**Research article**

# A study on the prevalence and risk factors of coronary artery disease in patients with metabolic syndrome infected and not infected with COVID 19 from El- Oued (Algeria) region

**Maroua Hammadi[1, 2], Samir Derouiche[1,2]**

[1]Department of Cellular and Molecular Biology, Faculty of the Sciences of Nature and Life El-Oued University, El-Oued 39000, El-Oued, Algeria

[2]Laboratory of Biodiversity and Application of Biotechnology in the Agricultural Field, University of El-Oued, El-Oued 39000, Algeria

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Corresponding author: **Samir Derouiche.** Email: dersamebio@gmail.com

## ABSTRACT

**Introduction and Aim:** Coronary artery disease (CAD) is a pathological process described by atherosclerosis plaque in the epicardial arteries. CAD is a chronic process that begins during adolescence and slowly progresses through life. Several traditional risk factors genetics and environmental, involve in the development of atherosclerosis process. This study was aimed to investigate the prevalence of CAD and its associated risk factors among the El Oued (Algeria) population.

**Materials and Methods:** An epidemiological study was carried out on 23422 patients who suffered from cardiovascular diseases. The study of risk factors analysis was focused on 300 voluntary individuals, their origins from different El-Oued areas, and the CAD and metabolic syndrome patients selected from public and private health interests. All the information was obtained by a questionnaire. The risk of socio-clinical factors has been estimated by Binary Logistic regression was carried out between CVD and its associated risk factors. $P < 0.05$ from two-sided statistical tests was regarded as statistically significant.

**Results:** Through the results presented in our study, we found that the clinical factors such as hypertension (OR=154.846, and; P =0.000), the group aged> 60 (OR=154.84, and; P =0.000 and chest pain (OR=42.667, and; P =0.000), present significant risk factors with CAD patients compared to healthy people (control), respectively, in contrast we show that the most dangerous Socioeconomic factors alcohol consumption and stress respectively for (OR=13.500= and; P =0.001), and obesity (OR=4.495= and; P =0.000), but we estimate that sport is important protective factors for the disease with OR=52.6, P 0.500) in the CAD patients compared to metabolic syndrome patients.

**Conclusion:** The increasing prevalence of risk factors for coronary artery disease among the population has raised concerns for public health, which creates a health threat, especially with inadequate promotion and awareness programs.

**Keywords:** CAD; CVD; risk factors; protective factors; El-Oued.

## INTRODUCTION

As we know that the burden of cardiovascular disease (CVD) presents unhealthy problems worldwide due to increase of mortality and morbidity, especially in the developing countries. Africa includes more than 1 billion people; it represents high rates in the burden of CVD, that makes the CVD related to 38% of deaths over all the non-communicable deaths (1). In North Africa, Algeria is one of the countries suffering from the increase of sudden death, because of CVD, particularly the heart ischemic disease (IHD) (2). In Algeria in 2012 the death percentage was estimated at approximately 41% of cardiovascular, 7% diabetes, which includes obesity (22.4% women and 9.6% men) (3). According to the United Nations reports of the NCDs in 2011, the WHO is working to reduce the premature disease caused by CVDs by 25% by 2025 (4). Among the CVD, which represent the most percent, lead to sudden death is ischemic heart disease, which is a threat of prevalence of CVDs (5). Ischemic heart disease is known as coronary artery disease (CAD) or coronary heart diseases (CHD), it is a pathological process described by atherosclerosis plaque in the epicardial arteries, where it obstructs the passage of the blood through the arteries, the disease can be stable or unstable in any time due to the presence of acute atherothrombotic, the progress nature of CAD results different clinical presentation, either acute coronary syndromes (ACS) or chronic coronary syndromes (CCS) (6). CAD is a chronic process that begins during adolescence and slowly progresses through life (7). Several traditional risk factors genetics and environmental, involve in the development of atherosclerosis process, such as family history of premature CAD, cigarette smoking, diabetes mellitus, hypertension, Metabolic Syndrome , a sedentary lifestyle, advanced age, gender and obesity (5). These risk factors may complex or induce the inflammatory process which include in the progress of

