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Evaluation of Cardiovascular Diseases Risk in the Iranian Population

Meisam Akhlaghdoust [1], Davoud Pirani [2,*], Mohamad Nasiri [3], Sahar Lashkari Ahangarani [2], Nazgol Haghsetan [2], Mohsen Karbalaiea [2] and Poorya Davoodi [4,5]

[1] Functional Neurosurgery Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[2] Shahid Beheshti University of Medical Sciences, Tehran, Iran
[3] Volunteers Organization of the Iranian Red Crescent Society, Tehran, Iran
[4] Department of Molecular Medicine, University of Padua, Padua, Italy
[5] Pars Advanced and Minimally Invasive Medical Manners Research Center, Pars Hospital, Iran University of Medical Sciences, Tehran, Iran

[*] *Corresponding author*: Department of Health in Disasters and Emergencies, School of Public Health and Safety, ACECR, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Email: davoodpirani@sbmu.ac.ir

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Abstract

Background: Cardiovascular diseases (CVDs) are among the leading causes of death and morbidity around the world. Risk score assessment can assist in anticipating a person's CVD risk over the next five years.
Objectives: This study aimed to investigate the risk of CVDs in the general Iranian population.
Methods: This study was conducted in September 2020, and 5324 participants aged 35 to 74 years were registered from 95 metro stations throughout Tehran. Participants' demographics (ie, age, gender, current smoking and exercise habits, and family history of hypertension, CVDs, and diabetes) were collected by in-person interviews, and their body mass index (BMI) and systolic blood pressure (SBP) were measured. The five-year risk of CVDs was estimated and categorized into low (< 10%), some risk (10 - 20%), moderate (21 - 30%), increased (31 - 40%), and high (> 40%) groups, and its association with the participants' demographics was evaluated by SPSS version 21.
Results: The mean age of 5324 participants was 45.3 ± 14.8 years, and 64% were male. The frequency of CVD risk scores was as follows: low (54%), some risk (17.5%), moderate (15.4%), increased (5.7%), and high (3.5%), which were significantly associated with gender ($P < 0.001$), smoking status ($P = 0.048$), exercise ($P = 0.014$), and family history of diseases (all $P < 0.001$). Age ($\beta = 0.774$, $P < 0.001$) increased the odds of CVD, while other variables had small or no effects on CVD.
Conclusions: This study found a high prevalence of high-risk CVD in the Iranian population, emphasizing the importance of risk score assessment, which should include not only basic non-laboratory risk assessment scores, but also exercise and a positive family history of associated diseases.

Keywords: Cardiovascular Diseases, Risk Assessment, Incidence, Iran

1. Background

Cardiovascular diseases (CVDs) are one of the world's top three causes of mortality, accounting for about one-third of all deaths worldwide (17.3 million deaths) in 2013, which is more than the combination of communicable, maternal, neonatal, and nutritional disorders mortality rates, and two-folds the number of deaths caused by cancers (1, 2). In the United States, CVDs are responsible for one death every 40 seconds, causing more than 2200 Americans' deaths each day (3). In Europe, CVDs cause more than four million deaths each year, accounting for 45% of all deaths, with large differences in disease burden among countries in the European Region (4). In addition, the incidence and mortality rates of CVDs are anticipated to rise by 2020, especially in developing countries (5). Among Asian countries, central Asian countries have the highest age-adjusted mortality rate from CVD, followed by west Asian, south Asian, and south-east Asian countries (6). In Iran, the annual mortality rate of ischemic heart disease (IHD) in the population over 40 years old is estimated at 14 per 1000 persons (7).

In European countries, the prevalence of CVDs in the general population was 9.2% in 2016, same for both sexes (4); meanwhile, about one-fifth (21.3%) of patients referring to England's primary care suffered from CVDs, according to the reports in 2018 (8). The different incidence rates of CVDs is attributed to the different prevalence of the risk factors of CVDs in the target population among various countries or between men and women (9). Besides age,

which serves as a significant risk factor, dyslipidemia, hypertension, diabetes mellitus, obesity, and smoking are considered the main modifiable risk factors for CVDs (10).

