Prevalence, Predictors, and Impact of Low High-Density Lipoprotein Cholesterol on in-Hospital Outcomes Among Acute Coronary Syndrome Patients in the Middle East

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Abstract: Objective: To estimate the prevalence, predictors, and impact of low high-density lipoprotein cholesterol (HDL-C) on in-hospital outcomes among acute coronary syndrome (ACS) patients in the Middle East.

Methods: Data were collected prospectively from 6,266 consecutive patients admitted with a diagnosis of ACS and enrolled in the Gulf Registry of Acute Coronary Events (Gulf RACE). A low HDL-C was defined as a level <40 mg/dL (1.0 mmol/L) for males and <50 mg/dL (1.3 mmol/L) for females. Analyses were performed using univariate and multivariate statistical techniques.

Results: The overall mean age of the cohort was 56±12 years and majority were males (77%). The overall prevalence of low HDL-C was 62%. During in-hospital stay and at discharge, the majority were on statin therapy (83%) while 10% were on other cholesterol lowering agents. After adjustment of demographic and clinical characteristics, the predictors for low HDL-C were higher body mass index (BMI), prior myocardial infarction (MI), diabetes mellitus, smoking and impaired renal function. Multivariable adjustment revealed that low HDL-C was associated with higher in-hospital mortality (odds ratio (OR), 1.54; 95% CI: 1.06-2.24; p=0.022) and cardiogenic shock (OR, 1.61; 95% CI: 1.20-2.14; p=0.001).

Conclusions: ACS patients in the Middle East have a high prevalence of low HDL-C. Higher BMI, prior MI, diabetes mellitus, smoking, and impaired renal function were predictors of low HDL-C. Significantly higher in-hospital mortality and cardiogenic shock were associated with low HDL-C in men but not in women.

Keywords: High density lipoprotein cholesterol, low density lipoprotein cholesterol, triglycerides, acute coronary syndrome, myocardial infarction, gender, Middle East.

INTRODUCTION

There is consistent epidemiological and clinical evidence showing low high-density lipoprotein cholesterol (HDL-C) to be a strong independent risk factor for coronary heart disease (CHD) [1]. There is also evidence that CHD progression can be attenuated by increasing HDL-C levels [2,3]. In addition, low levels of HDL-C may account for a significant percentage of residual cardiovascular risk in patients with CHD [4-6]. Low HDL-C levels in patients with CHD is frequently associated with metabolic syndrome [7]. Furthermore, the fact that there is no exact definition of optimal plasma HDL-C levels, a threshold of <1.05 mmol/L is likely to be undesirable in patients with CHD or CHD equivalents [8].

To our knowledge, there is scant literature on the subject from the Gulf, with only 1 published study by our group on
the prevalence of low HDL-C in Oman [9]. The Gulf Registry of Acute Coronary Events (Gulf RACE) is a prospective, multi-country, multi-centre registry of consecutive patients hospitalized with the final diagnosis of acute coronary syndrome (ACS) in 6 Arabian Gulf countries over a period of 6 months in 2006 and 2007 [10]. This registry provided a unique opportunity to study the prevalence, predictors, and impact of low HDL-C on in-hospital outcomes among ACS patients in the region.

METHODS

Gulf RACE design and methods have been previously reported [10]. In summary, Gulf RACE was a prospective, multi-national, multi-centre registry of consecutive patients above 18 years of age hospitalized with the final diagnosis of ACS from 65 hospitals in 6 Middle Eastern countries, namely: Oman, United Arab Emirates (UAE), Qatar, Bahrain, Kuwait and Yemen. A pilot phase was conducted from May 8, 2006 to June 6, 2006. Enrolment in the next phase of the registry started in January 29, 2007 and continued for 5 months till June 29, 2007. In Oman, UAE and Yemen, most hospitals (covering at least 85% of the population) participated in the survey. There were no exclusion criteria. The diagnosis of the different types of ACS and definitions of data variables were based on the ACC clinical data standards [11].

