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Cardiovascular Risk Assessment Using the Framingham Risk Score in Type 2 Diabetic Population in Nepal: Hospital-Based Study

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ABSTRACT

Introduction: There is a growing concern about the link between type 2 diabetes and increased cardiovascular risk in the Nepalese population. There is limited data on the utility of cardiovascular risk assessment tools in our population. This study examines the 10-year risk of cardiovascular events in type 2 diabetic patients in eastern Nepal using the Framingham Risk Score.

Objective: The primary objective was to estimate the 10-year risk of coronary heart disease among type 2 diabetic patients using the Framingham Risk Score and categorize these patients into low, moderate, and high-risk groups.

Methods: A hospital-based cross-sectional study was conducted from April 2023 to March 2024 at Nobel Medical College Teaching Hospital, Biratnagar, Nepal, with ethical approval from the institutional review committee. A total of 225 type 2 diabetic patients aged 30-74 years were enrolled from the medicine out-patient department. Data collected included demographics, clinical measurements (Basal metabolic rate, blood pressure), and biochemical data (fasting blood sugar, postprandial blood sugar, total cholesterol, HDL-cholesterol, and triglycerides). The Framingham Risk Score was used to estimate 10-year cardiovascular risk, categorizing patients into low (<10%), moderate (10-20%), and high (>20%) risk categories.

Results: The mean 10-year Cardiovascular risk was 16.01% (95% CI: 14.50 – 17.52), with males showing a significantly higher risk (18.9%) compared to females (11.0%). Risk increased with age, peaking at 22.3% in patients >60 years. Approximately 38.4% of participants were classified as high-risk, with males comprising 51.1% of this group. The average heart age exceeded chronological age by 16.93 years (66.95 vs 50.02 years).

Conclusion: This study reveals a substantial 10-year cardiovascular disease risk among type 2 diabetic patients in Nepal, with significant gender differences and increased risk with age. These findings emphasize the need for routine cardiovascular risk assessment and tailored prevention strategies, as well as the validation of risk assessment tools for the Nepalese population.

Keywords: Cardiovascular disease; Risk assessment; Type 2 diabetes mellitus.

INTRODUCTION

Concerns about the rising prevalence of coronary heart disease among type 2 diabetic cohorts have drawn attention to the strong link between diabetes and elevated risk of atherosclerotic events, leading to increased morbidity and mortality.[1]With the considerable prevalence of type 2 diabetes (10%), there is a consistently high risk of cardiovascular events

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in the Nepalese population.[2,3]Very few studies have demonstrated the utilization of cardiovascular risk assessment tools in Nepal; however, their use in people of eastern Nepal is yet to be explored.[4]A recent study in western part of Nepal showed poor glycemic control (66.4%) among type 2 diabetes and the presence of clusters of cardiovascular risk factors in the population.[3]Assessing the 10-year cardiovascular risk in Nepalese patients with type 2 diabetes will provide insights to guide effective prevention and management strategies.

We collected the cross-sectional data from the type 2 diabetic population visiting Nobel Medical College Teaching Hospital, Biratnagar, to examine the 10-year risk of developing cardiovascular events using Framingham Risk Score (FRS) tool.[5, 6] Our primary objectives were to estimate the 10-year risk of coronary heart disease among type 2 diabetic patients using the Framingham risk score and categorize these patients into low, moderate, and high risk groups.

METHODS

This is a hospital-based cross-sectional descriptive study, done from April 2023 to March 2024 at Nobel Medical College Teaching Hospital, Biratnagar, Nepal after obtaining ethical approval from institutional review committee (IRC-NMCTH 716/2022). A total of 225 type 2 diabetic patients of age 30-74 years were enrolled from medicine OPD in the study. Sample size was calculated as 225 based on previous data showing mean 10 year Coronary Heart Diasease (CHD) risk in Nepalese population was 17.1% ± 12.1.[4]

Patients diagnosed with type 2 diabetes mellitus were enrolled consecutively during routine clinical visits after providing and explaining information sheet and then obtaining written consent.To be eligible, patient had to be above age 30 years and have a confirmed diagnosis of type 2 diabetes mellitus according to diagnostic criteria of World Health Organization.[7] Patients with known history of cardiovascular disease, chronic kidney disease and pregnancy were excluded from the study. Demographic, clinical and biochemical data of the patients were collected by personal interview and laboratory report by recording in a pre-formed questionnaire. The primary variables in our study were age, sex, Body mass index (BMI), fasting blood sugar, postprandial blood sugar, smoking habit, blood pressure (systolic and diastolic), total cholesterol (TC), High density lipoprotein (HDL) cholesterol and triglyceride.