According to evidence, controlling these risk factors, especially simultaneously, can effectively prevent or slow the disease, especially in high-risk patients (11, 12). In a large cohort study (the SCORE project), Conroya et al. developed a risk assessment chart for the estimation of 10-year risk of CVDs based on age, sex, systolic blood pressure (SBP), serum level of cholesterol, and smoking status (13). In 2008, the Framingham Heart Study developed a CVD risk score of men and women based on age, serum levels of high-density lipoprotein (HDL) and total cholesterol, treated and untreated SBP, smoking status, and diabetes (14). Gaziano et al. considered a combination of risk factors and developed a chart for calculating the absolute risk of the 5-year probability of CVD (15-18). Cardiovascular diseases risk scores have been assessed by laboratory methods in Iran (19-21), while the non-laboratory risk score assessment, developed by Gaziano et al., is a more simple method with similar values, and thus, can be used as an appropriate alternative (15).

The risk assessment of non-laboratory CVDs is highly correlated with laboratory scores, and the number of high-risk individuals identified by laboratory assessment has been very close to the number of individuals identified by non-laboratory assessment. Therefore, the risk assessment of non-laboratory CVDs can be implemented in the community (16, 17).

2. Objectives

As the validity of non-laboratory method for CVDs risk assessment has not been evaluated in an Iranian population, the present study aimed to investigate the non-laboratory risk of CVDs in an Iranian population by in-person interviews conducted by medical students at Tehran metro stations.

3. Methods

3.1. Study Design

In this cross-sectional study, the CVD risk of the general population was assessed by medical students. The study protocol was approved by the Ethics committee of Iran University of Medical Sciences research center, and all ethical considerations were observed throughout the study steps.

The sample size was considered as many people who were present at the selected stations, met the inclusion criteria, and gave consent to participate in the study during the collection day; 800 medical students, who were fluent in Persian, were selected from four universities and included in the study voluntarily. Before starting the study, they were trained for 10 - 15 minutes on how to run the survey. Then, all the medical students visited 95 metro stations in Tehran city from 8 am to 4 pm in March 2020. All the metro stations of Tehran were selected. The inclusion criterion for this study was age range of 35 - 74 years. The exclusion criterion was patients with a positive history of diabetes, hypertension, and CVDs. The student chose any passenger who had the mentioned criteria and asked for their consent for participation in the study. First, the students described the study objectives to the passengers, in brief, asked them the questions on the study checklist, and continued sampling until saturation of the sample size.

The designed checklist recorded demographic characteristics of the participants, including age, gender, smoking status, exercise status, and family history of hypertension, cardiovascular diseases, and diabetes. The current smoking status was recorded as "Yes" or "No"; smokers who had quitted for more than five years were considered non-smokers. Participants' exercise status was considered as "Yes", when the individual had at least one hour of exercise three times a week. The participants' weight and height were measured, and their body mass index (BMI) were calculated; also, their SBP was measured from the participants' left hand in the sitting position after 15 minutes' rest.

3.2. Risk Score Chart

The risk of cardiovascular diseases was categorized into low or blue (< 10%), some risk or green (10 - 20%), moderate or yellow (21 - 30%), increased or pink (31 - 40%), and high or red (> 40%) based on the risk scoring chart, described by Gaziano et al. in Lancet journal (15). This chart scores the participant's risk based on their sex, age, current smoking status, and SBP, and the final risk is determined based on the relevant cell's color. As we additionally evaluated participants' exercise status and family history of relevant diseases, we examined the association of the risk scores with all the studied characteristics. Participants with high and increased risk scores were advised to refer to a physician as soon as possible. Gaziano et al.'s chart for calculating the five-year probability of CVD is shown in Figure 1.

