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Prevalence of Cardiovascular Risk Factors and Associated Estimated Risk of Atherosclerotic Cardiovascular Disease in Adult Volunteers in Jeddah, Saudi Arabia

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Abstract

Background The prevalence of cardiovascular disease and its risk factors are rising globally, including in the Kingdom of Saudi Arabia (KSA). The majority of epidemiologic data, however, was obtained from primary care centers or tertiary hospitals, and disease epidemiology in the general population needs to be better defined.

Objective This study aims to determine the prevalence of cardiometabolic risk factors in a random sample of adult volunteers in Jeddah, Saudi Arabia, and their risk for atherosclerotic cardiovascular disease (ASCVD).

Materials and Methods This cross-sectional study was based on data from volunteers participating in the "My Heart, My Health" community campaign conducted in a large-scale commercial center in Jeddah, KSA. Participants 20 years of age and above answered a questionnaire containing several risk factors of ASCVD. Anthropometric measurements and blood samples were collected for lipid profile and hemoglobin A1c. Ten-year and lifelong ASCVD risk scores were calculated.

Results Eight-hundred seven volunteers participated (390 men and 417 women). The most common risk factor for men was low-high-density lipoprotein cholesterol, which was more prevalent than in women (77.9 vs. 30.3%, $p < 0.01$). The most common risk factor for women was obesity that was more prevalent than for men (42.6 vs. 36.8%, $p = 0.30$). The mean ASCVD risk score in 10 years was 8.1% (standard deviation [SD]: 10.5), and the mean ASCVD risk factor optimization % was 2.0% (SD: 2.5). The mean lifelong risk score was 39.5% (SD: 13.9), and the mean ASCVD lifelong risk factor optimization was 6.6% (SD: 2.6).

Keywords
- obesity
- atherosclerotic cardiovascular disease
- cardiometabolic risk factors
- epidemiology
- Jeddah
- Saudi Arabia

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Conclusion This study identified a high prevalence of cardiometabolic risk factors in the Saudi general public visiting a large commercial center in Jeddah, Saudi Arabia. The leading cardiometabolic risk factor is dyslipidemia in men and obesity in women. The 10-year ASCVD risk factor score is modest.

Introduction

The last few decades have witnessed a global rise in the prevalence of chronic, noncommunicable diseases, specifically among third-world nations. These significant changes have been mostly attributed to a more urbanized way of life associated with an increase in unhealthy diet consumption and less physical activity.[1] While independent risk factors for coronary artery disease (CAD), such as obesity, remain high in developed nations, epidemiologic evidence in developing countries indicates a rising trend. As such, the global burden of cardiovascular disease is predicted to worsen unless effective intervention programs are launched.[2]

The Kingdom of Saudi Arabia (KSA) is well affected by the rise of noncommunicable diseases and their risk factors. Recent cross-sectional studies suggest that modifiable risk factors such as abdominal obesity, dyslipidemia, and hypertension were common in adult Saudis and expatriates attending general primary care clinics and adolescents and children.[3,4] Cardiovascular risk factors were prevalent even among young adults attending a tertiary ambulatory care facility, with overweight and obesity being the most common risk factors.[5] Data from a time serial cross-sectional study performed in the central region of the KSA demonstrated that type 2 diabetes mellitus (T2DM) affected one out of every five adults, with an age-adjusted prevalence of 31.6% and an overall prevalence of CAD of 6.9%.[6] Other known risk factors leading to these cardiometabolic disorders unique to this population include several micronutrient deficiencies such as vitamin D[7] and vitamin B12,[8] as well as premature biological aging secondary to gut dysbiosis.[9,10] The studies mentioned above suggest increasing rates of noncommunicable diseases over time in Saudi Arabia. On a regional level, the prevalence of low physical activity, particularly among women, is remarkably high and has contributed to the rise in obesity, diabetes, and hypertension within the Gulf region.[11] Prevention programs to combat these risk factors are few and are targeted among those with prediabetes and vitamin D deficiency.[12–14]

The epidemiologic studies above, however, were conducted in tertiary hospital and primary care settings which may not be representative of the general population. Published data on the cardiovascular health status of healthy individuals outside healthcare facilities must be included. This study, therefore, aims to bridge some of this gap in evidence by determining the prevalence of CVD risk factors in apparently healthy individuals visiting a commercial mall in the city of Jeddah, Saudi Arabia. This study also aims to determine the 10-year and lifetime estimated risk of developing atherosclerotic cardiovascular disease (ASCVD) within this cohort.