A total of 5 ml of fasting venous blood for fasting blood sugar (FBS) and lipid profile and 3 ml of postprandial venous blood for postprandial blood sugar (PPBS) after 2 hours of meal were collected from each participant under aseptic conditions. The samples were distributed into appropriate collection tubes: fluoride-oxalate vials for glucose estimation

and plain vacutainers for lipid profile.FBS and postprandial blood sugar PPBS levels were measured using the Hexokinase method. Serum total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) were estimated from serum samples using enzymatic colorimetric methods. All biochemical analyses were carried out using the AU480 automated chemistry analyzer (Beckman Coulter, USA) with standard reagent kits, following the manufacturer's instructions. Blood pressure was measured using a standard mercury sphygmomanometer after the participant had rested for at least 5 minutes in a seated position. Patient on anti-hypertensive drug was recordedas yes/no. BMI was calculated as weight (kg) divided by height in meters squared (kg/m^2), and smoking status was recorded based on participant self-report and was recorded as yes/no based on any cigarette smoking in the past month.

The Framingham Risk Score for estimation of 10-year Cardiovascular disease (CVD) risk calculated following the table in study by D'Agostino et. al.[6]. The 10-year CVD risk and heart age were calculated using the sex-specific multivariable risk functions outlined in the Framingham Heart Study, incorporating variables such as age, total cholesterol, HDL cholesterol, systolic blood pressure, treatment for hypertension, smoking status, and diabetes. The scoring algorithm from the referenced article was used to derive both CVD risk and estimated heart age for each participant. Estimated CVD risks were categorized as low (<10%), moderate (10-20%), and high (>20%).

To minimize selection bias, participants were consecutively enrolled from the medicine outpatient department, and only those who met the inclusion criteria were selected. Information bias was minimized by using standardized methods for measuring blood pressure, anthropometric parameters, and biochemical markers. Additionally, data on smoking habits and medical history were obtained through structured interviews to reduce recall bias.

Data entry was performed in MS-excel 2016 using its inbuilt data validation tool. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS), version 16.0 for Windows. Descriptive data were expressed as mean ±SD, and proportions were expressed as percentages. Point estimate with 95% CI were calculated for CVD risk percentage and heart age.

RESULTS

A total of 225 patients were enrolled, of whom 136 (60.5%) were males and 89 (39.5%) were females. Table 1 shows the baseline characteristics of study population. The mean age of the study population was around 50 years and BMI was 24.78 kg/m^2. All participants were diabetic and under treatment, with mean fasting blood sugar of 162.11 mg/dl and mean post prandial blood sugar of 271.23

mg/dl. 25.9% of the total population were smokers, and 25.4% were receiving active hypertension treatment.

Table 1: Baseline characteristics of the study population (N=225)

	Total (mean±SD)	Male (mean±SD)	Female (mean±SD)
Age (Years)	50.02 ± 10.13	49.61 ± 10.1)	50.64 ± 10.2
FBG (mg/dl)	162.11 ± 54.23	168.20 ± 58.46	152.81 ± 45.98
PPBG (mg/dl)	271.23 ± 102.99	287.26 ± 109.72	246.36 ± 86.74
SBP (mm Hg)	126.56 ± 15.7	128.50 ± 16.75	123.56 ± 13.47
DBP (mm Hg)	81.05 ± 11.20	82.41 ± 11.0	78.97 ± 11.27
BMI (kg/m^2)	24.78 ± 3.97	24.50 ± 3.23	25.20 ± 4.88
HDL Cholesterol (mg/dl)	42.47 ± 6.80	41.72 ± 6.32	43.69 ± 7.43
Total Cholesterol (mg/dl)	184.29 ± 38.77	187.13 ± 36.90	179.61 ± 41.55
Triglyceride (mg/dl)	192.01 ± 98.63	207.49 ± 112.73	166.54 ± 62.50
Smoker (%)	Yes = 25.9% No = 74.1%	Yes = 34.2% No = 65.8%	Yes = 13.3% No = 86.7 %
Hypertensive under treatment (%)	Yes = 25.4% No = 74.6%	Yes = 70.2% No = 29.8%	Yes = 81.3% No = 18.7%

Table 2 shows the mean % of having cardiovascular disease in 10 years among type 2 diabetes patients were 16.01%. Males were found to have higher risk (18.9%) compared to females (11.0%). Similarly, average heart age in our population was 64.95 years.