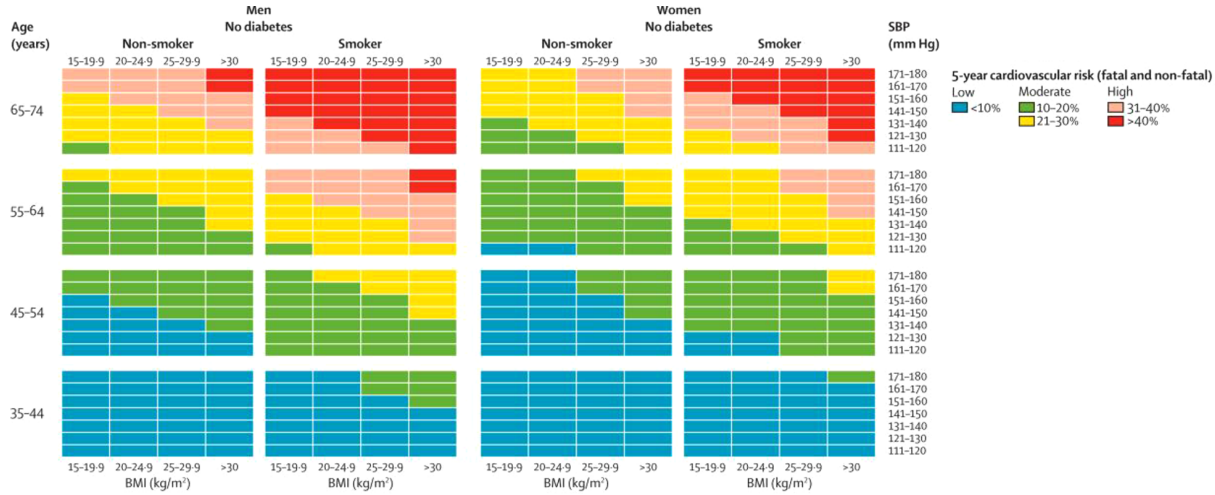

Figure 1. Risk score chart

3.3. Statistical Analysis

The collected information was input into SPSS version 21.0, by which all the statistical analyses were performed. First, the descriptive results were presented by frequency (percentage) and mean ± standard deviation (SD) for qualitative and quantitative variables, respectively. Then, the differences in the frequency of variables based on the calculated CVD risk scores were evaluated by chi-square test, and finally, the associations of variables were tested by Pearson's or Spearman's correlation coefficient. A P-value of less than 0.05 was considered statistically significant for all the tests.

4. Results

A total of 5324 participants were evaluated. The participants' mean age was 45.3 ± 14.8 years, and 64% were male. The mean five-year risk of CVD was 0.83 ± 1.12 in the general population. The frequency of CVDs risk scores of the participants were as follows: low (54%), some risk (17.5%), moderate (15.4%), increased (5.7%), and high (3.5%).

The frequencies of each of the studied variables were categorized according to the participant's CVD risk score. As presented in Table 1, the frequencies of the CVDs scores were significantly different according to the participant's gender (P < 0.001), smoking status (P = 0.048), exercise (P = 0.014), and family history of hypertension, CVD, and diabetes (all P < 0.001).

The associations of the variables with CVD risk were evaluated, the results of which are exhibited in Table 2. As demonstrated, age (β = 0.774, P < 0.001) and SBP (β = 0.041, P < 0.001) increased the odds of CVDs, while male gender (β = -0.032, P = 0.001), BMI (β = -0.035, P < 0.001), not smoking (β = -0.056, P < 0.001), and no family history of CVD (β = -0.025, P < 0.001) decreased the odds of CVD in the individual, and other variables did not have a significant effect (Table 2).

5. Discussion

We used the non-laboratory-based CVD risk score chart, described by Gaziano et al., which categorizes participants' CVD risk into low, some, moderate, increased, and high risk. High risk shows more than 40% probability of developing CVDs in the following five years, and increased risk shows 31 - 40% chance, both of which require urgent attention (15). Of the 5324 participants evaluated in the present study, 3.5% had high, and 5.7% had increased risk scores. In addition, 15.4% had a moderate risk, which shows 21 - 30% probability of CVDs. In the original study by Gaziano et al. performed in Bangladesh, Guatemala, Mexico, and South Africa, 4049 participants completed the study, of whom 5% had a high risk (> 20%) (22), which is much lower than the rate reported in the present study (24.6%), and 77.6% of the participants in their study had a low risk, while about half of our participants had a low risk (indicating CVDs chance of less than 10%). Despite these differences between the studies, Gaziano et al. reported that 17.4% had some risk, indicating 10 - 20% chance of CVDs, which was similar to the frequency of some risk in our participants (17.5%).

