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Original Article

Comparison of Framingham Cardiovascular Risk Criteria and ASCVD Score in Iranian Obese Patients

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Abstract

Background: Calculating and predicting the risk of disease plays an important role in preventive medicine. Today, some risk scores have been designed to estimate the risk of cardiovascular diseases (CVDs) by assessing different factors. Obesity is associated with an increased risk of cardiovascular disease, so we decided to calculate the possible risk of heart disease in obese Iranian people to suggest a more accurate calculator.

Methods: In this cross-sectional study, we compared the data of 289 people from Framingham Risk Score and ASCVD Risk Score calculations who had been referred to Shariati Hospital Obesity Clinic, Tehran, Iran from 2016 to 2019. In the form of sub-goals, we examined other factors such as blood pressure and hepatic aminotransferases, etc.

Results: The mean age of participants was 51.20±7.58 years, 86.2% being women. Of the whole, 19.72%, 31.83%, 21.11%, and 27.34% were categorized as overweight, Obese I, II, and III, respectively. According to the ASCVD score 80.3%, 4.8%, and 14.9%, and according to the Framingham score 95.5%, 3.5%, and 1% were classified as low-risk, intermediate-risk, and high-risk. Moreover, a fair agreement was observed between the two-risk score in the whole (Kappa=0.236; *P*<0.001), overweight (Kappa=0.304; *P*=0.028), Obese I (Kappa=0.210; *P*=0.048), Obese II (Kappa=0.268; *P*=0.015), and obese III (Kappa=0.202; *P*=0.023).

Conclusion: Despite its age limit, ASCVD has a higher risk of CVDs, causing statin care (which has a protective role for cardiovascular disease) to be given to a larger population.

Keywords: Obesity; Cardiovascular disease; Guidelines; Framingham

Introduction

Obesity or overweight is physiologically defined as the accumulation of fat in an abnormal or excessive pattern in adipose tissue and may cause serious health concerns. Racial differences can affect the definition and prevalence of obesity (1). The prevalence of overweight and obesity has

been reported at 34.1% (CI 95%: 32.3-35.9) and 15.4% (CI 95%: 14.0-16.8), respectively in the age group 20- to 84-year-old Iranian people (2). Increased prevalence of obesity and fat mass were associated with increased cardiovascular risk, type 2 diabetes and related risk factors (such as metabolic syndrome), high blood pressure, dyslipidemia, and sleep apnea and as a result, it is estimated to reduce life expectancy by about seven years (2).

Obesity is not limited to a specific country like the United States or even developed countries but exists in most parts of the world (3). Not surprisingly, the incidence of obesity-related diseases, including cardiovascular disease (CVDs), is growing rapidly worldwide. More than 25 million Americans have diabetes mellitus, and India will have more than 100 million diabetics by 2030. CVDs are the leading cause of death worldwide (4, 5).

Three anthropometric criteria are important for assessing the degree of obesity: height, weight, and waist circumference. Body Mass Index (BMI) is the most common and practical indicator for assessing overweight and obesity in adults worldwide (2). A lower BMI threshold is defined for overweight and obesity in Asians and Pacific People It seems that this population is at risk of abnormalities of sugar and fat at lower weights. Excess abdominal fat is independently associated with a higher risk of diabetes and cardiovascular diseases (6). INTERHEART and INTERSTROKE studies have concluded that more than 86% of CVD cases can be attributed to nine major risk factors (Smoking, dyslipidemia, hypertension, diabetes, obesity, unhealthy diet, physical inactivity, alcohol consumption, and psychosocial factors) (7).

It seems necessary to identify patients at risk for CVDs, especially obese individuals, and to use the appropriate tools for predicting the risk of cardiovascular diseases. There are many calculators, so identifying the most efficient and easy tools is doubly important. Therefore, in this study, we reviewed and compared the resulting scores of two risk estimator tools to determine the 10-year CVD risk in the present study, including the Framingham general cardiovascular risk profile and ACC/AHA tool (ASCVD risk score) in patients referred to the obesity clinic of Shariati Hospital, Tehran, Iran.

