Clinical Characteristics and Prognosis of Young Middle Eastern Adults with ST-Elevation Myocardial Infarction: One-Year Follow-Up

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ABSTRACT

Aims: Few studies have investigated premature ST-elevation myocardial infarction (STEMI) in the Middle East. We aimed to compare the clinical characteristics and one-year prognosis of young (<45 years) and older (≥45 years) Middle Eastern adults with STEMI.

Methods and Material: A total of 706 patients with STEMI, who were prospectively enrolled in the First Jordanian Percutaneous Coronary Intervention Registry, were stratified into two groups (<45 or ≥45 years). Baseline clinical variables and one-year major adverse cardiovascular events (MACE) were evaluated.

Results: Young patients (<45 years) comprised 17.4% of STEMI patients (123 of 706). Compared with older patients (≥45 years), young patients were mostly male (96% vs 82%, P<0.001), smokers (86% vs 49%, P<0.001) and less likely to have multi-vessel disease (26% vs 44%, P=0.001). Anterior STEMI was the most common diagnosis and left anterior descending artery was the most common culprit vessel in both groups. There were no significant differences between the younger and older patients in in-hospital (20% vs 19%, P=0.12) and one-year MACE (24% vs 26%, P=0.68). However, none (0%) of the young died during one-year follow-up while 21 (4%) of the older patients died (P=0.036).

Conclusions: Young adult patients in the Middle East with STEMI are more likely to be smoking men with multiple risk factors and single vessel disease by angiography. Although, younger patients had similar one-year MACE to older patients, their mortality rate appears to be better. A larger study is warranted to investigate this vulnerable group of patients to prevent future events.

Key words: Middle East, prevention, risk factors, ST-elevation myocardial infarction, young adults

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death in the Middle East and worldwide.¹⁻³ Patients admitted with myocardial infarction (MI) in the Middle East are usually seven to ten years younger than their counterparts in the West.⁴⁻⁶ Few studies have compared the differential risk...
factors and outcomes between young and old Middle Eastern patients with acute ST-elevation MI (STEMI).\cite{5,6}

ST-elevation myocardial infarction is a distinct type of MI that usually occurs due to plaque rupture causing total occlusion of a coronary artery, presents mostly as ST-segment elevation on the electrocardiogram, and carries significant mortality and morbidity.\cite{7}

It typically occurs in older patients with other atherosclerosis risk factors. However, there has been an increased incidence of STEMI in young patients, especially in developing countries.\cite{5,6,8} It constitutes approximately a third of all MI cases in young adults.\cite{9} Cigarette smoking, family history of premature coronary artery disease (CAD), male gender, obesity, hypertension, Type 2 diabetes mellitus, and dyslipidemia, which are the usual atherosclerosis risk factors, have also been identified as significant differential risk factors in the etiology of premature MI.\cite{8,10-12}

At the population level, risk factors naturally tend to accumulate with chronological age; in tandem, the incidence of cardiovascular disease increases exponentially.\cite{13} Therefore, the disproportionate incidence of cardiovascular disease in the young and old is no enigma. However, the prevalence of MI in older individuals certainly does not preclude young individuals with a significant risk factor profile from developing the disease. Indeed, at least one cardiovascular risk factor was identified in young patients who develop MI.\cite{8} However, the etiology of the disease in young adults is not well established, and the relative effect of recognized cardiovascular risk factors is region-and age-dependent.

Consequently, the differential risk factor profile in susceptible young individuals is unlikely to be conserved across populations.\cite{12} For example, the Third National Health and Nutrition Examination Survey reported that, in 10,085 adults between the ages of 18 and 45 years, approximately 25 percent of nonfatal MIs were attributable to frequent cocaine use.\cite{14} On the other hand, cocaine use is rare in our region.\cite{15} It is likely, then, that the delineation of population-specific differential risk factor profiles in young patients with MI offers targets for prevention efforts.\cite{16-18} The preceding consideration is of particular regional relevance since it has a significant socioeconomic impact on patients, families, and society, especially since young adults constitute a large proportion of the population in the Middle East.\cite{19,20} According to the INTERHEART study, the youngest age of the first presentation of MI and the highest proportion of cases with first MI at age 40 years or younger were in individuals from the Middle East.\cite{2}

The "young" patient is a loosely defined designation for individuals whose age at the time of presentation falls below an arbitrary cut-off point. Several cut-off points appear throughout the literature, with age 45 years being the most consistent.\cite{8,11} The differential clinical characteristics of young patients with STEMI compared with older patients has been the focus of few studies.\cite{11,12} Our aim is to compare the clinical characteristics and one-year prognosis of young (<45 years) and older (≥45 years) Middle Eastern adults with STEMI.

