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# FACTORS CONTRIBUTING TO CHOOSING PERCUTANEOUS CORONARY INTERVENTION OR CORONARY ARTERY BYPASS GRAFTING IN PATIENTS WITH CORONARY ARTERY DISEASE

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## ABSTRACT

**Introduction: Coronary artery disease is a heart disease that is the main cause of mortality in both developed and developing nations. Management of coronary artery disease by coronary artery bypass graft surgery has significant complications for patients. In this regard, we aimed to determine factors contributing to choosing percutaneous coronary intervention or coronary artery bypass graft in patients with coronary artery disease.**

**Methods: In this cross-sectional study, the patients who were diagnosed with coronary arteries disease who were admitted to rom Azadi Heart Canter and Vin Private Hospital Department of Cardiology in Duhok city from November 2021 to January 2022 were included. The coronary artery disease patients were of both genders aged 18 - 75 years with various socio-demographic characteristics who received percutaneous coronary intervention or coronary artery bypass graft were the target population of this study.**

**Results: The study found that the mean age of the patients was 58.2 between 34 and 75 years old. The majority of the study sample were male (66%). The study showed that smoking, BMI, and diabetes mellitus were the only predictors of receiving coronary artery bypass graft or percutaneous coronary intervention the coronary artery disease patients. Heavy smokers were 3.9 times more likely to receive percutaneous coronary intervention compared to non-smoker patients (95% CI 1.5-10.5, P=0.00061). In addition, the obese patients were 3.1 times more likely to receive coronary artery bypass graft compared to normal-weight patients (95% CI: 1.1-8.5: P=0.0259) and overweight compared to normal-weight patients (OR: 3.6 95%CI: 1.3-10.; P=0.0173). The diabetic patients were 0.6 times (60%) less likely to receive coronary artery bypass graft compared to non-diabetic patients.**

**Conclusions: The study showed that the patients who had diabetes mellitus and smokers were more likely to undergo the percutaneous coronary intervention. Being overweight and obese was shown to undergo the coronary artery bypass graft surgery rather than percutaneous coronary intervention.**

***KEYWORDS:*** Coronary artery disease, Coronary artery bypasses grafting, percutaneous coronary intervention.

## INTRODUCTION

Coronary artery disease (CAD) is a kind of heart disease that kills people in both developed and poor countries. Symptoms of CAD include stable angina, unstable angina, sudden cardiac death, and myocardial infarction (MI), which usually afflict the elderly. On the other hand, young individuals nowadays are commonly exposed to, which would be an inflammatory atherosclerotic disease (Álvarez-Álvarez et al., 2017). CAD is a primary cause of mortality and morbidity worldwide. CAD is a disease that affects many people. 4–10% of persons with proven CAD are under the age of 45, according to estimates (Shemirani and Separham, 2007, Doughty et al., 2002). Despite advances in percutaneous treatment, medication, and surgery, CAD remains a leading cause of death in both developed and poor countries. In the United States, CAD is responsible for one out of every six deaths. In the United States, a coronary episode happens every 25 seconds, and someone dies from just one every minute. Two of the most popular surgical procedures performed globally are percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG) surgery (Booth et al., 2008, Serruys et al., 2009).



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When it comes to the Kurdistan region of Iraq, according to Mohammad et al. (2015) there is a significant risk of early coronary artery disease. The frequency of angiographically documented premature coronary artery disease (PCAD) was determined to be 31%, according to the researchers. According to the researchers, premature coronary artery disease is linked to higher rates of hyperlipidemia, a positive family history of coronary artery disease, single-vessel disease, type A lesions, and medicinal treatment. Male sex, smoking, hypertension, hyperlipidemia, and a positive family history of coronary artery disease have all been linked to a higher risk of developing coronary artery disease early in individuals with multivessel coronary artery disease (CAD) and diabetes, coronary artery bypass grafting (CABG) surgery is a common technique to coronary revascularization and is still the gold standard (Neumann et al., 2019). People with chronic diabetes and multivessel coronary artery disease have a higher cardiovascular risk than those who do not have diabetes, and CABG has a better survival rate than PCI (Farkouh et al., 2008). Patients with multivessel coronary artery disease (MVCAD) or left main coronary artery disease (CAD) must choose between CABG surgery and percutaneous coronary intervention (PCI) (Mulukutla et al., 2019). Almost half of the people with severe coronary artery disease (CAD) have had at least one kind of chronic total occlusion (CTO), which may be detected via coronary angiography. Revascularization of CTOs accounts for just 10% of all percutaneous interventions (PCIs), and the majority of CTO patients are referred for coronary artery bypass graft surgery (CABG) (Fefer et al., 2012, Christofferson et al., 2005).

In this regard**,** we aimed to determine factors contributing to choosing PCI or CABG in patients with coronary artery disease.

Objectives of This Study: 1. to explore the contributing medical factors to choosing PCI and CABG in patients with coronary artery disease. 2. To examine the socio-demographic factors contributing to choosing PCI or CABG in patients with coronary artery disease.

## PATIENTS AND METHODS

### Study Design and sampling

In this cross-sectional study, the patients who were diagnosed with coronary arteries disease (CAD) were included purposively. The patients who were admitted to Azadi Heart Center and Vin Private Hospital Department of Cardiology in Duhok city from November 2021 to January 2022 met the initial eligibility criteria for this study. The medical records of patients who were diagnosed with CAD were consecutively screened for the eligibility criteria. The CAD patients of both genders aged 18 years and older with various education levels and socio-demographic characteristics who received PCI or CABG were the target population of this study. To obtain a representative sample of the target population, the researcher tried to include as much as possible the patients who met the eligibility criteria. In other words, the researcher tried to not miss any cases from the target study settings. In addition, the researcher advised his friends to announce him about the possible cases. In this regard, the patients were included from both the public and private sectors at a suitable time.

