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Risk Factors for Coronary Artery Disease in Egyptian Women

Bahnasawy MH*; Habbak LZ*; Al-Ashry MA and Al-Maie MM***

* Zoology department, Faculty of science, Damietta University, Egypt

** Intensive care unit, Damietta chest hospital, Damietta, Egypt

Abstract

Introduction: Coronary artery disease (CAD) is a major public health problem both in developed and in developing countries. The disease is multifactorial and many predisposing risk factors are responsible for this disease. The present study was performed to determine the prevalence of CAD risk factors among Egyptian women at Damietta governorate.

Patients and methods: The study was based on investigation of 113 randomly chosen women who had CAD. Demographic data, risk factors were determined by taking history, physical examination and laboratory tests.

Results: The results indicated that the age of the patients ranged from 24 to 82 years with a mean of 55.95±11.04 years. The mean total cholesterol, LDL-C and HDL-C were 233.17, 150.77 and 44.80 respectively. The blood sugar ranged from 75 to 488. Risk factors analysis revealed a significant higher prevalence of obesity and overweight (96.46%), hypertension (83.19%), total cholesterol (78.76%), physical inactivity (70.8%), stress (69.03%), diabetes mellitus (57.52%) and family history of CAD (46.9%).

Conclusion: This study provides useful information about the health characteristics of the Egyptian women at Damietta governorate and indicates that the development of health education programs and early chick-up is necessary to prevent the risk factors of this disease.

Key words: Coronary – risk factors – Damietta - women

- TG : triglyceride
- mmHg : Millimeter Hg
- mg/dl : Milligram per Deciliter

Introduction

Coronary artery disease (CAD), the most common form of cardio-vascular disease (CVD), is the leading cause of mortality and morbidity in developed countries and is emerging as an epidemic in developing countries **[1, 2].** CAD is characterized by the presence of atherosclerosis in the epicardial coronary arteries **[3].** Atherosclerosis is a disease in which fatty substance such as cholesterol, cellular waste, calcium and other substance are deposited along the lining of the artery walls. These sticky, yellowish deposits, known as plaques, may progress to the narrowing of the arteries and is the most common cause of chronic arterial occlusive disease **[4].**

An estimated 17.3 million people died from CVDs in 2008, representing 30% of all global deaths. Of these deaths, an estimated 7.3 million were due to coronary artery disease and 6.2 million were due to a stroke **[5].** Advances in the field of medicine over the past few decades enabled the identification of the risk factors that may contribute toward the development of CAD. The risk factors that can be modified are elevated blood cholesterol, hypertension (high blood pressure), cigarette smoking, overweight and obesity, diabetes mellitus, alcohol consumption, stress and physical inactivity. Non-modifiable risk factors of course include age, gender and family history **[6, 7].**

In Egypt, mortality secondary to CAD is rapidly rising **[8].** According to the latest WHO data, coronary artery disease deaths in Egypt reached 78,879 or 21.73% of total deaths. The age adjusted death rate is 173.98 per 100000 of population ranks Egypt 33 in the world **[9].**

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There is geographic and genetic variability in the prevalence of cardiovascular risk factors and then contribution to the development of CAD **[8].**

The primary aim of this study is to identify and record risk factors for coronary artery disease among female patients in Damietta Governorate. Indirectly, the knowledge of risk factors is useful in planning of preventive health care programs in the community.

Patients and Methods

The present study is across-sectional analytical population – based study carried in Damietta governorate from (January to September 2012). The study sample consisted of 113 female patients who were the user of cardiology Department of three medical centers in Damietta (Damietta general hospital, Damietta specialized hospital, the heart and gastroenterology center in Damietta). All patients were informed by this study and then verbal consent was obtained.

An informative questionnaire was designed to be completed by the researcher and to obtain information on the following CAD risk factors: overweight and obesity, family history of heart disease, smoking habit, systolic and diastolic blood pressure, serum cholesterol, serum high density lipoprotein, serum low density lipoprotein, serum glucose, alcohol consumption, exercise habit and stress.

