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A case-control study on various risk factors causing coronary artery disease among patients of the selected hospital in Hail region, Kingdom of Saudi Arabia

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ABSTRACT

Certain risk factors increase the probability of developing coronary artery disease and it increases the number of death all over the World. The aim of this study is to identify the various risk factors in cases among subjects with coronary artery disease and in the control population who are unaffected with coronary artery disease and aimed to estimate the odds ratio among cases and controls. A case-control Epidemiological observational study was used. Sample Case: Patients with coronary artery disease were included. Control: Matched outpatients who don't have coronary artery disease and fulfill the inclusion criteria. The sample size of this study in each group was 40. For Cases Simple random sampling technique was used and Controls are chosen randomly who were matching with the case group. Smoking acts as the strongest risk factor with p-value zero, so the odds of having CAD is 31 times in smokers than non-smokers. This is followed by anti-hypertensive Drug which has an odd of CAD with 10.5 times on patients taking anti-hypertensive drugs than those who do not take such drugs. The studied population has a high prevalence and clustering of traditional risk factors.

1. Introduction

Coronary artery disease is a condition in which the blood supply to the heart muscle is partially or completely blocked. The heart muscle needs a constant supply of oxygen-rich blood. The concept of "risk factors" in coronary heart disease was first coined by the Framingham heart study, which published its findings in 1957. Cardiovascular disease is primarily caused by atherosclerosis, a chronic inflammatory disease of the arteries in which the deposition of cholesterol and fibrous materials in artery walls forms a plaque or lesion. FHS demonstrated the epidemiologic relations of cigarette smoking, blood pressure, and cholesterol levels to the incidence of coronary artery disease. The findings were truly revolutionary for it helped bring about a change in the way medicine is practiced (O'Donnell and Elosua, 2008).

There are many risk factors for Coronary artery disease and some can be controlled. The risk factors that can be controlled (modifiable) are High BP; high blood cholesterol levels; smoking; diabetes; overweight or obesity; lack of physical activity; unhealthy diet and stress. Those that cannot be controlled (conventional) are Age (simply getting older increases risk); sex (men are generally at greater risk of coronary artery disease); family history; and race (Hajar, 2017; James et al., 2015).

Key risk factors that associate with the number of atherosclerotic Coronary artery disease events include the total concentration of cholesterol found in the blood, as well as the cholesterol found in individual lipoprotein subclasses (WHO, 2018). Serum concentrations of low-density lipoprotein-cholesterol (LDL-C) and high-density lipoprotein-cholesterol (HDL-C) have opposite effects on Coronary artery disease risk, consistent with the role of LDL particles in the promotion of, and HDL particles in the protection against, atherosclerosis (Krishnan et al., 2016).

In 2018 the World Health Organization estimated that trans fats were the cause of more than half a million deaths per year (WHO, 2018). It has been well established that cigarette smoking is a powerful risk factor for coronary artery disease. A number of epidemiologic studies have shown a strong

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association between cigarette smoking and atherosclerosis, myocardial infarction and death from coronary artery disease (Inoue, 2004; Stallones, 2015). In addition to active smoking, passive smoking can also carry a risk of coronary artery disease. These results were confirmed by other epidemiological studies. Also, passive smoking also increases the risk of Coronary artery disease (Hackshaw et al., 2018).

Diabetes is treatable but even if glucose levels are under control it greatly increases the risk of heart disease and stroke because people with diabetes also have other conditions that are risks for developing Coronary artery diseases such as hypertension, smoking, abnormal cholesterol, obesity, lack of physical activity, and metabolic syndrome. The relative risk of death from Coronary artery disease for sedentary compared with active individuals is 1.9 (95% confidence interval) (Wang et al., 2016).

Obesity is also an independent risk factor for all-cause mortality. It is a metabolic disorder associated with comorbidities such as coronary vascular disease, type 2 diabetes, hypertension, and sleep apnea. Alterations in metabolic profile and various adaptations in cardiac structure and function occur as excess adipose tissue accumulates. A recent study reported that higher body mass index (BMI) during childhood is associated with an increased risk of Coronary artery disease in adulthood. The prevention and control of overweight and obesity in adults and children have become a key element for the prevention of cardiovascular diseases (Carnethon, 2009; Khan et al., 2015; Winzer et al., 2018).

