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Original Article

Gender Differences in the Risk of Coronary Artery Disease in Iran

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Abstract

Background: Given gender differences in the risk of coronary artery disease (CAD), the present study sought to investigate these dissimilarities amongst patients who underwent angiography at a major, tertiary heart hospital in Iran.

Methods: Between 2005 and 2010, 44,820 patients who underwent coronary angiography were enrolled in a registry. Pre-procedural data such as demographics, CAD risk factors, presenting symptoms, and laboratory tests, as well as post-procedural data were collected. The data were, subsequently, compared between the men and women.

Results: Out of the 44,820 patients (16,378 women), who underwent coronary angiography, 37,358 patients (11,995 women) had CAD. Amongst the CAD patients, the females were not only significantly older, less educated, and more overweight than were the males but also had higher levels of triglyceride, cholesterol, low-density lipoprotein, high-density lipoprotein, and fasting blood sugar ($P< 0.001$). Of all the risk factors, hypertension and diabetes mellitus showed the strongest association in our female CAD patients (OR=3.45, 95%CI: 3.28-3.61 and OR=2.37, 95%CI: 2.26-2.48, respectively). Acute coronary syndrome was more prevalent in the men (76.1% vs. 68.6%, $P< 0.001$), and chronic stable angina was more frequent in the females (31.4% vs. 23.9%, $P< 0.001$). With respect to post-procedural recommendations, the frequency of recommendations for non-invasive modalities was higher in the females (20.1% vs. 18.6%, $P< 0.001$).

Conclusion: Hypertension and diabetes mellitus had the strongest association with CAD in our female patients. In the extensive CAD patients, medical treatment was recommended to the women more often.

Keywords: Coronary artery disease, Risk factors, Male, Female, Iran.

Introduction

The recent years have witnessed a dramatic decline in cardiac mortality, but ischemic heart disease is still the leading killer in many parts of the world (1). In Iran, similarly, coronary artery disease (CAD) is the principal culprit for mortality, morbidity, and disability (2).

CAD may be common in both sexes, but there are differences in various aspects of the disease between men and women. Despite approximately equal prevalence rates for both sexes in their seventh decade of life, the ischemic heart disease prevalence in females is relatively low before menopause (3, 4). In the last forty years, although age-adjusted death due to cardiovascular disease has decreased, this decline has been less significant in women (5). As a case in point,

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more CAD-related deaths have occurred in women than men in the United States since 1984 (6). In the year 2000, in comparison with males, about 60,000 more cardiovascular-related deaths were reported amongst females there (7). Supplementary evidence shows that much as male admissions due to CAD are more frequent, women have not only higher one-year death and reinfarction rates (8) but also higher in-hospital mortality rates (5). Furthermore, when considering females of all ages, ischemic heart disease is at the top of the killers list (even higher than breast cancer), with higher annual mortality rates in women under the ages of 35, 45, and 55 years (7). A recent report from the Center for Disease Control shows that whereas only 22% of all deaths in woman are due to cancer, 38% of them are secondary to ischemic heart disease (9). Sex differences in coronary artery disorders are not all inevitable. Lawlor et al., analyzing data from fifty countries, maintained that environmental factors were important in the occurrence of CAD in both sexes: Whereas the highest sex ratios for mortality from CAD were detected in Poland, France, and Norway, the lowest ratios were seen in rural China, Cuba, and Armenia (5). The Murray and Lopez study, published by the World Health Organization in 1996, reported that cardiovascular disorders were responsible for 49% of deaths at the age of 60 and over in women of developing countries; this percentage for men in those countries was 42% (10). In India, between 1995 and 2002, CAD had an increase in women, but there was no evidence of a similar increase amongst men (11).Women with ischemic heart disease have often more adverse outcomes and an overall worse prognosis than men (12), and younger women with myocardial infarction (MI) have higher mortality rates (13). Recent reports show that a combination of traditional risk factors is to blame for the usual underestimation in the risk in females (14). In addition, women are less likely than men to identify their risk factors, and surprisingly, females are less likely to receive secondary preventive therapy (statins or aspirin) at initial assessment (5). Also, the notion that females are protected against cardiovascular problems often leads to an underestimation of the risk of CAD in women, leaving them with untreated risk factors and thus prone to MI.

In Iran, coronary atherosclerosis is the leading cause of mortality (2) and some studies have focused on the differences between the two sexes in regard to the various aspects of CAD in small groups of patients. The current study was designed to investigate these dissimilarities between men and women with angiographically documented CAD on a larger scale at a major tertiary heart hospital.

