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Risk Factors of Coronary Artery Disease in Palestinian Patients Undergoing Coronary Angiography: A Case–Control Study

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Authors' contributions

Both authors of this research paper have directly and sufficiently participated in all stages of the study including the planning, execution, analysis and manuscript preparation. Both authors have read and approved the final version prior to submission.

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ABSTRACT

Aims: To identify the most significant risk factors of coronary artery disease (CAD) in Palestinian patients undergoing coronary angiography.
Study Design: A retrospective case control design.
Place and Duration of Study: The study was conducted in the only two cardiac catheterization centers in Gaza strip, Palestinian territories (European center in the south and Julis center in the mid-zone) from June to September 2010.
Methodology: Based on coronary angiography results, we recruited a systematic random sample of 100 cases formally diagnosed with CAD matched with sex to 100 controls who had normal findings and were free from the disease. Data was collected using a questionnaire which included socio-demographic data and health profile. Chi square, univariate and multivariate logistic regression were used to test the differences between cases and controls and to determine the predictors of CAD.
Results: Most cases were male (72.9%), ≥50 years old (70%) and living in refugee camps

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(57.9%). The most common risk factors were physical inactivity (OR 3.96, *P*=0.002), hypertension (OR 2.73, *P*<0.001), diabetes (OR 2.21, *P*=0.006), LDL/HDL ratio ≥3 (OR 3.76, *P*<0.001), smoking (OR 1.96, *P*=0.031), positive family history (OR 2.12, *P*=0.012), multigravida (OR 10.5, *P*=0.034) and living in refugee camps (OR 1.92, *P*=0.023). Coronary artery disease was not significantly correlated with age, body mass index, unemployment and monthly income.

Conclusion: Sedentary lifestyle, high LDL, low HDL, hypertension, diabetes, positive family history, smoking and multigravida remain the major modifiable risk factors of CAD among the Palestinians. Living in the refugee camps imposes more risk to have CAD. Gender differences indicated that the prevalence of CAD in males is more than females. Community-based interventions to promote exercise, family planning and smoking cessation in addition to improving the refugee life conditions may be crucial in decreasing the burden of coronary artery disease in Gaza strip.

Keywords: Coronary artery disease; coronary angiography; risk factors; Palestinians.

1. INTRODUCTION

Cardiovascular diseases (CVDs) are the first leading cause of death worldwide. An estimated 17.3 million people died from CVDs in 2008. Of these deaths, about 41.5% were due to coronary artery diseases (CADs). It is expected that this number will reach 23.3 million in the next decade especially in poor countries if no strict preventive measures are taken [1].

Palestinian people are undergoing rapid socioeconomic and epidemiological transition. Non-communicable diseases have now overtaken communicable diseases as the main causes of mortality [2]. In 2012, CAD was the first leading cause of death among the Palestinians with proportion of 39.4% of total deaths [3]. Yet, little is known about the risk factors of CADs and their correlation with socio-demographic variables of Palestinian patients in Gaza strip.

Gaza strip is a narrow piece of land (378 Km^2) on the eastern coast of the Mediterranean Sea. It is very crowded place with population number 1,672,865 mainly concentrated in four cities and eight refugee camps [4]. Palestinian refugees are persons who left their normal place of residence in historical Palestine as a result of the Arab-Israeli conflict and live now in many refugee camps including Gaza strip [5].

There is neither effective surveillance system nor community–based screening program to detect the potential cases of CADs among Palestinian people. Thus, this study was the first one to fill this gap and to try to identify major risk factors specific to the Palestinians which may lead to CAD. It is also hypothesized that the Palestinians refugees are at greater risk of developing CAD compared with non-refugees. We hope that the findings of this pioneer study in Gaza strip will contribute to setting priorities and establishing effective national preventive programs to decrease morbidity and mortality from CAD among the Palestinians.

