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Control of Risk Factors for Cardiovascular Disease among Multinational Patient Population in the Arabian Gulf



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Abstract: We evaluated the control of cardiovascular disease (CVD) risk factors among patients with atherosclerotic cardiovascular disease (ASCVD) in the Centralized Pan-Middle East Survey on the undertreatment of hypercholesterolaemia (CEPHEUS) in the Arabian Gulf. Of the 4398 enrolled patients, overall mean age was 57 ± 11 years, 60% were males, 13% were smokers, 76% had diabetes, 71% had metabolic syndrome and 78% had very high ASCVD risk status. The proportion of subjects with body mass index $<25 \text{ kg/m}^2$, HbA1c $<7\%$ (in diabetics), low-density lipoprotein cholesterol (LDL-C) $<2.6 \text{ mmol/L}$ (100 mg/dL) and $<1.8 \text{ mmol/L}$ (70 mg/dL) for high and very high ASCVD risk cohorts, respectively and controlled blood pressure ($<140/90 \text{ mmHg}$) was 14, 26, 31% and 60%, respectively. Only 1.4% of the participants had all of their CVD risk factors controlled with significant differences among the countries ($P < .001$). CVD risk goal attainment rates were significantly lower in those with very high ASCVD risk compared with those with high ASCVD risk status ($P < .001$). Females were also, generally, less likely to attain goals when compared with males ($P < .001$).

Keywords: Cardiovascular diseases, obesity, blood pressure, diabetes mellitus, non-HDL cholesterol, LDL cholesterol, Arabian Gulf.

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INTRODUCTION

The increase in the cardiovascular disease (CVD)-associated mortality rate in the Middle East is one of the highest in the World [1]. In addition, studies such as the Gulf Registry of Acute Coronary Events (Gulf RACE) and the international case-control analysis of the risk factors for a first myocardial infarction (MI) conducted in >15000 patients in 52 countries (INTERHEART) reported that patients in the Middle East present with heart attacks, 10-12 years earlier than those in Western countries [2, 3].

Some multi-national studies have focused on single CVD risk factor goal attainment [4-6] but others did address several CVD risk factors [7-12]. There is a high prevalence of obesity, diabetes mellitus (DM), metabolic syndrome (MetS), dyslipidaemia and hypertension in the Arabian Gulf [13-20], but data on the control of these factors among the multi-national patient population at high and very high atherosclerotic cardiovascular disease (ASCVD) risk in the region is limited [11, 12].

The objective of this study was to evaluate the control of CVD risk factors among the multi-national patient population with high and very high ASCVD risk status in the Centralized Pan-Middle East Survey on the undertreatment of hypercholesterolaemia (CEPHEUS) in the Arabian Gulf.

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METHODS

The methods have been described [21]. Briefly, the CEPHEUS study was a multi-centre non-interventional survey of patients on lipid lowering drugs (LLDs) in 6 Middle Eastern countries (Saudi Arabia, United Arab Emirates, Oman, Qatar, Bahrain and Kuwait). A total of 5457 patients were enrolled in this survey from outpatient clinics by 177 specialists and primary care physicians. The study was conducted between November 22, 2009 and July 7, 2010. The inclusion criteria were: patients ≥ 18 years of age taking LLDs for ≥ 3 months, with no dose change for a minimum of 6 weeks.

A fasting blood sample was obtained for measurement of total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG), apolipoprotein A1 (Apo A1), apolipoprotein B (Apo B), glucose and glycated haemoglobin A1c (HbA1c). Blood samples were collected in 3 tubes (5 ml in a gel tube, 2 ml in a fluoride tube and 2 ml in an ethylenediaminetetra-acetic acid (EDTA) tube). The blood samples were shipped by air courier and the tests were performed at the King Faisal Specialist Hospital and Research Centre (Riyadh, Saudi Arabia). All the laboratory tests underwent internal and external quality control checks. Criteria for ASCVD risk status was derived from the National Lipid Association (NLA) recommendations for patient-centered management of dyslipidaemia Part 1 – Executive Summary [22]. High risk group included patients with ≥ 3 major ASCVD risk factors, DM (type 1 or 2) with 0-1 other major ASCVD risk factor or LDL-C ≥ 190 mg/dL (5.0 mmol/L) (severe hypercholesterolaemia). The very high risk group included ASCVD and DM with ≥ 2 other major ASCVD risk factors [22].