Materials and Methods

Between January 2005 and April 2010, 44,820 patients, who underwent coronary angiography at Tehran Heart Center, were enrolled in a catheterization registry. Data on a number of variables, including demographics such as age, sex, marital status, education level, height, and weight; CAD risk factors such as family history, cigarette smoking, hyperlipidemia, hypertension, diabetes mellitus, and opium usage; presenting symptoms such as MI, typical chest pain, atypical chest pain, and dyspnea on exertion; and drug history, were collected. The results of the exercise tolerance tests, perfusion scans, electrocardiograms (ECG), and laboratory tests (including fasting blood sugar (FBS), triglyceride (TG), total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and creatinine) were collected as well. Additionally, the results of coronary angiography were added to the previously gathered data.

All the data were collected by trained physicians in the Outpatient and Inpatient Clinics. One day before catheterization, all the collected data were checked and revised via face-to-face interviews with the patients by two expert research nurses in case there were missing or invalid data. The registry forms were then entered by a trained operator via a secure password-protected

hospital network. The process was supervised, the reported data were audited, and 5% of the patients' medical records were randomly selected all by the Catheterization Registry manager to evaluate the accuracy of the data. The errors were, thereafter, identified and feedback was provided in order to fix the errors. Finally, the data were transferred to a SPSS file for analysis and report.

The comparisons of the data between the females and males were conducted using the independent samples *t*-test and chi-square test. The numerical variables are presented as mean±standard deviation, and the categorical variables are summarized by absolute frequencies and percentages. For the statistical analyses, the SPSS software version 17.0 for Windows was employed. All the *P*s were two-tailed, with statistical significance being defined by a $P \leq 0.05$.

Results

Out of the 44,820 patients (28,442 men and 16,378 women), who underwent coronary angiography, 7,462 patients were normal and 37,358 had angiographically documented CAD. Some of the patients' characteristics are depicted in Table 1.

With respect to the patients' characteristics, listed in Table 1, all the differences between sexes were significant. The female patients were older, less educated, and more overweight than were the males. The mean left ventricular ejection fraction of the women was higher and they had higher serum levels of TG, cholesterol, LDL, HDL, and FBS, whilst the mean serum creatinine level was higher in men.

With regard to the marital status of the patients with CAD (Table 2), most of them (90%) were married and only a few of them were either single (1%) or divorced (1%); the difference between the men and the women was significant ($P< 0.001$). Moreover, being single was not significantly different between the male and female patients ($P = 0.333$), but more men were married ($P < 0.001$) or divorced ($P < 0.001$) than were the women. Also, more females were widowed than were the males ($P < 0.001$).

Table 3 depicts the clinical presentations of the patients with CAD. The clinical presentations were significantly different between both sexes ($P< 0.001$). ST-elevation myocardial infarction (STEMI) presented more often in the men, whereas most of the women presented with unstable angina. Dyspnea on exertion was the least frequent presentation in either sex.

The patients with STEMI, non-ST elevation myocardial infarction (NSTEMI), or unstable angina were classified as the acute coronary syndrome group, and those with stable angina (including typical chest pain, atypical chest pain, and dyspnea on exertion) were categorized as the chronic stable angina group. A subsequent comparison of the presentations between these groups of patients revealed a significant difference between both sexes ($P< 0.001$): Whilst the males presented with acute coronary syndrome more often (76.1% vs. 68.6%), chronic stable angina was more frequent in the females (31.4% vs. 23.9%).

Furthermore, when the patients presenting with STEMI and NSTEMI were considered as the MI group and were compared with those presenting with unstable angina, a significant gender difference emerged ($P< 0.001$): The men presented with MI more often (65.1% vs. 45.3%), whereas unstable angina was more frequent in the women (54.7% vs. 34.9%).

In the patients with chronic stable angina, a comparison between those with dyspnea on exertion or typical chest pain presentations (patients with exertional symptoms) and the ones presenting with atypical chest pain (patients with non-exertional symptoms) demonstrated a significant sex difference ($P < 0.001$). Exertional symptoms were more frequent in the women (84.5% vs. 81.2%), and non-exertional symptoms were seen more frequently in the men (18.8% vs. 15.5%).

