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Association between Obesity and Coronary Heart Disease Risk among Saudi Subjects at Madinah Region

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Authors' contributions

This work was carried out in collaboration between both authors. Author SYS designed the study, managed the experimental process and wrote the first draft of the manuscript. Author MMMAL managed the experimental process and analysis of the results. Both authors read and approved the final manuscript.

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ABSTRACT

Purpose: To characterize the association between major cardiovascular diseases risk among Saudis and their body mass index (BMI).
Methods: A cross-sectional study was conducted (April to June 2015) to investigate the expected 10 years risk for cardiovascular diseases (CVD) among Saudi subjects (age range 20-70 years) using Framingham Risk Score (FRS) with respect to their BMI (analyzed October 2015).
Results: In the present study there was a significant association between the 10 years risk of developing CVD and BMI. The results revealed an increase in BMI contributing to significant

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increase in the 10 years risk of CVD among males. The overall distribution of FRS among males regardless the BMI category as a percentage of the total male subjects revealed that males were at low, medium and high CVD risk of 71.4%, 14.27% and 14.3%, respectively. However, female subjects showed 91.5%, 4.8% and 3.6% at low, medium and high FRS, respectively. In addition, significant increases in the Odd ratio amounting to 4.58 and 5.24 among intermediate and high risk males in comparison with female ones, respectively.

Conclusions: BMI strongly associated with the expected 10 years FRS for CVD. Moreover, there was gender specific susceptablity for CVD risk among Saudi males compared to female ones. Socioeconomic, behavioral, awareness about healthy choices and genetic characteristics of obesity should be taken in consideration since extrapolating other population's studies to Saudi one might be misleading.

Keywords: Obesity; cardiovascular diseases; Framingham; body mass index.

1. INTRODUCTION

Cardiovascular diseases represent a leading cause of death worldwide. It's well recognized that sedentarism [1], overweight and obesity increase the risk of cardiovascular diseases (CVD), diabetes mellitus (DM) and hypertension (HTN) [2,3]. Saudi Arabia has a high prevalence of obesity. Sociocultural factors play a great role in food consumption pattern. Social construct, sedentary life style, caloric-rich food are mail contributory factors for obesity among Saudies. In the Gulf area, women are often over protected due to religious or cultural barriers and can't publicly participate in physical activity [4,5]. Sedentarism, smoking, energy-dense food as well as modifiable risk factors (dyslipidemia, DM and HTN) [6,7] and obesity are strongly associated with CVD risk.

Saudi Arabia, considered a rapidly developing country, faces progressive urbanization and the fast adoption of a western lifestyle, factors might contribute to the raising burden of cardiovascular disease [8]. Hetari et al. [9] reported that obese adults without clinical CVD may already have a clustering of traditional CVD risk factors especially modifiable ones. Primary prevention of CVS is very important to reduce both morbidity & mortality of CVD [10]. In this respect, body weight control reduces the risk of atherosclerosis, HTN, DM and dyslipidemia. Positive correlation between BMI and arterial HTN was reported. Moreover, excessive BMI has been linked to higher levels of arterial HTN, blood sugar, triglycerides, and law density lipoprotein (LDL-C) levels and inversely related to high density lipoprotein (HDL-C) concentration level [11-13].

One of the most widely used 10-years risk assessment methods for the prediction of coronary heart disease is the Framingham risk score (FRS). High frequency of sedentarism and overweight/obesity might increase the coronary heart disease (CHD) risk prevalence. Dyslipidemia, age range, hypertension treatment, smoking, and total cholesterol were included in the updated FRS version with the exclusion of diabetes due to the fact that type 2 diabetes meanwhile is considered to be a CVD risk equivalent. However, type I diabetic patients are considered to be with slightly less aggressive goals [14]. The aim of the present study was to characterize the major cardiovascular risk factors using FRS among Saudi outpatients attending King Fahd hospital at Madinah, Saudi Arabia.

2. METHODS

A cross-sectional study was conducted in Madinah, Saudi Arabia (April to June 2015). Adult Saudi outpatients attending King Fahd hospital (general multiple specialities), aged 20 – 70 years were recruited randomly and spontaneously agreed to take part of the study. The study was performed on 167 individuals (83 females & 84 males). The study was approved by the Ethics Committee of the King Fahd Hospital, Madinah, Saudi Arabia for collecting the sample. All participants signed the free and clarified consent term according to Helsinki declaration. A questionnaire was checked prior to the participant leaving the study centre. Demographic data, anthropometric assessment, disease history & FRS parameters were determined. Inclusion criteria include self-identity as Saudis. Pregnant and/or breastfeeding, chronic diseases (cancer, heart disease, stroke and renal) subjects as well as those treated with hormonal replacement therapy, steroids and hypolipidemic agents were excluded.

