Comparison of Atherosclerotic Cardiovascular Disease Risk Scoring Systems in Bangladeshi Population

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Risk stratification is an important initial step for primary prevention of atherosclerotic cardiovascular diseases. There are a number of scoring systems for this purpose worldwide. We tried to evaluate two most updated scoring systems. To assess which one is the better for Bangladeshi population residing in Bangladesh. This cross-sectional study was conducted in a secondary and a tertiary care hospital in Bangladesh from January 2019 to June 2019. Total 274 patients were included in the study. They were evaluated using ASCVD scoring system and QRISK3 scoring system for the risk of atherosclerotic cardiovascular event (myocardial infarction and/or stroke) in next 10 years. Average age of the patients was 57.1±12.8 years and 192 of them were male and 92 of them were female. Half (50.4%) of the patients were smoker, half (51.1%) of them were hypertensive, 45.6% of them were diabetic, 29.6% of them had family history of premature atherosclerotic cardiovascular diseases and 27.0% of them were overweight or obese. According to ASCVD scoring 36.5% patients were at high risk, 32.5% at intermediate risk, 16.4% at low risk of cardiovascular events in next 10 years and risk evaluation was not possible in 14.6% patients. According to QRISK3 scoring method 55.5% are at high risk, 20.8% at intermediate risk, 16.0% at low risk of cardiovascular events and evaluation was not possible in 7.7% patients. Predictive value of QRISK3 scoring system is better to detect more patients who are at high risk for atherosclerotic cardiovascular events in next 10 years. QRISK3 can also evaluate the patients at a younger age. At present QRISK3 is better system to evaluate cardiovascular risk in Bangladeshi population. We need further study to evaluate its role in the form of clinical efficacy and cost effectiveness.

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Key words: Atherosclerotic cardiovascular risk, ASCVD, QRISK3, Risk scoring system

Introduction

Cardiovascular Diseases (CVD) are a major contributor to global deaths in developed countries, and its prevalence is rising in developing countries as well and posing a major challenge for the health sector[1,2]. Prevalence of CVD is also high in Bangladesh and risk factors for CVD are increasing, specially in elderly persons[3]. Cardiovascular risk stratification is a crucial step in public health policies, since effective control of the risk factors can reduce the mortality rate by up to 44%[4,5]. There is always a substantial room for risk factor control once it is detected. Risk stratification approach has also been primarily found to be cost-effective in resource-poor settings[6]. Identification of individual risk factors can overestimate or underestimates the risk for not considering the interaction between them[7]. For this reason, different scoring systems have developed considering multiple risk factors and their interaction with each other. More than hundred scoring system have been developed, like ASCVD score, QRISK3 score, Framingham risk score for Coronary artery disease, Framingham risk score for cardiovascular disease, SCORE for European population, WHO risk score system, etc.

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There is lack of agreement among these scores regarding risk evaluation[8]. Because none of them are universal and each of these scoring systems is validated in a specific population and none of them are validated in South Asian population, specially Bangladeshi population. However, every population should have a validated scoring system. Among the Asian populations, risk of atherosclerotic cardiovascular disease is higher in South Asians.[12] South Asian population has got different risk factor profile. Most of the risk models tend to either overestimate or underestimate risk in Asian populations[9-12]. Bangladeshi ethnicity is also important. A study conducted in USA revealed being Bangladeshi increases the risk of having coronary artery disease (CAD) and may be an independent risk factor for multi-vessel CAD[13]. 26.2% of Bangladeshi adult population has three or more risk factors for non-communicable diseases[14]. Most of them are under-diagnosed and the great degree of noncompliance exists regarding the treatment of these risk factors[15]. Framingham risk score is one of oldest risk analysis model. It underestimates the CVD risk in Asian Indians and socio-economically deprived individuals[16]. SCORE system is mainly for the European population, and it overestimates the CVD risk in general population and underestimates in diabetic population[17]. SCORE and Framingham risk scoring systems always take patients with type II diabetes mellitus (DM) as high-risk group. Among the other risk scoring systems ASCVD and QRISK 3 are the two most updated systems[18,19]. ASCVD scoring system may underestimate the risk in South Asian population. And QRISK 3 scoring system may be the better scoring system for Bangladeshi population as recommended by many authors[20]. Though QRisk is validated for the Bangladeshi population residing in UK, the representation of Bangladeshi population was only 1.9%[19]. There is no such validation for any of the scoring system in Bangladeshi population residing in Bangladesh. We tried to compare the two scoring systems in the patients with acute coronary syndrome admitted in two different hospitals to find out which one is the possible better scoring system for the Bangladeshi population. The best way to evaluate the scoring system is to conduct a prospective study. But it needs time and special set up and we can't stop providing pharmacological and non-pharmacological treatments in the follow up period. Therefore, cross-sectional study is a feasible one. We have included patients with acute MI, this explains that the patients were at high risk without any ambiguity. This would evaluate the risk score of these patients, if it were calculated before development of MI.