Materials and Methods

The "My Heart, My Health" campaign was a 2-day community awareness event conducted at the Mall of Arabia in Jeddah, Saudi Arabia. The mall is a large commercial enterprise frequented by many visitors. Participating volunteers in the event answered a questionnaire that included information on demographics, risk factors for ASCVD, and current or prior health problems. In addition to measuring vital signs and body mass index (BMI), nonfasting lipid profile and hemoglobin A1c (HbA1c) were determined using point-of-care testing. Participants at elevated risk were further offered medical advice. The above text served as a data source for this cross-sectional retrospective study, and consent was obtained after completing the questionnaire. All adults aged 20 years and above were included in the analysis.

Normal total cholesterol, triglycerides, and high-density lipoprotein (HDL) cholesterol are defined as 200, 150, and greater than 40mg/dL, respectively. The definition of acceptable low-density lipoprotein (LDL) is based on the ASCVD risk score. However, any value above or equal to 190mg/dl indicates starting statin therapy regardless of the estimated risk. Participants with LDL cholesterol levels above 190 mg/dL are excluded from the calculation of the ASCVD risk score. For HbA1c, a value less than 5.5% is normal, and more than 6.5% is considered diagnostic for diabetes. Any reading in between those is considered prediabetes.

Per the American College of Cardiology/American Heart Association (ACC/AHA) 2017 guidelines, normal blood pressure is less than 120/80 mm Hg. Hypertension is diagnosed if blood pressure is more than 140/90 mm Hg. Readings in between are considered prehypertension. Normal BMI is less than 25 kg/m^2, and normal waist circumference is defined as less than 102 cm for men and less than 88 cm for women. Positive history of CVD is considered if a cardiac event occurred in one of the first-degree relatives at the age of 65 years or below for men and 55 years or below for women.[15]

Data Analysis

Data were analyzed using SPSS version 17.0 (Chicago, Illinois, United States). Continuous variables were presented as mean $\pm$ standard deviation (SD). Categorical variables were presented as frequencies and percentages (%). The ASCVD risk score was calculated individually using the formula adopted by the ACC/AHA in 2013.[15] Chi-squared test was done to compare categorical variables. All participants' prevalence of risk factors, including men and women, was plotted using MS Excel (Redmond, Washington, United States). Significance was set at p-value less than 0.05.

Table 1 General characteristics

Parameters	*n*	Mean ± SD
Total	807	
Sex (Males/Females)	807	390/417
Age (years)	807	38.5 ± 12.2
Weight (kg)	802	80.4 ± 20.2
BMI (kg/m^2)	766	29.3 ± 6.6
Waist (cm)	777	90.6 ± 20.6
Systolic blood pressure (mm Hg)	800	131.9 ± 18.4
Diastolic blood pressure (mm Hg)	800	78.3 ± 11.3
Triglycerides (mg/dL)	799	153.4 ± 101.4
Total cholesterol (mg/dL)	799	189.6 ± 41.4
HDL-cholesterol (mg/dL)	799	41.5 ± 14.8
LDL-cholesterol (mg/dL)	674	119.2 ± 35.6
HbA1c	290	5.8 ± 1.5
ASCVD risk score in 10 years (%)	327	8.1 ± 10.5
ASCVD 10-year risk factor optimization (%)	327	2.0 ± 2.5
ASCVD lifelong risk score (%)	728	39.5 ± 13.9
ASCVD lifelong risk factor optimization (%)	732	6.6 ± 2.6

Abbreviations: ASCVD, atherosclerotic cardiovascular disease; BMI, body mass index; HbA1c, hemoglobin A1c; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SD, standard deviation.

Results

A total of 812 participants were included. The majority of participants were women (51.7%). Averaged values for cardiometabolic parameters are shown in ►**Table 1**. Hb1Ac values were available in 290 (35.7%) participants. Furthermore, ASCVD risk score in 10 years and ASCVD risk factor optimization were calculated in 327 (40.3%) participants. The mean ASCVD risk score in 10 years was 8.1% (SD ± 10.5), and the mean ASCVD risk factor optimization % was 2.0% (SD ± 2.5). The mean lifelong risk score was 39.5% (SD ± 13.9), and the mean ASCVD lifelong risk factor optimization was 6.6% (SD ± 2.6). The ASCVD lifelong risk scores and factor optimization were available in 89.6 and 90.1% of the participants, respectively.

