Original Article

The Burden of Cardiometabolic Risk Factors in Young People with Type 2 Diabetes: A Cross-Sectional Analysis

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ABSTRACT

Objective: To determine the frequency and distribution of cardiometabolic risk factors among individuals with T2DM under the age of 35

Methodology: This prospective cross-sectional study was conducted at the Baqai Institute of Diabetology and Endocrinology over eight months (July 2022 to February 2023) after obtaining approval from the Institutional Review Board. All individuals with Type 2 Diabetes Mellitus under 35 years of age, regardless of gender, were enrolled using convenience sampling after providing informed consent. Data collected included demographic details, clinical history and measurements (BMI, blood pressure, acanthosis nigricans), and relevant laboratory investigations. All information was recorded on a structured proforma and SPSS version 20.0 was used.

Results: A total of 327 T2DM patients were enrolled (58.1% male, 41.9% female), with 72.8% classified as obese (BMI ≥25 kg/m^2). Hypertension was present in 23.9%, and 85.6% had poor glycemic control (HbA1c ≥7%). Dyslipidemia was highly prevalent, with over 90% showing elevated cholesterol, LDL, and triglycerides, and 88.4% having low HDL. Obesity was more common in females (p = 0.014) and associated with worse glycemic and lipid profiles. Higher HbA1c correlated with increased rates of obesity, hypertension (p = 0.027), and dyslipidemia (p < 0.001) Obese individuals had significantly higher mean HbA1c (10.20 ± 1.79, p = 0.03), triglycerides (207.60 ± 46.0 mg/dL, p = 0.001), and LDL (146.96 ± 31.36 mg/dL, p = 0.001).

Conclusion: Young adults with T2DM exhibit a high burden and clustering of cardiometabolic risk factors, underscoring the critical need for early, integrated interventions to prevent premature cardiovascular complications in this high-risk group.

KEY WORDS: Type 2 Diabetes, Early Onset, Cardio Metabolic Risk Factors.

INTRODUCTION

Diabetes mellitus has emerged as a major global health concern, affecting an estimated 463 million people worldwide. Among these, Type 2 Diabetes Mellitus (T2DM) accounts for approximately 90% of all cases, making it the most prevalent form of the disease (International Diabetes Federation).[1] Traditionally considered a condition of middle-aged and older adults, T2DM is now increasingly being diagnosed in younger individuals, including adolescents and those under 35 years of age. This shift poses a unique and growing clinical challenge due to the earlier onset of complications and prolonged exposure to disease-related risk factors.

Hyperglycemia, the hallmark of T2DM, is a major contributor to the development of cardiovascular

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disease (CVD)—a leading cause of mortality in diabetic patients. Evidence shows that when hyperglycemia is diagnosed before the age of 45, it significantly elevates the risk of premature CVD.[2] Young individuals with T2DM often present with coexisting cardiometabolic risk factors (CMRFs), including obesity, insulin resistance, dyslipidemia, and hypertension, which synergistically increase the risk of cardiovascular morbidity and mortality.[3]

CMRFs contribute to nearly 30% of global deaths from CVD and are becoming increasingly prevalent among younger populations.[3,4] These risk factors may occur independently or in clusters and are frequently exacerbated by modifiable lifestyle behaviors such as physical inactivity, poor dietary habits, and smoking.[5] In youth-onset T2DM, the clustering of these risk factors tends to be more severe, often leading to early and aggressive disease progression, including kidney disease, retinopathy, and cardiovascular complications. These health outcomes not only strain healthcare systems but also compromise the quality of life and life expectancy of affected individuals.[6]

Alarmingly, youth-onset T2DM now constitutes between 20% and 50% of new diabetes cases in certain populations, underlining the urgency of early detection and intervention.[7] The long-term implications of chronic hyperglycemia during adolescence and early adulthood include an extended period of disease exposure, which substantially increases the likelihood of developing complications at a younger age.[8] Moreover, individuals diagnosed with T2DM early in life often lack awareness of their condition's severity, leading to delayed diagnosis, poor adherence to treatment, and suboptimal risk factor control.[9,10]

In light of the growing prevalence of T2DM among younger adults and the severe implications of its associated cardiometabolic risk profile, it is essential to understand the burden and clustering of CMRFs in this vulnerable population. Despite global concerns, there is a scarcity of region-specific data, particularly from low- and middle-income countries, where the disease burden is rising but remains under-characterized. Therefore, this study aims to assess the frequency and distribution of cardiometabolic risk factors among individuals with T2DM under the age of 35.

