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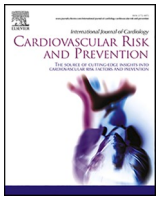

Cardiovascular risk in newly diagnosed patients with type 2 diabetes mellitus: a nationwide, facility-based, cross-sectional study in Bangladesh

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ABSTRACT

Aims: Evidence on cardiovascular (CV) risk stratification in Bangladeshi patients with type 2 diabetes mellitus (T2DM) who are asymptomatic for cardiovascular disease (CVD) is limited. This study aimed to assess the 10-year CV risk in newly diagnosed patients with T2DM.

Methods: In 2023, a cross-sectional study was carried out at endocrinology clinics in tertiary hospitals throughout Bangladesh, involving newly diagnosed patients with T2DM aged 25 to 84 who had no prior history of CVD and were asymptomatic for the condition. CV risk was assessed and classified using QRISK3.

Results: 1617 newly diagnosed patients with T2DM (age 44.92 ± 11.84 years, male 49.5 %) were analyzed. Their median QRISK3 score was 11.0 %, with 46.5 % at low, 25.7 % at moderate, and 27.8 % at high 10-year CV risk, respectively. The QRISK3 score increased with age for both men and women, with men consistently scoring

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higher than women in every age group. Among the age groups 25–39, 40–64, and 65–84, the percentages of patients with high 10-year CV risk were 3.3 %, 34.0 %, and 94.5 %, respectively. The median relative risk (RR) of CVD was 4.3. RR decreased with age for both sexes, and men had a lower RR than women across all age groups. A sleep duration of 6–9 h was associated with a lower 10-year CV risk.
Conclusions: Many newly diagnosed Bangladeshi patients with T2DM have substantial CV risk. QRISK3 can assist clinicians in predicting 10-year CV risk and choosing appropriate treatments to prevent CVD.

1. Introduction

The global prevalence of diabetes mellitus (DM) and its accompanying macrovascular and microvascular complications is rising. Presently, over 13.1 million adults in Bangladesh are living with DM, a figure anticipated to rise to 22.3 million by 2045. Type 2 DM (T2DM) is the most prevalent type of diabetes among these persons [1]. Cardiovascular disease (CVD) prevalence is strikingly high in South Asians compared to Western populations. Moreover, South Asians are recognized to have an increased risk of premature CVD [2]. Bangladeshi adults exhibit a high prevalence of CVD along with an increasing trend; a recent meta-analysis of 13 population-based studies reported that the weighted pooled prevalence of CVD was 5.0 % [3]. DM is a CV risk factor. Generally, DM confers a two-fold increased risk of vascular outcomes, such as coronary artery disease, ischemic stroke, and vascular deaths, independent of other risk factors. This risk is relatively higher for women than for men, especially with early onset of diabetes [4]. Approximately 75 % of T2DM patients die as a consequence of atherosclerotic CVD (ASCVD) [5]. South Asians exhibit higher proportional mortality rates from ASCVD than other Asian groups and non-Hispanics whites [3]. The prevalence of age-standardized years of life lost due to cardiovascular diseases is at least twice as high in South Asia compared to Western Europe and Australia; T2DM significantly contributes to this burden. T2DM, when combined with target organ damage or three or more major risk factors, poses a very high risk of ASCVD [6].

Notably, in T2DM, asymptomatic patients may have subclinical ASCVD. Its extent varies significantly, ranging from clinically insignificant plaque to silent myocardial infarction and death [5]. However, routine screening for coronary artery disease (CAD) is not recommended for asymptomatic individuals during regular diabetes check-ups, as it does not improve outcomes when ASCVD risk factors are properly managed. Instead, a holistic approach to managing CV risk serves as the foundational strategy for diabetes care, irrespective of underlying CVD [7]. Thus, the stratification of CV risk in T2DM remains an area of clinical interest. Due to the widely varied distribution of CV risk factors among the affected individuals, the risk of developing ASCVD events may differ by several folds across the T2DM spectrum. As a principle of precision medicine, CVD risk stratification can aid in individualizing management strategies and maximizing the value of healthcare delivery [8]. Some simple clinical tools may predict the risk of CV events in a real-world setting. To date, numerous CV risk scores and calculators have been developed (e.g., UKPDS Risk Engine, JBS3, Framingham Risk Score, SCORE, QRISK3, etc.) to assist clinicians in estimating the risk so that management can be tailored to the needs of the patient [9]. The American Heart Association recommends that clinical care providers conduct regular assessments and manage CV risk factors for patients with DM [10]. Management should also be tailored to the patient's ASCVD risk level, as recommended by the American Diabetes Association [11].

