The Epidemiology of Acute Coronary Syndrome in Oman

Results from the Oman-RACE study

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ABSTRACT: Objectives: This study aimed to evaluate the epidemiology and coronary risk factors of acute coronary syndrome (ACS) in Oman. Methods: Data were collected through a prospective, multinational, multicentre survey of consecutive patients, hospitalised over a 5-month period in 2007 with a diagnosis of ACS, in Yemen and five Arabian Gulf countries (Oman, Bahrain, Kuwait, Qatar, United Arab Emirates). Here we present data of Omani patients aged ≥20 years who received a provisional diagnosis of ACS and were consequently admitted to 14 different hospitals. Results: There where 1,340 confirmed ACS episodes in 748 men and 592 women (median age 61 years). The overall crude incidence rate of ACS was 338.9 per 100,000 person-years (P-Y). The age-standardised rate (ASR) of ACS was 779 and 674 per 100,000 P-Y for men and women, respectively. The ASR male-to-female rate ratio was 100,000:748:592≥20 years who received a provisional diagnosis of ACS and were consequently admitted to 14 different hospitals. This paper provides nationwide population-based incidence rates of acute coronary syndrome in a large prospective cohort recruited from multiple centres in Oman.

Advances in knowledge
- This paper provides nationwide population-based incidence rates of acute coronary syndrome in a large prospective cohort recruited from multiple centres in Oman.
- A comparable methodology was used, assessing the Oman population and other Arab, Asian, and European populations.

Keywords: Acute coronary syndrome; Incidence; Cardiovascular disease; Ischemic heart disease; Risk factors; Oman.
Current evidence indicates that cardiovascular diseases (CVD) make the largest contribution to mortality in most developing countries. Of all CVD, ischaemic heart disease (IHD) is the single largest cause of death in such nations. Worldwide, IHD was the second and third leading cause of disability-adjusted life years lost in men and women in 2002, respectively. Although rates of IHD have fallen by up to 70% in the past three decades in some industrialised countries, it is likely to remain as the undisputed leading cause of death globally until the year 2030.

Since the early 1990s, CVDs have been the leading cause of in-patient mortality in Oman. In 2006, IHD was Oman’s leading cause of morbidity and fourth cause of mortality among patients aged 45-60 years. Although clinical management patterns of acute coronary syndrome (ACS) have been reported in Oman, to the best of our knowledge, the epidemiology of IHD and/or ACS has not been studied. Through a joint collaborative effort, the Gulf Registry for Acute Coronary Events (Gulf RACE) was established in 2006 to study such events in five Arabian Gulf countries and Yemen. The aim of this registry was to estimate the incidence of ACS in the participating countries, the distribution of CVD risk factors among affected patients, and types and practice patterns for the management of ACS. This study details the epidemiology and coronary risk factors of ACS patients throughout Oman.

Methods

The Gulf Registry of Acute Coronary Events (Gulf RACE) study was organised as a prospective, multinational, multicentre survey of consecutive patients over 20 years-old who had been hospitalised with the final diagnosis of acute coronary syndrome (ACS) in Yemen and five Arabian Gulf countries—Oman, Bahrain, Kuwait, Qatar, and the United Arab Emirates (UAE)—over a period of 6 months. The pilot phase lasted throughout May 2006 and is described in detail elsewhere. Enrolment for the study itself commenced on 29 January 2007, and continued for 5 months. An attempt was made to include all admissions that had been given a provisional diagnosis of ACS with no exclusion criteria. Patients who were admitted for non-ACS causes to general wards but later developed ACS in hospital were also included in the study. Of the 16 requested centres (15 secondary and one tertiary care hospital, all with facilities to manage ACS patients), 14 participated in the registry and enrolled patients according to the survey’s inclusion criteria. The study thus covered at least 85% of the total population of Oman. Ethical approval for the study was granted by the national or institutional ethical bodies in all participating countries.

During the study period, all recruiting hospitals managed their patients independently. However, patients were referred to Royal Hospital in Muscat, the capital of Oman, on an emergency basis for primary angiography and/or angioplasty. Study forms initiated in the parent institution, or secondary care hospital, were sent with patients during transfer to the Royal Hospital to complete data collection procedures and avoid duplicate reporting. All medical services, including ACS management, are provided free of charge to Omani nationals throughout government institutions in the country.