atherosclerosis plaque (8). The incidence of CAD prevalence is associated with pattern of risk factors, according to the INTERHEART study which include 52 countries, it demonstrates that nine risk factors represent 90% initiate the myocardial infarction, these risk factors have a similar effects in both men and women, in different geographic regions, These nine risk factors include cigarette smoking, abnormal blood lipid levels, hypertension, diabetes, abdominal obesity, a lack of physical activity, low daily fruit and vegetable consumption, alcohol over consumption, and the psychosocial index (9). The increase of risk factors rate due to the modification in life style, such the fast urbanisation by years, The TAHINA (Epidemiological Transition and Health Impact In North Africa) project is currently investigating the burden of non-communicable disease in Tunisia and Algeria, and recent data demonstrate a high prevalence of hypertension (30% and 24%, respectively) and obesity (27% and 21%, respectively) (10). Our study research aims to the determination of clinical and social risk factors for coronary artery disease, to take the necessary prevention tools, to protect people's life from heart attack disease, which lead to myocardial infarction, and contribute to sudden death.

## MATERIALS AND METHODS

### Epidemiological study

Wilaya of El-Oued is in southeast Algeria, it covers an area estimated 54 573 km² and has a 28 commune, and 12 districts. The total population of Wilaya was estimated around 702,021 inhabitants, a density more than 12 inhabitants per $km^2$. El-Oued has a socioeconomic development in Algeria especially in the agricultural domain; in this study the El-Oued population over 20 years old was estimated at 99.29%.

### Data source

The data records of all patients' illness with coronary artery disease (CAD) were collected and diagnosed from internal diseases services of Ben Amor Djilani Hospital, and from Heart's clinic of Dr. Salhi in El Oued. We obtained information, such as age, gender, living address, and the antecedent disease of CAD patients in different areas of El Oued. The retrospective study included 23422 patients and was conducted over a period of 11 years from October 2010 until December 2021.

### Data analysis

The descriptive data, of coronary artery disease's patients which included various demographic variables such as age, gender etc., were encoded and classified to obtain the frequency prevalence of CAD in the El-Oued area. The different El-Oued areas were categorised according to the 12 districts by locations, Center (El-Oued) north (Guemar, Reguiba, Djamaa, Mghair), south (Bayadha, Robah), west (Mih Wensa), and east (Debila, Hassi Khalifa, Taleb Larbi, Magren).

### Study of risk factors

Our study is a transversal epidemiologic, destined for the determination of coronary artery disease's risk factors, clinical such as metabolic syndrome, hypertension, diabetes, genetics history, and socioeconomics like life style; physical activities, foods. In our article we present the Algerians who live in El Oued (it is Wilaya located in the south east of Algeria), patients and controls in different medicals centre of El Oued district, the site implanted in various area of El Oued, civilised and rural, the rural areas is located far of the civilised centre (around 30 and 50 Km from the centre city of El Oued), we estimated the controls levels of risk factors such as diabetes, metabolic syndrome, hypertension, for the patients diagnosed.

### Study population

The study focused on 300 voluntary people, divided to 3 groups, healthy people (n=100) with average age 35.50±10.22 years old, CAD patients (n=100) with average age 63.01± 10.22 years old and metabolic syndrome patients (n=100) with average age 57.32±14.80 years old, all the voluntary people live in different El Oued areas.

The variables demographics information was included such as age, gender, index mass, social case, job, educational level, and blood group; all were collected by the questionnaire by direct discussion with the voluntary people. In the questionnaire we relied on various variables, clinical and socioeconomics, which can be risk factors, contributed to the progress of the disease, such as HTA, genetics history, diabetes, and consumption of fried foods, meat consumption, and abdominal obesity.

### Inclusion and exclusion criteria

The criteria of the patient selection focused on the cardiologist and endocrinologist diagnosis, they confirmed that all the patients suffered of heart ischemic and chronic disease from a long time and there were who had a heart surgery or complication contribute to CAD, control people who had healthy, all of them were included. Other kinds of disease were excluded.