Height and weight were measured and body mass index was calculated as weight in kilograms divided by height in square meters. Blood pressure was measured with a mercury sphygmomanometer by trained physician with the patient in a sitting position. Venous blood samples were obtained after 12 hours overnight fasting for measurements of clinical chemistry profiles. Enzymatic methods were used for the measurement of glucose, total cholesterol and HDL cholesterol. LDL cholesterol fraction was determined indirectly according to Friedewald formula: LDL-C = TC - HDL-C - TG/5 (mg/dl) **[10, 11].**

Risk factors was defined as

- Obesity: body mass index (BMI) ≥ 30, overweight: 25<BMI<30 **[12].**
- Hypertension: systolic blood pressure ≥ 140 mmHg and diastolic blood pressure ≥ 90 mmHg **[13].**
- Dyslipidemia: total cholesterol (TC) > 200 mg/dl **[14],** high-density lipoprotein (HDL-C) <35 mg/dl **[14]**, and low density Lipoprotein (LDL-C) ≥ 160 mg/dl **[14].**
- Diabetes mellitus: Fasting blood glucose level ≥ 126 mg/dl **[12].**
- Family history of CAD – one or more parents died of heart disease **[15].**
- Exercise and practice any type of exercise less than 90 min per week **[15].**
- Stress – moderate or high score as self-reported **[15].**

Statistical analysis

The statistical package for the social sciences (SPSS) was used for analysis of all data obtained from the questionnaire and lipid, glucose measurement. Descriptive statistics for all studied variables and Chi-square test were used and P-value level < 0.05 was considered significant throughout the study.

Results

The present study included 113 randomly selected women suffering from CAD. Table 1 shows baseline characteristics of the study population. The age range of the patients was 24-82 years with a mean of 55.95 years. Mean values (mg /dl) for total cholesterol, LDL-C and HDL-C were 233.17, 150.77 and 44.80 respectively. The blood sugar of the

patients ranged from 75 - 488 mg /dl, while their BMI from 23.32 to 50.71.

The association between age and CAD incidence is shown in figure 1. Based on 10 years age intervals, the age of the patients is divided into 6 groups: 20-30, 31-40, 41-50, 51-60, 61-70 and over 70 years. 23.89% of the patients were between 41-50 years, 31.86% patients between 51-60 years and the age group 61-70 years contain 30 patients representing 26.55 % of all samples. Chi - square analysis revealed that age is a risk factor for CAD and the patients who are at higher risk are between 41- 70 years (82.3%).

The prevalence of CAD risk factors for the patients of the present study is presented in table 2. The majority (96.46%) of the patients were overweight or obese with a mean BMI of 36.67 kg/m2. 78.76% of the patients were found to have abnormal cholesterol (> 200 mg /dl). In addition 58.41% of the patients had normal LDL-C level. (Furthermore, 78.76% of the patients had normal HDL-C level).

Hypertension (Higher systolic ≥ 140 mmHg and diastolic ≥ 90mmHg) blood pressures were found in 83.19% of the patients. 57.52% of the patients were found to be diabetic. T. test analysis showed that there is a significant difference between the mean of normal and abnormal levels of obesity / overweight, hypertension, cholesterol, LDL cholesterol, HDL cholesterol, blood sugar. By applying Chi – square analysis, it is revealed that overweight / obesity, cholesterol and hypertension are risk factors for CAD incidence. 70.8% of the patients led a sedentary life style, and 69.03% of them are suffering from life stress. In addition to this, a history of CAD was given by 46.9% of the patients. Chi – square analysis indicated that physical inactivity and life stress are risk factors for CAD incidence.