WHO reported that cardiovascular diseases take the lives of 17.9 million people every year, 31% of all global deaths. Triggering these diseases–which manifest primarily as heart attacks and strokes–are tobacco use, unhealthy diet, physical inactivity and the harmful use of alcohol. These, in turn, show up in people as raised blood pressure, elevated blood glucose and overweight and obesity, risks detrimental to good heart health (WHO, 2018).

Al-Nozha et al. (2004) concluded that the overall prevalence of Coronary artery disease in KSA is 5.5%, a figure midway to those reported from other countries. Classical risk factors for Coronary artery disease; namely, older age, male gender, overweight, hypertension, current smoking, diabetes mellitus, hypertriglyceridemia, and hypercholesterolemia are important risk factors in Saudi population (Al-Nozha et al., 2004).

The objectives of this study are as follows:

1. To identify the various risk factors in cases among subjects at King Khalid hospital, Hail.
2. To identify the various risk factors in control among subjects at King Khalid hospital, Hail.
3. To estimate the odds ratio among cases and controls.

Also, the operational definitions of Keywords are as follows:

Case-control study: Is a type of epidemiological observational study in which subjects are observed in order to determine both their exposure and their outcome status. In this study case-control study involves two populations, cases with coronary artery disease and control population who are unaffected with Coronary artery disease.

Risk factors: In this study, it refers to the characteristics, conditions or behaviors that increase the possibility of coronary artery disease which includes smoking, diabetes, hypertension, family history, social class, sedentary activity, overweight (BMI>25kg/m2), high cholesterol, LDL, triglycerides and low HDL.

The hypothesis of this study is as follows:

H1: There will be an association between various risk factors and coronary artery disease.

2. Methodology

Research Design: The research design that was chosen for this study was Case-control design. Setting: The study was conducted in King Khalid hospital, Hail Population: Target population: Cases consist of patients diagnosed with coronary artery disease and Control consists of matching clients unaffected with coronary. Sample: Case: Patients with coronary artery disease who were there at the time of data collection and who fulfill sampling criteria were included. Control: Matched outpatients who don't have coronary artery disease and fulfill the inclusion criteria. Sample size: The sample size of this study in the group of Case were 40 patients who are diagnosed with CAD and in the group of Control, 40 matched patients without CAD. Sampling technique: For Cases Simple random sampling technique was used and Controls are chosen randomly who were matching with the case group. The following inclusion criteria Patients who are diagnosed with coronary artery diseases were present during the study period and Patients who are above 35 years were included in the group of cases. Patients matching with CAD patients and who don't have coronary artery disease were present during the study period and Patients who are above 35 years were included in the control group.

The tool consisted of three sections, Section-A: Demographic data which is the structured baseline data used to find out the demographic variables such as age, sex, religion, lifestyle, socioeconomic status, dietary pattern and regular physical activity. Section-B: An interview questionnaire was used to explore the patients' risk factors like family history, gender, alcohol, smoking, tobacco usage, hypertension, diabetes, diabetes with hypertension and overweight. Section –C: consists of Lipid profile (Total Cholesterol, HDL, LDL, VLDL, Triglycerides) of the patients been collected from the case files.

Phase 1: The investigator took 40 patients with CAD as case group study participants from the outpatient department and inpatient department of

King Khalid hospital, another 40 matched patients from the outpatient department without CAD were selected as a control group. Consent was obtained from each subject after giving assurance of confidentiality.

Phase 2: A structured baseline data sheet was administered to obtain demographic variable and an interview questionnaire was used to obtain risk factors. For both groups, the Patient's case files were referred for lipid profile. Ethical Consideration The study was carried out with the approval of the ethical committee of the University of Hail. Permission was taken from the Dean of the College of Nursing to carry out the study. Informed consent was received from each participant prior to the distribution of the questionnaire. Participants were assured that their responses would be confidential.

2.1. Statistical analysis

Independent variables (Risk factors) and the main outcome variable (Coronary artery disease) were treated as categorical variables. These are represented by numbers and percentages.

Cases and controls within each risk factor group were used to calculate Odds Ratio and their 95% confidence intervals in univariate analysis. A chi-square test was used to study the association between factors under consideration.

3. Results

A total of 80 patients from King Khalid hospital in Hail- KAS undergoing their first coronary angiogram for ischemic heart disease were recruited. This study presents the data of 51 male and 29 female patients from this cohort. The presence or absence of significant coronary artery disease was noted for each coronary artery disease risk factor group. Within each risk factor group, those showing significant CAD were regarded as cases while those showing mild coronary artery disease or normal coronaries were regarded as controls.