Demographic and other baseline clinical and biochemical characteristics of the patients along with statin and other dyslipidemic therapy use were evaluated. Other dyslipidemic therapy included cholesterylamine, colestipol, bezafibrate, fenofibrate, and gemfibrozil. Pre-admission medications, other than the use of aspirin, were not available. Current smoking was defined as smoking cigarettes or water-pipe (sheesha) within 1 month of index admission. A positive family history for CHD was defined as evidence of this disease in a parent, sibling, or children before 55 years of age. Low HDL–C [12,13] was defined as levels of <40 mg/dL (1.7 mmol/L). Institutional review board approval was obtained.

Statistical Analysis

For categorical variables, frequencies and percentages were reported. Differences between groups (low HDL-C status, no/yes) were analyzed using Pearson’s χ2 tests (or Fisher’s exact tests for cells <5). For age, mean and standard deviation were used to summarize the data while analysis was performed using Student’s t-test. For the variables, body mass index (BMI), waist circumference, total cholesterol, LDL-C, and triglycerides, which were abnormally distributed, median and interquartile ranges (IQRs) were used to describe the data and analysis was conducted using the non-parametric Mann–Whitney test.

The association between low HDL-C levels and various predictors was evaluated by multivariate logistic regression model utilizing stepwise-backwise elimination method on the variables on (Table 1). Furthermore, the impact of low HDL-C on various in-hospital outcomes (mortality, cardiogenic shock, re-infarction, re-ischemia, congestive heart failure) was also explored using multivariable logistic regression. Among the predictor variables used in the different models included country, age, gender, prior aspirin use, smoking status, and total cholesterol. The goodness-of-fit of the logistic models was examined using the Hosmer and Lemeshow goodness-of-fit statistic. Based on the χ2 distribution, a Hosmer and Lemeshow statistic with a p > 0.05 is considered a good fit. A 2-tailed level of significance was set at 0.05. Statistical analyses were conducted using STATA version 11.1 (STATA Corporation, College Station, TX).

RESULTS

A total of 8,176 ACS patients were recruited from 63 hospitals in the 6 Middle Eastern Gulf countries. The HDL-C levels were not available for 1,910 patients (23%). The remaining 6,266 patients (77%) represent the sample size for this study. The overall prevalence of low HDL-C was 62% (n=3,854), ranging from 76% in Kuwait to 43% in Yemen. The prevalence of low HDL-C in Oman, UAE, Qatar, and Bahrain was 53, 64, 66 and 59%, respectively. As shown in (Table 1), the mean age of the cohort was 56 ± 12 years. The cohort was mostly male (77%), was associated with higher median BMI (27 [24-30] kg/m2) and waist circumference (95 [86-102] cm), had a significant proportion of patients with hypertension (48%), diabetes (40%), smokers (39%) as well as prior aspirin users (39%). Most of the patients had non-ST-elevation acute coronary syndrome (NSTEMI-ACS) (59%). The cohort was also associated with higher median total cholesterol (4.7 [3.7-5.7] mmol/L) and LDL-C (3.1[2.4-4.0] mmol/L). Furthermore, during in-hospital stay and at discharge, majority of the patients received statin therapy (83%) but only 10% (n=647) received other dyslipidemic therapy. A total of 8% of the patients (n=308/3,854) that had low HDL-C were neither on statin nor other dyslipidemic therapy.

The low HDL-C group, compared with the satisfactory HDL-C cohort, had higher rates of females (29 vs 14%; p<0.001), higher median BMI (27 vs 26 kg/m2; p<0.001), greater waist circumference (95 vs 93 cm; p<0.001), diabetes (44 vs 33%; p<0.001), hypertension (51 vs 43%; p<0.001), prior MI (25 vs 20%; p<0.001), prior percutaneous coronary intervention (PCI) (12 vs 9%; p<0.001), renal impairment (5.6 vs 4.0%; p=0.005) and NSTEMI-ACS (59 vs 41%; p<0.001). The low HDL-C group was also associated with lower median total cholesterol (4.5 vs 5.0 mmol/L; p<0.001), LDL-C (3.1 vs 3.3 mmol/L; p<0.001) as well as higher median triglyceride levels (1.6 vs 1.5 mmol/L; p=0.049).