The distribution of the risk factors amongst our CAD patients is demonstrated in Table 4. Surprisingly, all the traditional risk factors were significantly different between both genders ($P< 0.001$ for each one). Cigarette smoking was the most frequent risk factor in the men (54%), whilst hypertension had the highest frequency in the women (73%). In addition, positive family history of CAD was the least frequent risk factor in the men, and opium usage was the least frequent risk factor in the women. A comparison between the two sexes demonstrated that whereas there were significantly more male cigarette smokers or opium users, there was a significantly higher frequency of positive history for hypertension, diabetes mellitus, family history of CAD, hypertriglyceridemia, or hypercholesterolemia amongst the women.

Based upon the results of coronary angiography, coronary artery bypass grafting (CABG), percutaneous coronary intervention (PCI), or medical treatment were recommended to the patients by physicians (Table 5). There was a statistically significant difference between the sexes in terms of these recommendations ($P< 0.001$): CABG and medical treatment were recommended the most for the men (40.8%) and the women (42.2%), respectively, and PCI was recommended the least for both men (27.4%) and women (23.8%). When considering CABG or PCI recommendations as invasive recommendations and medical treatment as a non-invasive module, there was still a significant difference between both sexes ($P< 0.001$). In other words, whereas 64.9% of the patients were recommended to undergo invasive procedures (68.2% of men and 59.7% of women), non-invasive methods were recommended to 35.1% (31.8% of men and 42.1% of women).

Comparisons between the different recommendations for those with angiographycally documented extensive CAD (including two-vessel disease, three-vessel disease, or left main) revealed a statistically significant gender difference ($P = 0.019$): Although the patients with extensive CAD were more frequently recommended to undergo invasive treatment (81%), the frequency of non-invasive recommendations was higher in the women in this group of patients (20.1% vs. 18.6%).

A separate analysis was required to determine whether there was any difference in terms of recommendations for CABG or PCI between the males and females with single-vessel disease, two-vessel disease, or three-vessel disease. The analysis showed that although those with single-vessel disease or two-vessel disease were mostly recommended to undergo PCI (86% and 56.6%, respectively) and the ones with three-vessel disease were mostly recommended to undergo CABG (85.5%), there was no significant difference between the men and women in this regard ($P = 0.085$, $P = 0.819$, and $P = 0.194$ for single-vessel disease, two-vessel disease, and three-vessel disease, respectively).

The different coronary artery involvements of the patient population are shown in Table 6. For each of the left main coronary artery, left anterior descending coronary artery, right coronary artery, and left circumflex coronary artery, there was a significant difference as regards involvement between the men and women ($P < 0.001$ for each one). The left anterior descending coronary artery was the most involved coronary artery and the left main coronary artery was the least involved coronary artery in both sexes. Also, the involvement of either the left anterior descending coronary artery or the left main coronary artery was more frequent in the men.

Table 7 illustrates the number of involved coronary arteries. The number of the involved coronary vessels differed significantly between the males and females ($P < 0.001$). Minimal CAD and single-vessel disease were reported more frequently in the females, whereas two-vessel disease and three-vessel disease were more prevalent amongst the men. Meanwhile, three-vessel disease was the most and minimal CAD was the least frequent types of coronary involvement in both genders as well as in each of the sexes.

The different combination types of coronary artery involvement are listed in Table 8.

Discussion

The presentations, complications, prognoses, final diagnoses, and treatments of CAD differ between men and women; these dissimilarities present formidable challenges to experts involved in the domain of cardiology (15). Unfortunately, for all the data in the existing literature on such differences (16-21), there is a dearth of relevant information in Iran.

CAD risk factors are relatively identical in both sexes; nevertheless, there are some gender-specific differences in response. Some studies have shown that age, diabetes, and levels of certain lipoproteins are stronger risk factors in women (22). In our patients, except for cigarette smoking, all the traditional risk factors were seen in the females more frequently. Amongst the risk factors that were more prevalent in our female subjects, hypertension and diabetes mellitus had the highest ratio. Surprisingly, in contrast to the Lewington et.al. meta analysis (23), which reported that the association between hypertension and ischemic heart disease risk was only slightly stronger in women than men, our findings demonstrated a very strong association. As records show, the rate of hypertension in the Iranian general population is approximately the same in both sexes (17.6% in men vs. 17.1%. in women) (24). Meanwhile, in our study, 72.7% of the females and 43.6% of the males with CAD were hypertensive, indicating that hypertension played a great role in the development of CAD in our patients, not least in the women. An incisive insight into why Iranian women with CAD are more prone to hypertension than are Iranian men requires further research, but it could be argued that it is in consequence of differences in genetics, eating habits, and/or lifestyle. In the present study, the female CAD patients were more obese than were the men and their body mass index was higher than that of the men, which must have rendered them more susceptible to hypertension (Table 1).

