The 10-year Absolute Risk of Cardiovascular (CV) Events in Northern Iran: a Population Based Study

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ABSTRACT

Background: The present study was conducted to estimate 10-year cardiovascular disease events (CVD) risk using three instruments in northern Iran.

Material and methods: Baseline data of 3201 participants 40-79 of a population based cohort which was conducted in Northern Iran were analyzed. Framingham risk score (FRS), World Health Organization (WHO) risk prediction charts and American college of cardiovascular / American heart association (ACC/AHA) tool were applied to assess 10-year CVD events risk. The agreement values between the risk assessment instruments were determined using the kappa statistics.

Results: Our study estimated 53.5% of male population aged 40-79 had a 10-year risk of CVD events ≥10% based on ACC/AHA approach, 48.9% based on FRS and 11.8% based on WHO risk charts. A 10-year risk≥10% was estimated among 20.1% of women using the ACC/AHA approach, 11.9% using FRS and 5.7% using WHO tool. ACC/AHA and Framingham tools had closest agreement in the estimation of 10-year risk≥10% (κ=0.7757) in meanwhile ACC/AHA and WHO approaches displayed highest agreement (κ=0.6123) in women.

Conclusion: Different estimations of 10-year risk of CVD event were provided by ACC/AHA, FRS and WHO approaches.

Key words: 10-year cardiovascular risk, Framingham risk score, ACC/AHA tool, WHO risk prediction charts, Northern Iran.

1. INTRODUCTION

Cardiovascular disease (CVD) is the most important common cause of death in the worldwide. A larger part of the global burden of CVD is belong to low and middle income countries due to epidemiologic transition, from communicable to non-communicable diseases (1, 2). On the other hand, a downward trend of CVD mortality in developed countries could be resulted from therapeutic approaches and prevention procedures (3). To apply the global disease prevention strategies and implement the effective target segmented interventions it is required to recognize the populations at higher risk. On the other hand, to diagnose the populations at risk the cardiovascular risk assessment tools may be valuable for which several effective instruments were developed (4-6). Among several CVD risk assessment tools Framingham risk score is an old popular tool used widely in clinical practice and research studies (4). A newer instrument was proposed by the American college of cardiovascular and American heart association jointly tailored to the American population (5). Although no risk assessment tools were suggested specially to our country the WHO developed the risk prediction charts which one of them was suggested to use in our population (6).

Iran was considered a middle income country for which an increasing trend of non-communicable diseases is predicted (7, 8). As a result providing an estimate of cardiovascular events in the next years may be extremely valuable in its population. Therefore, this study was conducted to determine the 10-year cardiovascular risk among the population of northern Iran using three above mentioned risk assessment tools.

2. MATERIALS AND METHODS

Study participants

The data of a population based cohort study carried out in Amol, one of the most populous cities in northern Iran, in 2009-
2010 were used. A representative sample of Amol population was drawn out. Health centers in where each person of inhabitants had a health record were used to collect the relevant information. The sampling was described elsewhere (9).

Because we used the data of subjects aged 40 to 79 years, the data of 3201 participants of 6140 subjects of cohort study were included to analyze. A schematic diagram of participants was displayed in Figure 1.

### Data collection

Trained healthcare workers collected related data including medical and personal history, anthropometric data and also blood pressure. For laboratory measures a venous blood sample was drawn from each participant following 10-hour fasting to assess fasting blood sugar (FBS) and lipid profiles.

FBS, triglycerides (TGs) and High-density lipoprotein (HDL) were assessed using the BS200 Auto analyzer (Mindray, China) measured by the glucose oxidase/peroxidase-4 amionophenazone-phenol method and TGs were measured using glycerol-3-phosphate oxidase peroxidase aminophenazone (Trulab N, Trulab Pars Azmoon, Iran). HDL values were assessed after dextran sulfate-magnesium chloride precipitation. The sampling was described elsewhere (9).

### Statistical analysis

To estimate the 10-year CVD events, the risks were calculated separately for men and women based on ACC/AHA equations, Framingham risk scores and WHO / IHS risk prediction charts. In ACC/AHA approach, the race- and sex-specific multivariate equations were used to compute the 10-year risk for a first hard ASCVD event. In these equations, the variables of age, current smoker (yes/no), total blood cholesterol; HDL, systolic blood pressure values and the treatment status of blood pressure (yes/no) were used. The risks were also estimated according to Framingham approach. In this approach the sum of the Framingham point scores corresponding to the categories of age, systolic blood pressure (treated or untreated), HDL, total cholesterol (by the age group) and smoking status (by the age group) were separately computed by gender. Thus the related risks corresponding to the sum of Framingham point scores were obtained for each participant. We obtained the relevant 10-year cardiovascular risks using WHO risk prediction charts too. These charts estimate the risks in five categories, <10%, 10 to <20%, 20% to <30%, 30% to <40% and ≥40%. There are two versions of WHO risk chart based on the use of the cholesterol for all epidemiological sub-regions of WHO member states. We used the Eastern Mediterranean region B (EMR B: low child mortality and low adult mortality) version of risk prediction charts included cholesterol to estimate the risk in addition to age, sex, smoking status and diabetes status.