Many studies have sought to characterize the burden of CVD and its risk factors in the Bangladeshi population [3,12]. Nonetheless, evidence is scarce regarding CV risk stratification in patients with T2DM who are asymptomatic for CVD. To overcome this limitation, we evaluated the CV risk profile in Bangladeshi adults with T2DM in the present study. In this real-world study, we measured QRISK3 scores in individuals newly diagnosed with T2DM who had no previous history of CVD and were asymptomatic for CVD visiting outpatient departments in institutions nationwide.

2. Materials and methods

2.1. Ethical considerations

The Institutional Review Board of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, provided ethical approval (Registration no. 762, Memo. No. BSMMU/2022/9702, Date: October 22, 2022) for this study. If necessary, written permissions were secured from the authorities of other hospitals. All eligible participants were briefed on the study's objectives and provided their consent by completing a form before participation. The principles of biomedical research outlined in the Declaration of Helsinki were adhered to during the execution of the study.

2.2. Study settings and participants

This cross-sectional study was conducted at specialized endocrinology outpatient clinics of seventeen tertiary public and private hospitals throughout eight divisions of Bangladesh, spanning from January to December 2023. A convenient sampling strategy was performed on all ambulatory patients of either sex aged 25–84 years newly diagnosed with T2DM who had no previous history of CVD and were asymptomatic for CVD. Exclusion criteria included other types of diabetes, acute diabetic complications (such as hyperosmolar hyperglycemic state and diabetic ketoacidosis), diagnosed CVD or symptoms indicative of CVD, acute illness, pregnancy, postpartum period, and lactation. In the absence of previous data, assuming that at least 50 % of the study subjects have moderate to high CVD risk when utilizing the QRISK3 calculator and considering a maximum margin of error of 3 %, a minimum of 1068 patients were needed for the survey to ensure adequate precision of the study findings.

2.3. Demographic and clinical variables

The variables of age, sex, physical activity, sleep duration, food habit, smoking status, alcohol intake, T2DM in a 1st-degree relative, angina or heart attack in a 1st-degree relative <60 years; having certain clinical conditions, like hypertension (HTN), chronic kidney disease, atrial fibrillation, migraines, rheumatoid arthritis, systemic lupus erythematosus (SLE), severe psychiatric illness (schizophrenia, bipolar disorder, and moderate/severe depression), erectile dysfunction (in men); drug histories, like antihypertensives, atypical antipsychotics, and steroids, were documented by a predesigned questionnaire (Appendix 1) and were completed by the study participants in a quiet room. Height was measured to an accuracy of 1 mm without footwear utilizing wall-mounted stadiometers. Body weight was assessed with an accuracy of 0.5 kg using standard weighing devices positioned on a firm, level surface while the subjects wore light clothing and no footwear. Body mass index (BMI) was calculated by dividing weight in kg by the square of height in meters and categorized as underweight (<18.5 kg/m^2), normal (18.5–22.9 kg/m^2), overweight (23–24.9 kg/m^2), and obese (≥25 kg/m^2) according to the World Health Organization cutoff values for the Asian population [13]. Blood pressure (BP) was measured twice in every study subject using the auscultatory method, using standard validated aneroid sphygmomanometers after at least 5 min of rest following

standard procedures [14]. Two separate readings were taken at intervals of at least 3 min; both values for systolic BP were recorded, and for diastolic BP, the average of the two readings was considered. HTN was defined as systolic BP $\geq$ 140 mmHg and/or diastolic BP $\geq$ 90 mmHg in a study subject not currently taking antihypertensive medications or self-reported history of HTN on antihypertensive medications [15].

2.4. Laboratory variables

The laboratory data included glycated hemoglobin (HbA1c), fasting plasma glucose (FPG), serum creatinine, serum alanine transaminase (ALT), urine routine examination, and fasting lipid profiles. All measurements were done using fasting blood samples collected following an overnight (8–12 h) fasting using automatic analyzers in the laboratory of the corresponding center; HbA1c was measured using the methods certified by the National Glycohemoglobin Standardization Program. Two-hour postprandial plasma glucose (2h PPG) was also measured in all study subjects. Criteria recommended by the American Diabetes Association were adopted to diagnose and classify DM [16]. The Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) Creatinine Equation (2021) was utilized to calculate the estimated glomerular filtration rate (eGFR) and to classify chronic kidney disease (CKD) [17, 18]. Lipid status was defined based on the cutoffs outlined in the Adult Treatment Panel III guidelines [19].