Adjusting for other factors in the model, the stepwise logistic regression (Table 2) demonstrated that ACS patients in UAE, Qatar, Bahrain and Kuwait were more likely while those in Yemen were less likely to have low HDL-C when compared with those patients from Oman. The model also demonstrated that patients with higher BMI, prior MI, diabetes mellitus, smokers, and renal impairment were more likely to have low HDL-C. However, those that were old, male, and had higher LDL-C and triglyceride levels were less likely to be associated with low HDL-C.

The impact of low HDL-C on in-hospital outcomes revealed that low HDL-C was associated with higher all-cause
mortality (odds ratio (OR), 1.54; 95% CI: 1.06-2.24; p=0.022) and cardiogenic shock (OR, 1.61; 95% CI: 1.20-2.14; p=0.001), compared with the satisfactory HDL-C group. The impact of low HDL-C on other in-hospital outcomes (re-infarction, re-ischemia, congestive heart failure) was not significant (Table 3). Of interest, after gender stratification, the impact of low HDL-C on in-hospital mortality and cardiogenic shock was demonstrated in males and not in females.

DISCUSSION
This study, in 6 Gulf Middle Eastern countries, demonstrated that a high prevalence of low HDL-C existed in patients presenting with ACS in the region. Patients with higher BMI, MI, diabetes mellitus, smoking, and renal impairment were more likely to have low HDL-C. However, those that were old, male, and had higher LDL-C and triglyceride levels were less likely to have low HDL-C. In addition, low HDL-C was associated with higher in-hospital mortality and cardiogenic shock. Furthermore, the study revealed that during in-hospital stay and at discharge, the majority of the patients received statin therapy while very few patients were taking other lipid lowering drugs.

In our study, the prevalence (62%) of low HDL-C in ACS patients was the highest among other reported studies on ACS which ranged from 28 to 57% (Table 4). One possible explanation could be attributed to the high prevalence of metabolic syndrome in the general population in the Gulf states, which is 10-15% higher than in most developed countries [14]. In addition, a high prevalence of metabolic syndrome [7] and obesity [15] in ACS in this region has also been reported.

### Table 1. Demographic, Clinical, and Lipid Characteristics of Study Population Stratified by Level of High Density Lipoprotein Cholesterol (HDL-C)