Materials and Methods

This retrospective cross-sectional study was performed during 2016-2019 in the Obesity Clinic of Shariati Hospital in Tehran, Iran. The main study inclusion criterion was obese patients referred to the Clinic.

BMI is calculated from the formula = weight (kg) / height(m^2), which assesses body fat and is related to disease risk, BMI 25-30 kg/m^2 and>30 are classified as overweight and obesity, respectively. Obesity is divided into three subgroups: class one: 30- 34.5, class two: 35- 39.9, and class three ≥ 40. We confirmed abdominal obesity by measuring waist circumference (WC) or waist-to-pelvic ratio. WC measurement is an assessment of visceral adipose tissue and should be measured by a non-elastic tape measure and measured horizontally between the top of the iliac crest to below the last rib (8).

According to the WHO data, the recommended sex-specific cut-off points are 94 cm (men) and 80 cm (women) for increased risk, and 102 cm (men) and 88 cm (women) for substantially increased risk. The substantially increased risk of waist circumference to hip circumference ratio is ≥ 0.9 in men and ≥ 0.85 in women (9).

Lipid profiles and fasting blood sugar (FBS) were evaluated from a venous blood sample following 12 hours of fasting and then measured using routine and standardized laboratory methods. We defined fasting glycemia as FBS > 100 and dyslipidemia cut-off points: total cholesterol ≥ 200 mg/dl, LDL ≥ 130 mg/dl, HDL < 40 mg/dl, triglycerides ≥ 150 mg/dl (10).

People who were on statin therapy or had a history of cardiovascular disease were excluded from the study. Patient information through checklists including medical history, clinical examinations, and demographic data (weight, height, abdominal circumference, waist circum-

ference, BMI) was collected and blood samples were taken for analysis of fasting blood sugar (FBS), total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL) and triglycerides (TG), vitamin D levels (Vit D), thyroid stimulating hormone (TSH) and liver enzymes. Using the collected data, Framingham and ASCVD scores were calculated for each patient.

The risk of ASCVD for the population aged 40 to 75 is calculated by combining variables of sex, race, age, total cholesterol, HDL, hypertension, receiving antihypertensive therapy, diabetes, and smoking. These data were entered into the Atherosclerotic Cardiovascular Disease 2013 Risk Calculator from AHA / ACC and the 10-year risk was calculated. According to the guideline for primary prevention of cardiovascular diseases AHA 2019: assess ASCVD risk in each age group and emphasize adherence to a healthy lifestyle, the calculated risk of low-risk group is ≤ 5%, and borderline risk: is 5% - 7.5%, which is recommends moderate statin therapy with a class of recommendation IIb, intermediate risk: 7.5% – 20% With that moderate statin therapy is recommended to reduce LDL by 30 to 40% (class I), calculated risk of high-risk group ≥ 20% and Statin treatment is recommended to reduce LDL by 50% or more (class I) (4, 11-17).

The Framingham Risk Score for Hard Coronary Heart Disease was calculated for people aged 30 to 75 years old using factors such as gender, age, smoking status, total cholesterol, HDL, and systolic blood pressure (SBP). The calculated risk by FRS is classified into three categories, Low risk < 10% (statin is not indicated generally), Medium risk 10 to 20% (start statin therapy to reduce LDL ≥ 50%), and High risk ≥ 20% (start statin therapy to reduce LDL ≥ 50%) (10, 18-20).

Permission to undertake the study was obtained from the Ethics Committee of Tehran University of Medical Sciences Tehran, Iran Code: IR.TUMS.MEDICINE.REC.1398.656.