2.5. Assessment of 10-year CV risk

For this study, 10-year CV risk was calculated using the QRISK3 chart, which is the most suitable for Bangladeshis [20]. The QRISK3 score was developed through comprehensive studies involving various ethnic groups, including the Indian ethnic group within the United Kingdom. A total of 159,488 individuals of Indian origin, consisting of 77,683 males and 81,805 females, were included in the derivation cohort sourced from 1309 practices. The risk score created from the derivation cohort was tested on a validation cohort consisting of 49,625 Indian individuals (23,146 males and 26,479 females), with a median follow-up period of 4.4 years. Including patients of Indian ethnicity in the development of QRISK3 enhances the score's relevance for individuals from the Indian subcontinent, considering the ethnic variations in CV risk. Additionally, QRISK3 can be utilized in patients with T2DM, unlike other risk calculators such as SCORE. Furthermore, the QRISK3 incorporates specific reliable and independent predictors of CVD risk that are frequently overlooked in many other risk assessment tools, such as erectile dysfunction, depression, anxiety, corticosteroid use, and autoimmune diseases, among others. Given the potential genetic factors related to Indian ethnicity, the QRISK3 score is the most accurate CVD risk screening tool currently available for our population. The 10-year CVD risk was categorized as low risk (QRISK3 score of less than 10 %), moderate risk (QRISK3 score of 10–20 %), and high risk (QRISK3 score of more than 20 %) [20].

2.6. Statistical analysis

Data cleaning, which involved removing duplicates, was performed using Microsoft Excel (Microsoft Corporation, 2024). Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) for Macintosh, version 29.0 (IBM Corp. Released 2023, IBM SPSS Statistics for Macintosh, Version 29.0.2.0 Armonk, NY: IBM Corp). The categorical variables are presented as frequencies (%); measurable variables with a normal distribution are shown as mean $\pm$ standard deviation (SD), while those that do not follow a normal distribution are represented as median (interquartile range, IQR). The Chi-square test or Fisher's exact test was conducted to compare the variables among participants in different groups. Binary logistic regression analysis identified the risk factors for moderate and high 10-year CV risk. A P-value of $\leq$0.05 was deemed statistically significant.

3. Results

3.1. Characteristics of the study participants

A total of 1617 newly diagnosed patients with T2DM who had no history or clinical symptoms of CVD were ultimately analyzed [Table 1]. The mean age was 44.92 years (SD 11.84), with most participants (56.2 %) belonging to the middle-aged (40–64 years) group. The proportions of male (49.5 %) and female (50.5 %) participants were nearly equal. Over half of them came from urban (40.1 %) and suburban (22 %) areas. The majority (59.6 %) were sedentary regarding physical activity. Most (72.4 %) slept between 6 and 9 h daily, and 21.9 % slept less than 6 h. Additionally, 93.3 % of the participants followed non-vegetarian diets, while 6.7 % adhered to vegetarian diets. The majority were nonsmokers (80.1 %) and did not consume alcohol (98.5 %). Most (72.2 %) had a first-degree relative with T2DM, and 24.4 % had a first-degree relative who experienced angina or a heart attack before age 60. Approximately one-third (32.8 %) of the participants were taking antihypertensive medications; the mean systolic and diastolic BP were 130.89 (SD 16.71) and 82.28 (SD 9.27) mmHg, respectively. Only a small number of participants had CKD (stages 3, 4, or 5) at 5.8 %, atrial fibrillation at 0.2 %, migraines at 2.1 %, rheumatoid arthritis at 0.4 %, SLE at 0.2 %, and severe mental illness at 0.4 %. Additionally, 0.3 % were on atypical antipsychotic medication, while 0.4 % regularly took steroid tablets. The mean BMI was 26.86 (SD 4.41) kg/m^2, with more than three-fourths classified as either overweight (16.8 %) or obese (65.6 %). The mean HbA1c among the study subjects was 9.24 % (SD 2.12). Additionally, 43.2 % had fatty liver, as observed in the USG. Nearly one-third (37.6 %) of participants were taking lipid-lowering medications. Abnormal levels of total cholesterol (TC), low-density lipoprotein cholesterol (LDLC), high-density lipoprotein cholesterol (HDLC), and triglycerides (TG) were observed in 51 %, 75 %, 53.6 %, and 79.3 % of the study subjects, respectively.