The FRS sheets were used to determine the 10-year risk of CHD [15]. For each subject included in the present study, a separate sheet was used to determine the FRS. The total score was calculated by summation of the points associated with the patient's age, cholesterol, HDL, smoking status, systolic blood pressure and diabetes mellitus either treated or untreated. The total points were computed by summing all the points for the risk factor profile. Then 10-year CHD risk was determined according to the score points. The required parameters were included and the correlation of risk of developing CHD and obesity has been analyzed and calculated [14].

2.1 Framingham Scoring Method and Assumptions

Each subject’s 10-year CHD risk was estimated on the basis of the assumptions underlying the Framingham Risk Score (FRS) [14]. Individuals with 10% or lower 10-years CHD risk were classified as being at "low risk"; those with a 10 to 20% risk were considered as being at "intermediate risk"; and others with 20% or higher were considered to be at "high risk".

Subjects who were currently smoking or had quit less than one year previously were classified as smokers. Non-smokers were classified as those who had never smoked or who had quit more than one year previously. Height was recorded in centimeters on a calibrated height board; weight was recorded in kilo-grams by means of a standard calibrated weighing scale and BMI was calculated and expressed as kg/m^2. Obesity was defined as a BMI over 30. Blood pressure and pulse rates were measured by automatic dynamap. Hypertension was defined as systolic blood pressure P140 mmHg or diastolic over 90 mmHg.

2.2 Statistical Analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 21 software (SPSS Inc., Chicago, IL, USA). We used Kolmogorov-Smirnov test of normality to check if data of BMI and FRS were normally distributed. Data was not normally distributed, so the non-parametric *Mann-Whitney* test was used to compare between males and females. Pearson Chi-Square and odds ration were calculated at 95% confidence intervals. Statistically significant difference is considered at a *p*-value of less than 0.05.

3. RESULTS

Regarding the cardiovascular risk factors among male and female subjects, the results showed 31% & 23.8% smokers, 21.4% & 16.7% with diabetes mellitus (DM), 20.2% & 15.5% with hypertension (HTN) and 8.3% & 2.4% for diabetic/hypertensive ones, respectively (Table 1). Based on six risk factors: gender, age, total cholesterol & HDL levels, systolic blood pressure (BP), smoking habit and diabetes, the FRS was calculated for each subject included in the present study. The BMI distribution among the enrolled subjects revealed 14% for normal healthy weight and 43% for either overweight or obese depending on their BMI calculation ($p > 0.05$) (Table 2).

Our results revealed that there was a significant increase in the cardiovascular disease risk among males showing overweight and obese amounting to 5.95% and 8.32% for intermediate risk and 4.76% and 7.14% for high risk ones, respectively (Table 2). Moreover, obese males showed significant increase in the percentage of those with high FRS. In parallel, the female subjects showed the same pattern regarding increase in low FRS percent with the increase in BMI. Also, the probability of high cardiovascular disease risk increased among female obese subjects amounting to 3.6% which was significantly lower than that reported for the high risk obese male ones. Interestingly, intermediate & high FRS was significantly higher among those overweight and obese males compared with those females of the same BMI category.

Table 1. Prevalence of risk factors by percentage among Saudis by gender, current smoking, diabetes and/or hypertension

Risk factors	Male (N=84)	Female (N=83)	Total (N=167)
	%	%	%
Smoking	31.0 15.5 (of the total 167)	23.8 11.9 (of the total 167)	27.4
Diabetic	21.4	16.7	19.0
Hypertensive	20.2	15.5	17.8
Diabetic/Hypertensive	8.3	2.4	5.4

Table 2. Body Mass Index (BMI) and Framingham Risk Score (FRS) distribution among subjects