### Settings of the study

Azadi Heart Center is the solo public medical setting for admission of cardiac diseases in the Duhok governorate. This setting has been established in 2012 in this region. The setting accepts a wide range of patients with cardiac diseases and has more than 15 cardiologists until now. In addition, Vin's private hospital department of cardiology is the main medical setting for accepting cardiac patients in the private sector.

### Inclusion and Exclusion Criteria

The patients who were included in this study patient were diagnosed with CAD by one of the cardiologists in the mentioned above settings. The patients of both genders aged 18 years and older regardless of socio-demographic aspects were included in this study. The patients who refused contribution, patients with an urgent situation, and elderly patients above 75 years were not included in the study. In this study, only two persons refused the participation due to not having sufficient time. We excluded the patients aged 75 years and older from this study. The patients who had emergency conditions were excluded from this study (n=26).

### Data Collection

The required information for this study was taken through a researcher-administered self-reported technique. In other words, the researcher asked the questions and the patients responded to his questions accordingly. Some information was taken from the medical records of the patients. The remaining information was taken from the patients or their facilities in the

hospital. The data collection is performed between 1/11/2021 and 30/1/2022.

**Diagnostic and Measurements tools**

The information of the patients was recorded in a pre-designed questionnaire approved by a list of experts as appropriate. The questionnaire was divided into some sections as follows.

CAD was diagnosed by a cardiologist in Azadi heart center and Vin private hospital based on Echocardiograph and diagnostic catheterization. Cardiac catheterization is the insertion of a catheter into vessels or a chamber of the heart. The purposes of carried out for diagnostic and interventional. Done for coronary artery disease and heart attacks.

The following socio-demographic characteristics were obtained from the patient's age, gender, education level, residency, marital status, family number, occupation, smoking, and alcohol consumption. The body mass index (BMI) was calculated by dividing weight in kg by squared height in meters. The BMI was categorized as underweight (<18.5), normal (18.5-24.9), overweight (25.0-29.9), and obese (≥30). This information was recorded in the first part of the questionnaire.

The comorbidity of the patients was calculated by Charlson Comorbidity Index CCI) as follows:

**The Charlson comorbidity scoring system**

CCI is an index to measure the comorbidity of the patients for a variety of diseases. For individuals who have one or more of the disorders in the model, the CCI index estimates ten-year death. This is a decision-making index that is utilized when a medical practitioner is given a possible treatment, but it must be considered the short and long-term benefits in a patient while taking treatment with additional comorbidities. In CCI, some conditions weigh more than the others in the Charlson comorbidity index of points, which is based on the adjusted risk of death. The higher the number of points awarded, the more likely the predicted negative consequence. After that, the index adds all the scores and calculates a 10-year survival/mortality prognosis.

**Age** – split into five risk groups: under 40 years of age (0 points), 41 to 50 years of age (1 point), 51 to 60 years of age (2 points), 61 to 70 years of age (3 points), and 71 years old and older (4 points). **Myocardial infarction** (MI), also known as acute myocardial infarction (AMI), is a kind of heart attack that can occur in either the patient or the family. **Congestive heart failure** (CHF) – heart failure with a high output, resulting in blood and oxygen deprivation in the organs. **Peripheral vascular disease** – fatty deposits in the arteries of the limbs that impede blood flow, also known as peripheral; obliterate arteriopathy and peripheral artery occlusive disease. Cerebrovascular Disease: is a category of disorders that disrupt the brain's blood flow and is the second most prevalent cause of cognitive impairment.

**Dementia** — thinking, memory loss, and language abilities are all hampered or disrupted in dementia. – **Chronic obstructive pulmonary disease** (COPD) is a lung disease that causes airflow blockages and is a leading cause of disability and death. **Connective tissue disease** (CTD) is a term used to describe a set of disorders that damage the body's connective tissue, such as fat, bone, and cartilage. **Peptic ulcer disease** (PUD) is an ulceration of the stomach lining and/or the first segment of the small intestine. **Diabetes mellitus** is a set of metabolic illnesses characterized by excessive blood sugar levels that are not controlled by adequate insulin levels. **Chronic kidney disease** (CKD) ranges from mild to severe; with varying degrees of renal function impairment. **Hemiplegia** is a weakening of one-half of the body caused by a stroke. **Leukemia** – cancer caused by faulty bone marrow and other blood-forming organs functioning abnormally, increasing immature and/or aberrant leucocytes. **Malignant lymphoma** is a malignancy that has spread throughout the lymphatic system. **Sarcomas**, carcinomas, and lymphomas are examples of solid tumors, which can be benign or malignant. **Liver disease** – damage to the liver caused by alcohol, viruses, or hereditary factors. **Acquired immune deficiency syndrome** (AIDS) is a disease caused by Human Immunodeficiency Virus (HIV) with myocardial Infarction.

**The Charlson comorbidity scoring (CCI scoring)**

Depending on the mortality risk linked with each of the comorbidities, each of the conditions listed previously receives 1, 2, 3, or 6 points.

–1 point conditions – cerebrovascular disease, Myocardial infarction, peripheral vascular disease, chronic liver disease dementia, diabetes mellitus, connective tissue disease, ulcer, and congestive heart failure.

– 2-point conditions – leukemia, moderate to severe renal illness, diabetes mellitus with end-organ damage, solid tumors, Hemiplegia, and lymphoma.

–3-point condition – A liver illness that ranges from mild to severe.

–6 point conditions – AIDS, malignancy tumor, and metastases (Charlson et al., 1994).

**Physical activity**: The International Physical Activity Questionnaire (IPAQ) - Short Form, which was designed by the IPAQ scientific group and evaluated for adult populations ranging from 15 to 69 years old, was used to assess physical activity. IPAQ-Short Form evaluates a wide range of activities, including free or leisure time, gardening and domestic activities, transportation, and work. The IPAQ Short Form assesses three types or categories of specific activities in the last seven days: walking, vigorous-intensity activities, and moderate-intensity activities.