Table1. Baseline characteristics of the study population

Characteristic	N	Range	Mean ± SD
Age (years)	113	24 - 82	55.95±11.04
Weight (kg)		58 - 145	97.71±16.72
BMI		23.32 - 50.71	36.67±6.33
Systolic blood pressure		70 - 300	156.53±30.62
Diastolic blood pressure		70 - 120	92.23±10.12
Cholesterol		119 - 382	233.17±46.08
LDL-C		51.4 - 316.0	150.77±46.06
HDL-C		21 - 88	44.80±13.37
Blood sugar		75 - 488	163.79±82.56

- N: number of total patients

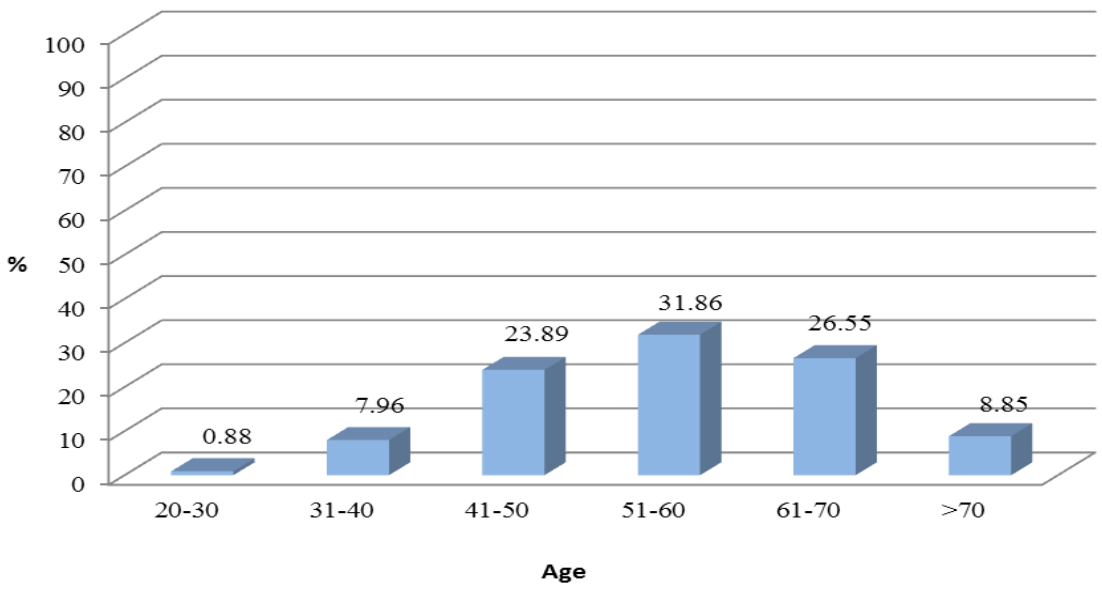

Figure1. Prevalence of age risk factor for women at Damietta governorate

Table2. Prevalence of CAD risk factors for women at Damietta governorate

Factors	State	Range	Mean	SE	Frequency	%	Sig.1	Sig.2
Obesity/Overweight	Normal	23.32 - 24.98	24.34	0.388	4	3.54	0.001	0.001
	Abnormal	25.01 - 50.71	37.13	0.572	109	96.46		
Cholesterol	Normal	119 - 194	170.79	4.784	24	21.24	0.001	0.001
	Abnormal	203 - 382	249.99	3.689	89	78.76		
LDL-cholesterol	Normal	51 - 160	120.8	3.255	66	58.41	0.001	0.074
	Abnormal	160 - 316	192.85	4.792	47	41.59		
HDL-cholesterol	Normal	35 - 88	49.09	1.233	89	78.76	0.001	0.001
	Abnormal	21 - 35	28.87	0.811	24	21.24		
Diabetes mellitus	Normal	75 - 123	99.23	1.933	48	42.48	0.001	0.11
	Abnormal	126 - 488	211.46	9.893	65	57.52		
Hypertension	Normal	70 - 135	122.07	1.560	19	16.81	0.001	0.001
	Abnormal	140 - 300	167.88	2.951	94	83.19		
Physical inactivity	Normal	-	-		33	29.2	-	0.001
	Abnormal	-	-		80	70.8		
Stress	Normal	-	-		35	30.97	-	0.001
	Abnormal	-	-		78	69.03		
Family history	Normal	-	-		60	53.1	-	0.51
	Abnormal	-	-		53	46.9		

- Sig 1: for T-test
- Sig 2: for chi-square test (χ^2)

Discussion

This study supports the widely accepted view that CAD is of multifactorial origin. Obesity, high blood pressure, high serum cholesterol concentration, increased LDL-C level, physical inactivity, stress are the outstanding conditions associated with CAD in women at Damietta governorate.