		Gender		Total	*P*-value	Odds ratio (95% confidence intervals)
		Male n (%)	Female n (%)			
BMI group	Normal (18.5-24.9 kg/m²)	14 (16.7)	10 (12.0)	24 (14.4)	---	1
	Overweight (25 - 29.9 kg/m²)	33 (39.3)	25 (30.1)	58 (34.7)	0.905	0.94 (0.36 – 2.47)
	Obese (> 30 kg/m²)	37 (44.0)	48 (57.8)	85 (50.9)	0.199	0.55 (0.22 – 1.38)
FRS group	Low risk (less than 10)	58 (69.0)	76 (91.6)	134 (80.2)	---	1
	Intermediate risk (10 to 20)	14 (16.7)	4 (4.8)	18 (10.8)	0.006	4.59 (1.43 – 14.67)
	High risk (more than 20)	12 (14.3)	3 (3.6)	15 (9.0)	0.007	5.24 (1.41 - 19.44)

Pearson Chi-Square (Sig. 2-sided p < 0.05)

The overall distribution of FRS among males regardless the BMI category revealed that males were at low, medium and high CHD risk of 71.4%, 14.27% and 14.3%, respectively. However, female subjects showed 91.5%, 4.8% and 3.6% at low, medium and high FRS, respectively. Male subjects showed an increase in medium and high FRS with the increase in BMI (p = 0.006 & 0.007, respectively) which was revealed only with obese females. The vast majority of Saudi females were at a low risk for the 10 years risk of CHD. Contrary, the study showed that the increase in BMI significantly increase for the 10 years risk of CHD among males. Thus gender variable showed preferential risk for the 10 years risk of CHD among Saudis.

Tables 2 and 3 revealed significant higher FRS risk among males in comparison with the females as well as a significant correlation at the 0.01 level was observed between them. Moreover, our results showed a significant increase in FRS among male subjects in comparison with the female ones with an Odd's ratio of 4.58 and 5,241, respectively.

Table 3. Comparison between males and females groups with respect to body mass index (BMI) and Framingham's Risk Score (FRS)

	Male (N=84)	Female (N=83)	*P-value
BMI group	29.2 (7.6) 19.0 – 45.5	30 (6.0) 23.0 – 40.0	0.483
FRS group	5.6 (10.8) 1 – 30	2.8 (4.3) 1 – 30	0.001

**By non-parametric Mann-Whitney test; Median (Interquartile range), Range (minimum – maximum)*

Table 5 showed TC and HDL levels as well as TC/HDL ratio revealing considerable increase in TC and decrease in HDL with the increase in BMI. Also, remarkable increase in the TC/HDL ratio of those obese ones compared with those with normal and overweight subjects. Moreover, remarkable significant increase in the median FRS among males compared to females over all BMI distribution categories.

Table 4. Correlation between FRS and BMI among subjected included in the present study

Correlation		FRS group	BMI group
FRS group	Pearson correlation	1	0.212**
	Sig. (2-tailed)	---	.006
	N	167	167
BMI group	Pearson correlation	0.212**	1
	Sig. (2-tailed)	0.006	---
	N	167	167

*** Correlation is significant at the 0.01 level (2-tailed).*
N represents total number of subjects included

4. DISCUSSION

Cardiovascular disease (CVD) is the leading cause of mortality and morbidity worldwide, and developing countries representing the main contributors to this increase [16]. As CHD is considered a global health problem and has an association with hypertension, obesity and physical inactivity as preventable contributory risk factors [17]. Abate [10] reported that individuals who are able to control their BMI might be at reduced risk for developing a number of chronic diseases, including diabetes, hypertension and CVD. Saudi Arabia, considered to be a rapidly developing country, faces progressive urbanization and fast adoption of a western lifestyle contributing to rise CVD burden [18]. Significant proportion among younger aged population is at increased risk for developing hard coronary heart events [3,19]. The predictive performance of cardiovascular risk scores varies substantially between different populations. Risk scores in diabetic individual have a little evidence regarding its precision in comparison with those obtained for the general population [20]. Moreover, dyslipidemia, age range, hypertension treatment,

Table 5. Distribution of the descriptive statistics of median Framingham's Risk Score (FRS), total cholesterol (TC) and high-density lipoprotein (HDL) among Saudi subject

Parameter	Gender	BMI ≤ 25 kg/m2 Healthy normal weight	BMI 25 - ≤30 kg/m2 Overweight	BMI ≥30 kg/m2 Obese
*FRS	F	2.40	1.70	3.90
	M	8.23	7.36	7.90
TC	F	4.14±0.69	4.55±0.65	5.07±0.95
	M	4.07±0.76	4.54±0.75	5.3±0.89
HDL	F	1.08±0.26	0.99±0.23	0.95±0.091
	M	1.04±0.29	0.92±0.21	0.88±0.22
TC/HDL ratio	F	4.19±1.68	5.14±2.01	6.11±2.95
	M	4.43±1.82	5.20±1.63	6.39±2.01