Physical activity frequency and duration are measured independently for each type of exercise in days per week and minutes per day. Due to the non-normal ranges or distribution of energy expenditure among populations, the IPAQ provides the data in continuous metrics such as median and interquartile. In this survey, vigorous-intensity activities are defined as activities that require a person to exert greater physical effort than usual, such as heavy digging, lifting, aerobics, or rapid riding. Moderate-intensity activities are those that require moderate physical exertion to make breathing somewhat harder than normal, such as light weights, doubles tennis, and biking at a constant speed. Walking also encompasses work at home and work, walking to get from one place to another, and individuals who walk exclusively for sport, leisure, recreation, or exercise (Bermúdez et al., 2013).

Smoking was determined as a non-smoker and light smoker (1-9 cigarettes/day), moderate (10-19 cigarettes/day), and heavy (>20 cigarettes/day or hookah).

The following medical information was collected from the study. Age was taken from (18-75 years), gender, height weight, education level, occupation, marital status, family member, alcohol consumption, current chronic disease, previous catheterizations (diagnostic cardiac catheterization, balloon, and stent), CABG detail (no. of grafts 1, 2, 3, 4, 5, and 6), graft used: (vein, artery) and timing of surgery (elective, urgent).

**Statistical analyses**

The general information of the patients was presented in number and percentage or mean and standard deviation. The prevalence of chronic disease and surgery types was determined in number and percentage. The comparisons of general and medical information between patients who received the CABG and PCI were examined in an independent t-test or Pearson Chi-squared tests. The role of demographic and medical factors in choosing surgery types between CABG and PCI by physicians was examined in logistic regression. The significant level of difference was determined by a p-value of less than 0.05. The magnitude of the effect was determined by an odds ratio and 95% confidence interval. The statistical calculations were performed in JMP Pro 14.3.0.

**Ethical consideration**

Approvals were taken from both the scientific committee at the College of Nursing and the Duhok General Directorate of Health (registered as 14582). The participation of the patients in the study was completely optional (two patients refused to participate). No intervention was applied to patients in this study. Also, the confidentiality of the personal information of the patients was protected through the study steps.

## RESULTS

The study found that the mean age of the patients was 58.2 between 34 and 75 years old. The patients were male (66.8%) and females (33.2%) and 46.5% of them were obese followed by overweight (38.6%). The patients had different education levels and occupations and marital states. The patients were from the rural (48.51%) and urban areas (51.49%) and had different family members (Table 1).

**Table (1):** General characteristics of patients received CABG or PCI

| **Characteristics (n=202)** | **Frequency Distribution** | |
|---|---|---|
| | **Number** | **Percentage** |
| **Age (Range: 34-75 years) Mean (SD)** | 58.2 | 8.9 |
| 34-39 | 7 | 3.5 |
| 40-49 | 29 | 14.4 |
| 50-59 | 57 | 28.2 |
| 60-69 | 87 | 43.1 |
| 70-79 | 22 | 10.9 |
| **Gender** | | |
| Male | 135 | 66.8 |
| Female | 67 | 33.2 |
| **BMI (Range: 19.7-43.3)** Mean (SD) | 29.5 | 4.5 |
| Normal | 30 | 14.9 |
| Overweight | 78 | 38.6 |
| Obese | 94 | 46.5 |
| **Education** | | |
| Illiterate | 97 | 48.02 |
| Primary school graduate | 47 | 23.27 |
| Secondary school graduate | 28 | 13.86 |
| High School graduate | 9 | 4.46 |
| College graduate | 21 | 10.4 |
| **Occupation** | | |
| Employee | 39 | 19.31 |
| Farmer, self-business | 9 | 4.46 |
| Profession | 2 | 0.99 |
| Unemployed | 47 | 23.27 |
| Worker | 37 | 18.32 |
| Other | 68 | 33.66 |
| **Marital Status** | | |
| Married | 171 | 84.65 |
| Separated | 3 | 1.49 |
| Single | 1 | 0.50 |
| Widow | 27 | 13.37 |
| **Residency** | | |
| Rural | 98 | 48.51 |
| Urban | 104 | 51.49 |
| **Family Member (1-20 persons)** | | |
| 1-5 | 65 | 32.2 |
| 6-10 | 114 | 56.4 |
| 11 and above | 23 | 11.4 |

The study found that most of the patients were not physically active (84.2%). Walking was the most prevalent type of physical activity among patients (6 days/week). A considerable percentage of the patients were smokers (40.1%) and mostly were heavy smokers (36.6%). A small percentage were alcohol consumers (Table 2).

**Table (2):** Lifestyles of coronary artery disease patients who received CABG or PCI

| Characteristics (n=202) | Frequency Distribution | |
|---|---|---|
| | **Number** | **Percentage** |
| **Physical activity** | | |
| No | 170 | 84.2 |
| Yes | 32 | 15.8 |
| **Physical activity patterns** | | |
| Not physically active | 170 | 84.2 |
| Irregular | 18 | 8.9 |
| Regular | 14 | 6.9 |
| Walking (Range: 2-7 days/week) Mean (SD) | 6.0 | 1.5 |
| Walking Duration (Range: 0.5-4 hrs.) Mean (SD) | 1.3 | 0.8 |
| Moderate PA (Range: 2-4 days/week) Mean (SD) | 3.2 | 0.8 |
| Moderate PA duration (Range: 0.5-2 hrs./day) Mean (SD) | 1.4 | 0.7 |
| **Smokers** | 81 | 40.1 |
| Non smoker | 121 | 59.9 |
| Light smoker | 3 | 1.5 |
| Moderate smoker | 4 | 2.0 |
| Heavy smoker | 74 | 36.6 |
| Alcohol consumer | 6 | 3.0 |

The mean value of Carlson's comorbidity index was 3.8. Most of the patients have received the diagnostic catheterization previously (82.7%) and 37.1% had previous PCI. The CABG group received a different number of grafts either by vein or artery. The selection of CABG was elective among 91.8% of the patients. Most of the patients had hypertension (58.42%) or diabetes mellitus (47.03%, Table 3).