### Statistical analysis

The obtained results of different groups are present as frequency per population or as the mean standard deviation (SD). We use the Chi-square test to extract the risk and protective factors of coronary artery disease. Relative risks and Odds ratios were calculated by Cochran's and Mantel Haenszel statistics using SPSS 25. Odds ratios >1 and $P<0.05$ indicate a significant risk factor. $OR<1$ and $P<0.05$ indicate a significant protective factor.

## RESULTS

### Epidemiological study

The study covers 3936 cases with CADs. Table 1 shows the frequency's prevalence of CADs among women and men based on age, gender, year wise, region wise, associated chronic disease such as HTA, diabetes, dyslipidemia, stroke, insufficiency renal, asthma, heart failure and dysthyroidia and lifestyle such obesity and smoking from October 2010 to December 2021.

**Table1**: Demographics of CAD patients in this study

| Variable | No. of cases | Frequency (%) |
|---|---|---|
| **Age groups** | | |
| ≤ 40 | 281 | 7.13 |
| 41–50 | 478 | 12.14 |
| 51–60 | 885 | 22.48 |
| 61–70 | 1019 | 25.91 |
| > 70 | 1273 | 32.34 |
| **Gender** | | |
| Male | 2265 | 58 |
| Female | 1671 | 42 |
| **Years** | | |
| 2010-2011 | 150 | 3.81 |
| 2012-2013 | 351 | 9 |
| 2014-2015 | 651 | 16.50 |
| 2016-2017 | 834 | 21.16 |
| 2018-2019 | 1077 | 27.36 |
| 2020-2021 | 873 | 22.17 |
| **Region** | | |
| Centre | 2723 | 69.18 |
| Northern | 349 | 8.86 |
| Eastern | 476 | 12.09 |
| Western | 77 | 1.97 |
| Southern | 311 | 7.9 |
| **CAD associated Diseases** | | |
| Diabetes | | |
| HTA | 1652 | 42 |
| Stroke | 2288 | 58.13 |
| Dyslipidaemia | 164 | 4.16 |
| Insufficiency | 237 | 6.02 |
| Renal | 42 | 1.06 |
| Asthma | 67 | 1.70 |
| Heart failure | 251 | 6.37 |
| Dysthyroidia | 23 | 0.58 |
| Smoking | 379 | 9.62 |
| Obesity | 315 | 8 |

The eleven years appear continuous increases of the coronary artery diseases rate prevalence. The prevalence in El Oued, over the period 2010-2017 shows a significant rate, especially with the chronic disease and the bad routine of life.

### Study of CAD risk factors

### Population characterisation

The description of population demographics is shown in Table 2. This study included 300 volunteers with each group containing 100 people (50 women and 50 men). The results showed a significant homogeneity for both metabolic syndrome and coronary artery disease patients, while there is a significant difference concerning age, job (worker, unworked, retired) and educational level between the coronary artery disease patients and control groups. The blood types are similar approximately in the distribution of percent for the three groups studied.

### Study of socioeconomic and clinical factors

The Tables 3 and 4 present significant risk factors for clinic pathological factors; we estimate from odds ratio (OR) values that CAD heredity, heart diseases, stroke, HTA, diabetes, cardiac surgery, metabolic syndrome, rheumatism, chest pain, the age range between <40 and > 60 years old were a risk factors leading to CAD, with p-value <0.05. Also the odds ratio (OR) values for socioeconomic factors in table (3,4) show that smoke, alcohol consumption, depression and stress, epileptic crisis, obesity, with p-value <0.05, which demonstrated that the wrong routine followed in life influence negatively on the human health, which present a high risk rate lead to atherosclerosis with p-value <0.05, also the tables showed the sport practise as protective factors to CAD.