►**Table 2** shows the risk factors of the participants. Only 42 (5.2%) participants had the pre-existing cardiac disease at the time of inclusion. Out of the 42, 36 participants had information according to the type of cardiac disease: unknown ($n = 8$), valvular ($n = 4$), CAD ($n = 2$), cardiomyopathy ($n = 2$), congenital ($n = 2$), decreased ejection fraction ($n = 2$), and ischemic heart disease ($n = 2$). The remaining participants had other types of cardiac disease, as shown in ►**Table 2**. Smoking history was noted in 20.4% of participants, and 6.9% claimed to be past smokers. The mean duration of years since smoking cessation was 7.3. A family history of premature CVD was found in 149 participants (18.9%), followed by hypertension (11.7%), T2DM (10.0%),

Table 2 Risk factors of participants

Risk factor	*n*	Percentage (%)
Type of cardiac disease		
Four-vessel disease post-CABG	1	0.1
Atrial fibrillation	1	0.1
Arrhythmia	1	0.1
Arrhythmia with ICD	1	0.1
CAD	2	0.2
Cardiac dysfunction	1	0.1
Cardiomyopathy	2	0.2
Chest pain	1	0.1
Congenital	2	0.2
Decreased ejection fraction	2	0.2
Endocarditis	1	0.1
ICD, CABG	1	0.1
IHD	2	0.2
LBBB	1	0.1
MI	1	0.1
MI S/P CABG	1	0.1
RED	1	0.1
Right bundle branch block	1	0.1
Status post-PCI	1	0.1
Unknown	8	1.0
Valvular disease	4	0.4
Cardiac disease	42	5.2
Smoking history		
Current smoker (1)	162	20.4
Nonsmoker (2)	576	72.6
Past smoker (3)	55	6.9
Years since quitting (mean [min-max])	54	7.3 (0-30)
Cigarette pack/day (mean [min-max])	134	1.24 (0.1-10.0)
Family history		
CVD	148	18.9
Hypertension	90	11.7
DMT1	18	2.2
DMT2	81	10.0
GDM	10	1.2
Dyslipidemia	79	9.7
Medical history		
DM	109	13.8
Hypertension	109	13.8
Leg swelling	82	11.5
Syncope	38	5.4
Palpitation	158	22.2
NYHA		
1	557	85.3
2	75	11.5
3	18	2.8
4	3	0.5
CCS		
1	610	86.4
2	69	9.8
3	18	2.5
4	7	1.0

Abbreviations: CABG, coronary artery bypass grafting; CCS, Canadian Cardiovascular Society; CVD, cardiovascular disease; DM, diabetes mellitus; DMT1, Type 1 Diabetes; GDM, Guidelines Directed Medical therapy; ICD, implantable cardioverter-defibrillator; IHD, ischemic heart disease; LBBB, left bundle branch block; NYHA, New York Heart Association; PCI, Percutaneous Coronary Intervention.

Table 3 Medications taken by participants

Hypertension	*n*	Percentage (%)
Abrovil 150mg	1	0.1
Amlor	8	0.8
Atacal	1	0.1
Carvedilol	1	0.1
Concor	7	0.7
Cozaar	1	0.1
Exforge	1	0.1
Lopressor	1	0.1
Losartan	1	0.1
Nabila	1	0.1
Natrilix	1	0.1
Tafitain	1	0.1
Unknown	44	5.4
Valsartan	1	0.1
Dyslipidemia		
Atorvastatin	2	0.2
Lipitor	16	1.8
Libthen	1	0.1
Simvastatin	1	0.1
Unknown	34	4.2
Aspirin		
Yes	74	9.6
No	697	90.3
Not sure	1	0.1
Warfarin	1	0.1

and dyslipidemia (9.7%). Regarding personal medical history, palpitation (22.2%) was the most common symptom. A total of 557 (85.3%) participants had dyspnea on more than ordinary activity (New York Heart Association [NYHA 1]), and 75 (11.5%) had dyspnea during ordinary physical activity (NYHA 2). Three participants had dyspnea on minimal activity or at rest (NYHA 4), while most were free of chest pain (Canadian Cardiovascular Society (CCS) class 0). Seven participants had exertional angina. Other symptoms included leg swelling (11.5%) and syncope (5.4%). The prevalence of diabetes and hypertension was equal (13.8%).

