Comparison Between ASCVD Versus WHO Risk Score in Predicting of 10-Year Cardiovascular Risk in an Iranian Adult: A Hospital-Based Cross-Sectional Study

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Abstract- Cardiovascular disease (CVD) mortality has increased in the Iranian population. Word Health Organization (WHO) risk score was recently used in Iranian prevention and control of non-communicable disease programs for risk assessment. The purpose of the study was to compare the 10-year cardiovascular risk using atherosclerotic cardiovascular disease (ASCVD) and WHO risk score. In a cross-sectional study, data from patients with cardiac symptoms without any documents related to CVD were collected from the outpatient clinic. The proportion of subjects with high CVD risk according to ASCVD and WHO risk score and also agreement between two scores was presented. The sensitivity and specificity of ASCVD according to the WHO risk score as a national risk assessment tool were calculated. The study included 284 subjects with a mean age of 53.80 (8.78) years and 68 % of women. The frequency of subjects with high CVD risk based on ASCVD and WHO was 35% and 6%, respectively. The agreement between the two scores was moderate (κ=0.45), with the most agreement in identifying low-risk subjects. The sensitivity and specificity of ASCVD according to the WHO risk score was 95.3% and 75.1%, respectively. The present finding showed that Agreement between two risk scores was moderated, especially in stratifying low-risk subjects. But, the ASCVD risk score categorized more people as a high risk rather than the WHO tool. Assessment of the accuracy of the WHO risk score with comparing predicted risk with observed risk in a cohort study for the Iranian population is necessary.

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Introduction

Cardiovascular disease (CVD) mortality has decreased in several developed countries. On the other hand, more than 80% of mortality from CVD and other non-communicable diseases occur in low and middle-income countries (1). CVD is the most common cause of death in Iran, and it's responsible for 46% of total death (2). Data from World Health Organization (WHO) show that the coronary diseases mortality rate has increased in Iran compared to past years (3). A recent cohort study confirmed the superior incidence rates of CVD mortality, especially premature ones in Iran, compared to developed countries (2). It has previously been reported the higher prevalence of premature death in Iran is related to dyslipidemia in men and type 2 diabetes, overweight, and also prediabetes in women (4). According to the preventable nature of CVD mortality, conducting appropriate interventions to reduce and control cardiovascular risk factors should be considered in public health programs. Many studies showed lifestyle modification programs like dietary and physical

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activity interventions are cost-effective in medium and high-risk groups (3). There are several prediction models to identify individuals with high CVD risks that may assist the preventive programs. The WHO risk score was developed by World Health Organization, and the International Society of Hypertension (WHO/ISH) was recommended as a prediction tool for primary care settings, especially in low-resource countries (5). In 2013, the American College of Cardiology (ACC) and the American Heart Association (6) reported a risk score to estimate the 10-year risk of atherosclerotic cardiovascular disease (ASCVD) for different races in every individual (7). Recently, WHO risk score was used in Iranian prevention and control of non communicable disease program (8). The purpose of the study is to compare the 10 year CVD risk among symptomatic individual without cardiac disease using ASCVD and WHO risk score tools.

Materials and Methods

Study design and subjects

This is a cross sectional study according to outpatient referral hospital data in Rasht, Guilan province of Iran during 2018. Dr. Heshmat hospital is a university hospital which delivers specialized services to thousands of patients annually. Through simple sampling method, necessary information related to all patients 30-79 years old with cardiac symptoms like chest pain, dyspnea and palpitation after ruling out any cardiovascular disease collected for this study during one year.

Exclusion and inclusion criteria

Exclusion criteria were any history of myocardial infarction, stroke, and any evidence of ischemia in coronary angiography or echocardiography. All patients evaluated by cardiologist and selected for the study according to inclusion and exclusion criteria. All the study population were reviewed and signed informed consent.

Data collection

All study participants were interviewed in person to collect information on selected demographic characteristics, current smoking status, family history of CVD and diagnosis and treatment history for diabetes (DM) and hypertension (HTN). The clinical examination elements included measurement of weight, height, blood pressure (BP) and collection of laboratory data including total cholesterol, and HDL. Study subjects were weighed without shoes and heavy Clothing. Height was measured without shoes. Body Mass Index (BMI) was calculated from the measured weight and height as kg/m^2. BP was assessed twice from the right and left arm with appropriate sized cuff in the sitting position after 5 min of rest. The higher value was considered for BP. Laboratory data were derived from every patient's document.

Measurement

The 10-year CVD risk events were calculated based on the ASCVD algorithm and WHO tool separately. The 10-year and lifetime cardiovascular risks for the ASCVD were calculated using the AHA/ACC risk calculator equations provided on an excel spreadsheet (http://www.cvriskcalculator.com/). For this risk calculator, the variables of age, sex (male/ female), race (WH for whites), and current smoker (yes/no), total blood cholesterol; HDL, systolic blood pressure values (SBP), diabetes status (yes/no) and the treatment status of blood pressure (yes/no) were used. Ten-year CVD risk was stratified into low risk (<7.5%) and high risk (>7.5%) for study subjects in age 40-79 years.