With regards to body mass index (BMI), classifications were based on international (World Health Organization) reference ranges. Normal weight was < 25 kg/m², overweight was 25-30 kg/m² and obese was > 30 kg/m². As per the recent unified definition by the International Diabetes Federation (IDF) and the American Heart Association/National Heart, Lung and Blood Institute (AHA/NHLBI) using the modified National Cholesterol Education Program – Adult Treatment Panel III (NCEP ATP III) guidelines, MetS was defined as having 3 or more of the following criteria: 1-increased abdominal obesity (waist circumference of ≥ 94 cm for men and ≥ 80 cm for women for Middle Eastern (Mediterranean/European) populations), 2-elevated triglycerides of ≥ 150 mg/dL (1.7 mmol/L), 3-reduced HDL-C of < 40 mg/dL (1.04 mmol/L) for males and < 50 mg/dL (1.3 mmol/L) for females, 4-elevated BP ≥ 130 mmHg for systolic and/or ≥ 85 mmHg for diastolic, and 5-elevated fasting blood glucose of ≥ 100 mg/dL (5.6 mmol/L) [23].

LDL-C targets for the high ASCVD risk patients were < 100 mg/dL (2.6 mmol/L) and < 70 mg/dL (1.8 mmol/L) for those with high and very high ASCVD risk status, respectively [22]. Blood pressure (BP) goals were adapted from the Eighth Joint National Committee (JNC-8) 2014 Hypertension Guideline Management Algorithm. BP goals for those without DM and ≥ 60 years and those < 60 years were $< 150/90$ and $< 140/90$ mmHg, respectively. For those with

DM irrespective of age, the BP goal was $< 140/90$ mmHg [24].

Statistical Analysis

For continuous variables, mean and standard deviation were used to summarize the data. For categorical variables, frequencies and percentages were reported. Differences between groups were analysed using Pearson's χ^2 tests (or Fisher's exact tests for cells < 5). For continuous variables, analyses were performed using univariate ordinary least squares (OLS) regression. An *a priori* two-tailed level of significance was set at 0.05. Statistical analyses were conducted using STATA version 13.1 (STATA Corporation, College Station, TX, USA).

Ethics Approval

This study complied with the Declaration of Helsinki. The study had approval from the internal review bodies/ethics committees of each participating institution. Informed written consent was also obtained from all patients enrolled in the study.

RESULTS

A total of 5457 patients participated in the survey. Laboratory data were missing for 160 patients, 6 patients were underage and 15 patients missed the ASCVD risk level data. Patients with low and moderate ASCVD risk ($n = 878$) were not included in this study. Therefore, the final study sample included 4398 patients.

Table 1 outlines the demographics and clinical characteristics of the cohort. The overall mean age of the cohort was 57 ± 11 years with 60% ($n = 2621$) males and 75% ($n = 3312$) were Arab Gulf citizens. The average BMI was 31 ± 7 kg/m². The proportion of patients with coronary heart disease (CHD), DM and MetS were 37% ($n = 1616$), 76% ($n = 3350$) and 71% ($n = 2948$), respectively. Most of the patients (78%; $n = 3431$) had a very high ASCVD risk status. The majority (94% $n = 4136$) were on statin monotherapy. Patients on statin combination and other dyslipidaemic therapy were 5.0% ($n = 220$) and 1.0% ($n = 42$), respectively.

Table 2 outlines CVD risk factor goal achievements stratified by country and ASCVD risk status. Non-smoking was observed in 87% ($n = 3837$) of the subjects while only a fraction (14%; $n = 598$) of the cohort had normal BMIs (< 25 kg/m²) with significant differences among the countries ($P < .001$). HbA1c $< 7\%$ was achieved in 26% ($n = 868$) of the diabetic patients with the HbA1c control highest in Kuwait (55%; $n = 23$) and lowest in Qatar (20%; $n = 9$) ($P < .001$). LDL-C goal attainment was achieved in 31% ($n = 1348$) of the subjects with significant differences among the countries ($P < .001$); highest in Bahrain (61%; $n = 41$) and lowest in Oman (26%; $n = 103$). Overall BP goal attainment was achieved in 60% ($n = 2622$) of the subjects with significant differences among the countries ($P < .001$). When compared with high ASCVD risk patients, differences in CVD risk goal achievements among the countries were mainly observed in the very high ASCVD risk cohort (all P values $< .001$).

Table 1. Demographic and clinical characteristics of the CEPHEUS cohort stratified by country.