**Table (3):** Medical characteristics of patients who received CABG or PCI

| Medical conditions (n=202) | Frequency Distribution | |
|---|---|---|
| | **Number** | **Percentage** |
| Comorbidity index (Range: 0-10) Mean (SD) | 3.8 | 1.8 |
| **Past catheterization** | | |
| Yes | 167 | 82.7 |
| No | 35 | 17.3 |
| **Previous PCI** | | |
| Yes | 75 | 37.1 |
| No | 127 | 62.9 |
| **Number of grafts** | | |
| 1 | 1 | 0.5 |
| 2 | 3 | 1.5 |
| 3 | 22 | 10.9 |
| 4 | 16 | 7.9 |
| 5 | 7 | 3.5 |
| **Graft used for CABG** | | |
| No graft used (PCI) | 153 | 75.7 |
| Artery | 2 | 1.0 |
| Vein | 2 | 1.0 |
| Vein and artery | 45 | 22.3 |
| **Timing of CABG** | | |
| Elective | 45 | 91.8 |
| Emergency | 4 | 8.2 |
| **Hypertension** | | |
| No | 84 | 41.58 |
| Yes | 118 | 58.42 |
| **Diabetes mellitus** | | |
| No | 107 | 52.97 |
| Yes | 95 | 47.03 |

The study showed that smoker patients were more likely to undergo PCI (85.2%) compared to non-smokers (69.4%; P=0.0104). The study did not find a significant difference between the CABG and PCI in terms of general and lifestyle factors (Table 4).

**Table (4):** Comparisons of demographic characteristics between patients who received CABG and PCI

| Characteristics | Study groups | | P-value (two-sided) |
|---|---|---|---|
| | **CABG (n=49, 24.3%)** | **PCI (n=153, 75.7%)** | |
| Age | 58.6 (7.2) | 58.1 (9.4) | 0.7510[a] |
| **Gender** | | | 0.1914[b] |
| Male | 29 (59.18 | 106 (69.28 | |
| Female | 20 (40.82 | 47 (30.72 | |
| **BMI** | | | 0.0894[b] |
| Normal | 12 (24.49 | 18 (11.76 | |
| Overweight | 16 (32.65 | 62 (40.52 | |
| Obese | 21 (42.86 | 73 (47.71 | |
| **Education** | | | 0.6718b |
| Illiterate | 23 (46.94 | 74 (48.37 | |
| Primary school graduate | 11 (22.45 | 36 (23.53 | |
| Secondary school graduate | 7 (14.29 | 21 (13.73 | |
| High School graduate | 4 (8.16 | 5 (3.27 | |
| College graduate | 4 (8.16 | 17 (11.11 | |
| **Occupation** | | | **0.0491**[b] |
| Employee | 10 (20.41 | 29 (18.95 | |
| Farmer, self-business | 4 (8.16 | 5 (3.27 | |
| Profession | 0 (0.00 | 2 (1.31 | |
| Unemployed | 14 (28.57 | 33 (21.57 | |
| Worker | 2 (4.08 | 35 (22.88 | |
| Other | 19 (38.78 | 49 (32.03 | |
| **Marital status** | | | 0.4643[b] |
| Married | 40 (81.63 | 131 (85.62 | |
| Separated | 0 (0.00 | 3 (1.96 | |
| Single | 0 (0.00 | 1 (0.65 | |
| Widow | 9 (18.37 | 18 (11.76 | |
| **Residency** | | | 0.2891[b] |
| Rural | 27 (55.10 | 71 (46.41 | |
| Urban | 22 (44.90 | 82 (53.59 | |
| **Family Member category** | | | 0.7361[b] |
| 1-5 | 16 (32.65 | 49 (32.03 | |
| 6-10 | 26 (53.06 | 88 (57.52 | |
| 11 and above | 7 (14.29 | 16 (10.46 | |
| Yes, **Physical Activity** | | | 0.9149[b] |
| No | 41 (83.67 | 129 (84.31 | |
| | 8 (16.33 | 24 (15.69 | |
| Walking frequency (days/week) | 5.9 (1.4 | 6.1 (1.5 | 0.7346[a] |
| Waling duration (hrs./day) | 1.2 (1.0 | 1.3 (0.8 | 0.7172[a] |
| Moderate PA frequency | 3.0 (0.0 | 3.3 (1.2 | 0.7244[a] |
| Moderate PA duration | 1.5 (0.7 | 1.3 (0.8 | 0.8223[a] |
| **PA Patterns** | | | 0.9120 |
| Not physically active | 41 (83.67 | 129 (84.31 | |
| Irregular | 5 (10.20 | 13 (8.50 | |
| Regular | 3 (6.12 | 11 (7.19 | |
| **Smoking** | | | **0.0104** |
| No | 37 (30.6 | 84 (69.4 | |
| Yes | 12 (14.8 | 69 (85.2 | |



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| | | | |
|---|---|---|---|
| **Smoking Type** | | | 0.0674 |
| Non smoker | 37 (75.51 | 84 (54.90 | |
| Light smoker | 0 (0.00 | 3 (1.96 | |
| Moderate smoker | 1 (2.04 | 3 (1.96 | |
| Heavy smoker | 11 (22.45 | 63 (41.18 | |
| **Alcohol** | | | 0.6551 |
| No | 48 (97.96 | 147 (96.71 | |
| Yes | 1 (2.04 | 5 (3.29 | |

[a] an independent t-test and [b] Pearson chi-squared tests were performed for statistical analyses.

The study showed that the patients who received the past catheterization or had the previous PCI or had diabetes mellitus were more likely to undergo the PCI (Table 5).