Statistical analysis

Continuous data are presented as mean and standard deviation and categorical data are presented as frequency and percent. To compare continuous data according to BMI categories ANOVA test was used and Gabriel test was applied as a post-hoc test whenever it was necessary. To compare continuous data according to BMI categories *P* value of Kendal's tau-b was calculated. To assess the agreement between the cardiovascular risk scores, the weighted Kappa statistics were calculated. The Kappa statistics show a slight agreement for values 0 to 2, fair agreement for values 0.21 to 0.40, moderate agreement for values 0.41 to 0.60, substantial agreement for values 0.61 to 0.80, and perfect agreement for values 0.81 to 1.00 (21). All statistical analyses were done by statistical package R 3.6.1. *P* values of less than 0.05 were considered significant.

Results

Totally 289 subjects were enrolled, of whom 40 (13.84%) cases were male and 249 (86.16%) were female. The mean age of the study subjects was 51.20±7.58 years (ranges 40 – 73 years) .The mean BMI of the subjects was 35.21 ± 6.65. Of the whole, 57 (19.72%) cases were overweight, 92 cases (31.83%), 61 cases (21.11%), and 79 cases (27.34%) were categorized as Obese I, II, and III categories, respectively.

Subjects' characteristics, clinical data, and drug usage according to BMI category are presented in Table 1. The subjects' BMI category did not differ significantly in sex, age, smoking status, LDL, and TSH level (*P*>0.05). It was observed a statically significant increment in the mean of SBP (*P*<0.001), DBP (*P*<0.001), and total cholesterol (*P*=0.003) with a rising BMI. Furthermore, the mean of HDL of overweight subjects was statistically significantly higher than the other groups (*P*=0.021), also the mean of vitamin D significantly differed according to BMI categories (*P*=0.039). Moreover, subjects with higher BMI categories were more likely to have a family history of obesity (*P*=0.017).

Table 1: Characteristics of study subjects according to BMI category

Characteristics	***BMI category***				
	Overweight (n=57)	Obese I (n=92)	Obese II (n=61)	Obese III (n=79)	*P* value**
Sex N (%)					
Male	7 (12.3)	16 (17.4)	4 (6.6)	13 (16.5)	0.223
Female	50 (87.7)	76 (82.6)	57 (93.4)	66 (83.5)	
Age	51.33 ± 9.15	50.47 ± 6.59	52.36 ± 8.21	51.06 ± 6.90	0.508
Smoker or ex-smoker N (%)	2 (3.5)	9 (9.8)	4 (6.6)	5 (6.3)	0.529
Family history of obesity N (%)	25 (43.9)	59 (64.1)	42 (68.9)	53 (67.1)	0.017
SBP mean ± SD	117.2 ± 14.91	120.5 ± 15.75	125.3 ± 14.07	133.9 ± 23.71*‡ν	<0.001
DBP mean ± SD	77.89 ± 10.69	77.45 ± 10.69	83.03 ± 10.93‡	86.46 ± 14.44*‡	<0.001
Total Cholesterol mean ± SD	212.1 ± 48.81	199.2 ± 43.38	200.6 ± 49.31	183.2 ± 41.48*	0.003
LDL mean ± SD	126.9 ± 37.45	119.8 ± 34.04	116.4 ± 38.50	110.6 ± 37.52	0.078
HDL mean ± SD	51.33 ± 11.99	45.97 ± 11.62*	49.49 ± 13.27	46.18 ± 11.18	0.021
TSH mean ± SD	2.73 ± 2.93	2.72 ± 4.23	2.72 ± 3.12	3.20 ± 3.60	0.802
Vit D mean ± SD	50.06 ± 37.95	43.13 ± 37.29	46.12 ± 38.12	33.61 ± 25.92*	0.039

****P* values are calculated based on Kendal's tau-b correlation or ANOVA.
Post hoc test:
*: statistically significant compared to overweight,
‡: statistically significant compared to obese I,
ν: statistically significant compared to obese II.

According to the ASCVD score 232 (80.3%), 14 (4.8%), and 43 (14.9%) were categorized as low risk, intermediate risk, and high risk, respectively. Also, according to the Framingham score 276 (95.5%), 10 (3.5%), and 3 (1%) were categorized as low risk, intermediate risk, and high risk, respectively (Fig.1).