Characteristic	All (n = 4398)	Bahrain (n = 66)	KSA (n = 3259)	Kuwait (n = 46)	Oman (n = 399)	Qatar (n = 97)	UAE (n = 531)	P
Gulf citizen	3312 (75%)	52 (79%)	2614 (80%)	38 (83%)	398 (99%)	8 (8.3%)	202 (38%)	<.001
Male, n (%)	2621 (60%)	52 (80%)	1854 (57%)	12 (26%)	207 (52%)	92 (95%)	404 (76%)	<.001
Age, mean ± SD, years	57±11	56±7	56±11	57±12	58±12	56±12	58±11	<.001
Weight, mean ± SD, kg	82±17	84±19	83±17	86±22	76±18	80±15	81±16	<.001
Waist, mean ± SD, cm	104±14	102±13	105±14	105±16	102±13	101±11	101±12	<.001
BMI, mean ± SD, kg/m ²	31±7	30±6	32±7	34±9	31±7	28±5	30±6	<.001
BMI ≥30 kg/m ² , n (%)	2323 (53%)	27 (41%)	1835 (56%)	29 (63%)	203 (52%)	28 (29%)	201 (38%)	<.001
Smoking, n (%)	561 (13%)	13 (20%)	455 (14%)	3 (6.5%)	17 (4.3%)	11 (11%)	62 (12%)	<.001
Hypertension, n (%)	3075 (70%)	58 (88%)	2195 (67%)	34 (74%)	307 (77%)	56 (58%)	425 (80%)	<.001
Coronary heart disease	1616 (37%)	43 (65%)	898 (28%)	7 (15%)	177 (44%)	87 (90%)	404 (76%)	<.001
Peripheral artery disease	149 (3.4%)	0	117 (3.6%)	0	15 (3.8%)	6 (6.2%)	11 (2.1%)	.092
Cardiovascular disease	192 (4.4%)	4 (6.1%)	132 (4.1%)	3 (6.5%)	30 (7.5%)	2 (2.1%)	21 (4.0%)	.030
Diabetes mellitus	3350 (76%)	40 (61%)	2672 (82%)	42 (91%)	246 (62%)	45 (46%)	305 (57%)	<.001
Metabolic syndrome	2948 (71%)	43 (74%)	2287 (73%)	32 (70%)	252 (65%)	51 (56%)	283 (63%)	<.001
<i>ASCVD risk status</i>								
High risk	967 (22%)	9 (14%)	810 (25%)	9 (20%)	83 (21%)	5 (5.2%)	51 (9.6%)	<.001
Very high risk	3431 (78%)	57 (86%)	2449 (75%)	37 (80%)	316 (79%)	92 (95%)	480 (90%)	<.001
<i>Dyslipidaemic therapy</i>								
Statin monotherapy	4136 (94%)	62 (94%)	3064 (94%)	43 (93%)	383 (96%)	89 (92%)	495 (93%)	.510
Atorvastatin	1786 (43%)	6 (9.7%)	1389 (45%)	40 (93%)	0	66 (74%)	285 (58%)	<.001
Rosuvastatin	486 (12%)	45 (73%)	257 (8.4%)	1 (2.3%)	23 (6.0%)	7 (7.9%)	153 (31%)	<.001
Simvastatin	1792 (43%)	8 (13%)	1378 (45%)	2 (4.7%)	359 (94%)	5 (5.6%)	40 (8.1%)	<.001
Statin combination	220 (5.0%)	4 (6.1%)	171 (5.3%)	1 (2.2%)	8 (2.0%)	5 (5.2%)	31 (5.8%)	.095
Others	42 (1.0%)	0	24 (0.7%)	2 (4.4%)	8 (2.0%)	3 (3.1%)	5 (0.9%)	.006
<i>Lipid levels on treatment, mean ± SD, mmol/L, unless specified otherwise</i>								
LDL-C	2.53±0.94	1.90±0.63	2.59±0.93	2.35±0.68	2.68±1.03	2.13±0.81	2.20±0.84	<.001
HDL-C	1.15±0.31	1.10±0.26	1.17±0.31	1.18±0.33	1.14±0.31	0.99±0.25	1.08±0.30	<.001
Apo B, g/L	0.91±0.27	0.76±0.21	0.93±0.27	0.87±0.18	0.95±0.29	0.85±0.26	0.83±0.25	<.001
Non-HDL-C	3.15±1.09	2.47±0.67	3.21±1.09	3.08±0.84	3.30±1.18	2.85±0.94	2.80±0.98	<.001
TG	1.74±1.26	1.52±0.70	1.80±1.30	1.65±1.01	1.54±1.40	1.73±1.18	1.55±0.93	<.001
<i>Blood pressure, mean ± SD, mmHg, unless specified otherwise</i>								
Systolic blood pressure	133±18	139±18	132±18	125±16	140±22	130±18	132±18	<.001
Diastolic blood pressure	79±10	77±10	79±10	78±10	77±11	75±9	78±11	<.001