METHODOLOGY

This prospective cross-sectional study was conducted at the Baqai Institute of Diabetology and Endocrinology (BIDE) after obtaining ethical approval from the Institutional Review Board (IRB) of BIDE, Baqai Medical University. The study was carried out over a period of eight months, with data collection spanning from July 2022 to February 2023.

Study Population and Sample Selection: All individuals with a diagnosis of Type 2 Diabetes Mellitus (T2D) who met the inclusion criteria and visited the outpatient department (OPD) of BIDE during the specified timeframe were included in the study. A non-probability convenience sampling technique was employed for participant selection.

The inclusion criteria consisted of individuals aged less than 35 years, regardless of gender, who had been diagnosed with T2D and were willing to participate in the study. Participants were excluded if they had Type 1 diabetes, were pregnant, or had other endocrine disorders, such as diseases of the thyroid, adrenal, or pituitary glands.

Table-I: Cardiometabolic and Demographic Characteristics of Study Participants.

Parameters		*N (%)*
N		327 (100)
Gender	Male	190(58.1)
	Female	137(41.9)
Marital status	Married	288 (88.1)
	Single	39 (11.9)
Body mass index	Non Obese (<25 kg/m^2)	88 (26.9)
	Obese (≥25 kg/m^2)	238 (72.8)
Smoking Habit	No	294 (90.2)
	Yes	32 (9.8)
	Ex-smoker	2(0.6)
Hypertension	Yes	78 (23.85)
	No	249 (76.14)
Duration of Diabetes	< 1 year	134 (41.0)
	1 to 5 Years	120 (36.7)
	> 5 Years	73 (22.3)
HbA1c	<7 %	44 (13.5)
	≥7%	280 (85.6)
Lipid Profile	High cholesterol (>200 mg/dl)	313(96.0)
	High triglyceride (>150 mg/dl)	309 (94.5)
	High LDL (>100 mg/dl)	313 (95.7)
	Low HDL (male <40 mg/dl, female <50 mg/dl)	289 (88.4)

Data Collection: After obtaining written informed consent, each participant underwent a structured clinical evaluation during their OPD visit. Demographic data such as age, gender, smoking status, alcohol intake, physical activity and family history of diabetes were recorded. Clinical parameters including body mass index (BMI), blood pressure, and waist circumference were measured. Surrogate markers of insulin resistance including skin tags, and acanthosis nigricans were also checked and recorded. Participants also underwent relevant laboratory investigations, including fasting blood glucose, HbA1c, and lipid profile, All findings were documented on a pre-designed proforma that captured demographic, clinical, and laboratory data.

Statistical Analysis: The collected data were entered and analyzed using SPSS version 20.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Appropriate statistical tests, including the Chi-square test for categorical variables and the Mann-Whitney U test for continuous variables, were applied. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 327 participants with type 2 diabetes were enrolled in the study, of whom 58.1% were male and 41.9% were female. The majority of participants were married (88.1%). Obesity was highly prevalent, with 72.8% having a body mass index (BMI) ≥25 kg/m². The overall prevalence of hypertension was 23.9% and smoking was reported by 9.8% of the participants, all of whom were male. Most participants (85.6%) had suboptimal glycemic control with HbA1c levels ≥7%. Additionally, a substantial burden of dyslipidemia was observed: over 90% had elevated total cholesterol, LDL, and triglyceride levels, while 88.4% had low HDL levels. The duration of diabetes varied, with 41% being newly diagnosed (within 1 year), while 22.3% had the condition for more than five years as shown in Table-I.

A significant association was observed between body mass index (BMI) and several cardiometabolic risk factors. Obesity (BMI ≥25 kg/m²) was more prevalent among females (80.1%) compared to males (67.9%) (p = 0.014). Although hypertension was more