**Table (5):** Comparisons of medical characteristics between patients who received CABG and PCI

| Characteristics (n=202) | Study groups | | P-value (two-sided) |
|---|---|---|---|
| | **CABG (n=49)** | **PCI (n=153)** | |
| Comorbidity index | 4.1 (1.7 | 3.7 (1.9 | 0.1857 |
| **Past catheterization** | | | |
| Yes | 49 (28.30) | 124 (71.7) | **0.0010** |
| No | 0 (0.0) | 29 (100) | |
| **Previous PCI** | | | **0.0354** |
| Yes | 12 (16.00 | 63 (84.00 | |
| No | 37 (29.13 | 90 (70.87 | |
| **Hypertension** | | | 0.6467 |
| Yes | 30 (25.4 | 88 (74.6 | |
| No | 19 (22.6 | 65 (77.4 | |
| **Diabetes mellitus** | | | **0.0222** |
| Yes | 30 (31.6 | 65 (68.4 | |
| No | 19 (17.8 | 88 (82.2 | |

Pearson chi-squared test was performed for statistical analyses.

The study showed that smoking, BMI, and diabetes mellitus were the only predictors of receiving CABG or PCI the CAD patients. Heavy smokers were 3.9 times more likely to receive PCI compared to non-smoker patients (95% CI 1.5-10.5, P=0.00061). In addition, the obese patients were 3.1 times more likely to receive CABG compared to normal-weight patients (95% CI: 1.1-8.5: P=0.0259) and overweight compared to normal-weight patients (OR: 3.6 95%CI: 1.3-10.; P=0.0173). The diabetic patients were 0.6 times (60%) less likely to receive CABG compared to non-diabetic patients (Table 6). The model was shown to cover most CABG cases in a small sample size (Fig 1).

The study showed that the patients with diabetes mellitus were more likely to be non-smokers (72.63 vs. 27.37; P=0.0005). In addition, the non-smoker patients had significantly higher scores of comorbidities compared to smokers (4.3 vs. 3.1; p<0.001; data not shown in tables).

**Table (6):** Contributing factors for choosing CABG over PCI in coronary artery disease patients

| Factors (n=202) | Outcome: CABG | | P-value |
|---|---|---|---|
| | **OR (95% CI)** | **Presentation** | |
| **Smoking Type** | | | **0.01502** |
| Light smoker/ Heavy smoker | 5379822.7 (0.0-. | | 0.9960 |
| Moderate smoker/ Heavy smoker | 0.4 (0.0-4.6 | | 0.4560 |
| Moderate smoker/ Light smoker | 7.3 (0.0-. | | 0.9957 |
| Non-smoker/ Heavy smoker | 0.3 (0.1-0.7 | | **0.0061** |
| Non-smoker/ Light smoker | 4.7 (0.0-. | | 0.9956 |
| Heavy smoker/ Moderate smoker | 2.6 (0.2-30.2 | | 0.4560 |
| Heavy smoker/non-smoker | 3.9 (1.5-10.4 | | **0.0061** |
| **BMI categories** | | | **0.04001** |
| Obese/ Normal | 3.1 (1.1-8.5 | | **0.0259** |
| Overweight/ Normal | 3.6 (1.3-10.3 | | **0.0173** |
| Overweight/ Obese | 1.1 (0.5-2.8 | | 0.7560 |
| **Diabetes mellitus** | | | **0.04149** |
| Yes/ No | 0.4 (0.2-1.0 | | **0.0445** |
| **Age categories** | | | 0.13592 |
| 70-79/34-39 | 2.044e-7 (0.0-. | | 0.9942 |
| 70-79/40-49 | 2.8 (0.4-19.0 | | 0.3036 |
| 70-79/50-59 | 3.6 (0.8-16.5 | | 0.1061 |
| 70-79/60-69 | 3.1 (0.7-13.1 | | 0.1179 |
| **Education** | | | 0.46394 |
| Illiterate/ College graduate | 1.4 (0.3-6.0 | | 0.6213 |
| Illiterate/ High School graduate | 5.1 (0.9-27.9 | | 0.0579 |
| Primary school graduate/ College graduate | 1.0 (0.2-4.1 | | 0.9576 |
| Primary school graduate/ High School graduate | 3.4 (0.6-18.5 | | 0.1496 |
| Secondary school graduate/ High School graduate | 3.3 (0.6-19.3 | | 0.1825 |
| College graduate/ High School graduate | 3.6 (0.5-24.2 | | 0.1908 |
| **Hypertension** | | | 0.59051 |
| Yes/ No | 1.3 (0.5-2.9 | | 0.5903 |
| **Alcohol** | | | 0.69279 |
| Yes/ No | 1.7 (0.1-25.3 | | 0.7013 |
| **Physical Activity** | | | 0.72676 |
| No/ Yes | 1.2 (0.4-3.4 | | 0.7253 |
| **Gender** | | | 0.82572 |
| Female/ Male | 1.1 (0.4-3.0 | | 0.8257 |
| Comorbidity Index | 0.97 (0.7-1.3 | | 0.82598 |

Nominal logistic regression was performed for statistical analyses.
The odds ratios of non-Signiant factors were not shown in this table.
The red bold numbers show the predictors.