**SUBJECTS AND METHODS**

The study population consisted of 706 patients who were consecutively and prospectively enrolled in the First Jordanian Percutaneous Coronary Intervention Registry (JoPCR1) and had the diagnosis of STEMI. JoPCR1 consisted of 2426 consecutive patients with acute coronary syndrome undergoing percutaneous coronary intervention (PCI) between January 2013 and February 2014 in one of 12 tertiary hospitals in Jordan. The results of JoPCR1 have been reported elsewhere.\cite{21} All patients were followed up for one-year. A case report form was used to record patient data prospectively during the index hospitalization and one-year follow-up. Data were collected during follow-up visits or through phone calls to patients, one of their household relatives, or their primary care physicians.

The clinical, electrocardiographic, echocardiographic, and coronary angiographic features in patients younger than 45 years of age were compared with those patients 45 years of age or older. The PCI procedure details and cardiovascular events during hospitalization and at one-year follow-up were compared between the two groups. All PCI procedures were performed according to current standard practice guidelines. The arterial access site, choice of antiplatelet therapy, and type of stent were left to the operator’s discretion. STEMI is defined by the presence of cardiac ischemic chest pain and ST-segment elevation >1 mm in at least two contiguous leads by the 12-lead electrocardiogram or new left bundle branch block using the criteria recommended by the Task Force for the Third Universal Definition of MI.\cite{22}

Cigarette smokers were defined as those who had reported having smoked every day or some days at the time of history-taking.\cite{23} Family history of premature CAD was defined as established CAD in first-degree male relatives of age ≤55 years or female relatives of age ≤65 years.

History of systemic hypertension was defined as previously documented systolic blood pressure repeatedly >140 mmHg or diastolic blood pressure repeatedly >90 mmHg, or as the use of antihypertensive medication. History of type 2 diabetes mellitus was defined as a new finding of glycated hemoglobin A1c ≥6.5% or a fasting blood sugar ≥126 mg/dL (criteria of the American Diabetes Association), or the use of anti-diabetic medication.\cite{24} History of dyslipidemia was defined as fasting total cholesterol >200 mg/dL, low-density lipoprotein >130 mg/dL, or high-density lipoprotein <40 mg/dL (National Cholesterol Education...
Program (NCEP) Treatment Panel (ATP) III guidelines), or the use of statin therapy.[25] Major adverse cardiovascular events (MACE) included cardiac deaths (all deaths were considered cardiac unless a definite noncardiac cause could be established), definite and probable stent thrombosis as defined by the Academic Research Consortium, major bleeding and readmission for acute coronary syndrome, congestive heart failure, or target vessel/lesion revascularization.[26]

Major bleeding events were defined according to the CRUSADE study classification and included intracranial hemorrhage, retroperitoneal bleeding, hematocrit drop >12% from baseline, any red blood cell transfusion when baseline hematocrit was >28%, or any red blood cell transfusion when baseline hematocrit was <28% with witnessed bleeding.[27] The Institutional Review Board of each participating hospital approved the study.

**Data analysis**

Patients were stratified into two age groups. The young cohort comprised those younger than 45 years of age (<45 years), and the older cohort comprised those 45 years of age and older (≥45 years). Data analyses were performed using R (version 3.5.2; R Core Team, R Foundation for Statistical Computing, Vienna, Austria). The differences in demographics, clinical characteristics, and MACE during hospitalization and one-year follow-up between both patient groups were assessed using means (and standard deviations) or absolute frequencies (and relative frequencies) as appropriate. Pearson’s Chi-squared test and Fisher’s exact test were used, as appropriate, to assess the association between clinical variables and the age groups under study. Multivariable logistic regression models were developed for MACE during hospitalization and at the one-year follow-up to adjust for significant risk factors. Only variables with significant P value by univariable analysis were included in the multivariable logistic regression analysis model. A P < 0.05 was considered statistically significant.