## DISCUSSION

Our research outcomes showed the age prevalence among women and men, was 63 years old, with average age 63.018±1.632 years old (1-100 years old), which agrees with the study of Khaira *et al.*, in Setif (Algeria) population, they found the average age of CAD patients 62.7 ± 11 years (20-91 years) (11). Our epidemiological and clinical data shows differences among men and women in several aspects. There is dominance prevalence in men with 58% than women with 42%, these outcomes were confirmed with the study of Kaveh *et al.*, they found overall, 68% of the patients were men and 32% were some may due to lifestyle risk factors, for example smoking is common in men than women (12) genetics history and response to therapy this agree with the study of Manuel *et al.*, (13).

Regarding the difference prevalence of CAD between rural and urban, we found higher percent in the urban; El Oued centre with 69.18%, due to the important urbanisation, and the lifestyle with food habits of people, which associated with the increase of risk factors also it is may to the several environmental factors, between the city and rural, this opinion agree with Framingham study (14).

**Table 2:** Description of study population of control, MS Patients and CAD patients' group (n=300)

| **Variable** | | **Control** | **MS Patients** | **CAD Patients** |
|---|---|---|---|---|
| Age (years) | | 10.22±35.5 | 57.32±14.8 | 63.01±12.41 |
| Length | | 38.96±38.99 | 40.05±39.79 | 38.83±37.39 |
| Weight (kg) | | 74.33±19.26 | 76.46±18.32 | 74.02±12.24 |
| Body mass index (BMI) (kg/m$^2$) | | 35.23±32.54 | 36.6±33.18 | 35.29±31.19 |
| Job % | Worker | 79 | 37 | 24 |
| | Unworked | 18 | 47 | 51 |
| | Retired | 3 | 16 | 25 |
| Educational level % | Illiterate | 3 | 35 | 50 |
| | Primary | 3 | 20 | 16 |
| | Medium–Secondary | 50 | 30 | 33 |
| | High School | 44 | 15 | 1 |
| Address (living) | Inside El Oued | 61 | 61 | 46 |
| | Outside El Oued | 39 | 39 | 54 |
| Blood types % | O | 50 | 59 | 54 |
| | A | 30 | 25 | 23 |
| | B | 17 | 11 | 19 |
| | AB | 3 | 5 | 4 |
| SARS-COV-19 % | exposed | 60,3% | 59.2 | 40.8 |
| | Not exposed | 43,4% | 44.4 | 55.6 |

**Table 3:** Comparison of the clinical factors of coronary artery disease patients and control group

| **N** | **Risk factor** | **Control (%)** | **CAD patients (%)** | **OR** | **CI 95%** | ***P-value*** |
|---|---|---|---|---|---|---|
| 1 | CAD Heredity<br>Positive<br>Negative | <br>50.9<br>49.7 | <br>49.1<br>50.3 | 0.952 | 0.515-1.759 | 0.500 |
| 2 | Heart disease<br>Positive<br>Negative | <br>12,5<br>51,6 | <br>87,5<br>48,4 | 7,452 | 0,900-61,729 | **0,032** |
| 3 | Stroke<br>Positive<br>Negative | <br>10<br>52,1 | <br>90<br>47,9 | 9,791 | 1,217-78,806 | **0,009** |
| 4 | Hypertension<br>Positive<br>Negative | <br>1,6<br>71,7 | <br>98,4<br>28,3 | 154,84 | 20,739-1156,136 | **0,000** |
| 5 | Cardio surgery<br>Positive<br>Negative | <br>4,8<br>44,7 | <br>95,2<br>55,3 | 16,162 | 2,123-123,039 | **0,000** |
| 6 | Diabetes<br>Positive<br>Negative | <br>1,8<br>68,3 | <br>98,2<br>31,7 | 116,21 | 15,592-866,248 | **0,000** |
| 7 | Metabolic syndrome<br>Positive<br>Negative | <br>2,5<br>61,9 | <br>97,5<br>38,1 | 63,295 | 8,477-472,583 | **0,000** |
| 8 | Rheumatism<br>Positive<br>Negative | <br>5<br>55 | <br>95<br>45 | 23.222 | 3.047-177.207 | **0.000** |
| 9 | Chest pain<br>Positive<br>Negative | <br>5.9<br>72.7 | <br>94.1<br>27.3 | 42.667 | 14.485-125.68 | **0.000** |
| 10 | Age <40 years<br>Positive<br>Negative | <br>95,8<br>24,2 | <br>4,2<br>75,8 | 0,014 | 0,004-0,047 | **0,000** |
| 11 | Age > 60 years<br>Positive<br>Negative | <br>1,6<br>71,7 | <br>98,4<br>28,3 | 154,84 | 20,739-1156,13 | **0,000** |