A fair agreement was observed between the ASCVD risk score and Framingham risk score, even in the whole subjects (weighted Kappa=0.236) or according to the BMI categories (overweight: weighted Kappa=0.304; Obese I: weighted Kappa=0.210; Obese II: weighted Kappa=0.268; obese III: weighted Kappa=0.202). The result of the agreement between these scores is shown in Table 2. Furthermore, there was not observed any statistically significant relationship between the BMI category and none of the ASCD risk group (*P*=0.403) and Framingham risk group (*P*=0.869).

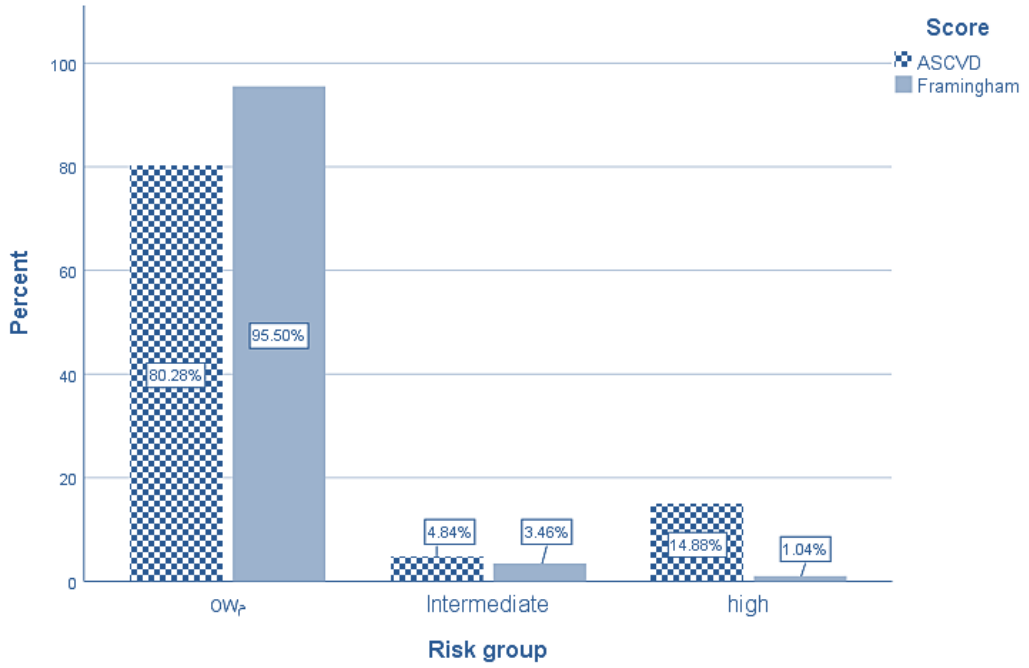

Fig. 1: Description of subjects according to the cardiovascular risk group of ASCVD and Framingham score

Table 2: Agreement between the risk scores according to the study groups

Risk score		***Framingham***					
Study groups	ASCVD	Low N	Inter-mediate N	High N	N (%)	Weighted Kappa (95% CI)	*P* value
Total	Low	232	0	0	232 (80.28)	0.236 (0.128 – 0.344)	<0.001
	Intermediate	14	0	0	14 (4.84)		
	High	30	10	3	43 (14.88)		
Overweight	Low	46	0	0	46 (80.70)	0.304 (0.034 – 0.575)	0.028
	Intermediate	3	0	0	3 (5.26)		
	High	5	2	1	8 (14.04)		
Obese I	Low	75	0	0	75 (81.52)	0.210 (0.002 – 0.417)	0.048
	Intermediate	5	0	0	5 (5.44)		
	High	9	2	1	12 (13.04)		
Obese II	Low	52	0	0	52 (85.25)	0.268 (0.052 – 0.483)	0.015
	Intermediate	1	0	0	1 (1.64)		
	High	5	3	0	8 (13.11)		
Obese III	Low	59	0	0	59 (74.68)	0.202 (0.028 – 0.377)	0.023
	Intermediate	5	0	0	5 (6.33)		
	High	11	3	1	15 (18.99)		

