MedCrave
Step into the World of Research

Journal of Cardiology & Current Research

Clinical Paper

Open Access

CrossMark

The Framigham risk score estimation among patients attending referred clinic in Atbara, Sudan: what does it tell?

Abstract

Background: Cardiovascular diseases are major healthcare problem worldwide leading to several complications and deaths. Risk assessment is used to estimate the predicted cardiovascular disease risk for asymptomatic individuals in order to offer preventive therapy for individuals at high risk.

Objective: This study was designed to determine the risk estimation of cardiovascular diseases in patients attending a referred clinic at Atbara Teaching Hospital.

Materials and methods: A descriptive, cross-sectional, hospital-based survey was conducted in 108 individuals selected based on convenience sampling during the period from November 2016 to January 2017. . The questionnaire was developed using the Framingham Risk Score framework. Data was collected, cleared and analyzed using descriptive and univariate analyses through SPSS v. 21.0

Results: The study found that more than two thirds of respondents (77.6%) were diabetic and (37.9%) were hypertensive, while the overweight patients were (38.3%). Those on prophylactic dose of aspirin were (21.3%). Approximately (53%) of study participants were at low risk, (25%) at moderate risk and (22.2%) at high risk of cardiovascular diseases. The main predictors of the risk of developing cardiovascular diseases were age ($p = 0.000$), being a male ($p = 0.002$), having hypertension ($p = 0.000$), and low HDL level ($p = 0.023$). The intake of prophylactic aspirin dose for low risk group was (39.1%), for moderate risk group was (26.1%) and for high risk was (34.8%).

Conclusion: The10-year CVD risk estimation among patients attending Atbara teaching hospital referred clinic is high and those patients are not receiving optimal treatment.

Volume 16 Issue 5 - 2023

Sufian K Noor,[1] Noha Salah Ahmed,[2] Wadie ME Imadhoun,[3] Sarra OBushara,[1] Tarig Mohamed A[1]

[1]Department of Medicine, Nile Valley University, Sudan
[2]Federal Ministry of Health, Sudan
[3]Department of Pathology, Nile Valley University, Sudan

Correspondence: Tarig Mohamed A (MD), Faculty of medicine, Nile valley university Sudan, Tel 00249122830073, Email TARIGMOHAMED11@GMAIL.COM

Received: November 08, 2023 | **Published:** November 24, 2023

Introduction

The Framingham Risk Score is a gender-specific algorithm used to estimate the 10-year cardiovascular risk of an individual. It is a simple risk-prediction tool to promptly identify those individuals at risk. It can also be used to stratify risk and hence determine the indication for pharmacotherapy and or lifestyle modification.[1]

Cardiovascular disease (CVD) currently accounts for nearly half of non-communicable diseases (NCD). NCD have overtaken communicable diseases as world Major disease burden with CVD remaining the leading global cause of death, accounting for 17.3 million death year, a number that is expected to grow to >23.6 million by 2030.[1,2] Even in developing countries, such as Sudan NCDs and particularly CVDs have overcome other disease entities.(2) Currently, almost 30% of coronary heart disease (CHD) events in both men and women were singularly attributable to blood pressure levels that exceeded high normal (≥130/85), showing that blood pressure management and monitoring is paramount both to cardiovascular health and prediction of outcomes.[1]

Assessing a person's cardiovascular (CVD) risk has become the accepted way of targeting preventive treatment at patients who are asymptomatic but at high risk of CVD.[3]

Coronary heart disease (CHD) risk at 10 years in percent can be calculated with the help of the Framingham Risk Score. Individuals with low risk have 10% or less CHD risk at 10 years, with intermediate risk 10-20%, and with high risk of 20% or more.[4]

Depending on their absolute risk, asymptomatic people may be offered blood pressure and cholesterol lowering treatment and aspirin in addition to advice about relevant health behavior. Such interventions may be lifelong and are associated with risks as well as benefits.[3]

Due to lack of information about the use of Framingham risk score in Sudan, this study aimed to categorize patients attending a referred clinic in Atbara teaching hospital according to this score and to find out whether patients are appropriately managed based on their risk score.