2. MATERIALS AND METHODS

2.1 Study Design

We performed a retrospective case control study in the two cardiac catheterization centers from June to September 2010 in Gaza strip. Based on coronary angiography results, we recruited a systematic random sample of 107 cases from the European center in the south which is owned by the government and from Julis center in the mid-zone of Gaza strip which is a privately-owned center. All cases were aged 30 years old and more from both genders and formally diagnosed with coronary artery disease after cardiac catheterization. Only 7 cases did not comply with the standard of the study, therefore, they were excluded from the study. The final number of the cases was 100 with the response rate 96%. A further same number of controls (n=100) were chosen from the same centers after undergoing coronary angiography. All controls had normal findings and proved to be free from coronary artery disease. The response rate among the controls was 100%. Controls were matched with cases for gender.

The ethical and administrative considerations were taken. We obtained an ethical approval to perform the study from Helsinki Committee in Gaza. Administrative permissions were obtained from ministry of health and Julis center. Every

participant in the study received a complete explanation about the purpose of the study and assurance about the confidentiality of the information.

2.2 Data Collection

The data were collected from the medical records of both groups and by answering the questionnaire of the study in face-to-face interviews. The questionnaire covered the following data: 1.Socio-demographic and economic data included gender, age, place of residency, educational level, occupation and income. 2. Clinical data included history of diabetes, hypertension, smoking, number of previous pregnancies for females, physical exercise, family history of CAD, low density lipoprotein (LDL), high density lipoprotein (HDL), weight, height and Body Mass Index (BMI).

Education was categorized into three groups based on the number of education years: Primary (up to10 years), Secondary (11-13 years) and Tertiary (≥14 years). Monthly income was also categorized into three groups: low (<300 US$), middle (300-800 US$) and high (>800 US$). Residency area was divided into three major zones: North, Middle and South. Most of the population in the Middle area is refugees living in eight refugee camps while people in the North and South are non-refugees living in cities and villages. LDL/HDL ratio is determined by dividing the LDL cholesterol into the HDL cholesterol. BMI was calculated after obtaining the weight and height of the participants. History of hypertension and diabetes mellitus were considered positive if the cases and controls were previously diagnosed and/or if systolic blood pressure / diastolic blood pressure (SBP/DBP) ≥140/90 mm Hg and fasting blood sugar (FBS) ≥126 mg/dl respectively.

2.3 Statistical Analysis

SPSS version 20 was used to analyze the data. Frequency, percentages and means were calculated for describing the socio-demographic and economic variables. Cross tabulation was conducted to determine the relationships between two variables or more. We used Chi squire, t- test, and ANOVA to test the significant differences in categorical and continuous variables of the socio-demographic characteristics between the CAD group and the controls. For logistic modeling, obesity (BMI 25-30) and overweight (BMI >30) categories were grouped and compared with normal weight (BMI < 25). South and north residency area (non-refugee population) were grouped and compared with middle area (refugee camps).

Then, we calculated the unadjusted odds ratios for all sociodemographic characteristics and health profile variables using the univariate logistic regression model to determine the association between the independent and dependent variables and to measure the risk. In the final multivariate logistic regression model, some covariates were excluded as confounders. The adjusted odds ratios and confidence intervals analysis were performed to determine the final association between the CAD and the risk factors. If the CI did not include 1, the AOR was considered significant. For all comparisons, we defined statistical significance as any *P* value less than or equal to 0.05.

3. RESULTS AND DISCUSSION

3.1 Study Sample

(Table 1) shows that 78% of CAD group were male and 36% aged between 50-59 years old compared with only 31% of controls. The highest percent of cases and controls were ≥60 years old. About 42.1% of CAD patients were low educated compared with 55% of controls. Most of the cases and controls were employed but with low monthly income. Approximately 57.9% of cases live in refugee camps compared with only 46% of controls. Moreover, (Table 1) shows that the differences in most of the socio-demographic variables (gender, occupation, age, education, monthly income, BMI) among the patients diagnosed with CAD and the control group were not statistically significant ($p>0.05$). However, the results showed the differences regarding place of residency between CAD group and controls were statistically significant ($P=0.049$).