The age of patients, in this study, lies between 24 and 82 years with a mean of 55.95 years. The prevalence of risk factors was higher among the age of 41-70 years representing 82.3% of the total population sample. Age is by far the most important risk factor in developing cardiovascular disease, with approximately a tripling of risk with each decade of life. It is estimated that 87% of people who die of coronary heart disease are 60 and older **[16].** The serum total cholesterol level increases as age increases and the increase continues sharply until the age of 60 to 65 years in women **[17].** In addition to this, the decrease in estrogen production in women after menopause changes the female lipid metabolism toward a more atherogenic form by decreasing the HDL-C cholesterol level and by increasing LDL-C and total cholesterol, and triglyceride **[18].** In addition to the lipid effect, estrogen may have cardio protective effects through glucose metabolism and the haemostatic system, and it may also have a direct effect on endothelial cell function **[19].** Ageing is also associated with changes in the mechanical and structural properties of the vascular wall, which leads to the loss of arterial elasticity and reduced arterial compliance and may subsequently lead to coronary artery disease **[16].**

The present study revealed that the majority of sample population (70.8%) does not practice any type of physical exercise. This result is in agreement with the study of many authors who reported that physical inactivity is common among female with CAD **[20, 21]. Castanho et al. [22]** showed that 52% of Brazilian females with CAD were leading a sedentary life style. 48% of the Iranian women with CAD were physically inactive **[3].** 73% of Palestinian women with CAD were physically inactive **[23].** A recent analysis suggests that 37% of deaths from CAD are attributable to physical inactivity, this second only to raised blood cholesterol **[21].**

Physical inactivity may result in coronary artery disease through various physiological mechanisms which related partly to detrimental effects on blood pressure, serum lipoprotein profiles, as well as insulin and glucose metabolism. Each of these effects may have a subsequent influence on atherosclerotic process **[24].**

It is known that obesity and /or overweight promotes or aggravates all the atherogenic risk factors predisposing subjects of all ages to coronary events **[25].** The present study confirms this view. 96.46% of the patients in the present study were overweight or obese. The concept of obesity and overweight being a major risk factor for CAD is in agreement with previous studies. In Yazd (Iran), **Namayandeh et al. [12]** found that obesity was significantly higher in females (24.29%) than males (9.1%) and about 62.01% of females with CAD were overweight. About 64% of females with CAD from Tehran (Iran) were found to be overweight or obese **[26].** In US, it was estimated that approximately 47.6% of women were overweight **[27].** In addition to this, the study of **khwaiter [23]** showed that 30.8% and 46.2% of the Palestinian women with CAD were obese and overweight respectively. The high prevalence of overweight and obesity among females of CAD may be attributed to difference in eating habits, physical activity and sexual hormones that affect fat distribution **[26, 28].** In Damietta, there is a trend toward consumption of fat rich and cholesterol-rich food in addition to different types of sweets, this with a sedentary life style. Obesity promotes insulin resistance, hyperinsulinism, hypertension, hypertriglyceridemia, low

HDL cholesterol, small dense LDL cholesterol and prothrombic factors **[29].**

The present study showed that 78.76% of the patients had high serum cholesterol (> 200 mg/dl), and 41.59% of them had higher level (≥ 160 mg/dl) of LDL-C. This result is in agreement with previous studies of many authors who found a strong and graded positive association between total cholesterol as well as LDL-C in women and the risk of CAD **[30, 31].** 35.12% of Indian women with CAD had higher level of LDL-C **[32]. Khwaiter [23]** recorded 11.5% of Palestinian women with CAD had high level of cholesterol (240 mg/dl) and 15.4% of them had higher level of LDL-C (≥ 160 mg/dl). Environmental factors such as dietary constituents, socioeconomic levels, physical activity, as well as race and hereditary background are involved in determining lipid profiles **[12].** Total cholesterol and LDL-C level in women rise or even exceed the levels in men following the menopause. Estrogen is potent LDL-C receptor up regulating agents. In the presence of low endogenous estrogen level, LDL-C receptor activity is reduced. This leads to the elevated LDL-C concentration observed in postmenopausal women **[33].**