Materials and methods

Study Design: A cross-sectional, descriptive, hospital-based study.

Study Period: This Study was conducted in the period from November 2016 to January 2017.

Study Area: The study was conducted at Atbara Teaching hospital, which is the largest referral hospital in River Nile State.

Study Population: patients aged 30- 74 years of both sexes who attended the medical outpatient clinic at Atbara teaching hospital over a three months period.

***Exclusion Criteria*:** Pregnant ladies, cardiovascular disease patients, and patients with Chronic kidney disease as the recommended by the Framingham Risk Score.

Sample size and sampling techniques

Sample Type: Convenient sampling was used and a total coverage of study population was done i.e. all patients who were available at the time of data collection period were included.

Sample Size: Total coverage yielded 108 eligible participants.

Data collection tool: A questionnaire was used to collect data on study variables. Data were collected by trained investigators (physicians, medical officers, house officers). The team was sustained with regular meeting, email exchange, and phone calls.

Study Variables: Study variables covered three dimensions which were included in the questionnaire: demographic, clinical variables and diagnostic variables.

Scoring

To date, many CVD risk assessment tools are advised.[4,5]In the current study, we used Framingham General CVD risk Score (2008) which estimates 10 years risk of developing CVD for an individual, due to its simplicity and practicality in our settings.

Framingham risk score variables

-Age

-Gender

-Total cholesterol (mg / dl)

HDL (mg/dl/)

-Systolic blood pressure

-Blood pressure treatment (yes or no)

-Diabetes mellitus (yes or no)

-Current smoking [Yes or no] Table 1.

An online Framingham risk score calculator was used.[7]

Table 1 Risk scoring level of Cardiovascular disease

Point	Risk level
<10'/,	Low
10-19 '/,	Intermediate
>20 '/,	High

Data management and analysis

Data were entered, managed, and analyzed using statistical package for the social science (windows version 21.0, SPSS).

Descriptive statistics were conducted for all variables (e.g., frequencies, percentages, minimum, and maximum), data were presented as mean ± standard deviation for continuous variables, and proportions for categorical data. Parametric or nonparametric tests were used for continuous variables. Chi squared test was used to compare means for categorical variables.

P value of less than 0.05 was considered statistically significant. Data were presented in form of frequency distribution tables, cross tabulation tables, figures and narrative illustration.

Ethical consideration

Ethical consideration obtained from federal ministry of health river Nile state

A written consent was obtained from each participant after explaining the study and its aim. Confidentiality of data as well as anonymity of individual identity was adhered to as far as possible.

Results

One hundred eight patients participated in this study; more than two thirds were females (72%), mean age was (51 ± 10.6) years, in a range from 30to 74 years. Most common age group was 41to 50 years (34%).

Most of participants (63%) came from urban areas rather than rural areas (37%). Regarding diabetes status, (78%) of participants were diabetic, (54%) of them were diabetic for less than five years,(37.9%) were hypertensive, most of them have the disease for up to nine years (75%). Almost all of them on antihypertensive treatments (37%).

The majority of respondents were nonsmokers (97%) and had negative family history of first degree relative death from cardiovascular disease CVD (98%).

Table 2 shows the socio-demographic characteristic of the study population.

Table 2 The socio-demographic characteristic of the study population

Variable	Frequency
Age	
41-50	19.4
51-60	34.3
61-70	25.9
71-80	17.6
	2.8
Gender	
Male	27.8
Female	72.2
Residence	
Rural	37.1
Urban	62.9

Table 3 shows the Cardiovascular Disease Risk Factors and Risk Score.