Abbreviations: SD, standard deviation; BMI, body mass index; ASCVD, atherosclerotic cardiovascular disease; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; Apo B, apolipoprotein B; TG, triglycerides.

Criteria for ASCVD risk status was adapted from the National Lipid Association criteria²² for atherosclerotic cardiovascular disease. High risk group included patients with ≥3 major ASCVD risk factors, diabetes mellitus (type 1 or 2) with 0/1 major ASCVD risk factor and LDL-C ≥190 mg/dL (5.0 mmol/L) (severe hypercholesterolaemia). Very high ASCVD risk group included those with coronary heart disease, peripheral artery disease, cerebrovascular disease and diabetes mellitus with ≥2 other major ASCVD risk factors.

Age (n=8), gender (n=14), weight (n=4), BMI (n=15), metabolic syndrome (n=227), Apo B (n=14), TG (n=1) and blood pressure (n=8) were missing in some subjects.

Table 2. Cardiovascular risk factors goal achievements stratified by country and ASCVD risk status.

Characteristic	Overall (N = 4398)	Bahrain (n = 66)	KSA (n = 3259)	Kuwait (n = 46)	Oman (n = 399)	Qatar (n = 97)	UAE (n = 531)	P
No smoking, n (%)	3837 (87%)	53 (80%)	2804 (86%)	43 (93%)	382 (96%)	86 (89%)	469 (88%)	<.001
In high ASCVD	848 (88%)	5 (56%)	714 (88%)	9 (100%)	77 (93%)	3 (60%)	40 (78%)	.001
In very high ASCVD	2989 (87%)	48 (84%)	2090 (85%)	34 (92%)	305 (97%)	83 (90%)	429 (89%)	<.001
BMI, <25 kg/m ²	598 (14%)	13 (20%)	365 (11%)	5 (11%)	72 (18%)	28 (29%)	115 (22%)	<.001
In high ASCVD	98 (10%)	1 (11%)	76 (9.4%)	1 (11%)	13 (16%)	1 (20%)	6 (12%)	.318
In very high ASCVD	500 (15%)	12 (21%)	289 (12%)	4 (11%)	59 (19%)	27 (30%)	109 (23%)	<.001
HbA1c, <7%, in diabetics only	868 (26%)	13 (32%)	651 (24%)	23 (55%)	75 (31%)	9 (20%)	97 (32%)	<.001
In high ASCVD	156 (27%)	n/a	141 (27%)	5 (56%)	7 (22%)	0	3 (21%)	.343
In very high ASCVD	712 (26%)	13 (32%)	510 (24%)	18 (55%)	68 (32%)	9 (20%)	94 (32%)	<.001
LDL-C goal attainment	1348 (31%)	41 (62%)	926 (28%)	14 (30%)	103 (26%)	41 (42%)	223 (42%)	<.001
In high ASCVD	445 (46%)	7 (78%)	369 (46%)	4 (44%)	37 (45%)	2 (40%)	26 (51%)	.501
In very high ASCVD	903 (26%)	34 (60%)	557 (23%)	10 (27%)	66 (21%)	39 (42%)	197 (41%)	<.001
BP goal attainment	2622 (60%)	31 (48%)	1933 (59%)	29 (63%)	217 (55%)	70 (74%)	342 (64%)	.001
In high ASCVD	723 (71%)	5 (56%)	624 (77%)	6 (67%)	51 (62%)	1 (20%)	36 (71%)	.002
In very high ASCVD	1899 (55%)	26 (47%)	1309 (53%)	23 (62%)	166 (53%)	69 (77%)	306 (64%)	<.001

Abbreviations: ASCVD, atherosclerotic cardiovascular disease; BMI, body mass index; LDL-C, low-density lipoprotein cholesterol; BP, blood pressure.