Data collected included patient demographics, past medical history, provisional diagnosis on admission, final discharge diagnosis, clinical features at hospital presentation, electrocardiogram (ECG) findings, laboratory investigations, medications administered within 24 hours of admission and those prescribed on discharge, use of cardiac procedures and interventions, inhospital outcomes, and in-hospital mortality. All management decisions were at the discretion of the treating physician. The external auditor visited 20% of the centres where filled forms and source documents (i.e. patients’ case notes) were inspected to verify that data collected in the case report form matched source documents. No attempt was made to validate the accuracy of discharge diagnosis of...
Diagnosis of the different types of ACS and definitions of data variables were based on the American College of Cardiology clinical data standards published in December 2001. These definitions are based on clinical presentations, ECG findings, and cardiac biomarkers. The biomarkers were measured locally at each hospital’s laboratory using its own assays and reference ranges. Only two centres used troponin (T) as routine assays in the diagnosis of myocardial injury. Body mass index (BMI) was used to characterise overweight (BMI 25–29.9 Kg/m²) or obese patients (BMI ≥30 Kg/m²). A waist circumference ≥94 cm in males and ≥80 cm in females was considered abnormal. Diagnosis of diabetes mellitus (DM) was based on past diagnosis by a physician, intake of anti-diabetic medications, or post-admission fasting plasma glucose (FPG) values using the 1999 diagnostic criteria recommended by the World Health Organization (WHO). Hypertension was diagnosed if systolic and/or diastolic arterial blood pressure exceeded 130/85 mmHg, or if a patient was on anti-hypertensive medication. Subjects were classified as having high total cholesterol if fasting levels exceeded 5.2 mmol/L; hypertriglyceridaemia if levels exceeded 1.69 mmol/L, and/or abnormal levels of high density lipoproteins if levels were <1.04 in males and <1.29 mmol/L in females.

Data were entered in Epi Info, Version 6 (Centers for Disease Control, Atlanta, Georgia, USA). Categorical variables were presented as a number of cases and percentages and compared using the chi-square test. The K-sample equality-of-medians test was used to examine differences between groups of median age. Incidence rates of coronary events were calculated from index episodes during the study period using the mid-year 2007 population estimates for Oman obtained from the Omani Ministry of National Economy. To facilitate comparisons with other published rates, age-standardised incidence rates (ASR) were calculated by direct method within 10-year bands for ages 20 years and above, using the world standard population. For comparisons with World Health Organization - Monitoring Trends and Determinants in Cardiovascular Disease (WHO-MONICA), MONICA age weights in the 5-year age bands for ages 35–64 years were used. A 95% confidence interval (CI) for ASR ratio (RR) was calculated using the standard error of the natural logarithm of the RR. Observed differences were expressed as P values. A value of P <0.05 was considered statistically significant. Analyses were performed with Intercooled Stata, version 9.1 (Stata Corporation, Texas, USA) and Microsoft Excel 2003 (Microsoft Corporation, Redmond, Washington, USA). Completeness of data was 98% for all the analysed variables. Patients with a diagnosis of left bundle branch block (n = 9) were grouped with the ST-elevation myocardial infarction (STEMI) patients.

Results

The baseline characteristics of the ACS patients enrolled in the study are given in Table 1. Over the 153-day recruitment period, 1,340 cases of ACS were reported with complete core data. The median age of ACS patients was 61 years (males 60 years and females 61 years; P = 0.39). Among the risk factors, a high prevalence of hypertension (56%), DM (38.2%), and hyperlipidaemia (36.4%) was reported on admission. When fasting blood sugar, blood pressure, and total cholesterol were measured 24 hours post-admission, there was a significant increase in the detection of hypertension (56–69%; P <0.01) and hyperlipidaemia (36.4–63.3%, P <0.01). The prevalence of DM was around 32% using random blood sugar, and increased to 46% when using fasting plasma glucose levels in patients with STEMI (P <0.01). One-half to two-thirds of ACS patients were either overweight or obese according to WHO criteria. Current tobacco use was relatively low (11.1%).