Table 3 The Cardiovascular Disease Risk Factors and Risk Score

BMI	
Normal	29
Overweight	38.3
Obese	32.7
Diabetic Status	
Yes	77.6
No	22.4
Duration of Diabetes	
<5 years	54
5-9	23.8
10-14	19.5
>15	2.6
Hypertension Status	
Yes	37.9
No	62.1
Duration of Hypertension	
<5 years	14.2
5-9	14.2
10-14	3.8
>15	5.7
On anti-hypertensive dug	
Yes	37
No	0.9
Smoking Status	
Yes	2.8
No	97.2
Duration of Smoking	
<5years	1.9
>15	0.9
Family History of CVD	
Yes	1.9
No	98.1
Prophylactic Aspirin	
Yes	21.3
No	78.7

Table 4 demonstrates the mean, standard deviation, minimum and the maximum of basic measurements of relevant risk factors related to CVD. The mean (± SD) systolic blood pressure was 128 (± 19.9) while the mean (± SD) diastolic blood pressure was 79 (± 8.3).

Table 4 CVD risk factors in relation to risk assessment scores

Variable	Value	Risk Score Categories			P - value
		Low	Moderate	High	
Gender	Male	30%	26.7%	43.3%	0.002
	Female	61.5%	24.4%	14.1%	
Age	30-40 years	76.2%	23.8%	0%	0.000
	41-50 years	78.4%	18.9%	2.7%	
	51-60 years	32.1%	35.7%	32.1%	
	61-70 years	15.8%	26.3%	57.9%	
	71-80 years	0%	0%	100%	
Residency	Rural	61.5%	20.5%	17.9%	0.432
	Urban	48.5%	27.3%	24.2%	
Diabetes	Yes	57.8%	22.9%	19.3%	0.101
	No	33.3%	33.3%	33.3%	
Hypertension	Yes	27.5%	40%	32.5%	0.000
	No	67.2%	16.4%	16.4%	
On Antihypertensive Drugs	Yes	27.5%	40%	32.5%	0.003
	No	100%	0%	0%	
Systolic Blood Pressure*	Grade1	10.5%	47.4%	42.1%	0.000
	Grade2	22.2%	22.2%	55.6%	
	Grade3	50%	0%	50%	
Smoking	Yes	0%	33.3%	66.7%	0.108
	No	54.3%	24.8%	21%	
Family History of CVD	Yes	0%	50%	50%	0.318
	No	53.8%	24.5%	21.7%	
BMI**	**Normal**	**51.6%**	**16.1%**	**32.3%**	**0.321**
	Overweight	58.5%	22%	19.5%	
	Obese	48.6%	34.3%	17.1%	
Total Cholesterol***	Desirable	54.3%	25.9%	19.8%	0.712
	Borderline high	42.1%	26.3%	31.6%	
	High	62.5%	12.5%	25%	
Variable	Value	Risk Score Categories			P - value
		Low	Moderate	High	
HDL***	Low	39.1%	13%	47.8%	0.023
	Not optimal	56.3%	28.1%	15.6%	
	High	57.1%	28.6%	14.3%	
LDL***	Optimal	56.3%	27.1%	16.7%	0.336
	Above optimal	65%	5%	30%	
	Borderline high	45%	35%	20%	
	High	42.9%	35.7%	21.4%	
	Very high	25%	25%	50%	
STG***	Optimal	50%	27.3%	22.7%	0.433
	Borderline high	58.8%	35.3%	5.9%	
	High	59.1%	13.6%	27.3%	
	Very high	50%	0%	50%	

*WHO, International Society of Hypertension statement on management[8-10]

Citation: Noor SK, Ahmed NS, Imadhoun WME, et al. The Framigham risk score estimation among patients attending referred clinic in Atbara, Sudan: what does it tell? *J Cardiol Curr Res.* 2023;16(5):128–133. DOI: 10.15406/jccr.2023.16.00591

Moreover, the mean (± SD) weight was 73 (± 14.9) kg and the mean (± SD) height was 161 (± 9.4) cm while the mean (± SD) BMI was 28 (± 5.6).

According to the body mass index classification most of study units were found to be overweight (38.3%) and obese (33%) while only (29%) had normal index, see figure 1.