Criteria for ASCVD risk status was adapted from the National Lipid Association criteria²² for atherosclerotic cardiovascular disease. High risk group included patients with ≥ 3 major ASCVD risk factors, diabetes mellitus (type 1 or 2) with 0/1 major ASCVD risk factor and LDL-C ≥ 190 mg/dL (5.02 mmol/L) (severe hypercholesterolemia). Very high risk group included ASCVD (coronary heart disease, peripheral artery disease, cerebrovascular disease) and diabetes mellitus with ≥ 2 other major ASCVD risk factors. Therapeutic lipoprotein targets for the high ASCVD risk patients were LDL-C < 2.6 mmol/L (100 mg/dL) and LDL-C < 1.8 mmol/L (70 mg/dL) for the very high ASCVD risk patients.

BP goals were adapted from the new JNC-8 2014 Hypertension Guideline Management Algorithm.²³ BP goals for those without diabetes mellitus (DM) and ≥ 60 years and those < 60 years were $< 150/90$ mmHg and $< 140/90$ mmHg, respectively. For those with DM irrespective of age, the BP goal was $< 140/90$ mmHg.

BMI (n=15), HbA1c (n=13) and blood pressure (n=8) were missing in some subjects.

Goal attainment rates of the different CVD risk factors (smoking, BMI, HbA1c, LDL-C and BP) stratified by high and very high ASCVD risk patients is outlined in Fig. (1). The number of patients that achieved 1, 2, 3 and 4 goals were (20%; n = 877), (37%; n = 1629), (29%; n = 1283) and (11%; n = 471), respectively. Only 1.4% (n = 61) of the subjects had all the 5 CVD risk factors at goal. Patients with very high ASCVD risk were more likely to make goal if they had only 1 risk factor (23 vs. 8.4%; $P < .001$). However, for those with more CVD risk factors, those with very high ASCVD risk were less likely to attain goal when compared with those with only high ASCVD risk (3 risk factors (27 vs. 38%; $P < .001$) and 4 risk factors (8.7 vs. 18%; $P < .001$)).

Fig. (2) summarizes goal attainment rates (smoking, BMI, HbA1c, LDL-C, and BP) in very high ASCVD risk patients stratified by gender. Males were more likely to attain BMI < 25 kg/m² (18 vs. 9%; $P < .001$), LDL-C (30 vs. 20%; $P < .001$) and BP (58 vs. 53%; $P < .001$) goal achievements when compared with females. Females on the other hand were less likely to smoke (98 vs. 81%; $P < .001$).

Fig. (3) summarizes goal attainment rates (smoking, BMI, HbA1c, LDL-C, and BP) in high ASCVD risk patients stratified by gender. Females were less likely to smoke (98

vs. 76%; $P < .001$). However, males were more likely to attain their BMI target of < 25 kg/m² (14 vs. 7%; $P = .001$).

DISCUSSION

Data on the control of CVD risk factors among the multi-national patient population with high and very high ASCVD risk groups in the Arabian Gulf is scarce [11, 12]. The current study evaluated the CVD risk factors and the goal attainments in a multi-national patient population on LLDs with high and very high ASCVD in the CEPHEUS study in the Arabian Gulf. The prevalence of obesity (> 30 kg/m²), DM, MetS, hypertension and smoking were 53, 76, 41, 70 and 13%, respectively.

Similar findings were observed in the two multi-national studies with patients from the Arabian Gulf [11, 12]. The Africa Middle East Cardiovascular Epidemiological (ACE) study, which surveyed 4378 outpatients (2337 outpatients from 8 countries in Africa, and 2041 outpatients from 6 countries in the Middle East including Saudi Arabia, United Arab Emirates and Kuwait) with intermediate and high risk CVD status, the prevalence of obesity, DM, hypertension and smoking were 37, 25, 43 and 25%, respectively [11]. The Reduction of Atherothrombosis for Continued Health

