipidemia in comparison 4(15.4%) with GGC (p=0.038).

Dyslipidemia was found to have significant association with age (p=0.001), duration of T1DM (p<0.001), obesity (p=0.018), HbA1c (p=0.015), and poor glycemic control (89.7% vs. 73.2%, p=0.038), and the details are shown in Table-III.

Table-II: Association of Demographical and Clinical Characteristics with Glycemic Control (n=121)

Characteristics		Glycemic control		*p*-value
		Poor (n=95) n (%)	Good (n=26) n (%)	
Gender	Boys	52(54.7%)	11(42.3%)	0.261
	Girls	43 (45.3%)	15 (57.7%)	
Age in years, Median (IQR)		12.0 (8.0-14.0)	8.0 (5.0-12.0)	0.006
Age at T1DM diagnosis in years, Median (IQR)		4.0 (3.0-5.0)	4.0 (2.0-5.0)	0.033
Duration of T1DM in years, Median (IQR)		6.0 (3.0-9.0)	4.0 (2.0-7.2)	0.066
Residence	Rural	57 (60.1%)	19(73.1%)	0.222
	Urban	38 (40.0%)	7(26.9%)	
Monthly family income	Low	50 (52.6%)	7(26.9%)	0.031
	Middle	32 (22.7%)	16(61.5%)	
	High	13 (13.7%)	3(11.5%)	
Hypertension		9 (9.5%)	2(7.7%)	0.780
Obesity		22 (23.2%)	3(11.5%)	0.195
Dyslipidemia		35 (36.8%)	4(15.4%)	0.038
HbA1c %, Median (IQR)		9.5 (9.0-11.0)	7.4 (7.0-7.6)	<0.001

Table-III: Association of Dyslipidemia with Demographical and Clinical Characteristics of Children with Type-1 Diabetes Mellitus (n=121)

Characteristics		Dyslipidemia		*p*-value
		Yes (n=39) n (%)	No (n=82) n (%)	
Gender	Boys	22(56.4%)	41(50.0%)	0.509
	Girls	17 (43.6%)	41 (50.0%)	
Median age (years)		12.0 (9.0-16.0)	8.0 (6.0-12.0)	0.001
Median age at T1DM diagnosis (years)		4.0 (3.0-5.0)	4.0 (3.0-5.0)	0.830
Median duration of T1DM (years)		8.0 (5.0-11.0)	5.0 (2.0-7.0)	<0.001
Residence	Rural	22 (56.4%)	54 (65.9%)	0.315
	Urban	17 (43.6%)	28 (34.1%)	
Monthly family income	Low	19 (48.7%)	38 (46.3%)	0.970
	Middle	15 (38.5%)	33 (40.2%)	
	High	5 (12.8%)	11 (13.4%)	
Hypertension		4 (10.3%)	7 (8.5%)	0.758
Obesity		13 (33.3%)	12 (14.6%)	0.018
HbA1c (%)		10.0 (8.5-11.0)	9.0 (7.7-10.0)	0.015
Glycemic control	Poor	35 (89.7%)	60 (73.2%)	0.038
	Good	4 (10.3%)	22 (26.8%)	

The correlation analysis revealed that HbA1c had positive and significant correlation with age at presentation (r=0.250, *p*=0.006), and duration of T1DM (r=0.213, *p*=0.019). Table-IV shows correlation matrix highlighting relationship between quantitative variables.

Table-IV: Correlation Analysis of Age at Diagnosis, Disease Duration, and HbA1c (n=121)

Variables		Variables			
		Age	Age at T1DM diagnosis	T1DM duration	HbA1c
Age	Spearman's correlation coefficient	1	0.423	0.924	0.250
	p-value		<0.001	<0.001	0.006
Age at T1DM diagnosis	Spearman's correlation coefficient	0.423	1	0.076	0.091
	p-value	<0.001		0.406	0.100
T1DM duration	Spearman's correlation coefficient	0.924	0.076	1	0.213
	p-value	<0.001	0.406		0.019
HbA1c	Spearman's correlation coefficient	0.250	0.100	0.213	1
	p-value	0.006	0.275	0.019	

DISCUSSION

Our findings revealed that 32.2% children with T1DM exhibited dyslipidemia. This prevalence is relatively lower compared to findings from other similar studies.[15,16] For instance, Melo *et al*. reported a dyslipidemia prevalence of 65.4% in their T1DM population.[17] Zabeen *et al*. found a dyslipidemia prevalence of 65% in T1DM.[18] The literature describes the burden of dyslipidemia varying between 29-73% in T1DM.[7,19-21] These discrepancies might be attributed to regional dietary habits, genetic predispositions, and differences in healthcare access and management practices.

In our study, a significant association was observed between dyslipidemia and HbA1c levels (*p*=0.015), and poor glycemic control (*p*=0.038). Melo *et al*. emphasized the importance of HbA1c as a critical factor associated with worsening lipid levels, underscoring the need for early intervention and continuous monitoring of lipid profiles in T1DM patients.[17] Our data corroborates this, showing a significant correlation between HbA1c and age at presentation (r=0.250, *p*=0.006) as well as the duration of T1DM (r=0.213, *p*=0.019). This aligns with a study which also reported a higher prevalence of dyslipidemia in patients with PGC.[13] Akhter *et al*. revealed dyslipidemia to have significant association with male gender, and relatively older children.[22] Mona *et al*., in their study, documented significantly higher proportion of dyslipidemia in children with T1DM, with notable associations with higher waist

circumference in dyslipidemic children.[23] Although our study did not assess waist circumference, the association of obesity with dyslipidemia highlights the importance of comprehensive management strategies that include dietary modifications and physical activity to improve overall metabolic health. The significant association between low monthly family income and poor glycemic control (p=0.031) is consistent with global observations that link lower socioeconomic status with poorer health outcomes due to limited access to healthcare resources, education, and healthy lifestyle options.[24] Addressing these disparities through public health initiatives and support programs is essential to improve glycemic control and reduce the burden of dyslipidemia and its complications in vulnerable populations.[25] Our findings emphasize the need for regular lipid profile monitoring and stringent glycemic control in children with T1DM to mitigate the risk of cardiovascular diseases.

LIMITATIONS OF STUDY

There are certain limitations to consider. The cross-sectional design precludes establishing causality. We could not enroll controls, which would have provided a comparative baseline for evaluating the impact of diabetes on lipid profiles.

CONCLUSION

Our study highlighted a significant prevalence of dyslipidemia among children with T1DM in South Punjab, Pakistan, with strong associations with age, duration of T1DM, obesity, HbA1c levels, and poor glycemic control.

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Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

SA & GAQ: Conception, study design, drafting the manuscript, approval of the final version to be published.

WIK & AI: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

MI: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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