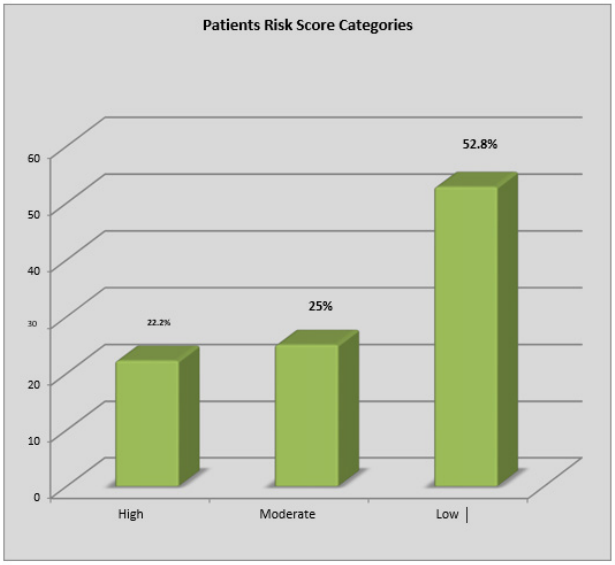

Figure 1 CVD risk score of patients.

The average fasting blood sugar was 139 (± 54.7) mg/dl, regarding the lipid profile of patient's results showed an average cholesterol level of 180 (± 44.9)mg/dl, HDL level of 49 (± 13)mg/dl, LDL level of 109 (± 52)mg/dl and STG level of 151 (± 114.7)mg/dl.

Association between Different Risk Factors and CVD Risk Assessment

The risk assessment for CVD revealed that (53%) of study participants had low risk of developing CVD and only (22%) had a high risk.

Among the fourteen commonest cardiovascular disease risk factors only six risk factors were found to be statistically significant in relation to risk assessment score, table 3 Men were found to have higher risk of developing CVD and this was found to be statistically significant (p- value = 0.002).

Likewise, increasing age was found to have a statistically significant relation with CVD risk (p- value = 0.000). Similarly there was a significant relationship between hypertension and CVD risk, p- value = 0.000.Grade of systolic hypertension was found to have a significant relation with CVD risk p- value = 0.000.

Most of the components of the lipid profile (Total Cholesterol, LDL, and STG) found insignificant association with CVD risk estimation; p- values were (0.712), (0.336), and (0.433) respectively. Except for low HDL level the relationship was statistically significant p- value was (0.023).

Figure 1 shows the CVD risk score of the patient demonstrating that most of the participants (52.8%) were in low risk of CVD while (22.2%) were at high risk.

Table 5 shows (39.1%)of participants in low risk group were on aspirin followed by high risk group (35%) and moderate risk group (26%);but this fact was statistically insignificant (p- value = 0.210).

Table 5 Preventive Aspirin intake according to patients' risk score

Variable	Value	Risk Score Categories			P - value
		Low	Moderate	High	
On Aspirin	Yes	39.1%	26.1%	34.8%	0.210
	No	56.5%	24.7%	18.8%	

Discussion

This study aimed at determining the risk estimation of cardiovascular disease in patients attending the referred clinic at Atbara Teaching Hospital and to the best of our knowledge there were no similar studies carried out to investigate the same topic in Sudan.

The study highlights the following main findings: (1) age, gender, hypertension and HDL level are the main CVD risk predictors; (2) hypertensive patients although on antihypertensive medications still have significant increase the CVD risk score P value (0.003) (3) Aspirin taken as preventive therapy for CVDs is misused among the three risk groups.

Participants in this study were predominantly females, of middle age and urban.