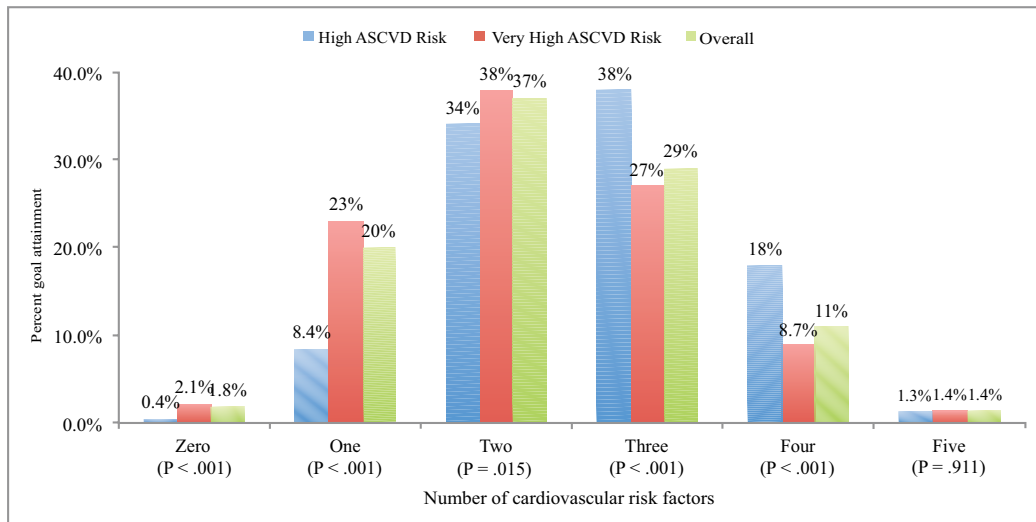


Fig. (1). Overall goal attainment rates of the different cardiovascular risk factors (smoking, BMI, HbA1c, LDL-C, and BP) stratified by atherosclerotic cardiovascular disease (ASCVD) risk status in the Arabian Gulf (N = 4398).

Abbreviations: BMI, body mass index; LDL-C, low-density lipoprotein cholesterol; BP, blood pressure.

Criteria for ASCVD risk status was adapted from the National Lipid Association criteria²² for atherosclerotic cardiovascular disease. High risk group included patients with ≥ 3 major ASCVD risk factors, diabetes mellitus (type 1 or 2) with 0/1 major ASCVD risk factor and LDL-C ≥ 190 mg/dL (5.02 mmol/L) (severe hypercholesterolemia). Very high ASCVD risk group included coronary heart disease, peripheral artery disease, cerebrovascular disease and diabetes mellitus with ≥ 2 other major ASCVD risk factors.

CVD risk factor goal attainments were no smoking, BMI < 25 kg/m², HbA1c $< 7\%$ and LDL-C for the high and very high ASCVD risk patients were LDL-C < 100 mg/dL (2.6 mmol/L) and LDL-C < 70 mg/dL (1.8 mmol/L), respectively.

BP goals were adapted from the new JNC-8 2014 Hypertension Guideline Management Algorithm.²³ BP goals for those without diabetes mellitus (DM) and ≥ 60 years and those < 60 years were $< 150/90$ mmHg and $< 140/90$ mmHg, respectively. For those with DM irrespective of age, the BP goal was $< 140/90$ mmHg.

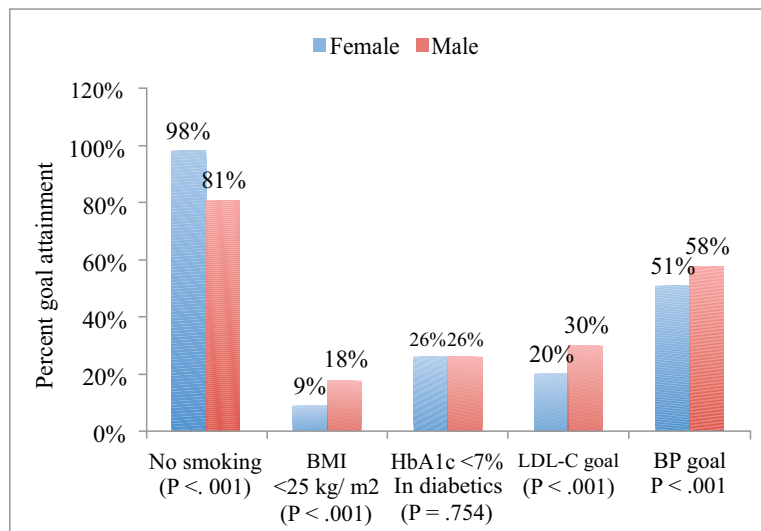


Fig. (2). Overall goal attainment rates (smoking, BMI, HbA1c, LDL-C, and BP) in very high atherosclerotic cardiovascular disease (ASCVD) risk patients stratified by gender in the Arabian Gulf (N = 3431).

Abbreviations: BMI, body mass index; LDL-C, low-density lipoprotein cholesterol; BP, blood pressure.