Methods

It was an observational study conducted in Manikganj Sadar Hospital (a secondary hospital outside the capital city of Bangladesh) and Sir Salimullah Medical College and Mitford Hospital (a tertiary level hospital in the capital city of Bangladesh). The study was conducted from January 2019 to June 2019. Total 274 patients admitted with acute myocardial infarction and fulfilled the inclusion and exclusion criteria were included in the study. Patients' following demographic characteristics were evaluated-

i) age (years), ii) sex (male/female), iii) height (meter), weight (Kg), iv) blood pressure (BP) (Systolic and diastolic BP), v) history of smoking, vi) diabetes mellitus (diagnosed case of diabetes mellitus with or without treatment or admission blood glucose ≥11.1 mmol/l with HbA1C ≥6.5), vii) hypertension (systolic BP≥ 140 mm Hg ± diastolic BP ≥90 mm Hg or history of taking anti-hypertensive drugs), viii) psychiatric diseases, connective tissue diseases (rheumatoid arthritis or SLE), ix) erectile dysfunction, x) migraine, xi) history of taking anti -hypertensive drugs, aspirin and statin.

Blood sample was collected on admission and serum lipid profile, blood sugar, serum creatinine was estimated. Cardiovascular risk scoring was done of every patient using ASCVD[18] scoring system and QRISK3[19] scoring system. Atherosclerotic cardiovascular risk in next 10 years estimated by ASCVD scoring system were classified as ≤7.4% - low risk, 7.5% - ≤20.0% - intermediate risk and ≥20.0% - high risk. Similarly atherosclerotic cardiovascular risk estimated by QRISK3 system was classified as - <10.0% cardiovascular risk in 10 years -low risk, 10.0% - <20% - intermediate risk, ≥20.0% - high risk. Statistical analysis was done to find out the prevalence of different risk factors among the study population. Distribution of high, medium and low risk groups of patients according to both scoring system and distribution of risk factors in

high, medium and low risk groups of different scoring systems were calculated. Impact of different risk factors on labeling the patient at high risk was calculated as odds ratio and p value <0.05 was taken as important. Eligibility of the patients for statin therapy was also calculated. Informed written consent of the patients was taken and the study was approved by the Ethical review committee of Sir Salimullah Medical College.

Results

This observational study was done for cardiovascular risk stratification of the patients who were admitted for acute MI, with a view to identify which is the better scoring system for Bangladeshi population. ASCVD risk scoring and QRISK3 scoring systems were used for risk stratification of the study population. Total 274 patients were included in the study.

Table I: Age and gender distribution of the study population (N=274)

Age range (years)	Total number of patients	Male	Female
20-30	05	04	01
31-40	19	19	00
41-50	83	61	22
51-60	73	52	21
61-70	63	41	22
71-80	22	10	12
81-90	07	05	02
91-100	02	00	02
Total	274	192	82

Most of the patients were in the group of 40-70 years and average age was 57.1±12.8 years. Male female ratio was 2.3:1. In female majority of the patients were in the age range of 40-80 and in male it is 30-80 years. Therefore, the incidence starts 10 years earlier in male patients.