Of the total ACS patients, 741 (55.3%) were discharged from hospitals with unstable angina, 345 (25.7%) with non-ST elevation myocardial infarction (NSTEMI) and 254 (18.9%) with STEMI [Table 1]. Unstable angina was also the most common diagnosis across all 10-year age strata, followed by NSTEMI and STEMI. Patients with unstable angina and NSTEMI were more likely to report a medical history of percutaneous coronary intervention, DM, hypertension, and hyperlipidaemia. On the other hand, STEMI patients were more likely to be current tobacco users. Women were more likely to present with unstable angina compared to men (54% versus 46%, P <0.03) [Table 2], while men were twice as likely to present with STEMI and NSTEMI compared to
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Table 2 demonstrates the crude and ASR of incidence of ACS in Oman in patients aged 20 years and above, and in a subgroup aged 35–64 years. The period of case ascertainment (5 months) encompassed 395,389 person-years (P-Y) of observations in 748 men and 592 women (all Omanis) with episodes of ACS. The overall crude incidence of ACS was 338.9 per 100,000 P-Y. The ASR of ACS was 779 and 674 per 100,000 P-Y for men and women, respectively. The ASR of ACS were significantly higher in men than women with
Clinical and Basic Research | 47

Table 2: Crude and age-standardised annual incidence rates (all per 100,000 person-years) of acute coronary syndrome and its components in Omani men and women aged 20 years and above (Oman RACE study, 2006)

<table>
<thead>
<tr>
<th>Age group</th>
<th>All ACS</th>
<th>STEMI</th>
<th>NSTEMI</th>
<th>Unstable Angina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (20+ years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of cases</td>
<td>748</td>
<td>184</td>
<td>224</td>
<td>340</td>
</tr>
<tr>
<td>P-Y</td>
<td>198,324</td>
<td>198,324</td>
<td>198,324</td>
<td>198,324</td>
</tr>
<tr>
<td>Crude rate (95% CI)</td>
<td>377.2 (350.6 to 405.1)</td>
<td>92.8 (79.9 to 107.2)</td>
<td>112.9 (98.6 to 128.8)</td>
<td>171.4 (153.7 to 190.6)</td>
</tr>
<tr>
<td>ASR (95% CI)</td>
<td>779.7 (723.2 to 836.2)</td>
<td>184.9 (164.6 to 221.5)</td>
<td>239.5 (200.5 to 262.3)</td>
<td>355.3 (723.2 to 836.2)</td>
</tr>
</tbody>
</table>

| Female (20+ years) | | | | |
| No. of cases | 592 | 70 | 121 | 401 |
| P-Y | 197,065 | 197,065 | 197,065 | 197,065 |
| All crude (95% CI) | 300.4 (276.7 to 325.6) | 35.5 (27.7 to 44.9) | 61.4 (50.9 to 73.4) | 203.5 (184.1 to 224.4) |
| All ASR (95% CI) | 674.3 (619.5 to 729.1) | 81.7 (64.1 to 103.8) | 142.2 (114.7 to 165.3) | 450.4 (619.5 to 729.1) |

| Male (35-64 years) | | | | |
| No. of cases | 448 | 139 | 103 | 206 |
| Person-years | 63,543 | 63,543 | 63,543 | 63,543 |
| ASR for ages 35–64 | 835.0 (757.3 to 912.8) | 189.7 (152.6 to 226.8) | 256.9 (213.7 to 300.2) | 388.3 (335.0 to 441.7) |

| Females (35-64 yrs) | | | | |
| No. of Cases | 350 | 39 | 241 |
| P-Y | 64,644 | 64,644 | 64,644 | 64,644 |
| ASR for ages 35–64 | 691.6 (618.7 to 764.5) | 81.1 (55.5 to 106.7) | 138.9 (106.0 to 171.7) | 471.6 (411.4 to 531.7) |

| Male:Female Rate ratio, 20+ years (95% CI) | 1.16 (1.01 to 1.32) | 2.26 (1.63 to 3.15) | 1.68 (1.28 to 2.21) | 0.79 (0.66 to 0.99) |
| Rate ratio, 35–64 years (95% CI) | 1.21 (1.01 to 1.45) | 2.34 (1.47 to 3.73) | 1.85 (1.28 to 2.68) | 0.82 (0.65 to 1.05) |

ACS = acute coronary syndrome; STEMI = ST-elevation myocardial infarction; NSTEMI = Non ST-elevation myocardial infarction; P-Y = person-years; ASR = age-standardised rate; CI = confidence interval.
For age-standardising, see reference no. 13.