Table 1. The Frequency of Demographic Characteristics of the Target Population Categorized Based on the Cardiovascular Risk Scores

Variables	Risk					Pearson χ^2	P-Value
	0	1	2	3	4		
Sex						37.8	< 0.001
Male	1757 (35.9)	544 (11.1)	512 (10.5)	213 (4.4)	145 (3.0)		
Female	998 (20.4)	345 (7.1)	267 (5.5)	77 (1.6)	33 (0.7)		
Smoking						9.56	0.048
Yes	553 (11.3)	159 (3.2)	181 (3.7)	67 (1.4)	42 (0.9)		
No	2209 (45.0)	735 (15.0)	606 (12.3)	225 (4.6)	136 (2.8)		
Exercise						12.5	0.014
Yes	1059 (21.6)	361 (7.4)	320 (6.5)	128 (2.6)	89 (1.8)		
No	1701 (34.7)	532 (10.8)	465 (9.5)	164 (3.3)	89 (1.8)		
Family history of hypertension						292.4	< 0.001
Yes	198 (4.0)	126 (2.6)	188 (3.8)	87 (1.8)	58 (1.2)		
No	2567 (52.2)	767 (15.6)	599 (12.2)	205 (4.2)	120 (2.4)		
Family history of cardiovascular diseases						182.9	< 0.001
Yes	170 (3.5)	105 (2.1)	112 (2.3)	55 (1.1)	57 (1.2)		
No	2595 (52.8)	789 (16.0)	675 (13.7)	237 (4.8)	121 (2.5)		
Family history of diabetes						160.7	< 0.001
Yes	114 (2.3)	79 (1.6)	113 (2.3)	48 (1.0)	34 (0.7)		
No	2650 (53.9)	814 (16.6)	672 (13.7)	244 (5.0)	144 (2.9)		

Table 2. The Results of Regression β-coefficients of Variables Used to Calculate Cardiovascular Disease Risk Scores in the Target Population

Variables	β-coefficients	95% Confidence Interval for B		P-Value
		Lower Limit	Upper Limit	
Age	0.774	0.058	0.061	< 0.001
Male gender (M = 1, F = 2)	-0.032	-0.121	-0.029	0.001
Body mass index	-0.035	-0.010	-0.003	< 0.001
Systolic blood pressure	0.041	0.012	0.037	< 0.001
Smoking (yes = 1, no = 2)	-0.056	-0.211	-0.105	< 0.001
Exercise (yes = 1, no = 2)	0.001	-0.039	0.046	0.877
Family history of BP (yes = 1, no = 2)	-0.016	-0.119	0.012	0.108
Family history of cardiovascular disease (yes = 1, no = 2)	-0.025	-0.163	-0.022	0.010
Family history of diabetes (yes = 1, no = 2)	-0.015	-0.142	0.014	0.109

These differences between studies could be due to the different demographic characteristics of the target populations, which significantly affects the risk of CVDs (10). For instance, 75% of the participants in Gaziano's study were female, while in the present study, 36% were female. In addition, age is an important predictor of CVD risk score, and individuals aged 30 are reported essentially risk-free within the next 10 years (13). Therefore, the difference in the mean age of participants can result in different CVD risks. Furthermore, race/ethnicity is a critical factor in the incidence of CVDs (23), which serves as another factor for the different risk scores.

Tehran Lipid and Glucose Studies have validated the efficacy of Framingham's CVD risk assessment method in the Iranian population (20, 21). In the surveillance of risk factors of non-communicable diseases (SuRFNCD) in 2011, 11,867 Iranian individuals aged 6 - 70 years were surveyed using the random complex sampling method, and 4759

participants aged 25 - 64 years gave consent for blood sampling (19). The analysis of 3944 individuals showed 10-year risk of coronary artery disease at 13.82 and 0.72, based on Framingham's and SCORE scoring systems, respectively. Based on Framingham's scores, 25.8 and 22.6% had high and intermediate risks, while based on SCORE only 9.2% and 1.8% had high and intermediate risks, respectively (19). The frequency of high-risk patients based on Framingham's scores in that study (25.8%) was close to the frequency of high-risk patients in our report (24.6%). However, Framingham's score includes assessing the serum lipid profile and glucose levels, while we used the non-laboratory scoring system, described by Gaziano et al. This scoring system was selected in the present study for the following reasons. Firstly, laboratory scoring systems have been previously validated in Iranian population, but the non-laboratory method has not; although Gaziano et al. have reported that the value of their risk assessment chart was similar to that of laboratory risk scoring methods (15). Secondly, in order to overcome the most important limitation in the study by Meysamie et al. (19), which excluded more than half of the study population, because the individuals did not gave consent for blood sampling. However, we excluded patients with diabetes and did not investigate the effect of diabetes on CVDs risk, although we were aware that diabetes is associated with a significantly increased risk of CVDs (14, 15); nevertheless, according to evidence, about one-quarter of diabetic patients in Iran are not aware of their disease (24). As we only recorded patients' statements about their medical history, we decided to exclude the effect of diabetes to eliminate the confounding effect of unaware patients.