**RESULTS**

The final study population comprised 706 STEMI patients who underwent PCI, of whom 123 (17.4%) were <45 years of age. Patient age in the young cohort ranged from 24 years to 44 years (median age, 40 years). Patient age in the older cohort ranged from 45 years to 93 years (median age, 58 years). The baseline clinical characteristics are shown in Table 1. All but five of the 123 patients in the young cohort were male (96%).

In comparison, a lesser proportion of the patients in the older cohort were male (478 out of 583 patients; 82%; P < 0.001). The vast majority of young patients were smokers (86%) compared with 49% (P < 0.001) of the older patients. Young patients were less likely to have history of hypertension (30% vs. 56%; P < 0.001), dyslipidemia (25% vs. 39%, P = 0.005), type 2 diabetes mellitus (39% vs. 58%; P < 0.001), and CAD (17% vs. 29%; P = 0.006) compared with older patients.

Family history of premature CAD was more prevalent in the young cohort compared with the older one (53% vs. 43%), but the association was not statistically significant (P = 0.055). None of the patients (0%) in either group had reported a history of substance abuse. Older patients were more likely to

| Clinical feature                        | Younger patients (age <45 years old) (n=123), n (%) | Older patients (age ≥45 years old) (n=583), n (%) | P     |
|----------------------------------------|----------------------------------------------------|-------------------------------------------------|-------|
| Age (years), mean±SD                   | 39.0±4.6                                           | 59.2±9.5                                        | <0.001|
| Men                                    | 118 (96)                                           | 478 (82)                                        | <0.001|
| Hypertension                           | 37 (30)                                            | 328 (56)                                        | <0.001|
| Dyslipidemia                           | 31 (25)                                            | 226 (39)                                        | 0.005 |
| Diabetes mellitus                      | 48 (39)                                            | 340 (58)                                        | <0.001|
| Family history of premature CVD*       | 65 (53)                                            | 253 (43)                                        | 0.055 |
| Current cigarette smoking              | 106 (86)                                           | 286 (49)                                        | <0.001|
| Any prior CVD*                         | 21 (17)                                            | 171 (29)                                        | 0.006 |
| Past history of MI                     | 7 (6)                                              | 38 (7)                                          | 0.8   |
| Previous PCI                           | 16 (13)                                            | 119 (20)                                        | 0.057 |
| Medications upon admission             |                                                    |                                                |       |
| Aspirin                                | 46 (37)                                            | 333 (55)                                        | <0.001|
| Second oral antiplatelet agent (ticagrelor or clopidogrel) | 10 (8)                                            | 105 (18)                                        | 0.007 |
| Statin                                 | 34 (28)                                            | 249 (43)                                        | 0.002 |
| Beta blocker                           | 33 (27)                                            | 219 (38)                                        | 0.023 |
| Renin angiotensin system blocker       | 25 (20)                                            | 185 (32)                                        | 0.012 |

*CVD: Coronary artery disease with or without prior myocardial infarction, percutaneous coronary intervention, heart failure, CVA and peripheral arterial disease. MI: Myocardial infarction, PCI: Percutaneous coronary intervention, CVA: Cerebrovascular accident, SD: Standard deviation
be on aspirin, a second oral antiplatelet agent, statins, beta-blockers oxford, and renin-angiotensin system blockers at presentation, as shown in Table 1.

Anterior STEMI or new left bundle branch block was the most common type of STEMI in both cohorts (67% vs. 63%; \(P = 0.5\)). Percutaneous coronary intervention was the most common initial revascularization strategy (85% vs. 90%; \(P = 0.065\)) in both young and old patients, respectively. The remaining patients received thrombolytic therapy.