3.1. Baseline characteristics of the study groups

Table 1 shows the baseline characteristics of the study population, where we divide the population into control and case groups. The age between cases and controls within the two main groups did not differ significantly. However, a proportion of patients with upper-class socioeconomic status are much higher (81.8%) in those with no Coronary artery disease than those with Coronary artery disease. Other percentages of risk factors are summarized in Table 1.

Table1: Frequency and percentage distribution of control –case risk factor of CAD

Risk Factors	Categories	Controls (40) Freq. (%)	Cases (40) Freq. (%)
Age	(35-50)	12 (30%)	9 (22.5%)
	50 and above	28 (70%)	31 (77.5%)
Gender	Male	21 (41.2%)	30 (58.8%)
	Female	19 (65.5%)	10 (34.5%)
Socio Economic Status	Upper class	18 (81.8%)	4 (18.2%)
	Middle class	22 (37.9%)	36 (62.1%)
Family History of CAD	No	15 (32.6%)	31 (67.4%)
	Yes	25 (73.5%)	9 (26.5%)
Physical activity	No	27 (42.9%)	36 (57.1%)
	Yes	13 (76.5%)	4 (23.5%)
High Fatty Diet	No	27 (77.1%)	8 (22.9%)
	Yes	13 (28.9%)	32 (71.1%)
BMI	Normal	4 (44.4%)	5 (55.6%)
	High	36 (50.7%)	35 (49.3%)
Hypertension	Normal	12 (26.1%)	34 (73.9%)
	High	28 (82.4%)	6 (17.6%)
Fasting Blood sugar	Normal	18 (64.3%)	10 (35.7%)
	High	22 (42.3%)	30 (57.7%)
On hypoglycemic Drug	No	30 (63.8%)	17 (36.2%)
	Yes	10 (30.3%)	23 (69.7%)
On anti-hypertensive Drug	No	32 (74.4%)	11 (25.6%)
	Yes	8 (21.6%)	29 (78.4%)
Smoking	No	31 (88.6%)	4 (11.4%)
	Yes	9 (20.0%)	36 (80.0%)
Alcohol	No	40 50.0%	40 50.0%
	Yes	0	0

3.2. Association of risk factors with significant coronary artery disease

Table 2 shows the overall odds ratios for individual risk factors in the total study population. Smoking acts as the strongest risk factor with p-value zero, so the odds of having CAD is 31 times in smokers than non-smokers. This is followed by anti-hypertensive Drug which has an odd of CAD with 10.5 times on patients taking anti-hypertensive drugs than those who do not take such drugs. High Fatty Diet followed with a high risk of CAD. High BMI, Family History of CAD and hypertension have small risk on CAD since the odds ratio is less than 1, hence they can be ignored.

3.3. Association of lipid profile with significant coronary artery disease

In this study four lipid factors were measures in the profile for all patients (n=80), odd ratio test and risk analysis in addition to chi-square fit test were conducted and the results were summarized in Table 3. The results show that Triglycerides is of the highest risk (6.378) with a significant level of CAD. This is followed by LDL which was of moderate risk (1.179) on CAD. The remaining lipid factors are with less risk on CAD since the odds ratio is less than 1.

Table 2: Association of risk factors with coronary artery disease in the total population (n: 80)

Variables (n)	CAD	OR (95% CI) Odds Ratio	p-value
Smoking 45	36	31.00 (8.689-110.600)	0.000
On anti-hypertensive Drug 37	29	10.545 (3.727-29.840)	0.000
High Fatty Diet 45	32	8.308 (2.999-23.012)	0.000
Socio Economic Status (middle class) 58	36	7.363 (2.204-24.602)	0.001
No Physical activity 63	36	4.329 (1.271-14.705)	0.027
On hypoglycemic Drug 33	23	4.059 (1.568-10.510)	0.006
Gender (Male) 51	30	2.710 (1.052- 6.993)	0.062
Fasting Blood sugar 52	30	2.455 (0.950-6.339)	0.100
Age (50 years or more) 59	31	1.476 (0.541-4.029)	0.612
High BMI 71	35	0.778 (0.193-3.137)	1.000
Family History of CAD 34	9	0.174 (0.065-0.464)	0.001
High Hypertension 34	6	0.076 (0.025-0.227)	0.000