Table II: Baseline characteristics of the study population (N=274)

Baseline characteristics	Mean±SD	Number of patients (Percentage) n (%)
Age (years)	67.1±12.8	-
Male		192 (70.1)
Height (meters)	1.6±0.8	-
Weight (Kg)	61.8±10.4	-
Underweight		16 (05.8)
Normal		184 (67.1)
Overweight		63 (23.0)
Obese		11 (04.0)
Smoker		138 (50.4)
Current smoker		128 (46.7)
HTN		140 (51.1)
Family history of IHD		81 (29.6)
History of Psychiatric illness		04 (01.5)
History of RA/SLE		07 (02.6)
Erectile dysfunction		24 (08.7)
Migraine		33 (12.0)

DM	125 (45.6)
Total Cholesterol > 200 mg/dl	130 (47.4)
HDL <40 mg/dl	196 (71.5)
TG >150 mg/dl	168 (61.3)
LDL>130 mg/dl	161 (58.7)
Chronic kidney disease (CKD)	41 (14.9)
Atrial fibrillation	06 (02.2)
Statin use	45 (16.4)
Aspirin use	48 (17.5)
Prolong treatment with Steroid	02 (00.7)

Table II reveals the baseline characteristics and risk factor distribution among the patients. Table III reveals the number of patients in different risk categories as classified by two scoring systems. The number of patients in low-risk category, i.e., cardiovascular risk <10% in next 10 years is almost equal in both the groups (16.4% vs. 16.0%). According to ASCVD scoring 36.5% patients were at high risk and 32.5% at intermediate risk, and risk evaluation was not possible in 14.6% patients. According to QRISK3 scoring method 55.5% are at high risk, 20.8% at intermediate risk and evaluation was not possible in 7.7% patients. Risk scoring was not possible in 40 patients according to ASCVD scoring and 21 patients according to QRISK3 scoring system. This failure of risk stratification was more in ASCVD scoring system.

Table III: Distribution of different risk categories in the study population (N=274)

Different risk categories	ASCVD	QRISK3	p value (chi-square test)
	n (%)	n (%)	
Low risk	45 (16.4)	44 (16.0)	0.90
Intermediate risk	89 (32.5)	57 (20.8)	0.001
High risk	100 (36.5)	152 (55.5)	<0.00001
Risk stratification was not possible	40 (14.6)	21 (07.7)	0.009

Table IV: Reasons of failure risk stratify the study population by these two scoring systems (N=274)

Reasons of failure risk stratify	ASCVD scoring	QRISK3 scoring
Higher age	17 (age >79)	09 (age >84)
Low age	13 (age <40)	-
High LDL	04 (LDL >190)	06 (TC/HD L>11)
Low LDL	03 (LDL <70)	-
High Blood Pressure	01 (SBP >200)	01 (SBP >215)
Height	-	05 (Height <140 cm)
TC Low	02 (TC <130)	-
Total	40	21

The reasons of failure to risk stratify are mentioned in Table IV. In ASCVD scoring, if we consider age >79, LDL >190 mg/dl and blood pressure >200 mm Hg as high- risk features, then 22 patients of these patients were in high-risk group and 18 of them were in low-risk group. Similarly, in QRISK3 scoring, if we consider age >84 years, systolic blood pressure >215 mm Hg and total cholesterol/ HDL level >11 are high risk features then 16 of them were in high- risk group. That means, 122 patients were in high risk

according to ASCVD scoring system, and 168 of them were high risk according to QRISK3 scoring system. Thus, QRISK 3 scoring system is more sensitive in detecting these high-risk patient groups.