In order to estimate the prevalence of a 10-year cardiovascular risk ≥10% and ≥20%, the calculated risks were converted to a dichotomous scale based on thresholds of 10% and 20%. As a result the continuous risks computed by ACC/AHA, the discrete risks estimated by the FRS and categorical risks obtained

### Table 1

Baseline demographic, anthropometric and metabolic characteristics of study participants between 40–79 years of age. $^*$ indicates abdominal volume index; BMI, body mass index; DBP, diastolic blood pressure; FBS, fasting blood sugar; HC, hip circumference; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SBP, systolic blood pressure; SD, standard deviation; TG, triglyceride; WC indicates waist circumference; WHR, waist to hip ratio; WHR, waist to height ratio. $^*$ Significance level for difference between men and women was considered at $p<0.05$. $^*$ Prevalence and related confidence interval of smoking, $^*$ prevalence and related confidence interval of BMI $≥25$, DBP $≥80$ mmHg, FBS $≥100$ mg/dl, HDL $≤40$ in men and HDL $≤50$ in women, LDL $≥130$ mg/dl, SBP $≥130$ mmHg, TG $≥150$ mg/dl, Total cholesterol $≥200$ mg/dl.

| Characteristics | Mean ± SD in men (n=1826) | Mean ± SD in women (n=1375) | $p$-value $^*$ |
|-----------------|---------------------------|-----------------------------|----------------|
| Age (year)      | 55.11 ±10.40              | 54.04 ± 9.65               | 0.0030         |
| WC (cm)         | 93.47 ± 11.19             | 96.17 ± 11.54              | <0.0001        |
| BMI (kg/m²)     | 27.14 ± 4.25              | 31.16 ± 5.05               | <0.0001        |
| FBS (mg/dl)     | 68.5 (66.4-70.6)          | 68.9 (87.3-90.5)           | <0.0001        |
| Current smoker$^*$ | 30.3 (28.0-32.6)          | 0.6 (0.12-1.0)             | <0.0001        |
| DBP (mm Hg)     | 77.92 ± 13.07             | 79.31 ± 13.11              | 0.0031         |
| SBP (mm Hg)     | 119.26 ± 17.13            | 121.35 ± 18.54             | <0.0001        |
| FBS (mg/dl)     | 33.4 (31.3-35.6)          | 44.4 (41.8-47.1)           | <0.0001        |
| TG (mg/dl)      | 149.80 ± 87.89            | 155.08 ± 90.86             | 0.1029         |
| Total cholesterol (mg/dl) | 187.21 ± 41.25 | 200.19 ± 42.84 | <0.0001 |
| LDL (mg/dl)     | 37.2 (35.0-39.4)          | 50.0 (47.4-52.7)           | <0.0001        |
| HDL (mg/dl)     | 110.89 ± 30.76            | 117.70 ± 31.28             | <0.0001        |
| Current smoker$^*$ | 25.4 (23.4-27.4)          | 33.3 (30.6-35.6)           | <0.0001        |

Figure 1. A schematic diagram of our participants

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We divided the population into four groups including male age group of 40-59, female of 40-59 and female of 60-79. The data on male and female of 40-79 were also analyzed in addition to four above mentioned age groups separately. A significantly larger part of our population will have a 10-year risk of cardiovascular events ≥10% and ≥20% except for 10-year risk ≥10% in women (p-value=0.2525), FRS in age groups of 40-80 and 60-80, both in male and female (all p-values were <0.0001). In the age group of 40-59, except for 10-year risk ≥10% in women (p-value=0.2525), FRS significantly made a greater estimate of the population will be at risk of CVD (both 10-risk ≥10% and ≥20%).

Table 2 lists an estimate of the population at 10-risk in which a significantly higher estimation was provided for men compared to women using both ACC/AHA and FRS risk assessment tools (all p-values were <0.0001), while no significant difference was detected by the use of WHO risk prediction charts between the two sexes.

Table 3 shows the results of the kappa coefficients between three cardiovascular risk assessment tools in the prediction of CVD events in which the results of the upper half of the table are related to women. In age group of 40-79 the ACC/AHA and Framingham tools showed the highest agreement values to estimate the 10-year risk in meanwhile in women ACC/AHA and WHO tools had the highest values. More details were reported in Table 3.