Several studies done in different countries around the world had resembling and differing findings

For instance a study was done in Kuwait where the mean (±SD) age of respondents was 37.7 (±12.4) years and 61% of participants were females.[11] Another study conducted in 2017 by T. Wang et al. showed that the mean (±SD) age of respondents was 75 (±9) years and 47% of participants were females.[12]

Moreover, in 1998 two studies were carried out, the first was in Europe done by P. Wilson et al. in which the mean age (±SD) was 48.6(±11.7) years for men and 49.8(±12) years for women.[13]

While the second study done by Y. Chia *et al*. among Asian population in which the mean age was 57 years with 66% females.[14]

Additionally, in 2009, S. Cessie and J. Gussekloo used Framingham risk score to predict cardiovascular mortality in older people. Participants were predominantly females (71%).[15]

In 2003, a study conducted by P. Brindle et al. to establish the predictive accuracy of the Framingham risk score for coronary heart disease in a representative British population result demonstrates that the age of the sample ranged between 40 – 59 years old.[16]

Most of Participant of our study were not smokers and had no previous family history of premature death from CVD. The low prevalence of smoking in this study may be attributed to the exclusion of subjects aged < 30 years (youth group) who are the most active age group for smoking behavior and secondly it may be attributed to the fact that more than three quarters of study population were females who did not smoke due to the conservative nature of Sudanese families that related to cultural and religious reasons.

Also, the majority of respondents were overweight and diabetic while relatively few were hypertensive but mostly all on antihypertensive medications.

Similarly a study was done in Kuwait About 60% of them were classified as either overweight or obese and 31.5% had hypertension and were taking antihypertensive medications.[11]

In Another study conducted in 2017 by T. Wang et al. About (17%) were smokers, (15%) were diabetic and (51%) on hypertension

therapy.[12] Moreover, in 1998 two studies were carried out, the first was in Europe done by P. Wilson *et al* ,Approximately half of the subjects for each sex had blood pressure levels in the normal or optimal range [(13)] While the second study done by Y. Chia et al. among Asian population , 6.1% smokers, 43.3% diabetics and 59.7% hypertensive and (59.7%) use antihypertensive agents.[14] in 2009, S. Cessie and J. Gussekloo study, (44%) were smokers and (14%) were diabetic.[17]

In 2003, P. Brindle *et al* study result demonstrates that (41.9%) were smokers and (1.1%) were diabetic.[16]

Furthermore, in this study the mean (± SD) systolic blood pressure was 128 (± 19.9) while the mean (± SD) diastolic blood pressure was 79 (± 8.3). Also, the biochemical profile of participants demonstrated an average fasting blood sugar of 139 (± 54.7) mg/dl, and an average total cholesterol level of 180 (± 44.9) mg/dl, HDL level of 49 (± 13) mg/dl, LDL level of 109 (± 52) mg/dl and STG level of 151 (± 114.7) mg/dl.

In the previously mentioned study by T. Wang et al. the mean (±SD) systolic blood pressure was 145 (±23) and mean (±SD) diastolic blood pressure was 76.[12] While the median BP among Asian study was found to be 140/80 mm Hg[14] and in the British the average systolic blood pressure was 143 and the average diastolic blood pressure was 81.[16] Likewise, S. Cessie found the median systolic BP in his study 154 mm Hg.[15]

Regarding the biochemical profiles of other studies, in former Kuwaiti study (28.3%) of subjects had fasting plasma glucose (FPG) levels ≥ 5.6 mmol/l. (11) Concerning the lipid profile the mean (± SD) total cholesterol of 6 mmol/L (1.3) and the HDL level of 1.2 (± 0.4) mmol/L were found among Asian respondents (14) while the median total cholesterol and HDL level were 5.7 mmol/L and1.3 mmol/L respectively in S. Cessie's investigation.[15] Whereas in China the10-year CHD predicted risk were 1.5% for men and The 10-year risk of developing CVDs in the study subjects per FRS was as follows: low risk (53%), moderate risk (25%) and high risk of (22%).[17] In contrast, the Kuwaiti study revealed that the 10-year risk was as follows: low risk of (82.4%), moderate risk of (15.5%) and high risk of (2.1%) 0.6% for women.[11]

However the predicted median Framingham general CVD risk score for the study units in Asian study was 21.5%[14] and in Britain it was 10.2%.[16]

In general, in this study FRM risk score for CVD was found significantly predicted by the following risk predictors: advancing age, male sex, having hypertension, increasing systolic blood pressure and low HDL levels.