*OR > 1 and P < 0.05 indicate a risk factor. *OR < 1 and P < 0.05 indicate a protective factor

**Table 4:** Comparison of the clinical factors of coronary artery disease patients (CAD) and patients with metabolic syndrome (MS)

| N | Risk factors | MS Patients (%) | CAD Patient (%) | OR | CI 95% | *P-value* |
|---|---|---|---|---|---|---|
| 1 | CAD Heredity | | | | | |
| | Positive | 49.1 | 50.9 | 1.051 | 0.565-1.956 | 0.500 |
| | Negative | 50.3 | 49.7 | | | |
| 2 | Heart disease | | | | | |
| | Positive | 61.1 | 38.9 | 0.609 | 0.226-1.641 | 0.230 |
| | Negative | 48.9 | 51.1 | | | |
| 3 | Stroke | | | | | |
| | Positive | 47.1 | 52.9 | 1.137 | 0.420-3.078 | 0.500 |
| | Negative | 50.3 | 49.7 | | | |
| 4 | Hypertension | | | | | |
| | Positive | 50 | 50 | 1.000 | 0.566-1.765 | 0.558 |
| | Negative | 50 | 50 | | | |
| 5 | Cardio surgery | | | | | |
| | Positive | 13 | 87 | 8,083 | 2,318-28,187 | **0.000** |
| | Negative | 54,8 | 45,2 | | | |
| 6 | Diabetes | | | | | |
| | Positive | 51.4 | 48.6 | 0.886 | 0507-1.547 | 0.388 |
| | Negative | 48.3 | 51.7 | | | |
| 7 | Metabolic syndrome | | | | | |
| | Positive | 71.9 | 28.1 | 3.564 | 2.731-4.651 | **0.000** |
| | Negative | 0 | 100 | | | |
| 8 | Rheumatism | | | | | |
| | Positive | 54.8 | 45.2 | 0.785 | 0.397-1.555 | 0.301 |
| | Negative | 48.7 | 51.3 | | | |
| 9 | Chest pain | | | | | |
| | Positive | 28.1 | 71.9 | 5.333 | 2.899-9.812 | **0.000** |
| | Negative | 67.6 | 32.4 | | | |
| 10 | AGE< 40 years | | | | | |
| | Positive | 80 | 20 | 0.227 | 0.062-0.830 | **0.014** |
| | Negative | 47.6 | 52.4 | | | |
| 11 | AGE > 60 years | | | | | |
| | Positive | 43 | 57 | 0.958 | 0.546-1.680 | 0.497 |
| | Negative | 42.9 | 58.1 | | | |

*OR > 1 and P < 0.05 indicate a risk factor. *OR < 1 and P < 0.05 indicate a protective factor

Regarding the prevalence of coronary artery disease by years, we observed a significant increase from 2010 to 2015 by 8.24%, but 2019 was the most year which registered the most high percent of prevalence with 16.6%, different studies show that the incidence of CAD, refer to the age, genetics and environmental factors, chronic disease associated with lifestyle such as arterial hypertension, diabetes mellitus and dyslipidemia, urbanisation and life stress, also work , and the factors of individual and social behaviour (15).