| Characteristic Unless Specified Otherwise | Satisfactory HDL-C (n=2,412) | Low HDL-C* (n=3,854) | P |
|-------------------------------------------|-------------------------------|----------------------|---|
| Mean age ± SD (years)                     | 56±12                         | 55±12                | 0.002 |
| Male gender                               | 2,063 (86%)                   | 2,744 (71%)          | <0.001 |
| Family history of CAD                     | 329 (14%)                     | 580 (15%)            | 0.122 |
| BMI, median (IQR), kg/m²                  | 26 (24-29)                    | 27 (24-30)           | <0.001 |
| Waist circumference, median (IQR), cm     | 93 (84-100)                   | 95 (88-103)          | <0.001 |
| Diabetes mellitus                         | 805 (33%)                     | 1,696 (44%)          | <0.001 |
| Hypertension                              | 1,049 (43%)                   | 1,975 (51%)          | <0.001 |
| Smoking (including sheesha)               | 952 (39%)                     | 1,478 (38%)          | 0.380 |
| Prior aspirin use                         | 876 (36%)                     | 1,598 (41%)          | <0.001 |
| Past myocardial infarction                | 477 (20%)                     | 964 (25%)            | <0.001 |
| Past PCI                                  | 206 (9%)                      | 476 (12%)            | <0.001 |
| Past CABG                                 | 117 (4.9%)                    | 224 (5.8%)           | 0.102 |
| Stroke                                    | 94 (3.9%)                     | 177 (4.6%)           | 0.188 |
| Renal impairment**                        | 93 (4.0%)                     | 211 (5.6%)           | 0.005 |
| Killip ≥3                                 | 206 (8.5%)                    | 309 (8.0%)           | 0.478 |
| NSTE-ACS                                  | 1,298 (54%)                   | 2,411 (63%)          | <0.001 |
| STEMI                                     | 1,114 (46%)                   | 1,443 (37%)          | <0.001 |
| Total cholesterol, median (IQR), mmol/l   | 5.0 (3.8-6.1)                 | 4.5 (3.6-5.4)        | <0.001 |
| LDL-C, median (IQR), mmol/l               | 3.3 (2.6-4.3)                 | 3.1 (2.4-3.9)        | <0.001 |
| Triglyceride, median (IQR), mmol/l        | 1.5 (1.0-2.5)                 | 1.6 (1.1-2.3)        | 0.049 |
| Initiation of Statin in-hospital          | 2,040 (85%)                   | 3,147 (82%)          | 0.003 |
| Initiation of Other lipid lowering therapy in-hospital | 174 (7.2%) | 473 (12%) | <0.001 |

SD = Standard deviation; CAD = Coronary artery disease; BMI = Body mass index; IQR = Interquartile range; PCI = Percutaneous coronary intervention; CABG = Coronary artery bypass graft surgery; *Low HDL-C was defined as a level <40 mg/dL (1.0 mmol/L) for males and <50 mg/dL (1.3 mmol/L) for females. **Defined as serum creatinine >177 μmol/L (2 mg/dL); NSTE-ACS = Non-ST-segment elevation acute coronary syndrome; STEMI = ST-segment elevation myocardial infarction.

Analyses were conducted using chi-square test, Student’s t-test, or Wilcoxon-Mann-Whitney test, whenever appropriate.
Table 2. Predictors of Low High Density Lipoprotein Cholesterol (HDL-C) Among the Study Cohort Utilizing Step-Wise Back-Wise Multivariable Logistic Regression

| Parameter                  | Odds Ratio | 95% CI       | P       |
|----------------------------|------------|--------------|---------|
| Oman (n = 1,458)           | Ref        | Ref          | Ref     |
| UAE (n = 1,369)            | 2.36       | 1.97-2.83    | <0.001  |
| Qatar (n = 392)            | 2.28       | 1.76-2.96    | <0.001  |
| Bahrain (n = 197)          | 1.45       | 1.02-2.04    | 0.036   |
| Kuwait (n = 1,847)         | 3.38       | 2.84-4.03    | <0.001  |
| Yemen (n = 1,003)          | 0.90       | 0.74-1.08    | 0.254   |
| Age                       | 0.99       | 0.99-0.99    | <0.001  |
| Male                      | 0.30       | 0.26-0.36    | <0.001  |
| Body mass index           | 1.02       | 1.01-1.04    | <0.001  |
| LDL-C                     | 0.86       | 0.82-0.90    | <0.001  |
| Myocardial infarction      | 1.17       | 1.01-1.36    | 0.035   |
| Diabetes mellitus         | 1.20       | 1.06-1.36    | 0.005   |
| Triglycerides              | 0.95       | 0.92-0.98    | 0.001   |
| Smoking                   | 1.21       | 1.06-1.38    | 0.006   |
| Renal impairment*          | 1.56       | 1.16-2.09    | 0.003   |

CI = Confidence interval; UAE = United Arab Emirates; LDL-C = Low-density lipoprotein cholesterol; Renal impairment* = serum creatinine >177 μmol/L (2 mg/dL); The variables that were dropped out of the multivariable logistic regression utilizing stepwise-backwise elimination method included family history of coronary artery disease, waist circumference, coronary artery bypass graft, myocardial infarction, statin use, fibrate/niacin use, ST-elevation myocardial infarction; percutaneous coronary intervention, Killip class score; prior aspirin use, diabetes mellitus and stroke. The logistic model is statistically significant (LR χ²(14) = 797; p<0.001). The Hosmer-Lemeshow chi-square statistic (a measure of the goodness-of-fit) was 10.3 and the p value was 0.244 denoting good model fit.