Table V: Distribution of individual risk factors in low- risk groups in different scoring systems (N=274)

	Total number (N)	ASCVD	QRISK 3
		n (%)	n (%)
Male	192	15 (07.8)	21 (10.9)
Overweight + obese	76	14 (18.4)	11 (14.5)
Smoker	143	07 (4.9)	13 (09.1)
HTN	141	22 (15.7)	17 (12.1)
Family history of IHD	81	10 (12.3)	11 (13.5)
DM	125	16 (12.8)	11(08.8)
Total cholesterol > 200	130	19 (14.6)	16 (12.3)
HDL <40	196	26 (13.2)	23 (11.7)
TG >150	168	27 (16.1)	24 (14.2)
LDL >130	161	16 (09.9)	16 (09.9)
CKD	41	03 (07.3)	02 (04.8)
Statin	45	01 (02.2)	01 (02.2)
Aspirin	48	00 (00.0)	00 (00.0)

Table VI: Distribution of individual risk factors in medium- risk groups in different scoring systems (N=274)

Individual risk factors	Total number (N)	ASCVD Intermediate risk patients (n=89)	QRISK3 intermediate risk patients (n=57)
		n (%)	n (%)
Male	192	69 (35.9)	30 (15.6)
Overweight+ obese	76	24 (31.5)	16 (21.0)
Smoker	143	45 (31.4)	25 (17.5)
HTN	141	44 (31.4)	31 (22.1)
Family history of IHD	81	28 (34.5)	11 (13.6)
DM	125	24 (19.2)	18 (14.4)
Total cholesterol >200 mg/dl	130	36 (27.7)	17 (13.1)
HDL <40 mg/dl	196	56 (28.6)	40 (20.4)
TG >150 mg/dl	168	43 (25.6)	27 (16.1)
LDL>130 mg/dl	161	46 (28.6)	26 (16.1)
CKD	41	09 (21.9)	06 (14.6)
Statin	45	07 (15.5)	02 (4.4)
Aspirin	48	08 (16.7)	03 (6.2)

Table VII: Distribution of individual risk factors in high- risk groups in different scoring systems (N=274)

Distribution of individual risk factors	Total number (N)	ASCVD n (%)	OR	QRISK3 n (%)	OR
Male	192	86 (44.8)	3.99 (2.1-7.5); p<0.0001	131 (68.2)	6.2 (3.5-11.2); p<0.0001
Overweight+ obese	74	39 (52.7)	2.5 (1.46- 4.38; p=0.0008	50 (67.5)	2.0 (1.14- 3.50); p=0.01
Smoker	143	74 (51.7)	4.33 (2.5-7.4); p<0.0001	94 (65.7)	2.41 (1.48-3.93); p=0.0004
HTN	141	74 (52.4)	4.54 (2.64-7.80); p<0.0001	97 (68.8)	2.68 (1.62-4.44); p=0.0001
Family history of IHD	81	34 (41.9)	1.39 (0.81-2.37); p=0.22	53 (65.4)	1.79 (1.04-3.07); p=0.03
DM	125	65 (52.0)	3.5 (2.1-5.9); p<0.0001	83 (66.4)	2.29 (1.4-3.74); p=0.0009
Total Cholesterol >200	130	59 (45.4)	2.08 (1.26-3.44); p=0.003	81 (62.3)	1.84 (1.14-2.99); p=0.01
HDL <40	196	87 (44.4)	3.99 (2.06-7.71); p<0.0001	121 (61.7)	2.44 (1.42-4.18); p=0.001
TG >150	168	75 (44.6)	2.6 (1.5-4.5); p=0.0005	100 (59.5)	1.5 (0.9-2.5); P=0.09
LDL>130	161	78 (48.4)	3.88 (2.22-6.79); p<0.0001	104 (64.6)	2.4 (1.5-4.0); p=0.0003
CKD	41	26 (63.4)	3.72 (1.86- 7.44); p=0.0002	32 (78.0)	3.34 (1.53-7.32); p=0.002
Atrial fibrillation	06	04 (66.6)	1.9 (0.53- 6.98); p= 0.31	04 (66.6)	1.9 (0.53- 6.98); p= 0.31
Erectile dysfunction	24	16 (66.6)	3.48 (1.41-8.55)	22 (75.0)	5.9 (1.35-26.2); p=0.018
Statin use	45	28 (62.2)	3.59 (1.8-6.97); p=0.0002	39 (86.6)	6.6 (2.7-16.3); p<0.0001
Aspirin use	48	29 (60.4)	3.33 (1.75-6.33); p= 0.0002	38 (79.2)	3.73 (1.77-7.85); p=0.0005

Table V, VI, VII reveals the distribution of different risk factors in three risk categories. Most of the risk factors were responsible for putting the patients in high-risk categories except atrial fibrillation.