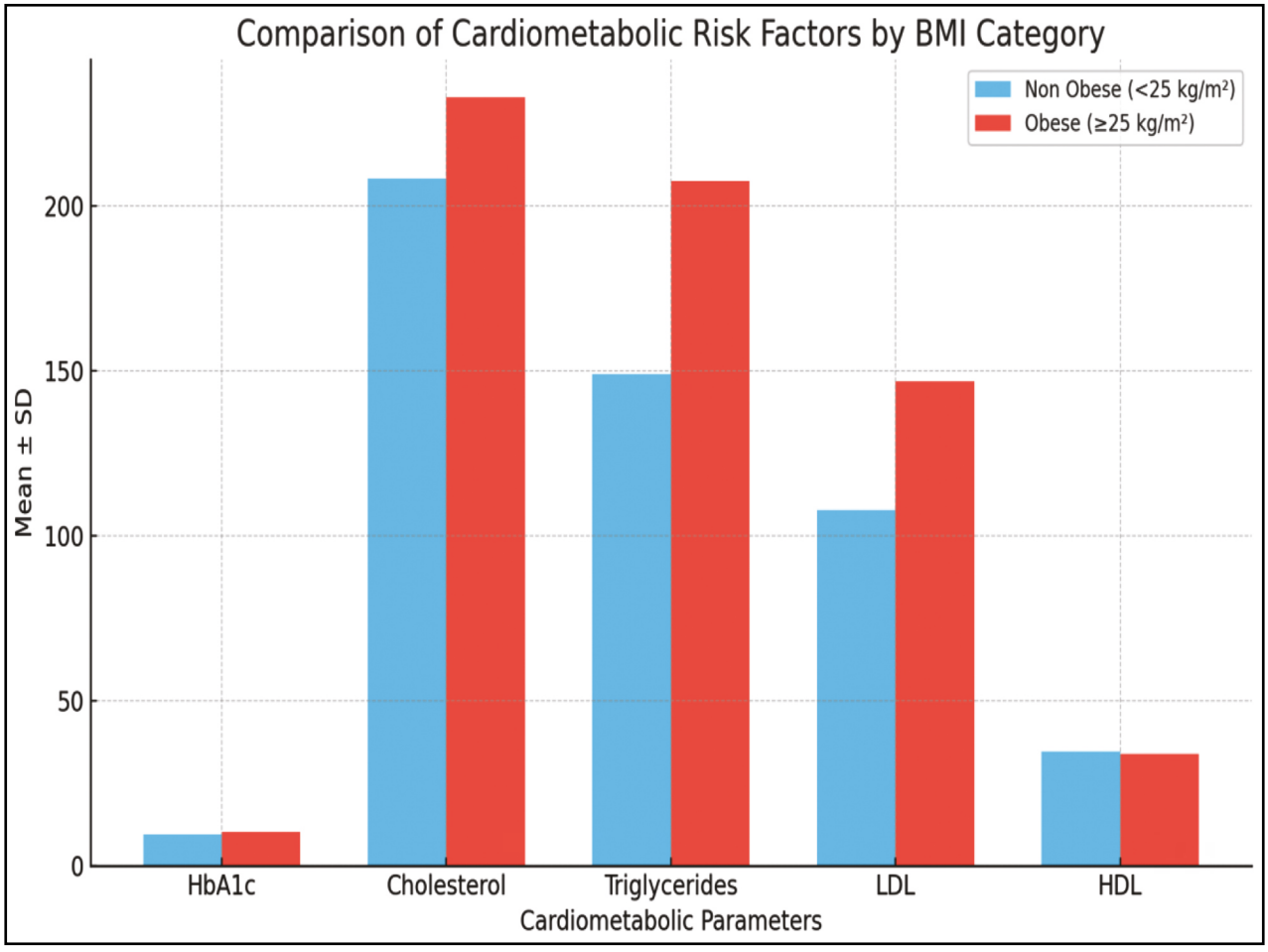

Fig.1: Association of BMI with Cardiometaolic Risk Factors among Study Participants.

common in obese individuals (78.2%) than non-obese (21.7%), the difference was not statistically significant (p = 0.214).

Obese participants demonstrated significantly worse metabolic profiles. They had higher mean HbA1c levels (10.20 ± 1.79 vs. 9.49 ± 2.12, p = 0.03), indicating poorer glycemic control. Additionally, lipid abnormalities were more pronounced in the obese group, with significantly elevated levels of total cholesterol (232.86 ± 40.66 mg/dL vs. 208.23 ± 54.2 mg/dL, p < 0.001), triglycerides (207.60 ± 46.0 mg/dL vs. 149.18 ± 59.0 mg/dL, p = 0.001), and LDL cholesterol (146.96 ± 31.36 mg/dL vs. 107.92 ± 37.4 mg/dL, p = 0.001) as presented in Fig.1.

Poor glycemic control (HbA1c ≥7%) was observed in the majority of participants (85.6%) and was significantly associated with several adverse cardiometabolic risk factors. Hypertension was more prevalent in individuals with poor glycemic control compared to those with HbA1c <7% (24.4% vs. 10.0%, p = 0.027). Obesity (BMI ≥25 kg/m²) was also significantly more common in this group (91.1% vs. 73.9%, p < 0.001).