Table 3. Impact of Low High-Density Lipoprotein Cholesterol (HDL-C) on in-Hospital Outcomes Among Acute Coronary Syndrome Patients in the Middle East

| In-Hospital Outcome          | Odds Ratio | 95% CI       | P       |
|------------------------------|------------|--------------|---------|
| Recurrent ischemia           | 1.17       | 0.96-1.41    | 0.112   |
| Congestive heart failure     | 1.05       | 0.90-1.22    | 0.509   |
| Reinfarction                 | 0.90       | 0.64-1.29    | 0.573   |
| Cardiogenic shock            | 1.61       | 1.20-2.14    | 0.001   |
| Mortality                    | 1.54       | 1.06-2.24    | 0.022   |

CI = Confidence interval; The different covariates in the adjusted multivariable logistic regression models included age, gender, prior aspirin use, smoking, and total cholesterol; all the adjusted models were statistically significant (P<0.001). The models also fit reasonably well (the P values for the Hosmer and Lemeshow statistics were all >.05).

Low HDL-C is a component of metabolic syndrome and seen more commonly with obesity and diabetes [16,17]. In our analysis, patients with higher BMI, and diabetes mellitus, were more likely to have low HDL-C even after adjusting for other factors. Diabetic patients who have low HDL-C levels have cardiovascular event rates greater than those of diabetic patients with normal HDL-C levels [18,19]. There is high prevalence of obesity among the Gulf countries. A previous published report from Gulf RACE revealed that an overall 67% of patients with ACS were overweight or obese and were more likely to be female and have diabetes mellitus. [15] Kato and colleagues [20], showed that among the components of metabolic syndrome, abdominal obesity and low HDL-C levels were more frequently observed in patients with multiple, complex coronary lesions. Therefore, abdominal obesity and low HDL-C are likely to be key factors for coronary plaque vulnerability and may be associated with the poor clinical outcomes of ACS patients. Low HDL-C appears to be potentially a modifiable risk factor for patients

Table 4. Prevalence and Impact of Low High-Density Lipoprotein Cholesterol (HDL-C) on Cardiovascular Outcomes in Hospitalized Patients with Acute Coronary Syndrome

| Author                     | Country | N    | Low HDL-C | Outcomes (Low HDL-C vs Satisfactory HDL-C)        |
|----------------------------|---------|------|-----------|--------------------------------------------------|
| Sachdeva et al. [25]       | USA     | 136,905 | 55%   | n/a                                              |
| Roe et al. [26]            | USA     | 93,263 | 53%   | Significantly higher all-cause hospital mortality |
|                            |         |       |         | Significantly higher risk of multi-vessel coronary disease on angiography |
| Wolfmann et al. [27]       | USA     | 1,032 | 53%   | Significant higher in-hospital mortality         |
|                            |         |       |         | Significant higher major adverse cardiac events |
| Pintó et al. [28]          | Spain   | 367   | 57%   | n/a                                              |
| Arai et al. [29]           | Japan   | 249   | 34%   | Significantly higher incidence of target lesion revascularization |
| Al-Zakwani et al. [9]      | Oman    | 1,458 | 53%   | Significant higher all-cause mortality (2.3 vs 0.6%; adjusted OR = 4.63; p=0.006) |
| Correia et al. [30]        | Brazil  | 97    | 28%   | Significant higher incidence of events (death, non-fatal myocardial infarction or recurrent unstable angina (33 vs 9%; OR = 3.6; p=0.05) |
| Al-Rasadi et al. (present study) | Middle East | 6,266 | 62%   | Significant higher all-cause mortality (2.52 vs 2.36%; adjusted OR = 1.54; p=0.022) |
|                            |         |       |         | Significant higher rate of in-hospital cardiogenic shock (4.49 vs 3.61%; p=0.001) |