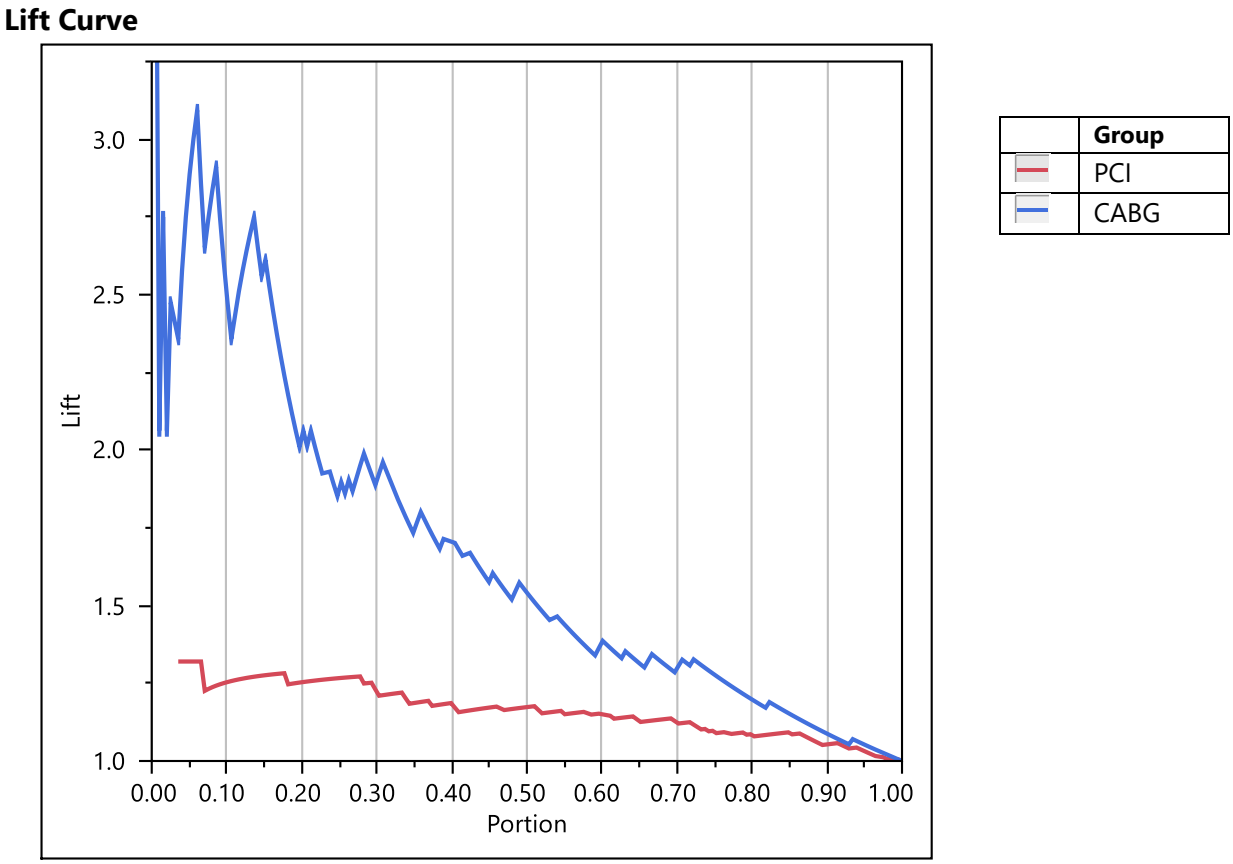


**Fig. (1):** Lift curve of role of general and medical factors on choosing CABG over PCI in coronary artery disease patients

## DISCUSSION

The study showed that BMI was the only predictor of receiving CABG on CAD patients, Smoking and diabetes mellitus, on the other hand, were revealed to be predictors of CAD patients having PCI. When compared to non-smoker patients, heavy smokers were 3.9 times more likely to have PCI. Furthermore, obese individuals were 3.1 times more likely than normal-weight patients to get CABG, and overweight patients were 3.1 times more likely than normal-weight patients to undergo CABG. Diabetic individuals were less likely than non-diabetic patients to have CABG.

In terms of smoking, studies have shown that it is a predictor of CAD patients needing CABG. For example, a study reported that smokers were twice as likely as non-smoker patients to have CABG. Cigarette smoking leads to cardiovascular disease in a variety of ways (Mirzaie et al., 2015). The reason for the effect of the smoking on CAD is that toxic cigarette products circulate in the circulation, triggering an inflammatory response and interfering with endothelial function, resulting in irregularities that lead to atherosclerotic lesions on the artery wall. This causes blood vessels to constrict, reducing blood flow and making the arteries stiffer, less elastic, and more prone to rupture (Khullar and Maa, 2012).

In smokers, a gradually diminished vasomotor responsiveness, as well as platelet dysfunction, can be observed over time. Smoking has been linked to elevated levels of C-reactive protein (CRP), fibrinogen, and homocysteine in previous research. Additionally, smoking enhances the inflammatory response, which, in combination with greater homocysteine levels, may be a key factor in the development of atherosclerosis (Bazzano et al., 2003).. However, our study showed that non-smokers were more likely to receive the CABG compared to smokers. One probable explanation is that we discovered that diabetic individuals were more likely to be non-smokers. Furthermore, as compared to smokers, non-smokers had a considerably higher comorbidity

score (data not shown in tables). Diabetes patients were more likely to quit smoking, and hence their comorbidity might be reduced compared to non-smokers. Patients who had quit smoking for at least six months were considered smokers in this research. Patients who quit smoking have a better chance of reducing their comorbidity. As a result, individuals have a better probability of receiving the CABG. According to (Bazzano et al. (2003)), quitting smoking at least 4 weeks before CABG decreased the incidence of significant pulmonary complications such as reintubation, complete tracheotomy, and lung infection/consolidation.

Even though smoking cessation is a major public health concern, research on the underlying mechanisms of smoking cessation's impact on the lungs is surprisingly sparse. Through physiologic improvements in ciliary action, small airway function, and macrophage activity, as well as a decrease in sputum generation, smoking cessation can reduce postoperative pulmonary problems (Barrera et al., 2005). Smoking cessation can lower arterial disease progression, myocardial infarction risk, and cardiovascular disease mortality by more than one-third, outperforming other preventative interventions (Hammal et al., 2014).