According to the results of the present study, the frequencies of the CVD risk scores were significantly different according to participants' gender, smoking status, exercise, and family history of hypertension, CVD, and diabetes, which demonstrates these variables as key risk factors for CVDs. In addition, according to the results of regression analysis, each unit increase in SBP increased the risk of CVDs by 4%, while each unit increase in BMI decreased the risk of CVD by 3%. In addition, the risk of CVDs in nonsmokers was 5% lower than that in smokers, and the risk in participants without a family history of related diseases was 2% lower than in those with a positive family history. The results of other studies have similarly shown that besides the effect of age, documented as an important risk factor for CVDs (13), hypertension is strongly associated with the risk of CVDs, even after adjusting for age, sex, and demographic variables (25-29). This association, confirmed in the present study, is mainly due to the great effects of hypertension on vessels and the heart (28). In addition, it has been well documented that the duration and amount of cigarette smoking significantly elevates the risk of CVDs (29, 30). The pathophysiology of this association, as suggested by the results in the present study, refers to the tissue remodeling, prothrombotic processes, and activation of systemic inflammatory signals, which result in atherogenic vessel wall changes (31). The above-mentioned factors have also been included in CVD risk assessment charts. In the Framingham Heart study, age, SBP, and smoking were significant risk factors for CVDs (14), which is consistent with the results of the present study. The NHANES study determined the usefulness of non-laboratory and easily obtainable risk factors, including age, SBP, smoking status, blood pressure treatment status, history of diabetes mellitus, and added the usefulness of BMI for the risk assessment of CVDs (32), which confirm the results of the present study on the significant effects of gender, smoking status, SBP, and positive family history on the odds of CVDs. Bozorgmanesh et al. have also reported the significant association of age, SBP, and smoking with the incidence of CVD in an Iranian population (20), which is consistent with the results of the present study. These results suggest the need for appropriate intervention to reduce smoking in the population (33, 34). In addition, we reported the additional value of positive family history of CVD in the general risk assessment, although the majority of previous risk scoring systems have not included family history in the charts. In one study, Sarrafzadegan et al. demonstrated the value of positive family history of CVD in an Iranian population (35). As the pooled analysis by Globorisk reported no risk chart for Iran (33), they developed a new CVD risk assessment chart (PARS) based on the individual's age, gender, SBP, diabetes status, waist-to-hip ratio, total cholesterol levels, and family history of CVD (35). The results of this study confirmed that the significant effect of age, sex, and family history of CVD; however, we did not use this scoring chart, as we aimed to investigate the CVD risk in the general population based a non-laboratory method for the reasons explained earlier. Furthermore, the results of the present study on the effect of BMI was contrary to the findings of other studies, which indicated adiposity and higher BMI as an important risk factor for CVDs (35, 36).

The present study was the first to examine the CVD risk in the Iranian general population based on a non-laboratory risk chart. However, the results of this study could be affected by several limitations. The main limitation was that we did not calculate the risk of bias in

this analysis and did not investigate the accuracy and validity of changing the main chart and excluding diabetes. Furthermore, we selected participants from passengers of metro stations of Tehran, and the results may not represent the situation in the whole population of the country.

5.1. Conclusions

We showed the five-year risk of CVDs at 0.83 in the general population, while 24.6% of the studied population had high CVDs risk (> 20%), and only 54% had a low risk (< 10%). This finding shows the necessity of paying greater attention to the issue of CVDs in the Iranian population and implementing strategies to monitor and manage the risk factors. According to the results, smoking, SBP, BMI, exercise, and family history of related diseases were significant predictors of CVDs. Therefore, attention should be focused on these risk factors to reduce the incidence of CVDs in the future in Iran. The risk assessment of non-laboratory CVD is very useful in cities and countries with high disease burden and lack of funding for drugs, equipment, and devices, and this method can be used as an alternative to laboratory assessment (16, 18). Assessing CVD risk by non-laboratory risk assessment chart suffers from the main limitation of including diabetes in the assessment, while many may not be aware of their disease; therefore, it is suggested to investigate the most appropriate non-laboratory risk assessment chart for Iranians in future studies.