Similarly, while investigating the risk score for predicting stroke or death in individuals with new onset atrial fibrillation by T. Wang et al. the risk score was derived by the following risk predictors: advancing age, female sex, increasing systolic blood pressure, prior stroke or transient ischemic attack, and diabetes.[12]

Analysis revealed that men had higher CVD risk than women and this was significant relationship. Scientifically this can be explained by the fact of hormonal difference between genders. It is well known that estrogen has a protective role against developing cardiovascular diseases in women and as estrogen levels reduce by aging and especially after menopause women started to exhibit the same CVD risk as men.[18]

Also in this research results showed that as the individuals get older they significantly had higher risk than younger age, again this can be clarified firstly by the fact that aging itself is a known independent risk factor for developing cardiovascular diseases and secondly aging is associated with development of other intermediate risk factors like hypertension, diabetes and dyslipidemia which in turn amplify the occurrence of risk.[19]

The study done in Britain showed inconsistent result where they consider old age, classic risk factors as included in the Framingham risk score no longer predict 5 year cardiovascular mortality in people with no history of cardiovascular disease.[16]

Again, the study revealed that being hypertensive and having higher levels of systolic blood pressure regarded as significant predictors and hence increases the risk of CVD. Lower levels of HDL were associated with higher risk scores. B. Kannel in his study stated that (575) of the incidence of hypertensive heart disease at Framingham arises in the (19 %) of the population having a systolic blood pressure of 160 mm Hg or greater.[20]

The study also showed that participants on antihypertensive medications at higher risk for developing cardiovascular diseases than those who were not on treatment. Scientifically, this phenomenon was attributed to the fact that the Framingham risk score calculations consider certain points for each item in the score; and for the item related to blood pressure treatment; those on medications received more point than those who were not on medications and eventually they will obtain more risk scores than their counterpart. Additionally, a logical explanation could be those on medications might have uncontrolled blood pressure either due to non-compliance or because they were not on regular followed up and hence will be at higher risks.

Regarding other risk factors included in FRS calculations like diabetes, smoking and total cholesterol; this study considered them as insignificant risk predictors. Unlike Coleman's study which demonstrated the fact that risk calculators are of particular relevance in diabetic patients given their 2–4 times higher CVD risk compared with the non-diabetic population.[21] Finally, the study revealed that there was misuse of preventive aspirin medication against the protocol; where physicians prescribed preventive aspirin for patients at low CVDs risk more than patients at moderate and high risks but this was insignificant. The guidelines usually recommended aspirin for patients at moderate and high CVDs risk while those at low risk they do not receive aspirin preventive therapy.

Limitations

There are two limitations

The Framingham Risk Score predicts only future coronary heart disease (CHD) events, however, it does not predict future total cardiovascular events, meaning that it does not predict risk for stroke, transient ischemic attack (TIA), and heart failure. These also important patient outcomes were included in the 2008 Framingham General Cardiovascular Risk Score.[11] The predicted risk for an individual usually is higher with the 2008 Framingham General Cardiovascular Risk Score than with the 2002 Framingham Risk Score.

The Framingham Risk Score could overestimate (or underestimate) risk in populations other than the US population,[12,13] and within the USA in populations other than European Americans and African Americans, e.g. Hispanic Americans and Native Americans.[14] It is not yet clear if this limitation is real, or appears to be real because of differences in methodology, etc. As a result, other countries may prefer to use another risk score, e.g. SCORE (HeartScore is the interactive version of SCORE - Systematic Coronary Risk Evaluation),[15] which has been recommended by the European Society of Cardiology in 2007.[16]

If possible, a cardiology professional should select the risk prediction model which is most appropriate for an individual patient and should remember that this is only an estimate.

Conclusion

The finding of this study provide important information about the prevalence of and risk factors for cardiovascular diseases, and estimates the 10-year risk CVD among the general population of Atbara.

Classic risk factors did not predict cardiovascular risk when used in the Framingham risk score except for age, gender, systolic blood pressure, hypertension, low HDL and that hypertensive patients even on antihypertensive medication are at higher risk of CVD risk score.