Cardiovascular disorders are twice as common in women with diabetes mellitus as those in women without it. Mortality in patients with CAD is three to five times higher in diabetic women than that in non-diabetic ones, whilst the risk is two to three times more in diabetic men than that in non-diabetic ones (25). In our study, diabetes was much more prevalent in females than in males and had a greater association with CAD. In contrast to previous research reporting that the rate of diabetes was almost alike in both sexes in the general population of Iran (9.15% of men vs. 9.18% of women) (24), 44.4% of the females and 25.2% of the males in our CAD patients had diabetes. Diabetes can, therefore, be deemed a potent risk factor in our female patients. One likely culprit for the higher rate of diabetes amongst Iranian female CAD patients, aside from some genetic factors, is the fact that Iranian women (like most other women in the Middle East), especially at their older age, are less physically active and more overweight than men (26), hence higher rate of diabetes amongst women. Our study also showed that the body mass index of the female CAD patients was higher than that of the men (Table 1).

In the United States, 15.6% of men and 16.9% of women suffer from hypercholesterolemia (27). This rate is 29.5% for men and 36.3% for women in Iran (24). The Center for Disease Control reported that after the fifth decade of life, women have greater values of total cholesterol (28). In our study, the rate of hypercholesterolemia in either sex was only slightly higher than what is seen in the general population. Unlike hypercholesterolemia, which is more prevalent in females in the general population of Iran, hypertriglyceridemia is more common in men (21.8% of men vs. 16.6% of women) (24). Nevertheless, in our patients with proven CAD, the rate of hypertriglyceridemia was significantly greater in the women than in the men. Hypertriglyceridemia is known to be a potent independent risk factor in females, and the concentration of triglyceride is believed to have a positive correlation with the number of

diseased vessels only in females (29). Consequently, it seems advisable that hypertriglyceridemia be treated more vigorously in women.

As to the age of patients, it is a universal finding that ischemic heart disease is less prevalent in females before menopause and females tend to develop this disease later than do males (30). This chimes in with the findings of our study in that the CAD females were older than the CAD males.

By comparison with 61.6% of American women, who are overweight (31), only 19.2% of Iranian women are reported to be obese (24). In our study, overweight was more frequent amongst the CAD female patients than the CAD male patients. In other words, much as the body mass indices of both sexes were higher than normal, the females had higher levels of body mass index; this finding is in line with previously reported data (31).

With respect to the marital status of our CAD patients, the majority of the males were married and widowhood was more frequent in the female patients. This finding seems reasonable on account of the fact that our female patients were older than our male subjects and were thus more likely to be widowed.

Regarding the education level of the patient population, the women with CAD were less educated than the CAD male patients; this pattern echoes what was previously reported in the general population of Iran (24).

Acute coronary syndrome and MI (especially NSTEMI) had a higher frequency in our male patients, whereas the female patients presented with chronic stable angina and unstable angina more frequently. It means that the presentations of our female subjects were less severe than were those of our male patients. It can be argued that men may be more prone to severe or acute coronary events than women. On the other hand, there may be no definite difference between the two sexes but men may seek medical advice late and thus exhibit more severe symptoms. In other words, Iranian men, traditionally, may not be inclined to complain about their medical problems unless they are severe. What is more, the false positiveness of diagnostic measures such as the exercise tolerance test or cardiac perfusion scan could be to blame for the selection of women with less severe symptoms for coronary angiography. Even when having non-severe symptoms, patients can be candidates for angiographic procedures due to the positive results of their exercise tests or cardiac perfusion scans; both of these diagnostic procedures have false positive results. Since the false positiveness of these diagnostic tests is considerably high in women, many female patients undergo coronary artery angiography when their symptoms are not significantly severe. The other possible reason for the less severe presentations of our female patients could be sought in their anxiety about developing CAD, which could prompt them to demand coronary angiography. Indubitably, further research is required to shed light on the factors responsible for the differences between men and women in terms of CAD presentations.