Table VIII: Expected statin therapy in study population according to scoring system

Expected statin therapy	ASCVD scoring	QRISK3 scoring	p value
	n (%)	n (%)	
No statin	20 (07.2)	30 (10.9)	0.13
Low intensity statin	25 (09.1)	14 (05.1)	0.06
Moderate intensity statin therapy	89 (32.5)	57 (20.8)	0.001
High intensity statin therapy	122 (44.5)	168 (61.3)	0.00008
No decision	18 (06.5)	05 (01.8)	0.005

Table VIII shows that if risk stratification is done in these 274 patients, more patients will be treated with high intensity statin in QRISK3 scoring system (168 vs. 122; p value- 0.00008) and more patients will be treated with intermediate intensity statin in ASCVD scoring system (89 vs. 57; p= 0.001). The number of patients who will not be treated with statin is more in QRISK3 scoring system and the number who will get low dose statin is more in the ASCVD scoring system; though these differences are not statistically significant. No decision can be taken in 18 patients in ASCVD scoring method and 05 patients in QRISK3 method; this also has got a statistical significance.

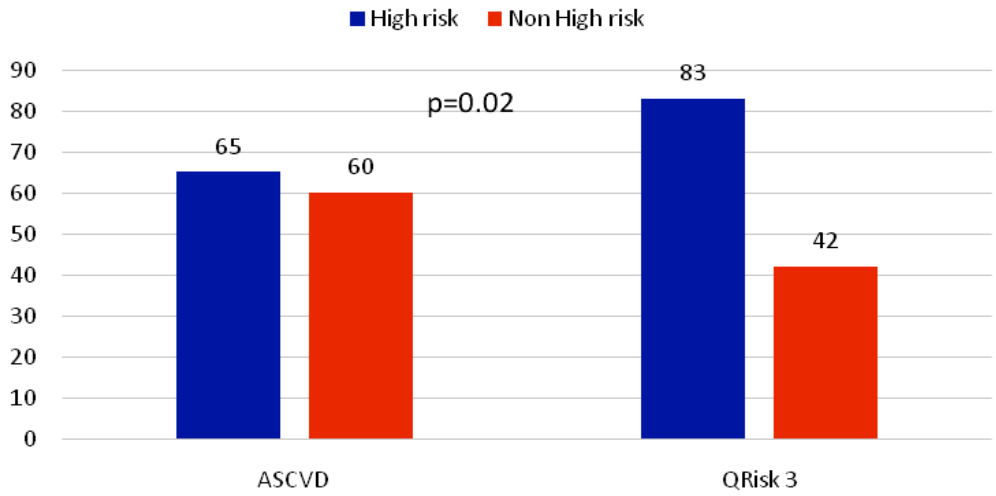

Figure 1: Distribution of High-risk groups among the diabetic patients according to different scoring system (n=125)

Total 125 patients were diabetic. According to ASCVD scoring system, 65 of them were in high-risk group and according to QRISK3 scoring system 83 of them were in high-risk group.