We also calculated 10- year cardiovascular risks using WHO risk prediction charts which are available in the national prevention and control of non-communicable disease program (8) in Iran. WHO risk equation was based on age, sex (male/ female), smoking status (yes/no), total blood cholesterol, SBP values, and diabetes status (yes/no). According to the WHO chart. 10-year CVD risk events for study subjects older than 30 years was categorized into low risk (<10%), moderate risk (10-< 20%), high risk (20-< 30%) and very high risk (≥ 30%) (5) .

Ethics approval

Also, the study design was approved by the vice-chancellor for research of Guilan University of medical science according to the Helsinki declaration. (Ethical Code: IR.GUMS.REC.1397.224).

Statistical analysis

Cardiovascular risk factors and CVD risk estimation by two CVD risk assessment tools were presented as frequency and percent (%).continues variables were presented as mean and standard (9) deviation. WHO CVD risk was classified into low risk (<10%) and high risk (<=10%) for comparison between two risk scores. Cohen's kappa coefficient (κ) was calculated for agreement assessment. Recently, the WHO risk score was used for the national cardiovascular risk assessment program in the health system. So, we considered the

WHO risk score as a base instrument, and then sensitivity and specificity were calculated for the ASCVD score. To do this, we classified subjects with WHO predicted risk equal or above 10% as positive (high risk) and those under the 10 % as negative (low risk). We compared this classification with the calculated risk score according to the ASCVD risk score and defined the subjects as true positive (TP), false positive (FP), true negative (TN), and false-negative (FN). Sensitivity defined as $\frac{TP}{(TP+FN)}$, $\frac{TN}{TN+FP}$, respectively. For all analyses, *P* less than 0.05 were considered statistically significant. Analyses were performed using IBM SPSS Statistics for Windows, Version 16.0.

Results

A total of 284 patients aged 40-78 years were selected for the study. The mean age of the patient was 53.80 (SD=8.78) years. More than 68 % of subjects were female, and 65.1% lived in the city. DM, HTN, and smoking frequency were 26 %, 40 %, and 17.2 %, respectively. (Table 1).

Table 1 Characteristics of study participants (n=284)

Categorical variables		**n**	**%**
gender	**male**	90	31.6
	female	194	68.3
location	**urban**	185	65.1
	rural	99	34.8
Education	**No schooling**	79	27.8
	≤12	167	58.8
	university	38	13.3
	Smoker	49	17.2
	Treatment for hypertension	114	40.1
	DM	74	26.05
BMI Category	**≤24.99**	64	22.5
	25-29.99	103	36.2
	≥30	117	41.1
Continues variables		mean	SD
Age(yr)		53.80	8.78
Cholesterol		171.49	35.55
HDL		38.8	5.21
SBP		133.46	21.57
Weight		78.84	21.9

DM Diabetes Mellitus, BMI Body Mass Index, SD Standard Deviation

The risk prediction using ASCVD and WHO/ISO algorithms is shown in Table 2. Using the ASCVD risk score, 64.4% of the study population were classified as low risk and 35% as high risk, while the WHO score identified 4.5% and 1.7% as high and very high risk, respectively. As observed in table 2, a higher estimation of CVD risk for men compared to women was reported using both risk assessment tools.

Table 2. Total and sex-stratified distribution of 10 year CVD according to ASCVD and WHO/ISO risk scores

		ASCVD		**WHO/ISO**			
	n	**Low**	**High**	**Low**	**Moderate**	**High**	**Very high**
		<7.5%	>=7.5%	<10%	10-20%	20-30%	>=30%
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Total	284	183(64.4)	101(35.3)	241 (84.8)	25(8.8)	13(4.5)	5(1.7)
male	90	38(41.3)	52(56.5)	73(79.3)	10(10.9)	6(6.5)	1(1.1)
female	194	145(74.7)	49(25.3)	168(86.6)	15(7.7)	7(3.6)	4(2.1)

Table 3 shows the result of the kappa coefficient between two risk prediction models. As seen, there was a moderate agreement between the two risk scores (κ=0.45). According to both ASCVD and WHO risk scores, 181 subjects from 284 were classified as low risk and 41 subjects as a high-risk group. And only 25% of low-risk subjects, based on WHO, were classified as a high-risk group by ASCVD. The sensitivity and specificity of the ASCVD risk score based on the WHO score were 95.3 % and 75.1%, respectively.