Discussion

The present study was performed on patients referred to the obesity clinic and participants were men and women with a mean age of 44.7 years All of them were obese and were not taking statins and had no history of cardiovascular disease. Abdominal and visceral fat is a major risk

factor for coronary heart disease and worsening of ischemic heart diseases and is also associated with high blood pressure, dyslipidemia, and diabetes. In a study, the prevalence of hypothyroidism was 4.8% in men, 12.8% in women, and 8.8% on average (22). In our study, the prevalence of hypothyroidism almost doubled to 16.7%.

Because high blood pressure is asymptomatic in the early stages, most people do not notice it. The increase in BMI was also positively associated with hypertension ($P< 0.001$) (22, 23). The increase in blood pressure and weight people were almost linear; furthermore, weight loss and reduction of waist circumference were related to decreased blood pressure (24). In the present study, as in the Tehran Lipid and Glucose Study (19), hypertension was more common in men than women. With increasing BMI, hypertension increased in both sexes ($P= 0.003$).

A systematic review and meta-analysis showed the prevalence of vitamin D deficiency in the Iranian community is very high. Women and older people are at a higher risk of vitamin D deficiency. The overall prevalence of Vit D deficiency was reported as 0.56 and the subgroup analysis showed that 0.64 of women and 0.44 of men were suffering from vitamin D deficiency (25). In the present study, the prevalence of Vit D deficiency in overweight and obese females and males gender was estimated at 55.3% and 57.5%, respectively.

Overall, this study showed that the mean of Framingham and ASCVD in Iranian obese individuals with a mean age of 51.20±7358 years was not high. On the other hand, this study was the first study of its kind in the obese Iranian Population and it can be useful to start a cohort study to understand and prove the superiority of one of the predictors of cardiovascular problems. Such studies help to extract a specific model for Iranians in certain groups. It is suggested that community-based studies be conducted in different cities of the country with different ethnicities with large sample sizes and cohort methods to achieve a general pattern for estimating the risk of cardiovascular disease and rational and correct policies. Early identification of people at risk for cardiovascular disease reduces the morbidity and mortality caused by such diseases and reduces the financial workload of the health system.

Conclusion

Despite its age limit, ASCVD has a higher risk of CVDs, causing statin care (which has a protective role for cardiovascular disease) to be given to a larger population.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsifications, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Competing interest

The authors declare that there is no conflict of interest.

References

1. Hulten EA, Bittencourt MS, Preston R, et al (2017). Obesity, metabolic syndrome and cardiovascular prognosis: from the Partners coronary computed tomography angiography registry. *Cardiovasc Diabetol,*16:14.
2. Rosengren A, Hawken S, Ounpuu S, et al (2004). Association of psychosocial risk factors with risk of acute myocardial infarction in 11119 cases and 13648 controls from 52 countries (the INTERHEART study): case-control study. *Lancet*;364(9438):953-62.
3. Ford ES, Mokdad AH (2008). Epidemiology of obesity in the Western Hemisphere. *The J Clin Endocrinol Metab,* 93 Suppl, (1):S1-8.