Eventually, all patients underwent cardiac catheterization. Most cardiac catheterization procedures were done via left femoral artery access (100% in young patients and 97% in older patients). Multi-vessel disease (defined as coronary artery narrowing \(\geq 50\%\) in two or more coronary arteries) was found in a greater proportion in the older patients (44%) compared with the younger patients (26%; \(P = 0.001\)). Drug-eluting stent type was the most common type used in both younger and older patients (80% vs. 86%; \(P = 0.1\)).

Left anterior descending artery was the most common culprit vessel in young and older patients (56% vs. 50%; \(P = 0.24\)). Comparable proportions of young and older patients had reduced left ventricular (LV) ejection fraction (EF) \(\leq 45\%\) (21% vs. 18%; \(P = 0.47\)).

Electrocardiographic and coronary angiographic features are shown in Table 2. Both groups showed excellent compliance with medical therapy, including dual antiplatelet therapy, statins, and beta-blockers use at one-year follow-up as shown in Table 2.

**Patient outcomes**

Patients were followed up for one-year per protocol, and only seven patients (<1%) were lost to follow-up. There were no significant differences between young and older patients in MACE during initial hospital admission and one-year follow-up, as presented in Table 3. None of the young patients (0%) were deceased at one-year follow-up, while 21 older patients (4%) were deceased at one-year follow-up (\(P = 0.036\)). There were no significant differences in stent thrombosis at one-year follow-up between young and older patients (2% vs. 2%; \(P = \text{NS}\)). None of the young patients with stent thrombosis (0%) were deceased at one-year follow-up, while four out of 17 older patients with stent thrombosis (24%) were deceased at one-year follow-up (\(P = \text{NS}\)).

Univariable analysis of the known risk factors and the potential development of MACE during initial STEMI hospitalization and one-year follow-up were performed. Variables included in the analysis were age (both as a continuous and binary (<45 and \(\geq 45\) variable), gender, hypertension, diabetes,

**Table 2: Electrocardiographic, coronary angiographic, percutaneous coronary intervention findings of index ST-elevation myocardial infarction procedure, and discharge and one-year medications in younger and older patients**

| Feature | Younger patients (age <45 years) (n=123), n (%) | Older patients (age \(\geq 45\) years) (n=583), n (%) | \(P\) |
|---------|-----------------------------------------------|--------------------------------------------------|-------|
| Anterior STEMI/LBBB | 82 (67) | 370 (63) | 0.50 |
| Thrombolytic agent | 19 (15) | 57 (10) | 0.065 |
| Glycoprotein IIb/IIIa inhibitors use during PCI | 44 (36) | 146 (25) | 0.015 |
| Number of diseased of coronary arteries | | | |
| Single vessel | 91 (74) | 327 (56) | 0.001 |
| Two vessels | 22 (18) | 188 (32) | 0.41 |
| Three vessels or more | 10 (8) | 68 (12) | 0.001 |
| Number of coronary arteries treated by PCI at presentation | | | |
| Single vessel | 105 (85) | 430 (74) | 0.022 |
| Two vessels | 14 (11) | 127 (22) | 0.60 |
| Three vessels or more | 4 (3) | 26 (4) | 0.96 |
| LV ejection fraction <45%*** | 26 (21) | 107 (18) | 0.47 |
| Discharge medications after index STEMI | | | |
| Aspirin | 122 (99) | 580 (99) | 0.54 |
| Second oral antiplatelet agent (ticagrelor, clopidogrel) | 123 (100) | 577 (99) | 0.60 |
| Statin | 120 (98) | 552 (95) | 0.25 |
| Beta blocker | 87 (71) | 411 (70) | 0.96 |
| Renin-angiotensin system blocker | 63 (51) | 302 (52) | 0.91 |
| 1-year medications | | | |
| Aspirin | 119 (97) | 550 (94) | 0.87 |
| Second oral antiplatelet agent (ticagrelor, clopidogrel) | 108 (88) | 508 (87) | 0.17 |
| Statin | 116 (94) | 521 (89) | 0.35 |
| Beta blocker | 98 (80) | 422 (72) | 0.41 |
| Renin-angiotensin system blocker | 75 (61) | 340 (58) | 0.94 |

***LV function by echocardiography during index hospitalization. LBBB: Left bundle branch block, PCI: Percutaneous coronary intervention, STEMI: ST-elevation myocardial infarction, LV: Left ventricular
dyslipidemia, smoking, family history of cardiovascular disease (CVD), chronic renal disease, past CVD, past PCI, prior use of aspirin, STEMI location (anterior vs. non-anterior), reduced LV function (EF <45%), number of vessels treated and type of stent used.