3.2 Crude Risk Factors for CAD

(Table 2) shows the correlated risk factors for coronary artery disease (CAD) using univariate logistic regression model. Results show that physical inactivity and sedentary lifestyle had 3.96 times greater risk of developing CAD. Furthermore, persons with hypertension and diabetes are more vulnerable to CAD and had 2.73 and 2.18 times the odds of developing CAD

respectively. The LDL/HDL ratio ≥ 3 was more prevalent in CAD group than in control group [73.8% vs. 50%, OR 3.76 (95% CI 2.02-6.99), (P<0.001)]. The patients in CAD group had also increased prevalence of smoking as compared to the controls [34.6% vs. 23%, OR 1.96 (95% CI 1.06-3.64), P=0.031]. About 41% of the cases had positive family history of CAD compared with only 27% of controls (OR 2.12, 95% CI 1.17-3.84, P=0.012). Repeated pregnancies among females (multigravidas ≥6) is highly associated with increased risk of having CAD (OR 10.5, 95% CI 1.18–92.72, P=0.034). Living in refugee camps had greater risk for developing the disease compared with cities and villages (OR 1.91, P=0.024). However, this retrospective study did not show any significant correlation between Age, BMI ≥25 (OR 1.38, P=0.254), unemployment (OR 1.34, P=0.441), education level and monthly income and developing CAD.

3.3 Adjusted Risk Factors for CAD

In the final multivariate logistic model (Table 3), occupation, age, residency area, monthly income and education level were excluded as these variables are considered confounders. The analysis revealed that LDL/HDL ratio ≥3 (AOR, 5.33, 95% CI: 2.66 - 10.68), physical inactivity (AOR, 3.57, 95% CI: 1.44 - 8.88), positive history of hypertension (AOR, 2.74, 95% CI: (1.49-5.03), positive family history (AOR, 2.37, 95% CI: 1.28 - 4.39), current smoker (AOR, 2.12, 95% CI: 1.11-4.03), positive history of diabetes (AOR, 1.93, 95% CI: 1.07 - 3.47) and repeated pregnancies ≥6 (AOR, 16.15, 95% CI: 1.58 - 165.12) remain significant CAD predictors and reach statistically significant levels.

3.4 Discussion

Coronary artery disease is considered the most prevalent leading cause of death among the Palestinians. Several conventional risk factors for CAD have been previously identified worldwide. However, there is a dearth of such information in Gaza strip. So, this study was the first attempt to identify the most significant risk factors for CAD among Palestinian population in one of the most disadvantaged areas in the world.

The majority of CAD patients in this study were males, aged 50 years or more, refugees, low educated and with low monthly income. According to Palestinian Ministry of Health (PMOH) report, the morbidity and mortality of CAD among males was higher than females [3]. World Heart Federation declared that "Your gender is significant: as a man you are at greater risk of heart disease than a pre-menopausal woman. But once past the menopause, a woman's risk is similar to a man's" [6].

Our study showed that there were no significant differences between cases and controls in most of the socioeconomic characteristics except for the place of residency. People who live in the middle zone of Gaza strip are more vulnerable than any other areas. Most people in this area are refugees living in very crowded camps with insufficient medical care and infrastructure. The life of those refugees in this area is not only affected by living conditions, but also by continuing political conflicts and outbursts of war leading to more psychological distress. Such findings were supported by other studies in which people with lower socioeconomic status are at greater risk of developing heart diseases compared to those who are wealthier or better educated [7,8].

The analysis in the present study showed that most related risk factors for CAD were sedentary lifestyle, LDL/HDL ratio ≥3, positive family history of CAD, hypertension, diabetes, smoking, living in refugee camps and repeated pregnancies ≥6.

In accord with our results, several studies demonstrated that physical activity is associated with significant reductions in the incidence and mortality of CAD [6,9,10] and the sedentary lifestyle is associated with greater risk for CAD and premature death [11]. WHO declared that the rise in CVDs reflects a significant change in physical activity levels worldwide as a result of industrialization, urbanization and food market globalization [12].