Numerous studies have shown that elevated serum low density lipoprotein (LDL) cholesterol is the crucial factor for the initiation and progression of the atherosclerosis, and lowering LDL cholesterol can largely reduce the incidence and mortality of cardio and cerebro-vascular diseases **[34].**

The low density lipoprotein particle is the major transporter of cholesterol around the body and has been shown to be strong independent risk factor for atherosclerotic events **[35].** It has proposed that the increasing surface area of LDL-C particle makes it more amenable to oxidation and glycation, both modifications being associated with antibody formation. Oxidized LDL-C has many characteristics that potentially promote atherogenesis. Firstly, oxidized LDL-C is recognized by the scavenger receptors and can therefore give raise to foam cells. Secondary, oxidized LDL-C stimulates endothelium to secrete monocyte chemo tactic protein1 which induce the infiltration of monocytes into the sub endothelial space. Oxidized LDL-C can also induce migration and proliferation of smooth muscle cells and impede endothelial cell migration. Finally, oxidized LDL-C may interfere with endothelium – mediated relaxation and stimulate platelet adhesion and aggregation through inhibition or reduced endothelial production of nitric oxide **[34].**

Some components of oxidized LDL-C may induce injury by both apoptotic and necrotic pathways. These pro-atherogenic properties of oxidized LDL-C may explain the great variability in the incidence of CAD at any level of plasma cholesterol and why the modification of LDL-C plays an important role in the development of atherosclerosis **[34].**

Lower HDL-C was found in 21.24% of the population sample. This result is in coinciding with the finding of **Achari and Thakur [32]** in which the prevalence of decreased HDL-C level was 23.86% in Indian women. **Ibrahim et al. [8]** reported that 27.7% of the Egyptian women with CAD had low HDL-C. HDL-C level are reported to correlate closely and inversely with the risk of CAD **[33, 35].** It is hypothesized that HDL-C promotes the removal of free cholesterol from peripheral tissue and its transport to the liver for eventual clearance **[36].** The anti-atherogenic role of HDL-C may be due to inhibition of LDL-C oxidation by HDL-C bound PONI (Paraoxinase I), protection of endothelial cells from cytotoxic damage caused by remnants of TRLs (triglyceride-rich lipoprotein), regulation of coagulation and fibrinolysis and inhibition of platelet function, stimulation of endothelial nitric oxide production and inhibition of the chemo taxis of monocytes and the adhesion of leukocytes to the endothelium **[30].**

Hypertension (elevated systolic and diastolic blood pressure) is the most

common risk factor for CAD and stroke, affecting 20% of the adult population in both developed and developing countries **[37].** In the present study 83.19% of the patients were suffering from hypertension. Both systolic and diastolic hypertension was shown to have a strong positive, continuous and graded relationship with CAD without any evidence of threshold risk level of blood pressure. The prevalence of hypertension among women with CAD had a wide range in different countries; from 23.5% in South America, to 51.3% in Punjabi Bhatia, to 23.89% in Yazd (Iran) **[12]**, to 40% in Copenhagen city **[38]**, to 28.3% in Isfahan (Iran) **[39].**

Differences in life style such as dietary habits, socioeconomic and environmental factors even the salt content of water can contribute to these variations **[12]. Roeters van Lennep et al. [33]** reported that isolated systolic hypertension is an indication of loss of arterial elasticity and is common finding in elderly women with a prevalence of 30% in women over 65 years of age.