Footnotes

Authors' Contribution: Study concept and design: DP, MN, and MA; Drafting of the manuscript: MA and DP; Critical revision of the manuscript: MA and SLA; Statistical analysis: PD, MK, and NH. All the authors have given final approval of the version to be published.

Conflict of Interests: The authors declare that they have no Conflict of interest.

Data Reproducibility: The datasets generated and/or analyzed during the current study are not publicly available (because of the rules of ethical research committee of Iran University of Medical Sciences research center) but are available from the corresponding author on reasonable request.

Ethical Approval: The study protocol was approved by the Ethics Committee of Iran University of Medical Sciences research center, and all ethical considerations were observed throughout the study steps.

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References

1. Murray C. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*. 2015;**385**(9963):117–71. doi: 10.1016/S0140-6736(14)61682-2. [PubMed: 25530442]. [PubMed Central: PMC4340604].
2. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012;**380**(9859):2095–128.
3. Roger VL, Go AS, Lloyd-Jones DM, Adams RJ, Berry JD, Brown TM, et al. Heart disease and stroke statistics-2011 update: a report from the American Heart Association. *Circulation*. 2011;**123**(4):e18–e209. doi: 10.1161/CIR.0b013e3182009701. [PubMed: 21160056]. [PubMed Central: PMC4418670].
4. Townsend N, Wilson L, Bhatnagar P, Wickramasinghe K, Rayner M, Nichols M. Cardiovascular disease in Europe: epidemiological update 2016. *Eur Heart J*. 2016;**37**(42):3232–45. doi: 10.1093/eurheartj/ehw334. [PubMed: 27523477].
5. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases: part I: general considerations, the epidemiologic transition, risk factors, and impact of urbanization. *Circulation*. 2001;**104**(22):2746–53. doi: 10.1161/hc4601.099487. [PubMed: 11723030].
6. Ohira T, Iso H. Cardiovascular disease epidemiology in Asia: an overview. *Circ J*. 2013;**77**(7):1646–52. doi: 10.1253/circj.cj-13-0702. [PubMed: 23803294].
7. Talebizadeh N, Haghdoust AA, Mirzazadeh A. An epidemiological model (Markov Chain) of cardiovascular disease in Iran. *Payesh*. 2009;**8**(2):163–70.
8. Hinton W, McGovern A, Coyle R, Han TS, Sharma P, Correa A, et al. Incidence and prevalence of cardiovascular disease in English primary care: a cross-sectional and follow-up study of the Royal College of General Practitioners (RCGP) Research and Surveillance Centre (RSC). *BMJ Open*. 2018;**8**(8). e020282. doi: 10.1136/bmjopen-2017-020282. [PubMed: 30127048]. [PubMed Central: PMC6104756].
9. Bhatnagar P, Wickramasinghe K, Wilkins E, Townsend N. Trends in the epidemiology of cardiovascular disease in the UK. *Heart*. 2016;**102**(24):1945–52. doi: 10.1136/heartjnl-2016-309573. [PubMed: 27550425]. [PubMed Central: PMC5256396].
10. Laslett LJ, Alagona PJ, Clark B3, Drozda JJ, Saldivar F, Wilson SR, et al. The worldwide environment of cardiovascular disease: prevalence, diagnosis, therapy, and policy issues: a report from the American College of Cardiology. *J Am Coll Cardiol*. 2012;**60**(25 Suppl):S1–49. doi: 10.1016/j.jacc.2012.11.002. [PubMed: 23257320].
11. American Diabetes Association. 8. Cardiovascular Disease and Risk Management. *Diabetes Care*. 2016;**39 Suppl 1**:S60–71. doi: 10.2337/dc16-S011. [PubMed: 26696684].
12. Wild RA, Carmina E, Diamanti-Kandarakis E, Dokras A, Escobar-Morreale HF, Futterweit W, et al. Assessment of cardiovascular risk and prevention of cardiovascular disease in women with the polycystic ovary syndrome: a consensus statement by the Androgen Excess and Polycystic Ovary Syndrome (AE-PCOS) Society. *J Clin Endocrinol Metab*. 2010;**95**(5):2038–49. doi: 10.1210/jc.2009-2724. [PubMed: 20375205].
13. Conroya RM, Pyörälä K, Fitzgerald AP. Estimation of ten-year risk of fatal cardiovascular disease in Europe: the SCORE project. *Eur Heart J*. 2003;**24**(11):987–1003.