Our study also agreed with previous articles indicating hypertension as one of the most powerful contributors to cardiovascular morbidity and mortality especially CAD [13,14]. In Gaza strip, where political instability, low socioeconomic status and overwhelming stress prevail, surveys on essential hypertension reported prevalence rates up to 17% of the adult population [15]. This means that about one fourth of the population in Gaza strip is vulnerable to CAD if no urgent preventive measures are implemented. The result of this study revealed high statistically significant relationship between diabetes mellitus and developing CAD. Such finding has been reported

in other recent reports which confirmed the vulnerability of diabetic patients to developing CAD [16,17].

In our study, positive family history of CAD was strongly correlated with developing CAD among the case group. This finding was consistent with a study conducted in Iran that reported CAD is highly associated in men with positive family history of coronary heart disease, smoking and hyperlipidemia. The prevalence of positive family history in that study was almost similar to ours (43.2% and 44% respectively) [18]. In multiple studies, positive family history has been shown to be the major coronary risk factor and it is highly associated with the incidence of premature CAD in young adult population [6,19-21].

Moreover, our findings showed that persons with LDL/HDL ratio ≥3 were at higher risks for developing CAD. The majority of our CAD group (79%) had higher levels of LDL and lower levels of HDL which increase the risk of coronary heart disease. A similar retrospective study in India has found that the prevalence of premature CAD increased in patients with reduced HDL and raised LDL [22]. On the same lines, another study in Tehran has shown that patients with low HDL remained at an elevated residual risk for coronary heart diseases even at the recommended LDL target. In an Iraqi study, dyslipidemia was the third major risk factors connected with ischemic heart diseases. However, our study is different from these studies in which large percent of the cases had elevated LDL compared with India (20%), Iran (30%), and Iraq (40%) [18,23,24]. The possible explanation could be the transition of Palestinian dietary lifestyle to high-fat, high-carbohydrate and low-fat diet with greater consumption of fast foods in combination with lack of activity and exercise.

The present study found an association between smoking and developing CAD but this association was not as strong as other factors. This may be explained by the fact that Gaza strip is witnessing a decline in the incidence of smoking and it has become religiously and socially less acceptable. According to the Palestinian Central Bureau of Statistics, the percentage of smokers among persons 18 years and above was 27.5% in the year 2000 and had declined during the last 10 years to reach 14.6% in Gaza strip [25]. In contrast to such findings, other studies revealed that smoking has been shown to play a major dominant role in developing CAD [18,22,23,24]. This moderate correlation between smoking and CAD in our study requires further investigation.

Interestingly, our study reported highly significant association between repeated pregnancies (≥6) and developing CAD. This finding is in agreement with a recent systematic literature review from 1966 to January 2009 included 44 articles related to coronary artery disease and pregnancy [26]. The review declared that the risk of CAD appears to be approximately three to four times higher in pregnancy compared with non-pregnant women of reproductive age. This risk increases significantly with age and occurs most commonly in multigravidas. Other studies indicated that cardiac disease complicates approximately 1% to 3% of pregnancies and is responsible for 10% to 15% of maternal deaths. It is postulated that the changes of cardiovascular physiology during pregnancy can impose additional load and risk on the cardiovascular system of women with heart disease [27].

Although obesity and old age are well-established predictors of CAD in the general population [28,29], surprisingly, our study found no significant association between age ≥50 and BMI ≥25, the cutoff point for the definition of overweight, and developing CAD. Small sample size, hospital-based recruitment and relatively short follow-up in our study may account for these null associations. Further prospective investigation with large community-based sample is highly recommended in this regard to verify the results of the present study. Interestingly, controversy still exists regarding obesity and heart diseases. A Spanish review study supported our findings and showed a paradoxical association between increased BMI and CAD, which may be due to limitations of the way we currently define obesity. The study suggested that measuring central obesity or total body fat content might be more appropriate than using the body mass index alone [30].