Univariable analysis for MACE during initial STEMI hospitalization showed that prior use of aspirin (OR 0.57, confidence interval [CI] 0.39–0.85, P=0.005), reduced LV function (EF <45%) (OR 23, CI 14–37, P < 0.001) and two or more vessels treated initially (OR 0.49, CI 0.27–0.86, P = 0.044) were significantly associated with MACE and remained statistically significant after multivariable logistic regression analysis as shown in Table 3. While history of diabetes was not associated with increased risk (OR 1.47, CI 0.99–2.19, P = 0.054) by univariable analysis and not included in multivariable logistic regression analysis model since P > 0.05.

Univariable analysis for MACE after 1-year follow-up was significantly increased with reduced LV function (EF <45%) (OR 9.29, CI 6.1–14.17), and age (as a continuous variable but not as a binary variable <45, ≥45) (OR 1.03, CI 1.01–1.04, P = 0.002). On the other hand, prior use of aspirin was associated with reduced risk (OR 0.7, CI 0.5–0.98, P = 0.035). These three factors remained statistically significant for MACE after 1-year follow-up, by multivariable logistic regression analysis as shown in Table 3. Two vessels treated at the index procedure was not associated with less risk for MACE after 1-year follow-up (OR 0.67, CI 0.45–1.007, P = 0.052) by univariable analysis and not included in multivariable logistic regression analysis model since P > 0.05.

DISCUSSION

The present study was undertaken to assess the differential clinical characteristics and one-year outcome of young Middle Eastern patients with STEMI compared to their older counterparts. Young patients (<45 years) with STEMI comprised 17% of all patients with STEMI (123 out of 706 patients). This is slightly higher than the rate reported by Chua et al. (11.6% of 849 Taiwanese STEMI patients).[11]

Seven baseline clinical variables were statistically significantly associated with the two age groups under study. Younger patients were more likely to be smoking men and less likely to be diabetic, hypertensive, and known to have dyslipidemia or prior CVD. Out of these seven significant risk factors, all 123 (100%) young patients had at least one risk factor, 97% of them had at least two or more risk factors and 74% of them had three or more risk factors. In comparison, 7% of the older patients had none or only one risk factor. This combination of multiple risk factors is higher than prior reports of young patients with myocardial infarction.

Hoit et al. reported that, in young patients (<45 years) with MI in California, 18% had three or more risk factors compared with only 5% of the elderly (>70 years) and 16% of the middle aged (46–70 years).[28] This increased number of multiple risk factors in our study population is likely due to population-specific differences and the fact that we are studying a higher risk type of myocardial infarction, specifically STEMI.

Cigarette smoking was the most important modifiable differential risk factor. The higher prevalence of cigarette smoking among younger patients has been