The results of risk factors study showed that the most risk age of CAD, is over than 50, that agree with the study of Getu *et al.*, report 31% (429) of all CVD cases affecting people aged between 51 to 60 years (16), with the ageing process, the body's system declines, such the cardiovascular system leading to progressive deterioration in the structure and vasculature which lead to atherosclerosis (7). Also most of metabolic syndrome and CAD patient represent a significant numbers of absence of awareness health, this make a risk factor in health awareness and this agree with the study of Gunhild *et al.*, who confirmed the importance of health literacy to avoid different risk factors such as smoking, alcohol, unhealthy food contribute to CAD (17).

We report that covid19 infection represent a threat for CAD, as show in the study of Lukasz lead to various complication such venous thrombosis and pulmonary embolism as a result of a disordered endothelial homeostasis triggered by either inflammatory cytokines storm or direct infection, causing, for instance, intracellular oxidative stress, that helps the development of atherosclerosis plaque (18). Also it is shown in the study of Jhumki *et al.*, confirming that the family history leads to the development of disease (19). Post mortem studies and death certificates revealed that 62-85% of patients who died out of hospital have past family history of CAD (13).

Marenberg *et al.*, show that in monozygotic twins the risk of death from CAD increased 3.8 to 15 times if a sibling died of CAD before age 75 (20). In addition, the study of Anderson *et al.*, have shown a large international case-control study reported a rise in the risk of MI if one parent had MI (OR=1.67), or one parent had MI before age 50 (OR=2.36), or both

parents had MI (OR=2.90) and if both parent had MI before age 50 (OR=6.56) (21). Also there are a strong association between the obesity, hypertension, diabetes and metabolic syndrome with CAD, this agree to the study of Wang, who show that the high blood glucose and hyper-insulinemia (insulin resistance), lead to the atherosclerotic cardiovascular disease (22), because the diabetes characterised by the increase of cholesterol and decrease of HDL level, high levels of very low-density lipoprotein (VLDL) cholesterol and high levels of total VLDL, the metabolic syndrome was defined as hypercholesterolemia or hypertriglyceridemia or both, with high low-density lipoprotein (LDL) and low high-density lipoprotein (HDL), also it is a raised in apo B to apo A-1 ratio. Also obesity makes health problems contribute to cardiovascular disease, due to the accumulation of fat in the abdominal visceral and an excess of fat in the abdominal tissues that activate the different metabolic structures such as increase in the level of LDL, leading to atherosclerosis (23).

Concerning the rheumatism, smoking, they present a significant risk factors for CAD, that agree with the study of Jacqueline *et al*., which confirmed the rheumatism is a pathological inflammatory associated with a large complication of CVD like atherosclerosis; vasculitis; cardiac valve failure; endo, myo, and pericarditis; and heart failure, a cohort studies involving 20 million people appear that 70 % of smokers with CAD more mortality than non-smokers with CAD (24),also another studies show that the smoking induce oxidative stress process lead to activation of cascade inflammatory process, which link with to coronary atherosclerosis (25) also intense cigarette smoking will in general increment myocardial $O_2$ consumption by increasing heart rate and blood pressure associated with blood flow in the coronary arteries in normal subjects compared with CAD patients there is no increase or actual decrease in coronary blood flow (26).

We found that physical activities protect factors with p value=0.500. They decrease obesity and get rid of abdominal obesity, also reduce insulin resistance, and also provide benefits for children and youth to facilitate maintenance of a healthy body weight (10). The physical activities is polypill due to its numerous beneficial effects on cardiovascular risk factors and cardiovascular system physiology, it was recommended for the coronary artery patients for because it increased survival among men and women with CAD, even among those with a doctors regimen, previously sedentary patients will need support to work up to 30-60 min most days, resistance exercises maintain muscle mass, strength, and function and, with aerobic activity, have benefits regarding insulin sensitivity and control of lipids (27).

## CONCLUSION

This study examines the distribution of CAD patients to improve facilities and implement effective treatment measures to control the disease and thus help to reduce mortality in the society associated with this disease. On the other hand, it was found that heredity, heart diseases, stroke, HTA, diabetes, cardiac surgery, metabolic syndrome, rheumatism, chest pain, the age range between 40-60 and < 60 years old are major risk factors for CAD.

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## CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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