3.2. 10-Year CV risk

The median 10-year CV risk, measured by the QRISK3 score, was 11.0 % (IQR 5.0–21.7), while the mean score was 16.4 % (SD 16.5). The prevalence of study participants with low, moderate, and high 10-year CV risk was 46.5 %, 25.7 %, and 27.8 %, respectively [Fig. 1]. The 10-year CV risk in both sexes increased with age [Fig. 2A]. Men had higher median QRISK3 scores than women across all age groups [25–39 years (5.3 vs. 3.2, P $<$ 0.001), 40–64 years (20.1 vs. 12.1, P $<$ 0.001), and 65–84 years (52.9 vs. 36.2, P $<$ 0.001)] [Fig. 2B]. 18.6 % of men versus 10.7 % of women had moderate CV risk, and 5.2 % of men versus 1.4 % of women had high CV risk among the participants aged 25–39 years. In the age group 40–64 years, the prevalence of men and women with moderate CV risk was 29.8 % and 41.5 %, and the prevalence with high CV risk was 50.1 % and 18.9 %, respectively. None of the men versus 8.6 % of women had moderate CV risk in the age group 65–84 years; the prevalence of men and women with high CV risk was 98.6 % and 89.7 %, respectively, in the same age group [Table 2].

The median relative risk (RR) of experiencing a heart attack or stroke within the next 10 years, compared to a healthy person of the same age, sex, and ethnic group, was 4.3 (IQR 3.0–6.9). The RR decreased with age in both sexes [Fig. 2C]. Men had a lower RR than women in all age groups compared to their healthy counterparts: 5.6 vs. 7.4 in the 25–39 age group, 3.6 vs. 4.1 in the 40–64 age group, and 2.2 vs. 2.4 in the 65–84 age group [Fig. 2D].

In bivariate logistic regression analyses, subjects who slept for 6–9 h had a lower risk of moderate and high 10-year CV risk compared to those who slept less than 6 h (OR 0.616, 95 % CI [0.481–0.789], P $<$ 0.001). However, residence, physical activity, dietary habits, alcohol consumption, having a first-degree relative with T2DM, fatty liver detected by USG, and elevated LDLC or TG did not increase the risk of moderate to high 10-year CV risk. [Table 3].

Table 1
Demographic, clinical, and metabolic characteristics of the study subjects (N = 1617).

Variable	Subgroup	Mean ± SD or n (%)
Age (years)		44.92 ± 11.84
Age group	25–39 years	580 (35.9)
	40–64 years	909 (56.2)
	65–84 years	128 (7.9)
Sex	Male	800 (49.5)
	Female	817 (50.5)
Residence	Rural	612 (37.8)
	Suburban	356 (22.0)
	Urban	649 (40.1)
Physical activity	Sedentary	964 (59.6)
	Moderate	603 (37.3)
	Heavy	50 (3.1)
Sleep duration (hours)	<6	354 (21.9)
	6–9	1170 (72.4)
	>9	93 (5.8)
Food habit	Veg	108 (6.7)
	Non-Veg	1509 (93.3)
Smoking status	Non-smoker	1296 (80.1)
	Ex-smoker	131 (8.1)
	Light smoker (<10/day)	112 (6.9)
	Moderate smoker (10–19/day)	54 (3.3)
	Heavy smoker (≥20/day)	24 (1.5)
H/O alcohol in last month	No	1593 (98.5 %)
	Yes Regular	8 (0.5)
	Occasional	16 (1.0)
T2DM in 1st-degree relative	No	449 (27.8)
	Yes	1168 (72.2)
Angina or heart attack in a 1st-degree relative <60 years	No	1222 (75.6)
	Yes	395 (24.4)
On blood pressure treatment	No	1087 (67.2)
	Yes	530 (32.8)
CKD (stage 3, 4 or 5)	No	1523 (94.2)
	Yes	94 (5.8)
Atrial fibrillation	No	1613 (99.8)
	Yes	4 (0.2)
Migraines	No	1583 (97.9)
	Yes	34 (2.1)
Rheumatoid arthritis	No	1611 (99.6)
	Yes	6 (0.4)
SLE	No	1614 (99.8)
	Yes	3 (0.2)
Severe mental illness	No	1611 (99.6)
	Yes	6 (0.4)
On atypical antipsychotic medication	No	1612 (99.7)
	Yes	5 (0.3)
On regular steroid tablets	No	1610 (99.6)
	Yes	7 (0.4)
A diagnosis of or treatment for erectile disfunction (in male, n = 800)	No	737 (92.1)
	Yes	63 (7.9)
BMI (kg/m^2)		26.86 ± 4.41
BMI category	Normal	262 (16.2)
	Underweight	23 (1.4)
	Overweight	271 (16.8)
	Obese	1061 (65.6)
Systolic BP (mmHg)		130.89 ± 16.71
Diastolic BP (mmHg)		82.28 ± 9.27
HbA1c (%)		9.24 ± 2.12
FPG (mmol/L)		10.24 ± 3.93
2h PPG (mmol/L)		15.96 ± 7.09
S. Creatinine (mg/dL)		0.97 ± 0.23
eGFR ($mL/min/1.73\ m^2$)		88.34 ± 20.71
S. ALT (U/L)		46.0 ± 26.3
Fatty liver in USG	Absent	918 (56.8)
	Present	699 (43.2)
TC (mg/dL)		202.72 ± 42.23
	≥200	824 (51)
LDLC (mg/dL)		127.91 ± 42.71
	≥100	1213 (75)
HDLC (mg/dL)		39.56 ± 8.6
	<40	866 (53.6)
TG (mg/dL)		246.79 ± 173.27
	≥150	1282 (79.3)
Current lipid-lowering drugs	No	1009 (62.4)
	Statin	547 (33.8)
	Fibrate	35 (2.2)
	Others	5 (0.3)
	Statin + Fibrate	21 (1.3)