n/a = Not available; OR = Odds ratio.
with ACS. Optimization of lifestyle modifications by moderate weight loss (by 5-10%) combined with exercise significantly decrease triglycerides and increase HDL-C levels, consequently improving cardiovascular risk [21].

Low HDL-C has been shown to be associated with a higher risk of cardiovascular events and a greater burden of atherosclerosis, even among patients with controlled LDL-C, including those who are treated with a high dose statins [22,23]. In this context, a meta-analysis by Jafri et al., showed that low levels of HDL-C remain significantly and independently associated with increased cardiovascular risk despite statin treatment [24]. Several other studies [9,25-31] including, our study (Table 3) have reported an association between low HDL-C and higher in-hospital or short-term mortality and adverse cardiac events. In the Can Rapid Stratification of Unstable Angina Patients Suppress Adverse Outcomes with Early Implementation of the American College of Cardiology (ACC)/American Heart Association (AHA) Guideline (CRUSADE) trial [26], around 53% of patients admitted with NSTE-ACS had low HDL-C (<1.0 mmol/L). In this study low HDL-C was independently associated with an increased likelihood of severe coronary disease and in-hospital mortality. Moreover, a study by Correia et al., [30] demonstrated that low levels of HDL-C at admission in individuals with non-ST-elevation ACS predicted recurrent in-hospital events during hospitalization and LDL-C and triglycerides were not associated with cardiovascular events. Similarly, analysis from the Myocardial Ischemia Reduction with Aggressive Cholesterol Lowering (MIRACL) trial [31], showed that despite aggressive lipid lowering with 80 mg of atorvastatin, HDL-C, but not LDL-C influenced short-term prognosis in patients after ACS. Furthermore, in the Japan Assessment of Pitavastatin and Atorvastatin in Acute Coronary Syndrome (JAPAN-ACS) [29], patients with low HDL-C had a significantly higher incidence of target lesion revascularization.

The actual rate of cardiogenic shock in patients with low HDL-C is poorly defined. In the current study, low HDL-C was an independent predictor of cardiogenic shock among ACS patients. Furthermore, Zeller et al., [32] showed that hyperglycemia and low HDL-C levels had the strongest association with severe heart failure and only hyperglycemia was an independent determinant of cardiogenic shock. Since this study is the only published to date, further studies are needed to corroborate this new possible association between low HDL-C and cardiogenic shock.

This study, compared to our previous published study on prevalence of low HDL-C from Oman [9], has looked more into the impact of low HDL-C on in-hospital outcomes after gender stratification because the population is greater (n = 6,266 vs 1,458) and consequently more powered to detect differences on the impact of low HDL-C on in-hospital outcomes than the Oman [9] study. In the current study (n = 6,266), women had a higher prevalence of low HDL-C compared with men (76 vs 57%; p<0.001) despite of no significant differences of in-hospital dyslipidemic therapy other statins, such as fibric acid, nicotinic acid, etc (1.2 vs 0.9%; p=0.473). This is likely related to the high prevalence of obesity and metabolic syndrome among women in the Gulf countries [7,15]. Similarly a published Gulf RACE study on gender differences showed that women had higher rates of other cardiovascular risk factors such as diabetes and hypertension [33]. Moreover in their study, women had higher adjusted in-hospital mortality compared with men. However, in our study, low HDL-C did not correlate with either mortality or cardiogenic shock in women and it is only in men that low HDL-C was significantly related to both mortality and cardiogenic shock.