Aspirin intake is misused and physicians need to follow the protocols.

Acknowledgments

None.

Conflicts of interest

None declared.

Funding

None.

References

1. Wilson PW, Culleton BF. Estimation of cardiovascular risk in an individual patient without known cardiovascular disease. Up To Date Textbook of Medicine. Waltham, MA: Massachusetts Medical Society, and Wolters Kluwer publishers. 2010.
2. Noor SK, Elmadhoun WM, Bushara SO, et al. The changing pattern of hospital admission to medical wards: Burden of non-communicable diseases at a hospital in a developing country. *Sultan Qaboos Univ Med J*. 2015;15(4):e517−522.
3. Wilson PW, D'Agostino RB, Levy D, et al. Prediction of coronary heart disease using risk factor categories. *Circulation*. 1998;97(18):1837−1847.
4. Collins DR, Tompson AC, Onakpoya IJ, et al. Global cardiovascular risk assessment in the primary prevention of cardiovascular disease in adults: systematic review of systematic reviews. *BMJ open*. 2017;7(3):e013650.
5. D'agostino RB, Vasan RS, Pencina MJ, et al. General cardiovascular risk profile for use in primary care. Circulation. 2008;117(6):74−753.
6. NHLBI, Estimate of 10-Year Risk for CHD.2013-09-14.
7. https://www.cvdriskchecksecure.com/FraminghamRiskScore.aspx
8. 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. J Hypertens. 2003;21(11):1983−1992.
9. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. *World Health Organ Tech Rep Ser*; 2000.
10. Grundy SM, Cleeman JI, Merz CN, et al. Implications of recent clinical trials for the national cholesterol education program adult treatment panel III guidelines. *Circulation*. 2004;110(2):227−239.
11. Awad AI, Alsaleh FM. 10-year risk estimation for type 2 diabetes mellitus and coronary heart disease in Kuwait: a cross-sectional population-based study. *PLoS One*. 2015;10(1):e0116742.
12. Wang TJ, Massaro JM, Levy D, et al. A risk score for predicting stroke or death in individuals with new-onset atrial fibrillation in the community: the Framingham heart study. *JAMA*. 2003;290(8):1049−1056.
13. Wilson PW, D'Agostino RB, Levy D, et al. Prediction of coronary heart disease using risk factor categories. *Circulation*. 1998;97(18):1837−1847.
14. Chia YC, Gray SY, Ching SM, et al. Validation of the framingham general cardiovascular risk score in a multiethnic Asian population: a retrospective cohort study. *BMJ open*. 2015;5(5):e007374.
15. De Ruijter W, Westendorp RG, Assendelft WJ, et al. Use of Framingham risk score and new biomarkers to predict cardiovascular mortality in older people: population based observational cohort study. *BMJ*. 2009;338:a3083.
16. Brindle P, Jonathan E, Lampe F, et al. Predictive accuracy of the Framingham coronary risk score in British men: prospective cohort study. *BMJ*. 2003;327(7426):1267.
17. Liu J, Hong Y, D'Agostino Sr RB, et al. Predictive value for the Chinese population of the Framingham CHD risk assessment tool compared with the Chinese multi-provincial cohort Study. *JAMA*. 2004;291(21):2591−2599.
18. Vitale C, Mendelsohn ME, Rosano GM. Gender differences in the cardiovascular effect of sex hormones. *Nat Rev Cardiol*. 2009;6(8):532−542.
19. Dhingra R, Vasan RS. Age as a risk factor. *Med Clin North Am*. 2012;96(1):87−91.
20. Kannel WB, McGee D, Gordon T. A general cardiovascular risk profile: the Framingham Study. *Am J Cardiol*. 1976;38(1):46−51.
21. Coleman RL, Stevens RJ, Retnakaran R, et al. Framingham, SCORE, and DECODE risk equations do not provide reliable cardiovascular risk estimates in type 2 diabetes. *Diabetes care*. 2007;30(5):1292−1293.