2h PPG, 2 h postprandial plasma glucose; ALT, Alanine transaminase; BP, blood pressure; BMI, Body mass index; CKD, Chronic kidney disease; eGFR; Estimated glomerular filtration rate; FPG, Fasting plasma glucose; HbA1c; Glycated hemoglobin; HDLC, High-density lipoprotein cholesterol; LDLC, Low-density lipoprotein cholesterol; SD, Standard deviation; SLE, Systemic lupus erythematosus; T2DM, Type 2 diabetes mellitus; TC, Total cholesterol; TG, Triglycerides.

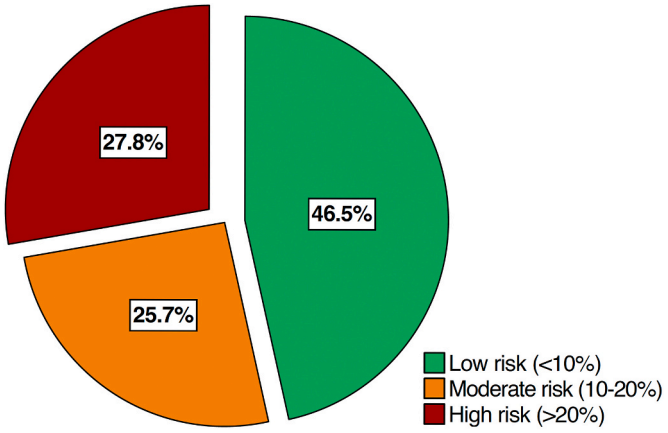

Fig. 1. Proportions of study subjects with low, moderate, and high 10-year cardiovascular risk.

4. Discussion

This multicenter nationwide study aimed to measure 10-year CV risk using QRISK3 in asymptomatic individuals and assessed 1617 subjects newly diagnosed with T2DM. The median 10-year CV risk was 11 %, with 25.7 % and 27.8 % of the subjects having moderate and high 10-year CV risk, respectively. This risk was 4.3 times greater than that of their healthy counterparts. For both sexes, the absolute risk increased while the relative risk decreased with age. Across all age groups, men exhibited a higher absolute risk and a lower relative risk than women.

There are few reports on the 10-year CV risk using QRISK3, especially from the Indian subcontinent. Ghosal et al. reported a median 10-year CV risk of 22.2 % using QRISK3 in their nationwide study in India, which included 1538 patients with T2DM. This risk was 5.7 times higher compared to a similar population of healthy adults [21]. Both the absolute and relative risks reported in the study by Ghosal et al. are greater than those observed in our research. However, Ghosal et al. included patients who were previously diagnosed with T2DM, whereas we included only those who were newly diagnosed. In their study, the median 10-year CV risk for individuals with a diabetes duration of five years or less was 13.1 %, with an RR of 3.7; these findings closely align with ours. The risk of diabetic complications steadily increases over time, and T2DM, combined with target organ damage, elevates the risk of ASCVD [22]. The mean age of the subjects in Ghosal et al.'s study was