►**Table 3** shows the most common medications taken by participants. Aspirin was used by 9.6% of participants. Seventy participants were taking antihypertensive agents, and within this group, 44 could not report the specific type of antihypertensive. Fifty-four participants reported using dyslipidemia drugs, and within this group, 34 could not recall the specific agent. The rest of the medication history is presented in ►**Table 3**.

►**Fig. 1** shows the prevalence of the different cardiometabolic risk factors. The overall prevalence of overweight was 37.3%, with men (40.8%) having a higher prevalence than women (33.9%; $p < 0.05$). However, women had a modestly higher prevalence of obesity than males (42.6 vs. 36.8%, $p = 0.30$). The prevalence of hypertension was significantly higher in men (41.3%) than in women (20.0%; $p < 0.05$), with an overall prevalence of 30.3%. Regarding lipid disorders, the prevalence of participants with total cholesterol levels higher than or equal to 200 mg/dL was 38.3%. The prevalence of participants with serum triglycerides more than or equal to 150 mg/dL was 40.9%, with men (50.3%) having a significantly higher prevalence than women (32.3%; $p < 0.01$). The overall prevalence of elevated LDL-cholesterol was 18.2%. Lastly, the overall prevalence of low HDL cholesterol was

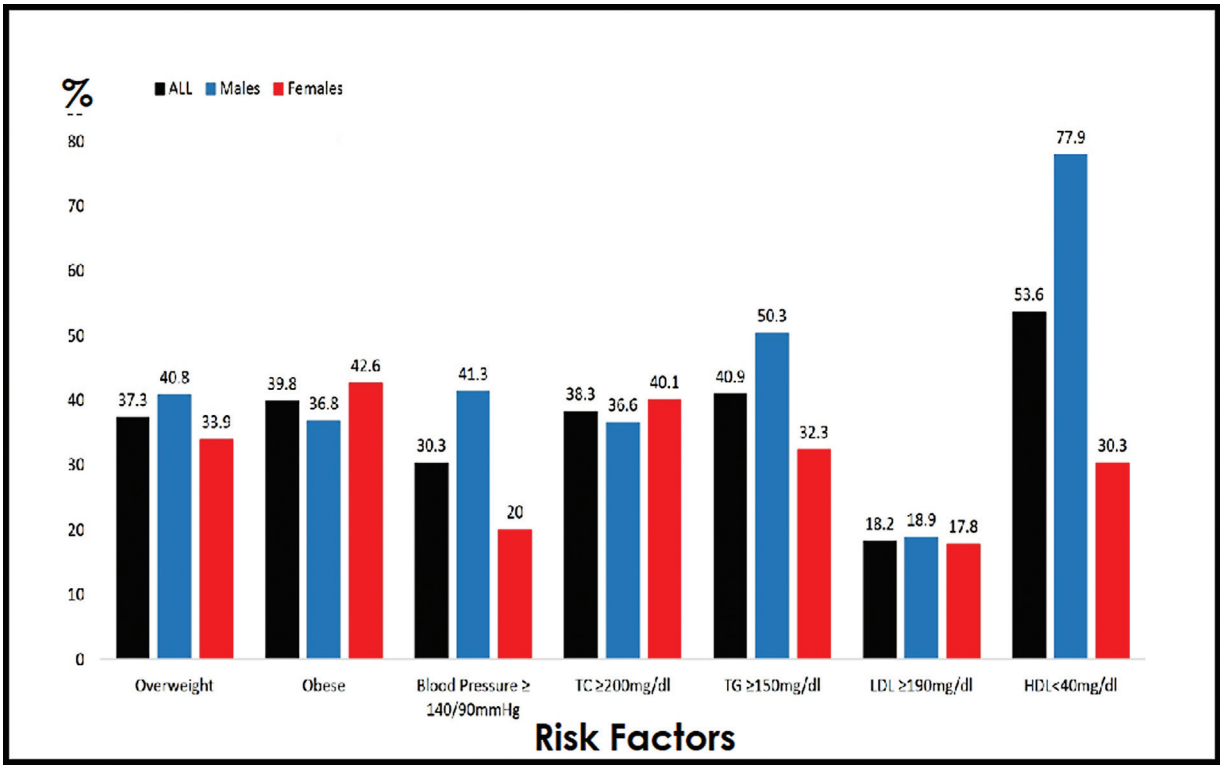

Fig. 1 The prevalence of the different cardiometabolic risk factors.