4. Wharton S, Lau DCW, Vallis M, et al (2020). Obesity in adults: a clinical practice guideline. *CMAJ*, 192(31):E875-E91.
5. Whiting DR, Guariguata L, Weil C, et al (2011). IDF diabetes atlas: global estimates of the prevalence of diabetes for 2011 and 2030. *Diabetes Res Clin Pract,* 94(3):311-21.
6. Arnett DK, Blumenthal RS, Albert MA, et al (2019). ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation,* 140(11):e563-e95.
7. D'Agostino RB Sr., Vasan RS, Pencina MJ, et al (2008). General cardiovascular risk profile for use in primary care: the Framingham Heart Study. *Circulation,* 117(6):743-53.
8. Arsenault BJ, Pibarot P, Després JP (2009). The Quest for the Optimal Assessment of Global Cardiovascular Risk: Are Traditional Risk Factors and Metabolic Syndrome Partners in Crime? *Cardiology*, 113:35–49.
9. Bove AA, Santamore WP, Homko C, et al (2011). Treatment of patients with intermediate cardiovascular risk: Are clinical measures enough? *J Nucl Cardiol,* 18(6):1021-5.
10. Koopman RJ, Swofford SJ, Beard MN, et al (2009). Obesity and metabolic disease. *Prim Care,* 36(2):257-70.
11. Aghasi M, Matinfar A, Golzarand M, et al (2020). Internet Use in Relation to Overweight and Obesity: A Systematic Review and Meta-Analysis of Cross-Sectional Studies. *Adv Nutr,* 11(2):349-356.
12. Ge L, Sadeghirad B, Ball GDC, et al (2020). Comparison of dietary macronutrient patterns of 14 popular named dietary programmes for weight and cardiovascular risk factor reduction in adults: systematic review and network meta-analysis of randomised trials. *BMJ*, 1; 369:m696.
13. Homaie Rad E, Khodadady-Hasankiadeh N, Kouchakinejad-Eramsadati L, et al (2020). The relationship between weight indices and injuries and mortalities caused by the motor vehicle accidents: a systematic review and meta-analysis. *J Inj Violence Res,* 12(1):85-101.
14. Koochakpoor G, Hosseini-Esfahani F, Daneshpour MS, (2016). Effect of interactions of polymorphisms in the Melanocortin-4 receptor gene with dietary factors on the risk of obesity and Type 2 diabetes: a systematic review. *Diabet Med,* 33(8):1026-34.
15. Litwin SE, Coles A, Hill CL, et al (2020). Discordances between predicted and actual risk in obese patients with suspected cardiac ischaemia. *Heart* ,106(4):273-9.
16. Pearson F, Huangfu P, Abu-Hijleh FM, et al (2020). Effect of subsidies on healthful consumption: a protocol for a systematic review update. *BMJ Open*, 20; 10(8):e036031
17. Poorolajal J, Sahraei F, Mohamdadi Y, et al (2020). Behavioral factors influencing childhood obesity: a systematic review and meta-analysis. *Obes Res Clin Pract,* 14(2):109-118.
18. Garg N, Muduli SK, Kapoor A, et al (2017). Comparison of different cardiovascular risk score calculators for cardiovascular risk prediction and guideline recommended statin uses. *Indian Heart J*, 69(4):458-63.
19. Rahmani M, Jeddi S, Ghanbari M, et al (2019). Reference Values for Serum Lipid Profiles in Iranian Adults: Tehran Lipid and Glucose Study. *Arch Iran Med,* 1; 22(1):24-3.
20. Yuan-Lung Cheng J-HS, Hsiu-Chuan Hsu, Ying Liang, et al (2018). High health literacy is associated with less obesity and lower Framingham risk score: Sub-study of the VGH-HEALTHCARE trial. *PloS One*, 13(3):e0194813.
21. McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med,* 22(3):276-82.
22. Aminorroaya A, Janghorbani M, Amini M, et al (2009). The prevalence of thyroid dysfunction in an iodine-sufficient area in Iran. *Arch Iran Med,* 12(3):262-70.
23. Guerra-Silva NM, Santucci FS, Moreira RC, et al(2017). Coronary disease risk assessment in men: Comparison between ASCVD Risk versus Framingham. *Int J Cardiol,* 1; 228:481-487.
24. Ulbrich AZ, Bertin RL, Bozza R, et al (2012). Probability of arterial hypertension from anthropometric measures in adults. *Arq Bras Endocrinol Metabol,* 56(6):351-7.
25. Motamed N, Rabiee B, Perumal D, et al (2017). Comparison of cardiovascular risk assessment tools and their guidelines in evaluation of 10-year CVD risk and preventive recommendations: A population based study. *Int J Cardiol,* 1; 228:52-57.