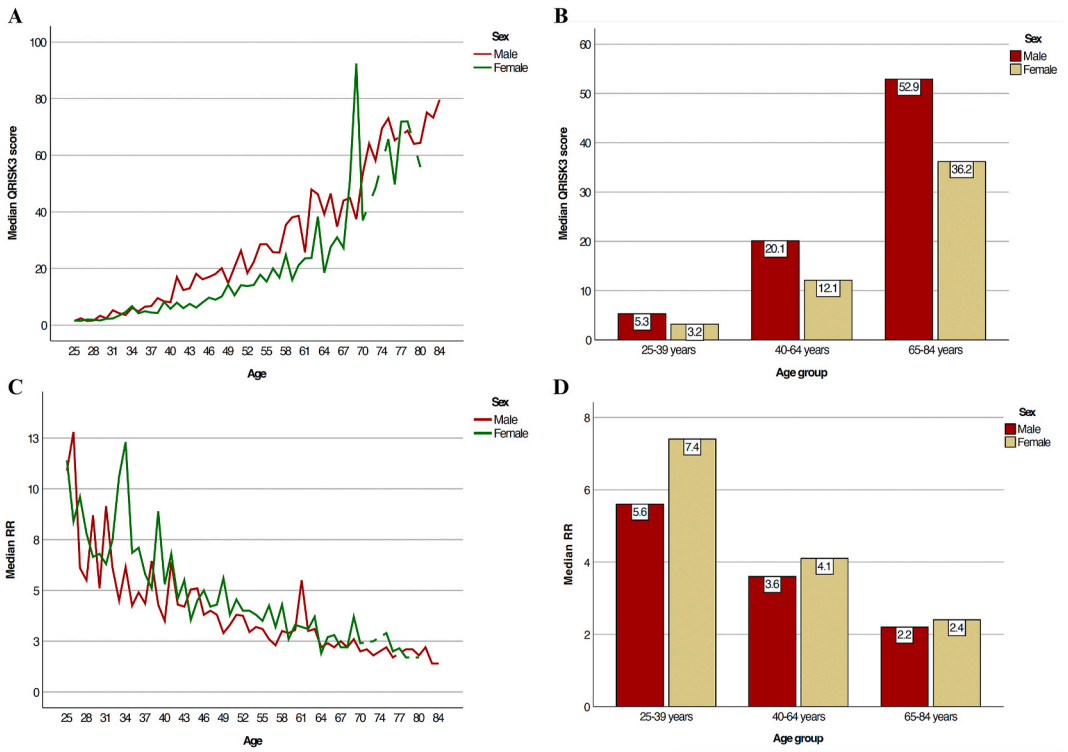

Fig. 2. **A.** Trend of median QRISK3 score with increasing age in men and women, **B.** Comparison of median QRISK3 score in men versus women of different age groups, **C.** Trend of median relative risk of CVD with increasing age in men and women, **D.** Comparison of median relative risk of CVD in men versus women of different age groups.

Table 2
Proportions of study subjects with low, moderate, and high cardiovascular risk in different age groups.

Age group	Sex	Low risk	Moderate risk	High risk
25–39 years	Both (n = 580)	476 (82.1 %)	85 (14.7 %)	19 (3.3 %)
	Male (n = 291)	222 (76.3 %)	54 (18.6 %)	15 (5.2 %)
	Female (n = 289)	254 (87.9 %)	31 (10.7 %)	4 (1.4 %)
40–64 years	Both (n = 909)	274 (30.1 %)	326 (35.9 %)	309 (34.0 %)
	Male (n = 439)	88 (20.0 %)	131 (29.8 %)	220 (50.1 %)
	Female (n = 470)	186 (39.6 %)	195 (41.5 %)	89 (18.9 %)
65–84 years	Both (n = 128)	2 (1.6 %)	5 (3.9 %)	121 (94.5 %)
	Male (n = 70)	1 (1.4 %)	0 (0 %)	69 (98.6 %)
	Female (n = 58)	1 (1.7 %)	5 (8.6 %)	52 (89.7 %)

Table 3
Bivariate logistic regression for other possible risk factors (other than those used to compute QRISK3) of moderate and high 10-year cardiovascular risk.

Variables	Sub-groups	Odds Ratio (95 % Confidence Interval)	P
Residence	Rural	Referent	
	Suburban	1.009 (0.774–1.316)	0.945
	Urban	1.115 (0.889–1.398)	0.345
Physical activity	Sedentary	Referent	
	Moderate	0.951 (0.769–1.177)	0.645
	Heavy	1.118 (0.624–2.003)	0.708
Sleep duration	<6 h	Referent	
	6–9 h	0.616 (0.481–0.789)	<0.001
	>9 h	0.714 (0.438–1.164)	0.177
Food habit	Veg	Referent	
	Non-Veg	0.964 (0.626–1.486)	0.868
Alcohol	No	Referent	
	Yes	2.381 (0.929–6.099)	0.71
T2DM in 1st degree relative	No	Referent	
	Yes	1.008 (0.803–1.265)	0.945
Fatty liver in USG	No	Referent	
	Yes	0.977 (0.798–1.197)	0.824
LDL status	<100 mg/dL	Referent	
	≥100 mg/dL	1.056 (0.839–1.330)	0.641
TG status	<150 mg/dL	Referent	
	≥150 mg/dL	1.182 (0.926–1.510)	0.180

LDLC, Low-density lipoprotein cholesterol; T2DM, Type 2 diabetes mellitus; TG, Triglycerides; USG, Ultrasonography.