Medical treatment via non-invasive modalities was recommended to most of our female patients, where invasive procedures (especially CABG) were recommended to most of our male patients. Such dissimilarities in recommendations should come as no surprise given the presentations and angiographic results. In the study sample both male and female patients with extensive CAD were recommended to undergo invasive procedures more frequently than non-invasive modalities, but medical treatment was recommended significantly more frequently to the females. One possible reason is that invasive treatments (either PCI or CABG) in women frequently tend to be complicated (32). Another reason could be the role of each sex in society. Men play a major role in the Iranian society, even though many women nowadays work and enjoy a larger ratio amongst university students. Between Iranian men and women with CAD, the men are more likely to do jobs that require strenuous physical activities, whilst women are more likely to be homemakers: The former would, therefore, be more prone to ischemic

heart disease than the latter. In a situation like this, it is not beyond the realms of possibility that physician factors in the responsibilities of the patient and opts not to candidate female patients for invasive treatments. Another possibility, albeit tenuous, could be inequity in medical care provided to male and female patients, discriminating in favor of males at the expense of females. The difference in recommendations for treatment between men and women should be addressed in future research.

In our study, the rate of coronary involvement was higher in the males. In both sexes, however, the left anterior descending coronary artery, right coronary artery, left circumflex coronary artery, and left main artery were the most frequently involved coronary vessels, respectively, which means that there was no gender difference in the preference of coronary vessel atherosclerosis.

This study has strengths and limitations. This is the first study of its kind to have been conducted in Iran using a very large sample of angiographically-documented CAD patients. In addition, the data were collected by trained physicians under meticulous quality control. However, the study has some caveats: 1) The study draws upon hospital records of patients admitted to Teheran Heart Centre, rendering generalization across the general population difficult. Then again, a case-control design would no doubt have added to the strength of the present study; still, coronary angiography is an invasive procedure with its own risks and it is not advisable to subject the general population to this invasive modality; 2) The classification of the patients with negative coronary angiography as the control group was not possible because although they had no CAD, they could still have met the criteria for coronary angiography; it is, therefore, impossible to consider these subjects as a normal population.

Recruiting a large sample size, we aimed to probe into the gender differences between male and female patients with angiographically-documented CAD. Nevertheless, more studies with different designs are required to further investigate the reasons for the observed differences.

Table 1: CAD Patients' Characteristics (n=37358, M=25363, F=11995)

	Men (Mean±SD)	Women (Mean±SD)	*P* value
Age (y)	58.52±10.48	61.28±9.19	< 0.001
Years of Education	8.39±5.44	4.03±4.65	< 0.001
BMI (kg/m^2)	26.86±3.87	29.31±4.91	< 0.001
LVEF (%)	49.36±11.36	53.17±10.81	< 0.001
Cholesterol (mg/dl)	184.29±46.04	200.04±50.75	< 0.001
Triglyceride (mg/dl)	176.33±116.55	192.68±136.30	< 0.001
LDL (mg/dl)	110.73±37.91	119.20±42.44	< 0.001
HDL (mg/dl)	40.75±9.91	45.26±11.11	< 0.001
FBS (mg/dl)	116.86±46.53	135.43±63.49	< 0.001
Creatinine (mg/dl)	1.17±0.60	1.02±0.55	< 0.001

CAD, Coronary artery disease; BMI, Body mass index; LVEF, Left ventricular ejection fraction; LDL, Low-density lipoprotein; HDL, High-density lipoprotein; FBS, Fasting blood sugar

Table 2: Marital status of CAD patients*

	Female (n=11184)	Male (n=23581)	Total (n=34765)
Single	112 (1.0)	211 (0.9)	323 (0.9)
Married	8562 (76.6)	22775 (96.6)	31337 (90.1)
Widowed	2369 (21.2)	429 (1.8)	2798 (8.0)
Divorced	141 (1.3)	166 (0.7)	307 (0.9)

Data are presented as n (%)
CAD, Coronary artery disease;
*P< 0.001

Table 3: Clinical presentations of CAD patients

Presentation	Female (n=11508)	Male (n=24108)	Total (n=35616)	*P* value
Acute Coronary Syndrome				< 0.001
STEMI	2278 (19.8)	8801 (36.5)	11079 (31.1)	
NSTEMI	1297 (11.3)	3141 (13.0)	4438 (12.5)	
UA	4322 (37.6)	6398 (26.5)	10720 (30.1)	
Chronic Stable Angina				< 0.001
SA (TCP)	2591 (22.5)	3962 (16.4)	6553 (18.4)	
SA (ACP)	560 (4.9)	1084 (4.5)	1644 (4.6)	
SA (DOE)	460 (4.0)	722 (3.0)	1182 (3.3)	

Data are presented as n (%)
CAD, Coronary artery disease; STEMI, ST-elevation myocardial infarction; NSTEMI, Non-ST-elevation myocardial infarction; UA, Unstable angina; SA, Stable angina; TCP, Typical chest pain; ACP, Atypical chest pain; DOE, Dyspnea on exertion