Criteria for ASCVD risk status was adapted from the National Lipid Association criteria²² for atherosclerotic cardiovascular disease. High risk group included patients with ≥ 3 major ASCVD risk factors, diabetes mellitus (type 1 or 2) with 0–1 major ASCVD risk factor and LDL-C ≥ 190 mg/dL (5.02 mmol/L) (severe hypercholesterolemia). Very high ASCVD risk group included coronary heart disease, peripheral artery disease, cerebrovascular disease and diabetes mellitus with ≥ 2 other major ASCVD risk factors.

CVD risk factor goal attainments were no smoking, BMI < 25 kg/m², HbA1c $< 7\%$ and LDL-C for the very ASCVD risk patients was LDL-C < 70 mg/dL (1.8 mmol/L).

BP goals were adapted from the new JNC-8 2014 Hypertension Guideline Management Algorithm.²³ BP goals for those without diabetes mellitus (DM) and ≥ 60 years and those < 60 years were $< 150/90$ mmHg and $< 140/90$ mmHg, respectively. For those with DM irrespective of age, the BP goal was $< 140/90$ mmHg.

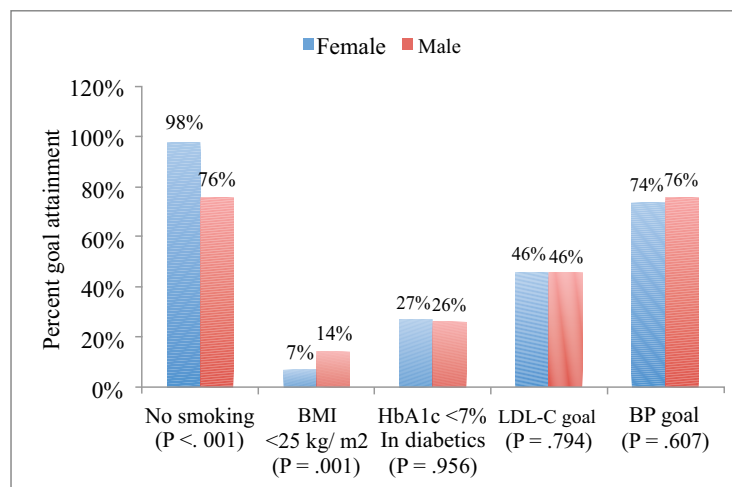


Fig. (3). Overall goal attainment rates (smoking, BMI, HbA1c, LDL-C, and BP) in the high atherosclerotic cardiovascular disease (ASCVD) risk patients stratified by gender in the Arabian Gulf (N = 967).

Abbreviations: BMI, body mass index; LDL-C, low-density lipoprotein cholesterol; BP, blood pressure.

Criteria for ASCVD risk status was adapted from the National Lipid Association criteria²² for atherosclerotic cardiovascular disease. High risk group included patients with ≥ 3 major ASCVD risk factors, diabetes mellitus (type 1 or 2) with 0–1 major ASCVD risk factor and LDL-C ≥ 190 mg/dL (5.02 mmol/L) (severe hypercholesterolemia). Very high ASCVD risk group included coronary heart disease, peripheral artery disease, cerebrovascular disease and diabetes mellitus with ≥ 2 other major ASCVD risk factors.

CVD risk factor goal attainments were no smoking, BMI < 25 kg/m², HbA1c $< 7\%$ and LDL-C for the high ASCVD risk patients was LDL-C < 100 mg/dL (2.6 mmol/L).

BP goals were adapted from the new JNC-8 2014 Hypertension Guideline Management Algorithm.²³ BP goals for those without diabetes mellitus (DM) and ≥ 60 years and those < 60 years were $< 150/90$ mmHg and $< 140/90$ mmHg, respectively. For those with DM irrespective of age, the BP goal was $< 140/90$ mmHg.

(REACH) study was conducted in 68000 patients from 44 countries including 4 Middle Eastern countries from Israel (374 patients), Lebanon (120 patients), Saudi Arabia (196 patients) and the United Arab Emirates (150 patients) in stable outpatients with established CVD or at least 3 risk factors for atherothrombosis [7]. Based on 840 patients from the Middle East, the prevalence of obesity, DM, hypertension and smoking were 38.6, 52.3, 80.2 and 46%, respectively [12]. Although the prevalence of dyslipidaemia in the two previous studies were 70 and 34.1%, respectively, in the current study all the patients were sampled from outpatients with dyslipidaemia and on LLDs.