also higher than in our study (54.5 vs. 44.9 years) [21]. The risk of CVD increases with age, acting as an independent risk factor that is further complicated by the rising prevalence of various other CVD risk factors with aging [23]. Moreover, the male-to-female ratio in Ghosal et al.'s study was higher than in our study (58.3:41.7 % vs. 49.5:50.5 %), which may further explain the elevated QRISK3 score in their findings. Another multicenter study conducted by Unnikrishnan et al. in India, focusing on newly diagnosed individuals with T2DM, reported a mean QRISK3 score of 15.3 % [24]. They also calculated the QRISK3 score by using the same data across all ethnicities available in the QRISK3 model, adjusting the ethnicity option in the calculator accordingly. This analysis yielded a mean score of 17.8 % for the Bangladeshi population, slightly higher than our finding of 16.4 %. The male-to-female ratio (64:36 % vs. 49.5:50.5 %) and the mean age (48.3 vs. 44.9 years) were once again higher than our study. Unnikrishnan et al. used the Lipid Association of India (LAI) criteria instead of the QRISK3 criteria for stratifying 10-year CV risk [25]. According to the LAI criteria, 39.5 % and 60.5 % of individuals in that study were classified as "high risk" and "very high risk" for ASCVD, respectively. Our observation suggests that the QRISK3 score rises with age, while the RR shows a different trend. This indicates that compared to healthy individuals of the same age and similar demographic profile, a younger individual with T2DM faces a higher risk of ASCVD than older individuals with T2DM. Ghosal et al. found a similar pattern [21]. This finding emphasizes the importance of

implementing CV risk management at a younger age to optimize benefits related to ASCVD prevention. Similar to previous studies, we also observed a higher CV risk in men than in women across all age groups. Unnikrishnan et al. noted that men face significantly higher CV risks than women after age 35 [24]. However, we observed a greater RR of CVD in women than in men across all groups. This indicates that when compared to healthy individuals of the same age group, gender, and similar demographic profile, a woman with T2DM faces a higher risk of ASCVD than a man with T2DM. Our findings align with previous studies indicating that women with T2DM face up to a 50 % higher risk of CVD than their male counterparts. However, the reasons behind these sex disparities remain unexplained [26].

This study reveals that individuals who sleep between 6 and 9 h daily exhibit a reduced risk of moderate to high CV risk compared to those who sleep less than 6 h a day. Existing evidence suggests that short sleep duration is a causal risk factor for coronary artery disease and heart failure [27]. This study found that factors like physical activity or fatty liver detected in USG did not seem to be associated with moderate to high CV risk. Physical activity can reduce CVD risk in people with diabetes. Engaging in regular physical activity before and after a diabetes diagnosis is crucial for CVD prevention. Implementing early intervention strategies is essential to encourage physical activity and exercise routines among individuals with pre-existing CV conditions following a diabetes diagnosis [28]. The mean HbA1c in this study was quite high, 9.24 %. HbA1c $\geq$ 6.0 % was associated with an increased risk of CVD and mortality outcomes; even an association between CVD and HbA1c levels of 5.5 %–5.9 %, considered in the "normal" range, was found [29]. Thus, HbA1c, even within a non-diabetic level, predicts CVD [30]. Hence, the present study subjects might harbor preclinical CVD, which started earlier in the course of diabetes development. Herein, the positive adoption of a healthy lifestyle is a crucial strategy for lowering future cardiovascular risk and the prevalence of CVD [31]. Most prior studies emphasize the link between non-alcoholic fatty liver disease (NAFLD) and CVD in patients both with and without T2DM. Furthermore, some studies that statistically adjust for the presence of T2DM and other CV factors suggest an independent association between NAFLD and CVD. However, to properly and specifically assess the risk of CVD in patients with T2DM and NAFLD compared to those without NAFLD, dedicated studies conducted within the T2DM population are needed [32].

4.1. Strengths and limitations

This is the first study to report the 10-year CV risk using QRISK3 among newly diagnosed Bangladeshi patients with T2DM. The sample size exceeded the requirement for statistical inference. The multicenter design, which includes all eight administrative divisions of the country, confirms its national representativeness. Including a nearly equal representation of male and female participants in the extensive cohort addresses gender bias. However, this study also has several limitations. Individuals identified as newly diagnosed with T2DM may have gone undetected for an extended period, potentially introducing some heterogeneity in CV risk factors among the included patients. It is essential to recognize the potential for observer bias that may emerge when multiple investigators participate in the data collection process. Additionally, biochemical tests were performed across various laboratories utilizing different analytical techniques, which could potentially influence the study's outcomes. Moreover, there are limitations to the QRISK3 tool, and upgrading the QRISK3 score would be necessary in the future due to Hu's novel classification of clinical risk factors by Chinese scholars [33].