Table 2: Ten-year mean CVD risk and heart age of the type 2 diabetic patients

	Mean±SD(95% CI)	Male (mean±SD)	Female (mean±SD)
CVD risk %	16.01 ± 9.46 (14.50 – 17.52)	18.9 ± 8.9	11.0 ± 8.3
Heart age (years)	66.95 ± 15.24 (64.53 – 69.38)	67.0 ± 15.5	66.9 ± 14.9

Among the various age group >60 years group was found to have higher mean risk % of 22.3 ± 8.3% while it was lowest for age group 30-39. (Table 3)

Table 3: Age-wise distribution of 10-year cardiovascular risk

Age group (years)	10-year Cardiovascular Risk % (mean±SD)
30-39	7.6±5.1
40-49	12.0±7.2
50-59	18.8±9.0
>60	22.3±8.3

Table 4: Distribution of population according to risk level

Risk category	Total (N=225)	Male	Female
Low (FRS < 10%)	34.2%	21.7%	55.6%
Moderate (FRS 10-19%)	27.4%	27.2%	27.8%
High (FRS ≥20%)	38.4%	51.1%	16.7%

Table 4 shows the risk stratification of population and majority (38.4%) were having high risk with 10-year risk of CVD to be greater than 20% and males were more prevalent (51.1%) than females. Majority of females (55.6%) fell under low risk category group.

DISCUSSION

This study assessed the 10-year cardiovascular disease risk in type 2 diabetes mellitus patients visiting medicine OPD of Nobel Medical College Teaching Hospital, Biratnagar, Nepal. Our study among 225 type 2 diabetic patients revealed a notable cardiovascular risk burden, with an average 10-year CVD risk of 16.01 ± 9.46 % and heart age exceeding chronological age (66.95 years heart age vs 50.02 years chronological age). Males had a higher mean CVD risk (18.9%) compared to females (11.0%). Risk increased progressively with age, with those >60 years showing the highest mean risk (22.3%). Based on FRS risk stratification categories, 38.4% of participants were classified as high-risk (≥20%), with the majority being males (51.1%), while 55.6% of females were in the low-risk group. These findings highlight a substantial cardiovascular risk burden among Nepalese diabetic patients, consistent with previous reports that show rising CVD risk and gender disparities in similar South Asian populations.[3,8,9]

The average 10-year CVD risk of 16.01% observed in this study is consistent with findings from similar studies in South Asian diabetic populations, which reported moderate to high CVD risk. A hospital-based study from Nepal reported a slightly higher mean Framingham risk of 17.7% among type 2 diabetic patients, with risk increasing with age and being higher in males.[4] In India, a large cross-sectional study of newly diagnosed type 2 diabetes patients found a mean 10-year CVD risk of 17.1 ± 9.9% (QRISK3), with female having lower risk than male.[10] Similarly, a large prospective cohort study in south Asian population showed hypertension, high non-HDL cholesterol, and diabetes contribute substantially to CVD risk.[11] The higher risk observed in South Asian populations, including Nepal, may be attributed to a combination of earlier onset of diabetes, higher prevalence of central adiposity, insulin resistance,

hypertension, and sociocultural factors such as dietary patterns and lower physical activity.[12-14]

In our study of type 2 diabetic patients, the observed heart age (66.95 years) exceeded the chronological age (50.02 years) by nearly 17 years, reflecting significant premature vascular aging in this population. This result is in agreement with evidence that cardiovascular aging and risk are accelerated in diabetes.[15,16] Diabetes is known to increase heart age by accelerating vascular damage through chronic hyperglycemia, dyslipidemia, and systemic inflammation.[17]

Our study revealed that 38.4% of participants are at high 10-year CVD risk, which is notably higher than some regional findings. For instance, a study assessing cardiovascular risk among patients with type 2 diabetes in India found that 20.9% were categorized as high-risk using the Framingham Risk Score (FRS).[18] The difference in population age group in our study (30-74 years vs 18-75 years in referenced study) and inclusion of broader type 2 population in our study rather than newly diagnosed cases might have lead to inclusion of more percentages of participants in high risk group in our study. The higher prevalence of high-risk individuals among males (51.1%) is shown in our study compared to females (16.7%). A study from South East Asia reported that 45.1% of male participants remained in the high CVD risk cluster over a 5-year follow-up, compared to 10.52% of female participants which aligns with our findings.[19]

This study has some limitations. First, its cross-sectional design limits it ability to draw causal inference. Second, the use of the Framingham Risk Score, developed in Western populations, may underestimate or overestimate risk in the Nepalese context due to ethnic and lifestyle differences. Additionally, other risk factors like family history or physical activity were not included.

CONCLUSION

In conclusion, our study reveals a substantial 10-year cardiovascular disease risk among type 2 diabetic patients attending a tertiary care center in Nepal, with an average risk of 16.01% and a heart age significantly exceeding chronological age. The pronounced gender differences and the progressive increase in risk with age underscore the need for tailored, gender-sensitive prevention strategies. These findings highlight the critical importance of routine cardiovascular risk assessment using tools like the Framingham Risk Score, while also emphasizing the necessity to validate and adapt such tools to the Nepalese population for more accurate risk prediction.

Conflict of Interest: none.

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