### Table 3: In-hospital and 1-year events in younger and older ST-elevation myocardial infarction patients

| Events                                      | Young patients (age <45 years old) (n=123), n (%) | Older patients (age ≥45 years old) (n=583), n (%) | P    |
|---------------------------------------------|--------------------------------------------------|--------------------------------------------------|------|
| In-hospital MACE*                           |                                                  |                                                  |      |
| Cardiac death                               | 0                                                | 11 (2)                                           | 0.23 |
| Stent thrombosis                            | 2 (2)                                            | 2 (0.3)                                          | 0.14 |
| Major bleeding                              | 1 (1)                                            | 7 (1)                                            | 0.68 |
| Congestive heart failure                    | 15 (12)                                          | 69 (12)                                          | 0.91 |
| Cardiogenic shock                           | 1 (1)                                            | 8 (1)                                            | 0.99 |
| Ventricular tachycardia                     | 5 (4)                                            | 10 (2)                                           | 0.25 |
| Emergency coronary bypass surgery           | 0                                                | 2 (0.3)                                          | 0.99 |
| MACE (any of the above)                     | 24 (20)                                          | 109 (19)                                         | 0.12 |
| 1-year MACE**                               |                                                  |                                                  |      |
| Cardiac death                               | 0                                                | 21 (4)                                           | 0.036|
| Stent thrombosis                            | 3 (2)                                            | 13 (2)                                           | 0.55 |
| Major bleeding                              | 1 (1)                                            | 8 (1)                                            | 0.99 |
| Congestive heart failure                    | 17 (14)                                          | 79 (14)                                          | 0.77 |
| Acute coronary syndrome                     | 3 (2)                                            | 17 (3)                                           | 0.60 |
| Target vessel or lesion revascularization   | 0                                                | 12 (2)                                           | 0.14 |
| MACE (any of the above)**                   | 30 (24)                                          | 170 (26)                                         | 0.68 |

*MACE including cardiac death, stent thrombosis, major bleeding, readmission for acute coronary syndrome, heart failure or target vessel or lesion revascularization, **1-year MACE includes all CVD events up to 1-year follow-up including all initial in-hospital MACE, ***Includes all events listed and events from initial admission including cardiogenic shock, ventricular tachycardia and emergency bypass. MACE: Major adverse cardiovascular events, CVD: Coronary artery disease
noted in a great number of previous studies. In fact, the prevalence of cigarette smoking (86%) of younger patients in the present study may be among the highest reported in the literature. For example, the reported smoking prevalence was 61% in 77 young patients (<40 years) with STEMI in Abu-Dhabi and 83% in 86 young STEMI patients from Tianjin, China. This finding highlights the importance of improving efforts to reduce smoking rates, especially in the younger population in the Middle East to reduce their risk of future myocardial infarction.

Young patients were almost exclusively male compared with a lesser majority of older patients. Indeed, this is in line with the results of previous studies. The prevalence of family history of premature CAD in younger patients in our study was only descriptively increased compared with the older patients (53% vs. 43%, respectively; \( P = 0.055 \)), but the overall rate in young patients was similar to the prevalence reported by Yunyun et al. of 55% in young STEMI patients from Tianjin, China. Our older patient group may have an increased prevalence of family history of premature CAD (43%) due to their lower mean (59 years) and median (58 years) age.

The prevalence of the other conventional risk factors such as DM, dyslipidemia, and HTN is subject to conflicting reports. Although, in the present study, the prevalence of these risk factors was high in the younger patients (DM 39%, known dyslipidemia 25% and HTN 30%), they were significantly much higher in older patients.

The most important significant differential angiographic finding was the presence of multi-vessel disease (two or more coronary arteries) in a greater proportion of the older patients (44%) compared to the younger patients (26%) \( (P = 0.001) \). Therefore, as expected, more patients in the younger cohort had single-vessel PCI compared with older ones (85% vs. 74%, \( P = 0.02 \)). This is in line with other reports from developing countries where 80% of the young (<40) STEMI patients from Kannur, India and 62% of the young (<40 years) STEMI patients from Abu Dhabi, UAE had single-vessel disease.\(^{[5,12]}\)

In the present report, glycoprotein IIb/IIIa inhibitors were more often used during PCI in the younger patients than their older counterparts (36% vs. 25%, respectively, \( P = 0.015 \)). This is likely because they are less likely to be on an antiplatelet agent at the time of STEMI presentation. Whether younger patients had larger clot burden with their STEMI than the older patients was not investigated in the present study.

To our surprise, younger patients with STEMI did not do better than their counterparts in regard to MACE during the index hospitalization or one-year follow-up. On the other hand, younger patients had significantly better one-year survival compared with older ones. None (0%) of the younger patients died during one-year follow-up while 21 patients (4%) of the older patients died \( (P = 0.036) \). Although this is limited by our small sample size, it is intriguing and similar to a prior report by Chua et al.\(^{[11]}\) They reported significantly lower mortality in 99 young STEMI patients versus 750 older counterparts after 4.5 years follow-up in a single-center experience in Taiwan (3% vs. 19%, respectively, \( P < 0.001 \)).