The most striking findings of this study are the high prevalence of obesity, DM, MetS and hypertension, which are in agreement with other studies carried out in the region [13–19]. In the Gulf RACE project, a multi-national registry of 8176 patients admitted with acute coronary syndromes (ACS) in 6 Arabian Gulf countries, 67% were overweight or obese, 40% of the patients had a history of DM and 46% had MetS [2, 13, 15]. Patients with DM and MetS were more likely to have congestive heart failure [19, 25]. Another finding from the present study is the relatively younger population with very high ASCVD risk, which is consistent with findings from the Gulf RACE and REACH registries in the Middle East [2, 12]. In the Gulf RACE, patients with ACS were a decade or two younger than what had been observed in international registries and younger patients with ACS have a higher relative increase in mortality related to heart failure [2].

The CVD risk factors goal attainments for the overall cohort in the current study were BMI < 25 kg/m² (14%),

HbA1c $< 7\%$ (26%), LDL-C (31%) and BP $< 140/90$ mmHg (60%). Smoking, HbA1c, LDL-C and BP goals were significantly less likely to be attained in the very high ASCVD risk patients when compared with those with high ASCVD risk. The Cepheus study (current study) was associated with better LDL-C target (46 vs. 21%) and BP goal (60 vs. 53%) attainments compared with the regional Gulf RACE study [13]. In the REACH registry in the Middle East, many patients in the overall group had a total cholesterol of > 5.29 mmol/L (30.2%), a BP of $> 140/90$ mmHg (43.5%) or a serum glucose of > 7 mmol/L (37.6%) [12]. In the same study, patients with only CVD risk factors were more likely to have an uncontrolled risk factor than patients with established CVD.

In the current study, women with very high ASCVD risk status were less likely to be smokers and attain their BMI, LDL-C and BP goals than men. In the high ASCVD risk group, women were significantly less likely to attain their BMI goal than men. This may be attributed to several factors like high prevalence of obesity, DM, dyslipidaemia and hypertension in women compared with men in the region [26–29]. In the Gulf RACE and Gulf RACE-2, obesity, hypertension, DM and dyslipidaemia were more prevalent in women than in men and were generally treated less conservatively compared with men [26, 27]. Both the prevalence of these factors and management differences contributed to worse outcomes in women (e.g. in-hospital mortality and heart failure) [26, 27].

Overall, 80% in our study had at least one uncontrolled risk factor and this percentage was even higher in the high ASCVD risk group (90%). This finding is in agreement with the REACH registry in the Middle East [12] where 75.6% in

the overall group had at least one uncontrolled risk factor. This finding highlights the significant gap in controlling CVD risk factors among Arabian Gulf population and therefore further work is needed to overcome the barriers to risk factor control in the triad of patient, physician and healthcare system. Goal attainment of the CVD risk factors may not be achieved because of physician lack of familiarity with treatment goals, inappropriate follow-up, and patient non-adherence with, or intolerance of, medications and the lesser use of evidence-based medications especially in women. There is a high priority need for more education, awareness campaigns for healthcare providers and the public and for screening programs for early identification of risk factors and implementation of healthy life style strategies.

The present analysis has several limitations. The data was collected from patients on LLDs and practice patterns in selected centers that participated in this multi-national study, may not accurately reflect the national trends within the respective countries. In addition, apart from the LLDs, no data were available for the treatment of other CVD risk factors. Furthermore, the findings are limited by the cross-sectional design and reliance on one-time measurements of risk factors, as well as the lack of data on other variables such as social class and diet that may affect CVD risk. In addition, we did not use any verification method for smoking status in this study. Nevertheless, the agreement of the study findings with other studies in the region help validate our results. Further epidemiological studies are needed to estimate the prevalence of CVD risk factors in the region, to observe any changes in prevalence rate over time and to assess the effect of prevention using longitudinal data collection methods that would provide accurate statistics on CVD risk factors prevalence, including details in key population subgroups like women and children [28, 29].

CONCLUSION

A large proportion of patients in the Arabian Gulf are uncontrolled in terms of CVD risk factors, especially in women and in those with very high ASCVD risk status. The findings highlight the significant gaps in controlling CVD risk factors among the Arabian Gulf population. More work is needed to overcome the barriers to risk factor control in the triad of patient, physician and healthcare system.

CONFLICT OF INTEREST

The authors disclose that they have no significant relationships with or financial interests in any commercial companies related to this study or article.

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