The clinical benefit of aggressive lowering of LDL-C among patients with ACS has been strongly demonstrated and has been translated into clinical practice [34,35]. Although, the current Adult Treatment Panel III (ATP III) guidelines recommend treatment of low HDL-C [36], increasing HDL-C levels among patients with ACS have apparently been poorly translated into clinical practice. This is further demonstrated in our study, which showed that only 473 out of 3,854 patients (12%) with low HDL-C levels were discharged on a combination therapy to increase HDL-C levels. Likely reasons for the observed under treatment in patients with low HDL-C include underestimation of therapy benefit, lack of prospective clinical trial data, and under-recognition of patients’ poor prognosis.

Strategies to aggressive management of HDL-C are fundamental for reducing cardiovascular outcomes in patients with ACS. Nissen et al., [37] reported a significant decrease in atheroma in patients with ACS who were treated with infusions containing apolipoprotein A-I Milano compared with placebo. The HDL-C Atherosclerosis Treatment Study (HATS) [38] showed that combining nicotinic acid with a statin improved HDL-C and LDL-C, inhibited the progression of atherosclerosis, and reduced cardiovascular event rates in a high-risk population with established CHD. Recently, Taylor and colleagues [39] have shown that the use of extended-release niacin causes significant regression of carotid intima media thickness when combined with statins.

One difficulty with HDL-C elevating therapy at present, is that there is no exact definition of the optimal plasma HDL-C level, although there is a consensus that <0.95 mmol/L is undesirable in patients with CHD or CHD equivalents [8]. Furthermore, the recent 2009 Canadian guidelines for the diagnosis and treatment of dyslipidemia do not specify treatment targets for HDL-C in high risk patients [40]. However, published studies to raise plasma HDL-C had shown that beneficial effects of HDL-C are likely not related simply to its abundance. Atherothrombosis Intervention in Metabolic Syndrome with Low HDL-C/High Triglyceride and Impact on Global Health Outcomes (AIM-HIGH) was recently discontinued [41]. The trial showed that adding extended-release niacin to statin therapy in people with established vascular disease and despite increasing plasma HDL-C it did not reduce the risk of cardiovascular events. These findings are preliminary and require full evaluation to look at specific reasons for the failure. Moreover, a meta-analysis by Briel et al., showed no association between changes in levels of HDL-C and reducing the risk of coronary heart disease events, coronary heart disease deaths or total deaths [42]. There is evidence that HDL-C functional assays, like cholesterol efflux study, paraoxonase 1 (PON1) activity, antioxidant and anti-inflammatory properties are better predictor of cardiac events than plasma HDL-C [43]. Studies had revealed that these HDL-C properties are impaired in patients with CHD compared with control healthy individuals [44].
Landmesser, and his research team recently showed that HDL-C of patients with either ACS or stable CAD compared to HDL-C from healthy individuals fail to stimulate endothelial nitric oxide (eNOS) activating pathways and nitric oxide (NO) production. As a result, the endothelial anti-inflammatory and endothelial repair effects of HDL are impaired [43].

Study Limitations

The limitations of a registry-type study apply, such as unidentified confounders which could influence the results. Furthermore, lipid levels may be partially affected during the acute phase of ACS and this could have influenced the estimation of low HDL-C levels [45]. However, a recent study found little change in lipid levels measured serially in the first days of hospitalization for ACS [46]. Treatment (with lipid lowering drugs or other medication) may also affect lipid levels and their interrelationships

CONCLUSIONS

This study demonstrated a high prevalence of low HDL-C levels in ACS patients in the Middle East and that this abnormality was more common in females than in males. BMI and diabetes were independent predictors for low HDL-C. Low HDL-C was associated with in-hospital mortality and cardiogenic shock in men but not in women. Although guidelines for LDL-C management in ACS are well established, treatment recommendations concerning HDL-C levels are not as rigorous or aggressive. Failure to recognize the prognostic value of low HDL-C in ACS may predispose these patients to higher risk of recurrent events and worse outcomes.

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