In addition, similar to our finding, they reported no differences in rates of repeated PCI (45.5% vs. 41.5%, \( P = 0.23 \)) and re-infarction (6.1% vs. 3.2%, \( P = 0.32 \)) between the two groups.\(^{[11]}\) The increased incidence of MACE in our younger patients group (similar to the older patients group) could be potentially explained by the higher number of younger patients with multiple risk factors.

Consistent with the well-established knowledge, reduced LV function (EF <45%) and age were the most important factors in predicting MACE after one-year follow-up. Indeed, reduced LV function (EF <45%) was the strongest predictor of worse outcomes during initial hospital admission and one-year follow-up by univariable analysis and multivariable regression analysis model.

Interestingly, in the present study, two or more vessel intervention was associated with less MACE during initial STEMI admission and one-year follow-up, this may be related, although not studied in our report, to improved LV function and perfusion by two or more vessel PCI. In addition, the patients undergoing two or more vessel PCI initially are less likely to come back for another vessel PCI during follow-up which would have been considered a MACE event.

Finally, our study highlights the modifiable risk factors in young Middle Eastern adult patients with STEMI and presents the rationale to implement CVD screening and prevention programs. This represents a great opportunity, especially in young smoking men with family history of CAD. Young adults usually have a false sense of security from suffering heart attacks.

### Table 4: Multivariable logistic regression analysis for in-hospital and 1-year major adverse cardiovascular events

| Variable                  | \( P \)   | OR (95% CI) |
|---------------------------|----------|------------|
| In-hospital               |          |            |
| Prior use of ASA          | 0.006    | 0.50 (0.30-0.81) |
| EF <45%                   | <0.001   | 25.27 (15.56-42.07) |
| ≥2 vessels treated        | 0.028    | 0.50 (0.26-0.91) |
| 1-year                    |          |            |
| Age***                    | <0.001   | 1.03 (1.01-1.05) |
| Prior ASA                 | 0.008    | 0.60 (0.41-0.87) |
| EF <45%                   | <0.001   | 9.61 (6.29-14.94) |

***Measured on a continuous scale. Only variables with significant \( P<0.05 \) reported in the table. OD: Odds ratio, CI: Confidence interval, EF: Expedited forwarding, ASA: American Society of Anaesthesiologists.
because of their young age, but as we and others have shown, they are at increased risk for MI which will affect them mentally and physically, their families and their communities in general for the rest of their lives.

We suggest having screening programs for dyslipidemia, obesity, and other CVD risk factors in this vulnerable group. Preventive efforts should include smoking cessation campaigns and lifestyle changes as well as public education about signs and symptoms of CVDs for early recognition and treatment.

Our study population was taken from the JoPCR registry and it is well known that observational registries are subject to selection bias, collection of nonrandomized data, and missing or incomplete information. Prospective enrollment of consecutive patients and participation was voluntary, and inclusion of all comers was not verified, and an independent committee did not adjudicate data reporting. Baseline lipid profile and body mass index were not available for all patients, and this is why it was not included in this report. The participating hospitals are high volume tertiary care centers. So, the results may not represent the PCI practice and outcome in all areas in the region. Despite these limitations, this report is unique in that it evaluated short- and intermediate-term outcomes of young STEMI patients who underwent PCI in the Middle East, a region that is not well represented in cardiovascular research.

Although our sample size is not very large, it is still among the largest reports of STEMI in young patients in the Middle East. And, unlike other published reports of myocardial infarction in young adults in developing countries,[11,12,36] our study was a multicenter study that followed patients prospectively for one year.

CONCLUSIONS

Young adult patients in the Middle East with STEMI are more likely to be smoking men with multiple CVD risk factors. Their angiographic findings are different from older patients, mostly involving single vessel disease. Although initial hospital admission and one-year MACE in younger patients is not better than that in older patients, their mortality rate appears to be better. A larger study is warranted to investigate this vulnerable group of patients to prevent future cardiovascular events.

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Conflicts of interest
There are no conflicts of interest.

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