Diabetes mellitus (DM) is one of the most important diseases in the modern society and represents not only a medical but also social problem. The present investigation revealed that 57.52% of the patients were diabetic. This result is in accordance with the studies of many authors who reported that diabetes and its predominant form, type 2diabetes has a distinctive association with CAD and those with CAD and those with diabetes have two to four fold higher risk of developing CAD than people without diabetes **[40, 41].** The occurrence of DM among the women patients with CAD is variable worldwide. In Iranian cities, it was 3.21% **[3]**, 44.4% **[41]**, 11.59% **[12]**, 7.3% **[39]** and 6.1% **[42].** 50% of Palestinian women with CAD were diabetic **[23].**

The high prevalence of DM in females with CAD may be accounted for women greater propensity towards developing diabetes wich is partly due to a more sedentary life style, obesity and inappropriate nutrition **[42].** In the present study, the prevalence of obesity / overweight and sedentary life style were 96.46% and 70.80% respectively. **Avogaro et al. [43]** reported that postmenopausal women may be in recently more resistant to diet related risk reduction.

Atherogenesis occurs due to a number of factors in diabetic individuals; both insulin resistance and elevated lipid levels, common in diabetes are primary triggers of atherogenic injury. It is also suggested that endothelium in diabetic arteries is more prone to atherogenic injury due to decreased production of endothelial nitric oxide, known to be antiatherogenic and increased production of plasminogen activator inhibitor **[44].** In addition, a complex mix of mechanistic processes such as oxidative stress, enhanced atherogencity of cholesterol particles, abnormal vascular reactivity, augmented homeostatic activation, and renal dysfunction have been proposed as features characteristic of T2DM that may confer excess risk of CAD **[40].**

In the present study, 69.03% of the patients were suffering from stress. This result is in agreement with the results of many authors who concluded that stress has a major impact upon the cardiovascular system, and a variety of cardiovascular disease are influenced by a stressors especially mental, behavioral and psychosocial stressors **[45, 46].**

The response to acute release of the sympathomimetic hormones, catecholamine resulting in vasoconstriction and increased platelets activation, altering blood clotting, this accelerating the development of atherosclerosis **[47].** Mental stress induces significant peripheral arterial vasoconstriction, with consequent increase in heart rate and blood pressure. Moreover, stress increase the clotting capability of blood producing complete or incomplete blocking of coronary arteries and leading to heart attack **[48].** In addition to this, stressful conditions lead to formation of excessive free radicals, which are a major

internal threat to cellular homeostasis of aerobic organisms **[49].** In this respect, **Chandola et al. [50]** reported that work stress may affect CAD through direct activation of neuroendocrine response to stressors, or more indirectly through unhealthy behaviors which increase the risk of CAD, such as smoking, lack of exercise or excessive alcohol consumption. **Xu et al. [51]** stated that job stress was associated with the systolic blood pressure of Chinese working women.

46.9% of patients, in the present study, were with a family history of CAD. Family history of heart disease has been reported to increase risk factor of coronary artery disease by two-seven folds in numerous studies **[52, 53].** This familial aggregation, genetic or environmental, of known cardiovascular risk factors such as raised blood pressure, hyperlipidemia and cigarette smoking is well recognized **[54].**

A study of 37 women who died of CAD under the age of 55 years showed that 62% of the first – degree relatives of the patients had premature CAD **[53]. Waly et al. [55]** recorded that 53.1 of the Egyptian patients with CAD were with family history of CAD. Another Swedish study reported a relative hazard of coronary death of 1.50 for females monozygotic twins and 2.6 for female dizygotic twins if then co – twins had died of CAD before the age of 65 **[53].**

In conclusion, this study reflects the reality of the prevalence of the risk factors for coronary artery disease in Damietta Governorate. The best treatment for the major chronic and degenerative disease like CAD is prevention, which is achieved by fighting the risk factors. An urgent need for development of health education programs to raise the health awareness and knowledge of women about risk factors for heart disease and encourage them to adopt a healthy dietary behavior and promote physical exercise.

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