Discussion

This cross-sectional study was done to evaluate which scoring system for evaluation of atherosclerotic cardiovascular disease risk in next 10 years is more appropriate for the Bangladeshi population residing in Bangladesh. Risk factor distribution in these patients is similar to the other studies conducted in acute coronary syndrome patients in Bangladesh[21,22]. But, the prevalence of HTN and DM are much higher than that in general population[23]. Inclusion of more patients from urban areas may be the reason behind this high prevalence. Two- updated scoring systems were selected for evaluation- ASCVD scoring system and QRISK3 scoring system. Risk scoring of the 40 patients was not possible in ASCVD scoring system and most common cause of that was age. ASCVD scoring system do not allow to risk stratify the patients below the age of 40 years. But we know very well that CVD presents in the population of Indian subcontinent 10 years earlier than that in western population[24-27]. So QRISK3 which can evaluate the patients at a range from 25-84 years will be more preferable. This study revealed that male sex, overweight and obesity, hypertension, diabetes mellitus, total cholesterol >200mg/dl, HDL <40 mg/dl, LDL cholesterol >130 mg/dl and chronic kidney disease are responsible for the high cardiovascular risk in the study population. The non-conventional risk factors were included in QRISK3 scoring system, but not in ASCVD scoring system. But these non conventional risk factors are important in some population including Bangladeshi[3,28-30]. In this study, 55.5% of the patients were stratified as having high risk for atherosclerotic cardiovascular disease in the next 10 years by QRISK 3 scoring system, in comparison to 33.5% of population by the ASCVD scoring system. On the other hand, 20.8% of patients were stratified as having intermediate risk in comparison to 32.5% by ASCVD scoring system. Similar results were revealed by the study conducted by Bansal M et al. in Indian population[31]. This indicates that in comparison to QRISK3 scoring system, ASCVD scoring system underestimates the risk of cardiovascular disease among the Bangladeshi population. According to this study if we use QRISK 3 scoring system more patients would be treated with high intensity statin (61.3% vs. 44.5%). Besides this, the target level of LDL cholesterol will also be different for these patients. Similar results were revealed in the study conducted by Garg N et al. in the Indian population[32,33]. Similar discrepancy may happen in the treatment of hypertension also. More patients in QRISK 3 scoring system will be treated with antihypertensive drugs at a lower level of blood pressure[34]. Bangladeshi population differs from US and European population in many aspects[26,35].

So, the risk stratification models would be different. Nontraditional risk factors that are not included in the conventional risk models are more prevalent in South Asians[36,37,39]. Based on the Q-RISK3 data, adjusted hazard ratios indicate that Bangladeshi (Women: 1.33-1.35, Men: 1.70) ethnic populations have a significantly higher cardiac risk compared to Caucasians (hazard ratio = 1.0) and even when compared to other Asian population (Women: 1.07-1.08, Men: 1.03)[40]. We need to select the better method of cardiovascular risk stratification for our population and if needed it has to be customized according conventional and unconventional risk factors, which are important for our population. And this has to be a simplified one for the use of physicians and patients also. More importantly, research should be done to find out whether this helps in primary prevention of CVD, and whether it is feasible and cost effective[29,41,42]. Other noninvasive imaging like- coronary CT angiogram, ankle brachial index and carotid intima media thickness, may be added for the early detection of CVD in high-risk group of patients[43,44]. Risk stratification of patients helps to respond appropriately for primary prevention. It also helps enhance patient- physician communication and facilitate informed, shared decision-making. This information also contributes formulation of national and regional health policy. Only a small percentage of physicians use these risk calculators at the moment[45,46]. So, both the primary care physicians and specialists should be encouraged to use these risk calculators.

Conclusion

Atherosclerotic cardiovascular disease is interplay of more than one risk factor in most of the patients. A risk scoring system, which will calibrate the interaction between the risk factors, is necessary for evaluation of cardiovascular risk for primary prevention. Among the updated scoring systems, QRISK3 is better than ASCVD scoring system to identify the high-risk persons in Bangladeshi population including the younger population. We need to adopt own scoring system with inclusion of appropriate risk factors and if needed, by customizing the existing scoring systems. But at this moment we can use the QRISK3 scoring system for this purpose. More importantly, we have to verify clinical effectiveness and cost effectiveness of primary prevention by using this scoring system.

Limitations of the study

All the patients were with myocardial infarction, so the recorded blood pressure may be lower than the original pressure. Some of the patients were getting statin, so the lipid levels might be lower than the original ones. But these were applicable for both the scoring systems. So, it was not supposed to influence the outcome.

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