53.6%. The majority of men had low-HDL cholesterol (77.9%), and it was significantly higher than females (30.3%; $p < 0.01$).

Discussion

This study is unique in a sense that it offers an insight into the prevalence of cardiovascular risk factors and ASCVD risk among a random sample of adults outside a healthcare setting. This study is also one of the few to use the ASCVD risk assessment score.

Among the study's important findings is the high prevalence of most cardiometabolic risk factors, particularly low levels of HDL-cholesterol among men. This is lower than a previous report in Riyadh that demonstrated an alarmingly high prevalence of low levels of HDL-cholesterol at 88.6% compared to 53.6% in this study.[16] The prevalence of low HDL cholesterol in this study might be higher if a different cutoff was used for women since HDL cholesterol levels are affected by gender. Other guidelines have suggested a cutoff of less than 50 mg/dL in women.[17] The overall prevalence of obesity was 39.8%, similar to its prevalence in another report from 2011,[6] suggesting that obesity rates may not have substantially changed over the past decade. This conclusion, however, should be considered in the context of differences in populations and the setting in which each study was conducted.[15]

The mean ASCVD risk score was modest, with an average of 8 and an optimized mean score of 2.0. The choice to use this score was based on its superiority to its predecessor, the Framingham Risk Score, in terms of cardiovascular risk estimation.[18] Furthermore, the ASCVD risk score has not gained momentum for epidemiologic studies in the Arab region, particularly in the KSA. The only study that used the ASCVD risk score within six Gulf Cooperation Council countries observed that those with very high ASCVD risk scores were less likely to be successful in optimizing their lipid levels.[19] Within Saudi Arabia, the ASCVD risk score has been assessed for its superiority over other scores by Abazid et al.[20] Its counterpart, the Framingham risk score, has been used in many local studies.[21–23] While we cannot validate the accuracy of the ASCVD risk score given the retrospective nature of our study, the significant decline in optimized risk suggests a substantial opportunity for lowering the risk of future cardiovascular disease among the general public. Future prospective studies aimed at validating ASCVD risk estimation are needed, as the people from this region needed to be better represented in the derivation cohort of the ASCVD risk score.

Finally, using commercial centers as study sites for medical research offers a practical way to obtain epidemiologic data with an alternative health perspective, given that the target population is more representative of the general public. This data collection method is not unique to our study and has been reported elsewhere.[24]

We acknowledge several limitations. Due to limited resources not, all participants were assessed for HbA1c despite the point-of-care testing. The target population in our study may be somewhat representative of the general Saudi population, including those in a rural setting and lower socioeconomic status. Furthermore, the risk obtained was based on the operational definition of ACC/AHA. It might not reflect the real risk when applied to a different ethnic group, such as Arab adults. While some of the findings confirm previous epidemiologic evidence, the study nevertheless has strengths and including its big sample size, the randomness of participation in shopping centers targeting the general adult public population, and the application of a relatively new risk score in the Saudi population.

In conclusion, this study identified a high prevalence of cardiometabolic risk factors in the general public visiting a commercial center in Jeddah, Saudi Arabia. The leading cardiometabolic risk factor is dyslipidemia in men and obesity in women. The ASCVD risk score is modest in the general adult population and can be optimized significantly. Meanwhile, establishing a local ASCVD risk calculator should be considered in future investigations, and public health awareness in commercial areas across Saudi Arabia should be promoted.

Authors' Contributions

All the named authors have participated in the conception of the study and data analysis. They all contributed to the drafting and revising of the manuscript.

Compliance with Ethical Principles

Ethical approval was obtained from the College of Science, King Saud University, Riyadh, Saudi Arabia

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None.

Conflict of Interest

None declared.

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