Table 3 Comparison between ASCVD Risk Score and WHO/ISO score

		n		ASCVD		*P*#	kappa	*P**
				LOW	HIGH			
				<7.5%	>=7.5%			
WHO/ISO	LOW	241	<10%	TN= 181(75.1%)	FP= 60(24.9%)	<0.001	0.45	<0.001
	HIGH	43	>=10%	FN= 2(4.7%)	TP= 41(95.3%)			

#McNemar test, * significance for kappa test, TP=true positive, TN=true negative, FP= false positive, FN= false negative

Discussion

The present study showed that a considerable number of the study subjects (35%) had a high 10-year ASCVD risk. But less than 10% of them were classified in the high-risk group according to the WHO CVD risk score. Furthermore, this pattern was observed among men and women. ASCVD risk score classified more people in the high-risk group rather than the WHO risk score. A national population-based survey in Asia using Framingham Risk Score, SCORE (Systematic Coronary Risk Evaluation), and the WHO model (10) showed that the WHO risk score couldn't identify high-risk individuals compared to the others two models. According to Meysami *et al*., a study using Framingham scored 20% of 3944 Iranian adults were in the high-risk group (3). This finding is consistent with the results of ASCVD score in the present study (35%) but in contrast to the WHO risk score (5%). However, a recent study assessed the general population, but we did subjects from the hospital. Several studies in different low resource countries mentioned in spite of the high prevalence of cardiovascular risk factors in these regions, the WHO risk score didn't show a considerable number of high CVD risk (5,11,12). According to the findings of these studies, the WHO risk score identified most people as having low cardiovascular risk. Furthermore, a recent study on the Australian population showed ASCVD score was slightly better than three Framingham-based CVD scores (13). However, all four risk scores overestimated risk when compared to observed risk specially the ASCVD score.

We also found a moderate agreement between the two CVD risk scores. We showed a considerable number of subjects were classified as low risk according to both risk scores. As well, a small number of subjects who were classified as low risk by WHO were identified as high-risk groups by ASCVD score. In our study, the sensitivity of the ASCVD risk score based on the WHO score was acceptable (95%), but specificity was slightly lower (75%). In fact, we can properly detect low-risk subjects by ASCVD, but we might be overestimated the high-risk group.

A retrospective study on the Asian population showed The ACC/AHA risk score (14) might be appropriate for risk assessment in primary settings among cases without receiving treatment for CVD risk factors but overestimated for those under treatment. Furthermore, A prospective multiethnic community-based cohort study showed the AHA/ACC risk score overestimates ASCVD risk among men, women, and all four ethnic American groups (6).

Several previous studies have shown that treatment of CVD risk factors including diabetes, hypertension, dyslipidemia, and smoking would result in a reduction of 10 years of CVD risk (15-17). It is noteworthy that preventive interventions should be addressed to moderate and high-risk individuals, which maximizes the benefit of the intervention. Hence, identification of individuals with high CVD risk through validated risk scores neither by underestimating nor by overestimating the risk which is suitable for every population is essential. Hence, The WHO cardiovascular risk model has been recommended for risk stratification in countries with limited resources. A multicenter study evaluated CVD risk based on WHO score in 8 countries, including Nigeria, Iran, China, Pakistan, Georgia, Nepal, Cuba, and Sri Lanka reported a 90-98% of the study population had a CVD risk< 20% and less than 10% of all population and 1.7% for Iran are in the high-risk group (CVD risk> 20%) (9). The findings of the recent study are near to the result of the WHO score (6.3%) but in

contrast with the ASCVD score (35%). Even though, recent Global Burden of Disease presented CVD as the primary global cause of death (31.8%), even higher for middle east countries including Iran was 42.5% (18).

Recent CVD prevention guidelines have shifted from the treatment of single risk factors individually, to the total cardiovascular risk management. During last decade, total CVD risk management has been recommended based on CVD risk scores in many developed countries (9). Recently, WHO guideline suggested CVD risk assessment before making decision on dyslipidemia therapy. The threshold of pharmacologic therapy for general population in national prevention program should be based on available resource in individual country. Also, the WHO developed a risk prediction chart for implementation of a cost-effective approach for primary health care to decrease the burden of CVD in low-resource settings. Although the clinical usefulness of WHO chart do not have locally assessed for Iranian people till now (9). But, According to khalili *et al*., study, Framingham CVD risk score was presented as a suitable screening tool in Iranian urban subjects (19). However, they mentioned using the result for entire population especially in rural area should be carefully described. On the other hands, Framingham CVD risk score was developed based on Caucasian subjects and it overestimates the CVD risk in African, Native American and Asian ethnic groups (20).

Our study involves several limitations including first, an important limitation of the present study was related to cross sectional design of the study. We can not compare the real CVD risk with predicted risk by every risk score for study subjects. Second, laboratory data were measured in different labs with various laboratory standards that can influence on validity of data gathering. Third, ASCVD risk score and WHO score were designed for different age category. As our sample size was limited, the frequency of appropriate subjects for both ASCVD and WHO score was small. Fourth, we had studied on patients attending tertiary hospital that were different with general population. Also, a number of study subjects took medicine for dyslipidemia and HTN could decrease the cholesterol level and blood pressure.

In conclusion, the result of our study indicated WHO and ASCVD risk scores had a moderated agreement, particularly in identifying subjects with low CVD risk. Furthermore, the ASCVD risk score stratified more subjects as high risk when compared with the WHO risk equation. As the Iranian ministry of health recently conducted CVD risk screening according to the WHO chart, there is a need for assessment of the validity of the WHO risk score in the Iranian population in a cohort study.

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