5. Conclusion

This study reveals that a significantly high proportion of Bangladeshi patients newly diagnosed with T2DM have an elevated CV risk, with 25.7 % and 27.8 % of the subjects classified as having moderate and high 10-year CV risk, respectively. Men have a higher absolute risk than women, and the risk increases with age in both sexes. In many of these patients, CV risk factors often precede the diagnosis of diabetes. Adopting a healthy lifestyle at an earlier age would be a crucial strategy for lowering future CV risk and the prevalence of CVD in such high-risk individuals. Therefore, identifying CV risk factors and calculating the 10-year CV risk with an appropriate risk calculator, such as QRISK3, can help physicians make therapeutic decisions and prevent diabetic complications.

CRediT authorship contribution statement

A.B.M. Kamrul-Hasan: Writing – review & editing, Writing – original draft, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Muhammad Shah Alam:** Writing – review & editing, Visualization, Supervision, Resources, Data curation. **Marufa Mustari:** Writing – review & editing, Visualization, Validation, Resources, Investigation, Data curation. **Mohammad Abdul Hannan:** Writing – review & editing, Visualization, Resources, Methodology, Data curation. **Emran Ur Rashid Chowdhury:** Writing – review & editing, Visualization, Resources, Formal analysis, Data curation. **Sumon Rahman Chowdhury:** Writing – review & editing, Visualization, Software, Resources, Data curation. **Md. Abu Jar Gaffar:** Writing – review & editing, Visualization, Resources, Formal analysis, Data curation. **Swapan Kumar Singha:** Writing – review & editing, Validation, Resources, Investigation, Data curation. **Choman Abdullah Mohana:** Writing – original draft, Visualization, Resources, Formal analysis, Data curation. **Ershad Mondal:** Writing – review & editing, Visualization, Resources, Investigation, Data curation. **Md. Shahinur Rahman:** Writing – review & editing, Visualization, Resources, Investigation, Data curation. **Mohammad Motiur Rahman:** Writing – original draft, Visualization, Validation, Resources, Data curation. **Sourav Sarker:** Writing – review & editing, Visualization, Validation, Resources, Data curation. **Md. Azizul Hoque:** Writing – review & editing, Visualization, Supervision, Resources, Data curation. **Md. Rashedul Islam:** Writing – review & editing, Visualization, Resources, Methodology, Data curation. **Md. Abdul Bari Robel:** Writing – review & editing, Visualization, Software, Resources, Investigation, Data curation. **Shahryar Ahmad:** Writing – review & editing, Visualization, Validation, Software, Resources, Data curation. **Ahmed Ifrad Bin Raunak:** Writing – original draft, Visualization, Resources, Formal analysis, Data curation. **Nur-A-Musabber:** Writing – review & editing, Visualization, Software, Resources, Data curation. **Md. Mostofa Kaisar:** Writing – review & editing, Visualization, Resources, Data curation. **Shahjada Selim:** Writing – review & editing, Visualization, Validation, Supervision, Resources, Project administration, Investigation, Conceptualization.

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Data availability statement

The data produced during this study can be obtained from the corresponding author upon request.

Declaration of competing interest

The authors assert the absence of any identifiable financial conflicts or personal relationships that could be perceived as impacting the integrity of the findings reported in this manuscript.

Abbreviations

2h PPG	2 h postprandial plasma glucose
ALT	Alanine transaminase
ASCVD	atherosclerotic cardiovascular disease
BP	blood pressure
BMI	Body mass index
CAD	Coronary artery disease
CKD	Chronic kidney disease
CKD-EPI	Chronic Kidney Disease Epidemiology Collaboration
CV	Cardiovascular
CVD	Cardiovascular disease
DM	Diabetes mellitus
FPG	Fasting plasma glucose
eGFR	Estimated glomerular filtration rate
FPG	Fasting plasma glucose
HbA1c	Glycated hemoglobin
HDLC	High-density lipoprotein cholesterol
HTN	Hypertension
IQR	interquartile range
LAI	Lipid Association of India
LDLC	Low-density lipoprotein cholesterol
NAFLD	non-alcoholic fatty liver disease
RR	relative risk
SD	Standard deviation
SLE	Systemic lupus erythematosus
SPSS	Statistical Package for the Social Sciences
T2DM	Type 2 diabetes mellitus
TC	Total cholesterol
TG	Triglycerides
USG	Ultrasonography

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijcrp.2025.200399.

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