Table 4: Distribution of risk factors amongst patients with proven CAD

	Female	Male	Total	*P* value	OR (95% CI)
Family History	2893 (24.6)	5075 (20.3)	7968 (21.7)	< 0.001	1.28 (1.21-1.34)
Cigarette Smoking	1074 (9.0)	13672 (53.9)	14701 (39.5)	< 0.001	0.08 (0.07-0.09)
Hypertriglyceridemia	2314 (26.1)	4358 (23.2)	6672 (24.2)	< 0.001	1.17 (1.10-1.23)
Hypercholesterolemia	3396 (38.4)	5584 (29.8)	8980 (32.5)	< 0.001	1.47 (1.39-1.54)
Hypertension	8698 (72.7)	11028 (43.6)	19726 (53.0)	< 0.001	3.45 (3.28-3.61)
Diabetes Mellitus	5314 (44.4)	6380 (25.2)	11694 (31.4)	< 0.001	2.37 (2.26-2.48)
Opium Usage	235 (2.7)	5001 (25.5)	5236 (18.6)	< 0.001	0.08 (0.07-0.09)

Data are presented as n (%), except for OR
CAD, Coronary artery disease;

Table 5: Post angiography treatment recommendations

	Female	Male	Total	*P* value
CABG	3547 (34.0)	9014 (40.8)	12561 (38.6)	
PCI	2483 (23.8)	6041 (27.4)	8524 (26.2)	
Medical Treatment	4393 (42.2)	7028 (31.8)	11421 (35.1)	
Total	10423	22083	32506	< 0.001

Data are presented as n (%)
CABG, Coronary artery bypass grafting; PCI, Percutaneous coronary angiography

Table 6: Coronary artery involvements

	Female	Male	Total	*P* value	OR (F/M)
LAD	8651 (72.1)	20397 (80.4)	29048 (77.8)	< 0.001	0.63
LCX	5906 (49.2)	14733 (58.1)	20639 (55.2)	< 0.001	0.70
RCA	6068 (50.6)	15348 (60.5)	21416 (57.3)	< 0.001	0.67
LM	1153 (9.6)	3339 (13.1)	4492 (12.0)	< 0.001	0.70

Data are presented as n (%)
F, Female; M, Male; LAD, Left anterior descending; LCX, Left circumflex; RCA, Right coronary artery; LM, Left main

Table 7: Number of coronary artery involvements*

	Female n=11995	Male n=25363	Total n=37358
Minimal	2221 (18.5)	2444 (9.6)	4665 (12.5)
SVD	3066 (25.6)	5813 (22.9)	8879 (23.8)
2VD	2565 (21.4)	6653 (26.2)	9218 (24.7)
3VD	4143 (34.5)	10453 (41.2)	14596 (39.1)

Data are presented as n (%)
SVD, Single-vessel disease; 2VS, Two-vessel disease; 3VD, Three-vessel disease
**P*< 0.001

Table 8: Combination of different coronary artery involvements*

	Female	Male	Total
Minimal	2190 (18.3)	2388 (9.4)	4578 (12.3)
Minimal + LM < 50%	29 (0.2)	44 (0.2)	73 (0.2)
Minimal + LM > 50%	2 (0)	12 (0)	14 (0)
Isolated SVD	2948 (24.6)	5539 (21.8)	8487 (22.7)
SVD + LM < 50%	93 (0.8)	203 (0.8)	296 (0.8)
SVD + LM > 50%	25 (0.2)	71 (0.3)	96 (0.3)
Isolated 2VD	2336 (19.5)	5911 (23.3)	8247 (22.1)
2VD + LM < 50%	160 (1.3)	532 (2.1)	692 (1.9)
2VD + LM > 50%	69 (0.6)	210 (0.8)	279 (0.7)
Isolated 3VD	3368 (28.1)	8186 (32.3)	11554 (30.9)
3VD + LM < 50%	508 (4.2)	1357 (5.4)	1865 (5.0)
3VD + LM > 50%	267 (2.2)	910 (3.6)	1177 (3.2)

Data are presented as n (%)
LM, Left main; SVD, Single-vessel disease; 2VS, Two-vessel disease; 3VD, Three-vessel disease
**P*< 0.001

Conclusion

This study found that among traditional CAD risk factors (excluding cigarette smoking) were more frequent in female patients. Hypertension and diabetes mellitus were the most important risk factors. However, the role that hypertension played as a risk factor among the female CAD patients was much stronger than what was previously reported.