Table 1. Sociodemographic characteristics and health profile of coronary artery disease group (CAD) and control group

Characteristic	Cases (*N* =107)	Controls (*N* =100)	χ^2 Test	*P* value[b]
Socio-demographic characteristics, n (%)				
Gender				
Male	78 (72.9)	78 (78)		
Female	22 (20.6)	22 (22)		
Age group			4.383	0.22
<40 years old	3 (2.8)	9 (9)		
40-49 years old	22 (20.6)	27 (27)		
50-59 years old	36 (33.6)	31 (31)		
≥60 years old	39 (36.5)	33 (33)		
Occupation			0.59	0.44
Unemployed	14 (13.1)	18 (18)		
Employed	86 (80.4)	82 (82)		
Education			2.99	0.22
Primary (up to10 years)	45 (42.1)	55 (55)		
Secondary (11-13 years)	25 (23.4)	16 (16)		
Tertiary (≥14 years)	30 (28.0)	29 (29)		
Monthly income			0.61	0.89
Low (<300 US$)	46 (43.0)	49 (49)		
Middle (300-800 US$)	35 (32.7)	30 (49)		
High (>800 US$)	19 (17.8)	21 (21)		
Residency area			9.51	0.04
North	24 (22.5)	29 (29)		
Middle	62 (57.9)	46 (46)		
South	14 (13.1)	25 (25)		
Health profile, n (%)				
Physical activity			10.03	0.02
Inactive	93 (87.0)	77 (77)		
Active	7 (6.5)	23 (23)		
Hypertension, SBP/DBP[a] ≥140/90 mmHg			11.28	0.01
Yes	74 (69.2)	51 (51)		
No	26 (24.3)	49 (49)		
Diabetes, FBS[a] ≥126 mg/dl			7.31	0.007
Yes	54 (50.5)	35 (35)		
No	46 (43.0)	65 (65)		
Family history of CAD			6.31	0.01
Positive	44 (41.1)	27 (27)		
Negative	56 (52.4)	73 (73)		
LDL/HDL[a] ratio			18.36	<0.001
≥3	79 (73.8)	50 (50)		
<3	21 (19.7)	50 (50)		
Current smoker			4.66	0.03
Yes	37 (34.6)	23 (23)		
No	63 (58.9)	77 (77)		
Number of previous pregnancies			4.25	0.03
≥6	21 (95.5)	16 (72.7)		
<6	1 (4.5)	6 (27.3)		
Body Mass Index			1.32	0.52
<25	18 (16.8)	20 (20)		
25-30	34 (31.8)	40 (40)		
>30	48 (44.9)	40 (40)		

[a] *Abbreviations: SBP, systolic blood sugar; DBP, diastolic blood sugar; FBS, fasting blood sugar; LDL, low-density lipoprotein; HDL, high density lipoprotein.* [b] *Significant difference between cases and controls at P<0.05*

Table 2. Univariate logistic Regression for the coronary artery disease risk factors[a]