In terms of lipid profiles, participants with higher HbA1c levels had markedly elevated mean levels of total cholesterol (231.2 ± 40.4 mg/dL vs. 192.3 ± 63.6 mg/dL, p < 0.001), triglycerides (205.9 ± 49.3 mg/dL vs. 183.1 ± 56.0 mg/dL, p = 0.005), and LDL cholesterol (145.7 ± 30.4 mg/dL vs. 138.5 ± 47.7 mg/dL, p < 0.001) as revealed in Fig.2.

DISCUSSION

This study highlights a concerningly high burden of cardiometabolic risk factors (CMRFs) among young adults with Type 2 Diabetes Mellitus under the age of 35 in a tertiary care setting in Karachi, Pakistan. The prevalence of obesity, poor glycemic control, dyslipidemia, and hypertension observed in this cohort reflects a pattern consistent with global trends, yet also underscores region-specific challenges in managing youth-onset T2DM and its cardiovascular risk profile.

The finding that 72.8% of participants were obese (BMI ≥25 kg/m²) aligns with prior international reports emphasizing the strong association between obesity and early-onset T2DM. For instance, a U.S. study by TODAY (Treatment Options for type 2 Diabetes in Adolescents and Youth)[11] reported obesity prevalence exceeding 80% among adolescents with T2DM, underscoring the crucial role of excess adiposity in this demographic's disease pathogenesis and progression.[12] Similarly, data from Asian populations, including India and China, reveal obesity rates ranging from 60–75% among young diabetics, although ethnic and genetic differences influence the distribution of adiposity and metabolic risk.[13-15] The higher obesity prevalence in females (80.1%) compared to males (67.9%) in our cohort is consistent with gender disparities noted in some South Asian studies, where cultural and lifestyle factors differentially impact women's weight and metabolic health.[16,17]

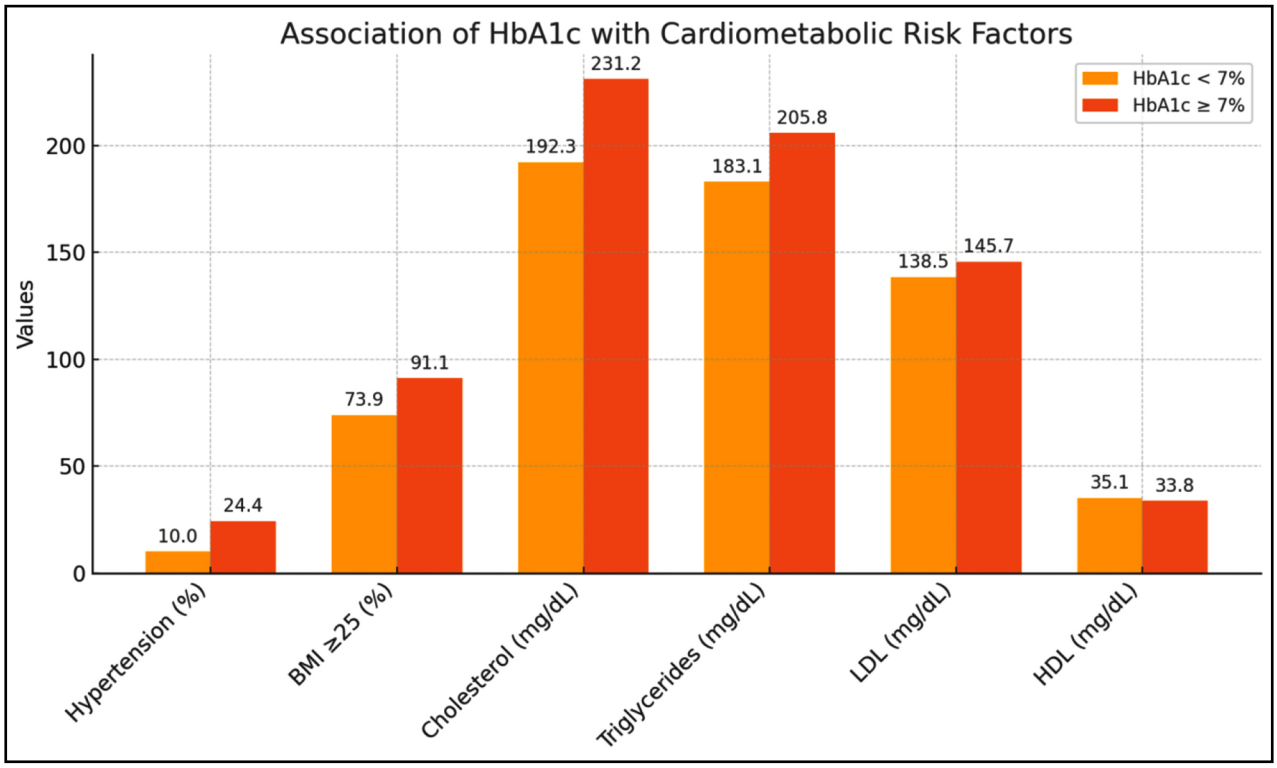

Fig.2: Association of HbA1c with Cardiometaolic Risk Factors among Study Participants.