The female patients reported less severe symptoms than did the males and invasive procedures were most frequently recommended treatment modality to male and female patients with exten-

sive CAD. However medical treatment (as sole treatment) was frequently recommended for females. There was no gender preference in coronary artery vessel involvement.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

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References

1. Shaw LJ, Bairey Merz CN, Pepine CJ, Reis SE, Bittner V, Kelsey SF, Olson M, Johnson BD, Mankad S, Sharaf BL, Rogers WJ, Wessel TR, Arant CB, Pohost GM, Lerman A, Quyyumi AA, Sopko G (2006). Insights from the NHLBI-Sponsored Women's Ischemia Syndrome Evaluation (WISE) Study: Part I: gender differences in traditional and novel risk factors, symptom evaluation, and gender-optimized diagnostic strategies. *J Am Coll Cardiol*, 47(3 Suppl): S4-20.
2. Hatmi ZN, Tahvildari S, Ghafarzadeh Motlagh A, Sabouri Kashani A (2007). Prevalence of coronary artery disease risk factors in Iran: a population based survey. *BMC Cardiovasc Disord*, 30(7): 32.
3. Shaw LJ, Bugiardini R, Merz CN (2009). Women and ischemic heart disease. *J Am Coll Cardiol*, 54(17): 1561-75.
4. Vitale C, Fini M, Speziale G, Chierchia S (2010). Gender differences in the cardiovascular effects of sex hormones. *Fundam Clin Pharmaco*l, 24(6): 567-85.
5. Stramba-Badiale M, Fox KM, Priori SG, Collins P, Daly C, Graham I, Jonsson B, Schenck-Gustafsson K, Tendera M (2006). Cardiovascular diseases in women: a statement from the policy conference of the European Society of Cardiology. *Eur Heart J*, 27(8): 994-1005.
6. Zhang Y (2010). Cardiovascular diseases in American women. *Nutr Metab Cardiovasc Dis*, 20(6): 386-93.
7. American Heart Association (2004). Heart Disease and Stroke Statistics: 2004 Update. Available from: http://americanheart.org/downloadable/heart/1072969766940HSStats2004Update.pdf. Accessed on 22 May. 2011.
8. Epstein AM, Weissman JS, Schneider EC, Gatsonis C, Leape LL, Piana RN (2003). Race and gender disparities in rates of cardiac revascularization: do they reflect appropriate use of procedures or problems in quality of care? *Med Care*, 41(11): 1240–55.
9. Nabel EG, Selker HP, Califf RM (2004). Women's Ischemic Syndrome Evaluation: current status and future research directions: report of the National Heart, Lung and Blood Institute workshop: October 2–4, 2002; section 3: diagnosis and treatment of acute cardiac ischemia: gender issues, *Circulation*, 109(6): e50-2.
10. Murray CJ, Lopez AD (1996). Evidence-based health policy--lessons from the Global Burden of Disease Study. *Science*, 274(5288): 740-3.
11. Ahmad N, Bhopal R (2005). Is coronary heart disease rising in India? A systematic review based on ECG defined coronary heart disease. *Heart*, 91(6): 719-25.
12. Stangl V, Baumann G, Stangl K (2002). Coronary atherogenic risk factors in women. *Eur Heart J*, 23(22): 1738–52.
13. Vaccarino V, Parsons L, Every NR, Barron HV, Krumholz HM; National Registry of Myocardial Infarction 2 participants