Variable	Regression coefficient (*B*)	Unadjusted OR[b] (95% CI)	Wald statistic	*P* value[c]
Occupation				
Unemployed	0.29	1.34 (0.63-2.88)	0.59	0.44
Employed	0	1 [Reference]		
Age group				
<40 years old	1.26	3.54 (0.88-14.18)	3.2	0.07
40-49 years old	0.37	1.45 (0.69-3.01)	0.99	0.31
50-59 years old	0.02	1.01 (0.52-1.98)	0.01	0.95
≥60 years old	0	1 [Reference]		
Education				
Primary	0.23	1.26 (0.66-2.41)	0.51	0.47
Secondary	-0.41	0.66 (0.29-1.48)	0.99	0.31
Tertiary	0	1 [Reference]		
Monthly income				
Low	-0.04	0.96 (0.46-2.02)	0.01	0.92
Middle	-0.25	0.77 (0.35-1.71)	0.39	0.53
High	0	1 [Reference]		
Residency area				
Refugee camps	0.65	1.91 (1.09-3.36)	5.11	0.02
Non-refugee camps	0	1 [Reference]		
Physical activity				
Inactive	1.38	3.96 (1.61-9.74)	9.04	0.002
Active	0	1 [Reference]		
Hypertension, SBP/DBP ≥140/90 mmHG				
Yes	1.01	2.73 (1.51-4.95)	11.01	<0.001
No	0	1 [Reference]		
Diabetes, FBS ≥126 mg/dl				
Yes	0.77	2.18 (1.23-3.85)	7.21	0.007
No	0	1 [Reference]		
Family history of CAD				
Positive	0.75	2.12 (1.17-3.84)	6.21	0.01
Negative	0	1 [Reference]		
LDL/HDL ratio				
≥3	1.32	3.76 (2.02-6.99)	17.51	<0.001
<3	0	1 [Reference]		
Current smoker				
Yes	0.67	1.96 (1.06-3.64)	4.6	0.03
No	0	1 [Reference]		
Number of previous pregnancies				
≥6	2.35	10.5 (1.18-92.72)	4.47	0.03
<6	0	1 [Reference]		
Body mass index				
≥25	0.33	1.38 (0.79-2.42)	1.29	0.25
<25	0	1 [Reference]		

[a] Not adjusted for covariates in univariate logistic regression model. [b] If the CI does not include 1, the ORs are significant. [c] P value significant at P<0.05

Table 3. Multivariate logistic regression for the coronary artery disease risk factors

Variable	Regression coefficient	Standard error	Wald	Adjusted OR[a] (95% CI)	*P* value[b]
Physically inactive	1.27	0.46	7.54	3.57 (1.44-8.88)	0.006
Positive history of hypertension	1.01	0.31	10.62	2.74 (1.49-5.03)	0.001
Positive history of diabetes	0.66	0.29	4.9	1.93 (1.07-3.47)	0.02
Positive family history	0.86	0.31	7.64	2.37 (1.28-4.39)	0.006
LDL/HDL ratio ≥3	1.67	0.35	22.25	5.33 (2.66-10.68)	<0.001
Current smoker	0.75	0.32	5.25	2.12 (1.11-4.03)	0.02
Number of previous pregnancies ≥6	2.78	1.18	5.5	16.15 (1.58-165.12)	0.01

[a] Adjusted for covariates (occupation, age, residency area, monthly income and education) in logistic model. [b] P value are significant at P<0.05

4. LIMITATIONS OF THE STUDY

This study has several limitations, most notably, the small size of the sample in comparison with the large number of Palestinians who underwent coronary angiography. The reason for that is the limited capacity of the two coronary angiography centers in Gaza strip. The majority of people traveled to Jordan or Egypt to conduct this procedure. Another limitation was the insufficient documented clinical data in the subjects' files. Finally, this study was hospital-based cross sectional, so, there was lack of longitudinal data to follow the changes over time in risk factors for CAD.

5. CONCLUSION

In conclusion, sedentary lifestyle, high LDL, low HDL, hypertension, diabetes, positive family history, smoking and repeated pregnancies remain the major modifiable risk factors of CAD among the Palestinians. Living in the refugee camps in Gaza strip imposes more risk to have CAD. Gender differences indicated that the prevalence of CAD in males is more than females.

Despite its limitations, this study was the first step to shed light on this growing problem among the disadvantaged population in Gaza strip. The findings of the study can be generalized to all Palestinians in the occupied territories as they have similar life conditions. It also highlighted the emerging need for setting priorities for the prevention and control of coronary heart disease in Gaza strip. Further studies should examine the prevalence and the influence of stress on developing CAD especially among the refugees. Finally, intensive community-based health awareness campaigns to promote exercise, family planning and smoking cessation may be crucial in decreasing the burden of CAD in Gaza strip.

CONSENT

All authors declare that 'written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images.

ETHICAL APPROVAL

An ethical approval to perform the study was obtained from Helsinki Committee, Ministry of Health, Gaza strip on June 3, 2009.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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