Table 3: Association of lipid profile with coronary artery disease in the total population (n: 80)

Variables (n)	CAD	OR (95% CI)(Odds Ratio)	p-value
Triglycerides 50	33	6.378 (2.280-17.842)	0.000
LDL (High) 65	33	1.179 (0.383-3.630)	1.000
Total Cholesterol 69	32	0.324 (0.079-1.327)	0.193
HDL (low) 35	10	0.200 (0.077-0.522)	0.001

4. Discussion

The study was designed to assess the prevalence of conventional coronary risk factors, and their strength of association with coronary artery disease from a sample of patients from King Khaled hospital in Hail-Kingdom of Saudi Arabia. Smoking, anti-hypertension drug, High Fatty Diet, Socio-Economic Status, No Physical activity and others were analyzed by univariate analysis to assess their strength of association with significant CAD.

A total of 80 patients who were scheduled for coronary angiography due to suspected coronary artery disease participated in this study. The sample was divided into case and control groups. Common coronary risk factors were noted in all the patients and every patient underwent coronary angiogram. We noted a high prevalence of coronary artery disease risk factors in our study population. The prevalence of smoking was around 80% in the total control group and 78.4% in the anti-hypertension drug control group. Similarly, a high prevalence of High Fatty Diet (71.3%), Socio-Economic Status (62.1%) and no physical activity (57.1%) were noted. These proportions are high if one considers the prevalence of other factors in previous studies. In comparison with the past years, the prevalence of smoking is high as the study done in Greece by Doyle et al. (1962). A study by Filippidis et al. (2017) showed the highest smoking prevalence in the world and constituted one of the most alarming public health issues for the development of coronary artery disease. In our study also the prevalence of current smoking in the study population remains too high. High prevalence of high-fat diet and physical inactivity have been observed and these observations are in line with the findings of the Hellenic Statistical authority report, which suggests a progressively increasing trend in the incidence of coronary artery disease. Undoubtedly the rising burden of coronary artery disease is mainly by prolonged exposure to a high-fat diet and physical inactivity (Lakier, 1992). This high prevalence of risk factors in our study population could be due to the selection bias of a hospital-based study. But it also reflects a high prevalence of multiple risk factors at a younger age in our community and fact that smoking to be a strong risk factor of ischemic heart disease in the population, leading to the low threshold of investigating chest pain.

This study showed a strong association of smoking, anti-hypertension drug, High Fatty Diet, Socio-Economic Status, No Physical activity with significant coronary artery disease. However, their relative importance differed in various groups. Smoking was found to be most strongly associated with CAD (Rosenberg et al., 1985).

Triglycerides, as we measured in this study, have shown a strong relationship with coronary artery disease while the remaining lipid measures such as Total cholesterol level, LDL and HDL show moderate to week relationship, association and risk on the coronary artery disease patients. The epidemiological study data support for triglycerides as a predictor of coronary artery disease and the study by Anderson et al. (1987) and Stamler et al. (1986); also point to the correlation of triglycerides and LDL in their role as a risk factor for coronary artery disease.

5. Conclusion

In our case-control study, we have shown that patients from the Hail KSA population have a high

prevalence and clustering of traditional risk factors. This makes it elementary to integrate these risk factors into a global risk score to better predict future coronary events. Similarly, preventive measures should address not only single risk factors but should be more encompassing. Physically active lifestyle to control abdominal obesity and diabetes, heart diseases and healthy diet and use of statins to control hyperlipidemia should be encouraged. Every attempt should be made to keep cigarette consumption in the population at the current level. These measures are economically feasible in our developing country.

6. Limitations

Ideally, to identify the association of risk factors to disease should be done through a prospective cohort study, but time constraints and limited resources forced us to choose a hospital-based case-control study. The clustering of risk factors was common in our study population.

Finally, the excessively high Odds Ratios and wide 95% Confidence intervals noted in the pre-menopausal group are probably due to a limited number of cases per risk factor. However, our study has shown some light on risk factors in this hitherto untouched group in KSA. A more extensive study in the future will be very helpful in resolving this issue.

Acknowledgment

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Compliance with ethical standards

Ethical considerations

All potential participants were informed of the purpose of the study and were given the choice not to participate. Written informed consent was secured prior to data collection. Confidentiality was a priority in this study, so no personal identifications were requested.

Conflict of interest

The authors declare that they have no conflict of interest.

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