*Data represents mean ± standard deviation; *Data represents the median*

smoking, and total cholesterol were included in the updated FRS version with the exclusion of diabetes due to the fact that type 2 diabetes meanwhile is considered to be a CVD risk equivalent [20]. Our results revealed that there was a significant increase in the cardiovascular disease risk among males showing overweight and physically inactive obese [21]. Moreover, the present study showed that obese males showed significant increase in the percentage of those with high FRS which are in accordance with those reported by Ford et al. [22] In parallel, the female subjects showed the same pattern regarding the increase in low FRS percent with increase in BMI. Interestingly, intermediate & high FRS was significantly higher among those overweight and obese males compared with those females of the same BMI category. This could be attributed to the clustering of either diabetes and/or hypertension among Saudi males. Our results are in accordance with those reported by Hetari et al. [9].

Obese adults without CVD may already have a clustering of traditional cardiovascular risk factors [9,23]. The prevalence of obesity among subjects of the present study represents 43% which is in accordance with that reported previously [24,25], that emphasizing the importance of changing the lifestyle to reduce the CVD risk among Saudi population. Our results revealed that Saudi females were at a low risk for the 10 years risk of CHD. However, the increase in male's BMI significantly increased low, medium & high 10 years risk of CHD among males. Table 2 showed significant increase in the risk for developing CVD at intermediate and high FRS levels ($P < 0.001$) plus significant correlation with the relevant BMI ($p = 0.006$) among Saudi males in comparison with those female ones. Thus preferential gender specific variability was observed regarding the 10 years risk of CHD among Saudis requiring further validation of FRS to be suited for Saudi population. In the present study male subjects had a significantly higher CVD risk than female ones. These results are in accordance with those reported by Huang et al. [26]. Our results revealed a significant increase in the Odd's ratio amounting to 4.58 and 5.24 among intermediate and high risk males in comparison with those of female ones, respectively. The adoption of the behavior patterns to the surrounding culture contributes to excess weight gain due to altered dietary patterns [27] and physical inactivity habits towards unhealthier choices. Acculturation might contribute to exacerbating chronic disease conditions at a greater rate among men in comparison with women. Gender disparities revealed the effect of acculturation on health which could be attributed to the lower tendency of men to use health care services [28]. These findings are in accordance with our results. Body mass index (BMI) provides a measure of obesity, and is a predictor of fatness-related health risks [29]. Using the risk stratification approach as an indicator rather than emphasizing results of each individual CVD risk factors will help in improving the awareness of health workers and beneficiaries on the joint adverse effects of them on cardiovascular health, and the importance of addressing all of them as a package [30]. Poor physical activity level of adult Saudis negatively impacts their health related-quality of life [12,23]. Hussein et al. [31] addressed a significant association between CHD risk and physical activity as well as BMI. High and increasing prevalence is probably due to interacting genetic, environmental and behavioral factors notably diet and lack of exercise. Regrettably, no information on either of them was obtained in the present study as well as the wide age range among

Saudi subjects include representing the study limitations. It seems to focus interventions on younger generations who appear to have higher risks than their parents. Survival of healthier elderly might be more likely reflecting the impact of the new affluent "Western" lifestyle experienced by younger generations whose parents grew up in less affluent. The FRS in this population is a cause of concern provided that it is validated for this population [32,33]. So, gender oriented polices and strategies might be better tailored to aid obese individuals to encourage their body weight control and cardiovascular risk factor screening, especially earlier screenings for diabetes and hypertension aiming [34].

5. CONCLUSIONS

The present study demonstrates that BMI strongly associated with the expected 10 years FRS for CVD. Moreover, there was gender specific susceptablity for CVD risk among Saudi males compared to female ones. The study highlights that holistic health promotion's programs should be considered when planning strategies to raise awareness about the preventive measures aiming to reduce the CVD risk among Saudis. It is important to validate the FRS among Saudis since extrapolating other studies among non-Saudi populations might reveal misleading results taking in consideration the socioeconomic and behavioral and awareness about healthy choices as well as genetic characteristics of obesity. The high proportion of risk factors mandates the conduct of community based surveys for early recognition and prevention of CVD and associated risk factors to reduce their impact.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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