Diabetes has been demonstrated to be a predictor of CAD patients having CABG. For example, among the 1593 diabetic patients with multivessel coronary disease, 44 percent (n=703) and 56 percent (n=890) said they wanted CABG or PCI, respectively. 434 (49%) of the 890 patients who had PCI were assessed appropriate for CABG, whereas 79 (11%) of the 703 patients who were scheduled for CABG were found acceptable for PCI. The main reasons investigators preferred CABG among CABG intended patients were the likelihood of success and safety, which were cited in 97 percent and 46 percent of patients, respectively, while the main reasons investigators preferred PCI among PCI intended patients were the likelihood of success and physician preference, which were cited in 6 percent and 26 percent of patients, respectively (Kim et al., 2009). Two hundred and twenty patients had treatment, with 127 receiving CABG and 93 receiving DES-PCI (Tarantini et al., 2009). The multivariable analysis revealed that angiographic findings that led to CABG, such as chronic total occlusions, triple vessel disease, significant LAD disease, the presence of type C lesions, and the extent of myocardial jeopardy, evidence-based long-term outcomes of PCI under specific anatomic circumstances and reflect existing technical limitations (Barsness et al., 1997, Feit et al., 2000, Smith Jr et al., 2002). Only older age (directly) and past PCI (inversely) were linked with revascularization technique selection among demographic and clinical characteristics. CABG was more likely to be chosen as people got older (Kim et al., 2009). Similar findings have been seen in other investigations (Ramanathan et al., 2017).

CABG is a standard therapeutic approach for surgical revascularization to restore cardiac blood circulation in patients with coronary artery disease (Koechlin et al., 2020). Obesity is a risk factor for problems following a PCI or CABG procedure (Ma et al., 2018). Despite possessing relatively low-risk coronary anatomy, people with mild to moderate obesity (but not severe obesity) are more likely to be revascularized with CABG or PCI in patients with CAD (Oreopoulos et al., 2009). Obesity had a greater incidence of sternum fissure, postoperative superficial wound infection, and renal failure, and a reduced incidence of postoperative atrial fibrillation in patients receiving CABG surgery (Gürbüz et al., 2014). Obesity is a global epidemic that affects 10–20 percent of the adult population and is reported to complicate anesthesia and surgery with fatal and non-fatal occurrences (Sharmeen and Mark, 2008). Prior research has found that obese patients have higher rates of surgical site infections, venous thromboembolism, significant blood loss, and the need for blood transfusions, as well as longer surgical times (Jiang et al., 2014). Obese patients also have higher rates of urine and respiratory infections, as well as post-surgery myocardial infarction events (Ashwell and Clarke, 2009). Obesity is a substantial risk factor for deep sternal wound infections following CABG surgery and hence serves as a signal of greater morbidity rates (Hollenbeak et al., 2000).

Patients with CTO are more likely to be sent to CABG than PCI, according to cardiologists. The cardiologist's expertise and local practice patterns play a large role in deciding on a coronary revascularization method. Prior CABG surgery is the only predictor of future CTO in CAD patients, according to a previous study done in this area.

**Limitations of the study**

We tried to include as much as possible the related factors to choosing the CABG and PCI by the cardiologists in this region. But possibly

we have not included some other factors due to technical issues. In addition, the clinical features of the patients were outside the scope of this study.

## RECOMMENDATIONS

It is recommended that the cardiologist encourage to consider PCI for the CAD patients rather than CABG based on the medical situation of the patients because the PCI techniques have high procedural success rates and low risk for procedural complications, and improve quality of life.

## CONCLUSIONS

The study showed that the patients who had diabetes mellitus and smokers were more likely to undergo the PCI. Being overweight and obese were shown to undergo the CABG surgery rather than PCI.

## REFERENCES


Álvarez-Álvarez, MM, Zanetti, D, Carreras-Torres, R, Moral, P & Athanasiadis, G (2017). A survey of sub-Saharan gene flow into the Mediterranean at risk loci for coronary artery disease. European Journal of Human Genetics, 25(4): 472-476.

Ashwell, M & Clarke, G (2009). Obesity risk: importance of the waist-to-height ratio. Nursing Standard (through 2013), 23(41): 49.

Barrera, R, Shi, W, Amar, D, Thaler, HT, Gabovich, N, Bains, MS, et al. (2005). Smoking and timing of cessation: impact on pulmonary complications after thoracotomy. Chest, 127(6): 1977-1983.

Barsness, GW, Peterson, ED, Ohman, EM, Nelson, CL, DeLong, ER, Reves, JG, et al. (1997). Relationship between diabetes mellitus and long-term survival after coronary bypass and angioplasty. Circulation, 96(8): 2551-2556.

Bazzano, LA, He, J, Muntner, P, Vupputuri, S & Whelton, PK (2003). Relationship between cigarette smoking and novel risk factors for cardiovascular disease in the United States. Annals of internal medicine, 138(11): 891-897.

Bermúdez, VJ, Rojas, JJ, Córdova, EB, Añez, R, Toledo, A, Aguirre, MA, et al. (2013). International physical activity questionnaire overestimation is ameliorated by individual analysis of the scores. American journal of therapeutics, 20(4): 448-458.

Booth, J, Clayton, T, Pepper, J, Nugara, F, Flather, M, Sigwart, U, et al. (2008). Randomized, controlled trial of coronary artery bypass surgery versus percutaneous coronary intervention in patients with multivessel coronary artery disease: six-year follow-up from the Stent or Surgery Trial (SoS). Circulation, 118(4): 381-388.

Charlson, M, Szatrowski, TP, Peterson, J & Gold, J (1994). Validation of a combined comorbidity index. Journal of clinical epidemiology, 47(11): 1245-1251.

Christofferson, RD, Lehmann, KG, Martin, GV, Every, N, Caldwell, JH & Kapadia, SR (2005). Effect of chronic total coronary occlusion on treatment strategy. The American journal of cardiology, 95(9): 1088-1091.

Doughty, M, Mehta, R, Bruckman, D, Das, S, Karavite, D, Tsai, T, et al. (2002). Acute myocardial infarction in the young—The University of Michigan experience. American heart journal, 143(1): 56-62.

Farkouh, ME, Dangas, G, Leon, MB, Smith, C, Nesto, R, Buse, JB, et al. (2008). Design of the Future REvascularization Evaluation in patients with Diabetes mellitus: Optimal management of Multivessel disease (FREEDOM) Trial. American heart journal, 155(2): 215-223.