Discussion
We provide the first age-standardised population-based incidence rates of ACS and associated risk factors in Oman. The ASR of ACS in Omani men (779, women 674 per 100,000 P-Y) were similar to rates reported among Palestinian Arabs of Jerusalem (796 and 503 per 100,000 men and women P-Y, respectively).17 These incidence rates are markedly higher than those reported in industrialised nations such as Denmark (men 331 and women 137 per 100,000 P-Y), Greece (both genders 226 per 100,000 P-Y), and France (men 262 and women 55 per 100,000 P-Y), thus confirming the double burden of already existing communicable diseases and the present non-communicable diseases in
middle and low-income developing countries. Notwithstanding the differences in the definitions of coronary events between the present study and the MONICA populations studied between 1981 and 1995, the coronary event incidence rate in Omani men aged 35–64 years (835 per 100,000 P-Y) are comparable to the highest rates recorded in the MONICA project (907 per 100,000 P-Y among Finnish men). Similarly, in the 35–64 year old cohort, the incidence rate of ACS among Omani women (692 per 100,000 P-Y) was more than double the rate in their Scottish counterparts in the UK (241 per 100,000 P-Y), although, the latter was the highest rate reported among MONICA women. When compared with other Arabs in the same age group of 35–64 years, the ACS incidence rate among Omani surpassed the rate reported in Palestinian men (799 per 100,000 P-Y) while the rate in Omani women was three times the rate in Palestinian women (234 per 100,000 P-Y).

The high incidence of ACS among Omaniis (and other Arab ethnic groups) may stem from greater susceptibility and excess exposure to established CVD risk factors. In Asian populations, morbidity and mortality appear to occur at lower cut-off point values for some CVD risk factors such as BMI and waist circumference than in Caucasians, possibly indicating greater susceptibility at a lower threshold for adverse health outcomes. In our study, Omani patients appeared to experience ACS at an earlier age (mean 60.7 years; median 61 years) than their counterparts from Europe, Australia, the United States, and Brazil (median range 63.4–68.1) by an average of 2 to 7 years. The difference in age can extend up to 11 years if compared with Europeans with unstable angina. Arab patients with ACS from other countries were also reported to be younger (mean age: Saudi Arabia 57.1, Kuwait 56.7, and Palestine 57.9). The INTERHEART study also showed Arab patients to be a decade younger at presentation with acute myocardial infarction than Europeans, Chinese, or Latin American patients. The earlier onset of ACS in Arabs has not been studied systematically. However, greater susceptibility to CVD risk factors may be implied, in a similar way suspected to occur among South Asians through genetic differences or a mismatch of metabolic processes during early or middle age. Other findings like low levels of high density lipoproteins and a lack of regular physical activity among Omaniis may have contributed further to their susceptibility to adverse coronary outcomes.

Our study’s main strength lies in the fact that it is the first to provide nationwide estimates of incidence and risk factors of ACS in a large prospective cohort recruited from multiple centres in Oman using a methodology comparable with other Arab Gulf states. On the other hand, the lack of a vital registration system within the country implies that sudden cardiac deaths due to ACS could not be estimated and thus are not included in the current incidence estimates presented here. Further, due to limited resources, out of 1,340 patients, T assays were used in less than 21% (277 patients) to diagnose myocardial injury. However, this is unlikely to have biased results towards the under-diagnosis of STEMI and NSTEMI as proportions of the later two in Oman are similar (42% and 58%, respectively) to the overall Gulf-RACE (39% and 61%, respectively) and Gulf-RACE 2 (46% and 54%, respectively) studies after discarding results from unstable angina patients. Finally, comparison data were presented with MONICA cohorts in spite of changes of some diagnostic criteria and temporality between the two studies, mainly due to wide use of T assays in the current survey.

Conclusion

The incidence of ACS among Omani is one of the highest in the world and flags up an impending CVD epidemic that is yet to reach its peak. The need to address root causes of established CVD risk factors could not be more urgent. Health reforms and prevention strategies are needed to counter a CVD epidemic, with a particular focus on reducing the high number of preventable risk factors.

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References