14. D'Agostino RS, Vasan RS, Pencina MJ, Wolf PA, Cobain M, Massaro JM, et al. General cardiovascular risk profile for use in primary care: the Framingham Heart Study. *Circulation*. 2008;**117**(6):743–53. doi: 10.1161/CIRCULATIONAHA.107.699579. [PubMed: 18212285].
15. Gaziano TA, Pandya A, Steyn K, Levitt N, Mollentze W, Joubert G, et al. Comparative assessment of absolute cardiovascular disease risk characterization from non-laboratory-based risk assessment in South African populations. *BMC Med*. 2013;**11**(1):170. doi: 10.1186/1741-7015-11-170. [PubMed: 23880010]. [PubMed Central: PMC3734109].
16. Peer N, Lombard C, Steyn K, Gaziano T, Levitt N. Comparability of total cardiovascular disease risk estimates using laboratory and non-laboratory based assessments in urban-dwelling South Africans: the CRIBSA study. *S Afr Med J*. 2014;**104**(10):691–6. doi: 10.7196/samj.8125. [PubMed: 25363056]. [PubMed Central: PMC4816643].
17. Gaziano TA, Pandya A, Steyn K, Levitt N, Mollentze W, Joubert G, et al. Comparative assessment of absolute cardiovascular disease risk characterization from non-laboratory-based risk assessment in South African populations. *BMC Med*. 2013;**11**(1):1–11. doi: 10.1186/1741-7015-11-170. [PubMed: 23880010]. [PubMed Central: PMC3734109].
18. Cooney MT, Dudina A, D'Agostino R, Graham IM. Cardiovascular risk-estimation systems in primary prevention: Do they differ? Do they make a difference? Can we see the future? *Circulation*. 2010;**122**(3):300–10. doi: 10.1161/CIRCULATIONAHA.109.852756. [PubMed: 20644026].
19. Meysamie A, Salarvand F, Khorasanizadeh M, Ghalehtaki R, Eskian M, Ghodsi S, et al. Cardiovascular risk assessment by FRS and SCORE in Iranian adult population. *J Diabetes Metab Disord*. 2017;**16**(1):35. doi: 10.1186/s40200-017-0316-4. [PubMed: 28852642]. [PubMed Central: PMC5568064].
20. Bozorgmanesh M, Hadaegh F, Azizi F. Predictive accuracy of the 'Framingham's general CVD algorithm' in a Middle Eastern population: Tehran Lipid and Glucose Study. *Int J Clin Pract*. 2011;**65**(3):264–73. doi: 10.1111/j.1742-1241.2010.02529.x. [PubMed: 21314863].
21. Khalili D, Hadaegh F, Soori H, Steyerberg EW, Bozorgmanesh M, Azizi F. Clinical usefulness of the Framingham cardiovascular risk profile beyond its statistical performance: the Tehran Lipid and Glucose Study. *Am J Epidemiol*. 2012;**176**(3):177–86. doi: 10.1093/aje/kws204. [PubMed: 22814370].
22. Gaziano TA, Abrahams-Gessel S, Denman CA, Montano CM, Khanam M, Puoane T, et al. An assessment of community health workers' ability to screen for cardiovascular disease risk with a simple, non-invasive risk assessment instrument in Bangladesh, Guatemala, Mexico, and South Africa: an observational study. *Lancet Glob Health*. 2015;**3**(9):556–63.
23. Chaturvedi N. Ethnic differences in cardiovascular disease. *Heart*. 2003;**89**(6):681–6. doi: 10.1136/heart.89.6.681. [PubMed: 12748237]. [PubMed Central: PMC1767706].
24. Esteghamati A, Larijani B, Aghajani MH, Ghaemi F, Kermanchi J, Shahrami A, et al. Diabetes in Iran: Prospective Analysis from First Nationwide Diabetes Report of National Program for Prevention and Control of Diabetes (NPPCD-2016). *Sci Rep*. 2017;**7**(1):13461. doi: 10.1038/s41598-017-13379-z. [PubMed: 29044139]. [PubMed Central: PMC5647418].