### Table 2

| Approaches | 10-year CVD events ≥10% | 10-year CVD events ≥20% |
|------------|-------------------------|-------------------------|
| ACC/AHA    | 0.3740 ±0.0213*         | 1.3752 ±0.0226          |
| Framingham | 0.4796 ±0.0248          | 1.4864 ±0.0215          |
| WHO        | 0.7557 ±0.0142          | 0.7154 ±0.0132          |

### Table 3

| Risk assessment tools | 10-year risk ≥10% | 10-year risk ≥20% |
|-----------------------|------------------|------------------|
| ACC/AHA               |                  |                  |
| Framingham            |                  |                  |
| WHO                   |                  |                  |

Table 3. The agreement value between risk assessment tools in various subpopulations of study. The results of the upper half of the table are related to women; k: kappa± standard error; ACC/AHA indicates American College of Cardiology /American Heart Association, WHO world health organization.
4. DISCUSSION

Different estimates of 10-year cardiovascular risk were computed by the use of three risk assessment tools. While ACC/AHA gave us a significantly greater estimate of risk, FRS and particularly WHO display a conservative image of 10-years risk of CVD events. The present study estimated a larger part of the male population is at risk of cardiovascular disease in the next decade in comparison with the female population. The prevalence of 10-years cardiovascular risk ≥10% and ≥20% was increased considerably in age group of 60-79 compared to age group of 40-59, so that a dramatically increase was estimated by all three risk assessment tools among former. We also examined the agreement values between three risk assessment instruments mutually of which the higher values were calculated for ACC/AHA and FRS approaches in men and also for ACC/AHA and WHO approaches in women.

A significant proportion of our population, particularly men were at risk for 10-year CVD events, although among three risk assessment tools a lower estimation was obtained using the WHO tool. A higher risk of CVD events in the incoming years is predictable for our country, because Iran is considered a middle income country in which an increasing trend of non-communicable disease will be foreseeable due to experiencing the epidemiologic transition (7, 8). Urbanization and industrialization imposed a sedentary lifestyle in addition to shift from a Mediterranean diet to western diet (10, 11).

Northern Iran is a wealthier region in the country where although benefited from an acceptable access to health care facilities, it was suffering from a high fat diet, sedentary lifestyle and their outcomes particularly obesity (12, 13). It is evident the obesity is strongly associated with cardiovascular risk factors, including, high blood pressure, insulin resistance, dyslipidemia (14-17). Although the obesity measures were not directly used in any of the risk assessment tools, the CVD risk factors which are related to obesity were entered into the instruments to provide an estimate of the CVD events. On the other hand, with regard to high prevalence of obesity in our population, the higher cardiovascular events will be forecasted in coming years in an agreement with ACC/AHA estimations.

A higher estimate of 10-year risk for male population was expected, because most of the risk assessment tools were developed based on sex in which a higher susceptibility to CVD for men is default. However, no difference of risk was significantly estimated between two sexes by WHO risk charts. On the other hand, FRS was not able to represent a correct status of CVD risk in age group of 40-80 in such a way that an expected dramatic increasing risk in women after menopause period was not portrayed appropriately. The results of FRS were not in agreement with loss of estrogen protection against to CVD events after menopause. Although the ACC/AHA tool well described the increasing trend of risk in both two sexes with the increase of age, it was not success to characterize risk in age group of 60-79 of female with regard to a higher risk of cardiovascular events expected in this age group of women.

While a higher agreement between ACC/AHA approach and FRS was revealed in men, the agreement was higher between ACC/AHA and WHO risk charts in women. It is seemed a male predominance susceptibility to CVD is less default in WHO approach. As a result the estimations of WHO will be more agreement with estimations of ACC/AHA approach in women. WHO risk charts are applied visually with an easier approach than two other risk tools in which HDL was not included. WHO and FRS obtain categorized and discrete estimation of risks bounded to ≥0.3 and ≥0.4 respectively, while ACC/AHA calculates continuous risks no bounded to any specific value. This property enables it to produce the continuous 10-year cardiovascular risk from 0 to 1 flexibly. However, despite the mentioned potential theoretical advantages, ACC/AHA approach was not tailored to non–American population. As a result, to validate it in prospective large sample size studies, the results produced by it should be cautiously translated into clinical practice or community based CVD risk management policies.

Our study estimated the 10-year risk of CVD by the use of three powerful approaches and obtained the agreement values between them in a population based study. However, we were not able to determine the validity of the instruments due to cross-sectional design of the study.

5. CONCLUSION

Although very different estimations of 10-year risk of CVD events were provided by ACC/AHA, FRS and WHO approaches, ACC/AHA approach showed a higher agreement with FRS and WHO tools in men and women of age group of 40-79 respectively.

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CONFLICT OF INTEREST: NONE DECLARED.

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