(1999). Sex-based differences in early mortality after myocardial infarction. *N Engl J Med*, 341(4): 217–25.
14. *Chambless LE*, Heiss G, Shahar (2004). Prediction of ischemic stroke risk in the Atherosclerosis Risk in Communities study. *Am J Epidemiol*, 160(3): 259–69.
15. Hsia J (2010). Managing cardiovascular risk factors: Trial evidence in women. *Nutr Metab Cardiovasc Dis*, 20(6): 445-50.
16. Soleimani A, Abbasi K, Nejatian M, Movahhedi N, Hajizaynali MA, Salehiomran A, Abbasi SH, Alidoosti M, Sheikhfathollahi M, Abbasi A (2010). Effect of gender and type 2 diabetes mellitus on heart rate recovery in patients with coronary artery disease after cardiac rehabilitation. *Minerva Endocrinol*, 35(1): 1-7.
17. Mandegar MH, Marzban M, Lebaschi AH, Ghaboussi P, Alamooti AR, Ardalan A (2008). Gender influence on hospital mortality after coronary artery bypass surgery. *Asian Cardiovasc Thorac Ann*, 16(3): 231-5.
18. Sotoudeh Anvari M, Boroumand MA, Emami B, Karimi AA, Soleymanzadeh M, Abbasi SH, Saadat S (2009). ABO Blood Group and Coronary Artery Diseases in Iranian Patients Awaiting Coronary Artery Bypass Graft Surgery. *LabMedicine*, 40(9): 528-30.
19. Sadeghian S, Graili P, Salarifar M, Karimi AA, Darvish S, Abbasi SH (2010). Opium consumption in men and diabetes mellitus in women are the most important risk factors of premature coronary artery disease in Iran. *Int J Cardiol*, 141(1): 116-8.
20. Karimi A, Ahmadi H, Davoodi S, Movahedi N, Marzban M, Abbasi K, Omran AS, Sadeghian S, Yazdanifard P, Abbasi SH, Fallah N (2008). Factors affecting postoperative morbidity and mortality in isolated coronary artery bypass graft surgery. *Surg Today*, 38(10): 890-8.
21. Karimi AA, Ahmadi SA, Davoodi S, Marzban M, Movahedi N, Abbasi K, Salehi Omran A, Shirzad M, Saeed Sadeghian, Abbasi SH, Lotfi-Tokaldany M, Soleymanzadeh M, Fehri A, Sheikh Fathollahi M (2008). First Database Report on Cardiothoracic Surgery in Tehran Heart Center. *Iranian J Publ Health*, 37(2): 1-8.
22. Bairey Merz CN, Shaw LJ, Reis SE, Bittner V, Kelsey SF, Olson M, Johnson BD, Pepine CJ, Mankad S, Sharaf BL, Rogers WJ, Pohost GM, Lerman A, Quyyumi AA, Sopko G; WISE Investigators (2006). Insights from the NHLBI-Sponsored Women's Ischemia Syndrome Evaluation (WISE) Study: Part II: gender differences in presentation, diagnosis, and outcome with regard to gender-based pathophysiology of atherosclerosis and macrovascular and microvascular coronary disease. *J Am Coll Cardiol*, 47(3 Suppl): S21-9.
23. Lewington S, Clarke R, Qizilbash N, Peto R, Collins R; Prospective Studies Collaboration (2002). Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. *Lancet*, 360(9349): 1903-13.
24. Anonymous, Countries: Iran. Available from: http://www.who.int/countries/irn/en/. Accessed on 22 May. 2011.
25. Rivellese AA, Riccardi G, Vaccaro O (2010). Cardiovascular risk in women with diabetes. *Nutr Metab Cardiovasc Dis*, 20(6): 474-80.
26. Shara NM (2010). Cardiovascular disease in Middle East Women. *Nutr Metab Cardiovasc Dis*, 20(6): 412-18.
27. Anonymous, Cholestrol: facts. Available from: www.cdc.gov/cholesterol/facts.htm. Accessed on 22 May. 2011.
28. Anonymous, Women's health: What's new in 2005. Available from: www.cdc.gov/Women/whatsnew/wn2005.htm. Accessed on 22 May. 2011.
29. Acarturk E, Cayli M, Akpinar O (2004). Relation between age and gender differences in plasma triglyceride concentrations and coronary artery

disease in Southern Turkey. *Clin Chim Acta*, 339(1-2):123–8.

30. Stefanick ML (2010). Postmenopausal hormone therapy and cardiovascular disease in women. *Nutr Metab Cardiovasc Dis*, 20(6): 451-8.
31. Thom T, Haase N, Rosamond W, Howard VJ, Rumsfeld J, Manolio T, Zheng ZJ, Flegal K, O'Donnell C, Kittner S, Lloyd-Jones D, Goff DC Jr, Hong Y, Adams R, Friday G, Furie K, Gorelick P, Kissela B, Marler J, Meigs J, Roger V, Sidney S, Sorlie P, Steinberger J, Wasserthiel-Smoller S, Wilson M, Wolf P; American Heart Association Statistics Committee and Stroke Statistics Subcommittee (2006). Heart disease and stroke statistics--2006 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circulation*, 113(6): e85-151.
32. Collins SD, Ahmad S, Waksman R (2010). Percutaneous revascularization in women with coronary artery disease: We've come so far, yet have so far to go. *Nutr Metab Cardiovasc Dis*, 20(6): 436-444.