Fefer, P, Knudtson, ML, Cheema, AN, Galbraith, PD, Osherov, AB, Yalonetsky, S, et al. (2012). Current perspectives on coronary chronic total occlusions: the Canadian Multicenter Chronic Total Occlusions Registry. Journal of the American College of Cardiology, 59(11): 991-997.

Feit, F, Brooks, MM, Sopko, G, Keller, NM, Rosen, A, Krone, R, et al. (2000). Long-term clinical outcome in the Bypass Angioplasty Revascularization Investigation Registry: comparison with the randomized trial. Circulation, 101(24): 2795-2802.

Gürbüz, HA, Durukan, AB, Salman, N, Uçar, H & Yorgancıoğlu, C (2014). Obesity is still a risk factor in coronary artery by-pass surgery. Anadolu Kardiyol Derg doi, 10(

Hammal, F, Ezekowitz, JA, Norris, CM, Wild, TC & Finegan, BA (2014). Smoking status and survival: impact on mortality of continuing to smoke one year after the angiographic diagnosis of coronary artery disease, a prospective cohort study. BMC Cardiovascular Disorders, 14(1): 1-9.

Hollenbeak, CS, Murphy, DM, Koenig, S, Woodward, RS, Dunagan, WC & Fraser, VJ (2000). The clinical and economic impact of deep chest surgical site infections following coronary artery bypass graft surgery. Chest, 118(2): 397-402.

Jiang, J, Teng, Y, Fan, Z, Khan, S & Xia, Y (2014). Does obesity affect the surgical outcome and complication rates of spinal surgery? A meta-analysis. Clinical Orthopaedics and Related Research®, 472(3): 968-975.

Khullar, D & Maa, J (2012). The impact of smoking on surgical outcomes. Journal of the American College of Surgeons, 215(3): 418-426.

Kim, LJ, King, SB, Kent, K, Brooks, MM, Kip, KE, Abbott, JD, et al. (2009). Factors related to the selection of surgical versus percutaneous revascularization in diabetic patients with multivessel coronary artery disease in the BARI 2D (Bypass Angioplasty Revascularization Investigation in Type 2 Diabetes) trial. JACC: Cardiovascular Interventions, 2(5): 384-392.

Koechlin, L, Zenklusen, U, Doebele, T, Rrahmani, B, Gahl, B, Schaeffer, T, et al. (2020). Analysis of myocardial ischemia parameters after coronary artery bypass grafting with minimal extracorporeal circulation and a novel microplegia versus off-pump coronary artery bypass grafting. Mediators of inflammation, 2020(

Ma, WQ, Sun, XJ, Wang, Y, Han, XQ, Zhu, Y & Liu, NF (2018). Does body mass index truly affect mortality and cardiovascular outcomes in patients after coronary revascularization with percutaneous coronary intervention or coronary artery bypass graft? A systematic review and network meta-analysis. Obesity reviews, 19(9): 1236-1247.

Mirzaie, M, Khajedaluee, M, Falsoleiman, H, Mirzaie, A, Emadzadeh, MR & Taghvaei, MRE (2015). Demographic and socioeconomic factors of patients with coronary artery diseases undertreatment of coronary artery bypass grafting, percutaneous coronary intervention and drug therapy in Mashhad, Iran. Iranian Red Crescent Medical Journal, 17(6).

Mohammad, AM, Jehangeer, HI & Shaikhow, SK (2015). Prevalence and risk factors of premature coronary artery disease in patients undergoing coronary angiography in Kurdistan, Iraq. BMC cardiovascular disorders, 15(1): 1-6.

Mulukutla, SR, Gleason, TG, Sharbaugh, M, Sultan, I, Marroquin, OC, Thoma, F, et al. (2019). Coronary bypass versus percutaneous revascularization in multivessel coronary artery disease. The Annals of thoracic surgery, 108(2): 474-480.

Neumann, F, Sousa-Uva, M, Ahlsson, A, Alfonso, F, Banning, A, Benedetto, U, et al. (2019). Zembala MO; ESC scientific document group. 2018 ESC/EACTS guidelines on myocardial revascularization. Eur Heart J, 40(2): 87-165.

Oreopoulos, A, McAlister, FA, Kalantar-Zadeh, K, Padwal, R, Ezekowitz, JA, Sharma, AM, et al. (2009). The relationship between body mass index, treatment, and mortality in patients with established coronary artery disease: a report from APPROACH. European heart journal, 30(21): 2584-2592.

Ramanathan, K, Abel, JG, Park, JE, Fung, A, Mathew, V, Taylor, CM, et al. (2017). Surgical versus percutaneous coronary revascularization in patients with diabetes and acute coronary syndromes. Journal of the American College of Cardiology, 70(24): 2995-3006.

Serruys, PW, Morice, M-C, Kappetein, AP, Colombo, A, Holmes, DR, Mack, MJ, et al. (2009). Percutaneous coronary intervention versus coronary-artery bypass grafting for severe coronary artery disease. New England journal of medicine, 360(10): 961-972.

Sharmeen, L & Mark, C (2008). Anaesthesia and morbid obesity. Contin Educ Anaesth Crit Care Pain, 8(5): 151-156.

Shemirani, H & Separham, K (2007). The relative impact of smoking or Hypertension on severity of premature coronary artery disease.

Smith Jr, SC, Faxon, D, Cascio, W, Schaff, H, Gardner, T, Jacobs, A, et al. (2002). Prevention conference VI: diabetes and cardiovascular disease: writing group VI: revascularization in diabetic patients. Circulation, 105(18): e165-e169.

Tarantini, G, Ramondo, A, Napodano, M, Favaretto, E, Gardin, A, Bilato, C, et al. (2009). PCI versus CABG for multivessel coronary disease in diabetics. Catheterization and Cardiovascular Interventions, 73(1): 50-58.