Poor glycemic control was strikingly common, with 85.6% of participants having HbA1c levels ≥7%. This aligns with prior reports of suboptimal diabetes management in low- and middle-income countries (LMICs), where limited healthcare access, low disease awareness, and socioeconomic constraints impair optimal glycemic control.[18,19] For comparison, a regional study in India documented poor control in approximately 70% of young T2DM patients.[20] Our data also demonstrate significantly higher mean HbA1c levels among obese patients and those with dyslipidemia, confirming the well-established interplay between adiposity, insulin resistance, and hyperglycemia.[21]

The prevalence of hypertension (23.9%) in this young diabetic cohort is notable and comparable to global estimates. A meta-analysis reported hypertension prevalence of 20–30% in youth with T2DM across diverse populations, highlighting hypertension as a frequent comorbidity even in younger adults with diabetes.[22] Although the association between hypertension and obesity was not statistically significant in our study, the trend of greater hypertension prevalence among obese participants mirrors findings from both pediatric and adult cohorts globally.[23] Early onset hypertension in diabetic youth is particularly worrisome, as it accelerates cardiovascular disease (CVD) risk, which is already elevated due to chronic hyperglycemia.

Dyslipidemia affected over 90% of participants, with particularly high levels of total cholesterol, LDL cholesterol, and triglycerides, and low HDL cholesterol. This lipid pattern is characteristic of diabetic dyslipidemia and has been well-documented in both youth and adults with T2DM worldwide.[24] Another a large U.S. cohort study found that over 85% of adolescents with T2DM exhibited atherogenic lipid profiles similar to those seen in our population.[25] However, the extremely high prevalence seen here may reflect regional dietary patterns, limited lipid-lowering therapy access, and genetic predispositions common in South Asians, who are known to have a heightened risk for dyslipidemia and CVD despite relatively lower BMI.[26]

The clustering of multiple cardiometabolic risk factors—obesity, hypertension, dyslipidemia, and poor glycemic control—in the majority of patients in our study supports the notion that youth-onset T2DM represents a more aggressive phenotype with a higher risk of early complications. This has been echoed in recent longitudinal studies such as the SEARCH for Diabetes in Youth study, which demonstrated that young individuals with T2DM experience more rapid progression to microvascular and macrovascular complications compared to those with adult-onset disease.[27] Our findings corroborate the imperative for early and comprehensive risk factor management to mitigate this trajectory.

In contrast to some studies from Western populations where smoking prevalence among youth with T2DM is reported as high as 30–40%,[28] smoking was relatively low (9.8%) and restricted to males in our cohort. This may reflect cultural norms and gender-related behaviours in our regional setting but also suggests an opportunity for targeted smoking cessation interventions in the male diabetic population to reduce additive cardiovascular risk. Moreover, while active smoking did not show significant associations with BMI, HbA1c, or diabetes duration in our study, ex-smokers had significantly lower HbA1c levels. This suggests that smoking cessation may have a favourable impact on glycemic control, as supported by other research indicating that smoking is associated with insulin resistance and poorer glycemic outcomes.[29]

Limitations: Limitations of this study include its cross-sectional design, which precludes causal inferences, and the use of convenience sampling from a single tertiary center, which may limit generalizability. Nonetheless, the sample size and comprehensive assessment of clinical and laboratory parameters provide valuable insights into the burden of CMRFs in young adults with T2DM in Karachi, Pakistan.

CONCLUSION

This study highlights the alarming clustering of obesity, hypertension, dyslipidemia, and poor glycemic control among young adults with T2DM, underscoring the critical need for early detection and integrated management to reduce premature cardiovascular disease in this vulnerable group.

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Authors contribution:

SA: Concept and design, interpretation of data, manuscript writing, final editing and approval.
SAK: Data collection, interpretation of data, manuscript writing
EA: Data collection, interpretation of data, manuscript writing.
All authors are accountable for the integrity of work.

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