25. Redon J, Tellez-Plaza M, Orozco-Beltran D, Gil-Guillen V, Pita Fernandez S, Navarro-Perez J, et al. Impact of hypertension on mortality and cardiovascular disease burden in patients with cardiovascular risk factors from a general practice setting: the ESCARVAL-risk study. *J Hypertens*. 2016;**34**(6):1075–83. doi: 10.1097/HJH.0000000000000930. [PubMed: 27074896].
26. Wu CY, Hu HY, Chou YJ, Huang N, Chou YC, Li CP. High Blood Pressure and All-Cause and Cardiovascular Disease Mortalities in Community-Dwelling Older Adults. *Medicine (Baltimore)*. 2015;**94**(47). e2160. doi: 10.1097/MD.0000000000002160. [PubMed: 26632749]. [PubMed Central: PMC5059018].
27. Tian J, Sheng CS, Sun W, Song X, Wang H, Li Q, et al. Effects of High Blood Pressure on Cardiovascular Disease Events Among Chinese Adults With Different Glucose Metabolism. *Diabetes Care*. 2018;**41**(9):1895–900. doi: 10.2337/dc18-0918. [PubMed: 30002198].
28. Simko F, Pechanova O. Remodelling of the heart and vessels in experimental hypertension: advances in protection. *J Hypertens*. 2010;**28 Suppl 1**:S1–6. doi: 10.1097/01.hjh.0000388487.43460.db. [PubMed: 20823710].
29. Erhardt L. Cigarette smoking: an undertreated risk factor for cardiovascular disease. *Atherosclerosis*. 2009;**205**(1):23–32. doi: 10.1016/j.atherosclerosis.2009.01.007. [PubMed: 19217623].
30. Khazaei S, Mohammadian-Hafshejani A, Pishkuhi MA, Salehiniya H. Proportion of mortality attributable to tobacco worldwide. *Iran J Public Health*. 2016;**45**(3):399–400.
31. Messner B, Bernhard D. Smoking and cardiovascular disease: mechanisms of endothelial dysfunction and early atherogenesis. *Arterioscler Thromb Vasc Biol*. 2014;**34**(3):509–15. doi: 10.1161/ATVBAHA.113.300156. [PubMed: 24554606].
32. Gaziano TA, Young CR, Fitzmaurice G, Atwood S, Gaziano JM. Laboratory-based versus non-laboratory-based method for assessment of cardiovascular disease risk: the NHANES I Follow-up Study cohort. *Lancet*. 2008;**371**(9616):923–31.
33. Damari B, Almadani H, Ahmadi Pishkuhi M. Iranian drug use survey in workplaces: A study protocol. *Med J Islam Repub Iran*. 2018;**32**:93. doi: 10.14196/mjiri.32.93. [PubMed: 30788330]. [PubMed Central: PMC6377027].
34. Damari B, Ahmadi Pishkuhi M, Masoudiasl I, Bostanmanesh G. Interventions to Reduce Drug Abuse in Pars Special Economic Energy Zone. *Iran Red Crescent Med J*. 2015;**17**(11). e32016. doi: 10.5812/ircmj.32016. [PubMed: 26734486]. [PubMed Central: PMC4698326].
35. Sarrafzadegan N, Hassannejad R, Marateb HR, Talaei M, Sadeghi M, Roohafza HR, et al. PARS risk charts: A 10-year study of risk assessment for cardiovascular diseases in Eastern Mediterranean Region. *PLoS One*. 2017;**12**(12). e0189389. doi: 10.1371/journal.pone.0189389. [PubMed: 29261727]. [PubMed Central: PMC5736201].
36. Lam BC, Koh GC, Chen C, Wong MT, Fallows SJ. Comparison of Body Mass Index (BMI), Body Adiposity Index (BAI), Waist Circumference (WC), Waist-To-Hip Ratio (WHR) and Waist-To-Height Ratio (WHtR) as predictors of cardiovascular disease risk factors in an adult population in Singapore. *PLoS One*. 2015;**10**(4). e0122985. doi: 10.1371/journal.pone.0122985. [PubMed: 25880905]. [PubMed Central: PMC4400161].