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Analytical Study of Cardiovascular Risk Factors and their Statistical Significance

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Abstract:

Heart diseases are the main leading causes of mortality at global level. The main objectives of the present study were to investigate heart risk factors in dataset posted on Kaggle. The data included 303 participants, of whom 138 persons with hear disease and 165 persons without heart disease. The dataset included several variables including age, gender, chest pain, resting blood pressure, cholesterol level, fast blood sugar, electrocardiogram on rest, maximum heart rate during the stress test, angina during exercise, old peak, slope of the ST segment, result of the blood flow observed with radioactive dye, and number of main blood vessels colored by the radioactive dye. Statistical analysis included descriptive analysis such as means and standard deviations for non-categorized variables, frequencies, and percentages for categorized variables. The relationships between variables were evaluated using independent T test. Significance was considered if $\alpha \leq 0.05$. the results showed that all variables listed above were significantly associated with heart disease except cholesterol and fast blood sugar. Taken together, fast blood sugar and cholesterol levels should be interpreted with cautious for their involvement as risk factors for cardiovascular disease.

Keywords: Cardiovascular disease, dataset, Kaggle, cholesterol, fast blood sugar

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INTRODUCTION

According to the World Health Organization (WHO), 17.5 million people will die from cardiovascular diseases (CVDs) in 2019, accounting for 30% of all fatalities globally (1). CVDs are the main cause of death worldwide, with more people dying each year from CVDs than from any other cause (1). Coronary heart disease is responsible for 7.4 million CVDs, while stroke, hypertension, coronary artery disease, rheumatic heart disease, and heart failure are responsible for 6.7 million. CVDs disproportionately afflict low- and middle-income countries. CVDs are anticipated to continue to be the largest cause of death in the world's poorest countries, with over 23.6 million people dying from them by 2030 (2). Several types of heart diseases are classified as CVDs. Coronary heart disease, the most prevalent of them all, can lead to heart attacks, which kill over 370,000 individuals each year. Heart failure is another CVD that causes morbidity and mortality, and it is one of the earliest symptoms of the disease. Multiple risk factors affecting the incidence and occurrence of heart failure have recently been listed by the World Heart Federation, including arterial hypertension, diabetes, smoking, faulty heart valves, injured heart muscles, and obesity (3). Because "traditional" CVD risk factors like hypertension have been successfully treated with medicine, the balance of risk factors based on age and sex, as well as their distribution in the general population, may vary with time. Furthermore, new and lesser-known risk factors may arise.When it comes to CVD diagnosis, speed and precision are crucial, but they aren't always guaranteed. Even though early and accurate CVD identification aids medical professionals in determining appropriate and effective treatments to improve patients' chances of life, many developing countries and low-income regions lack specialists to perform such diagnostic procedures. Furthermore, when CVD diagnoses are erroneous and medical procedures are conducted incorrectly, patient health may be jeopardized. Several organizations and scholars have established enormous databases of electronic health records in recent years (EHR). Such databases, in addition to providing prompt and accurate diagnoses, help to ongoing efforts to improve CVD patient life quality over time and provide researchers with the opportunity to identify potential CVD risk factors across age- and gender-specific populations.In the general population, there are sex-specific patient groupings. From this vantage point, computingThrough computer-assisted detection approaches, sciences provide valuable CVD forecasts to the healthcare industry (1).

According to the existing dataset, several risk factors were evaluated including age, gender, chest pain, resting blood pressure, cholesterol level, fast blood sugar, electrocardiogram on rest, maximum heart rate during the stress test, angina during exercise, old peak, slope of the ST

segment, result of the blood flow observed with radioactive dye, and number of main blood vessels colored by the radioactive dye.

Age has been reported as a risk factor for developing cardiovascular diseases because it contributes todeterioration of the function of cardiovascular system (4-6).

Gender is also a risk factor for developing heart disease, particularly the female gender (7).

Nahar et al (8) reported that asymptomatic chest discomfort and the presence of exercise-induced angina pectoris in both men and women were indicators of the presence of heart disease.Hypertension is one of significant risk factors for initiation of cardiovascular diseases (9).

Study objectives:

The main objectives of the present study were to investigate risk factors associated with heart diseases and their statistical significance among a sample of heart patients.

METHODS AND SUBJECTS

Data source:

Dataset was hosted on Kaggle (Heart Disease UCI), and it was from UCI Machine Learning Repository. It included records of 303 patients from Cleveland (10). The dataset included several variables including if the target participants had heart disease or not. Age, gender, chest pain, resting blood pressure, cholesterol level, fast blood sugar, electrocardiogram on rest, angina during exercise, old peak, slope of the ST segment,Results of the blood flow observed via the radioactive dye, and number of main blood vessels colored by the radioactive dye.

Statistical analysis:

The dataset was analyzed using SPSS version 21. Descriptive statistics including mean and standard deviation were used for continuous variables. For categorized variables, frequency and percentages were used. The relationships between variables were computed using independent T test. Significance was considered at $\alpha \leq 0.005$.

RESULTS:

General characteristics of participants

General characteristics of participants as shown in table (1) included study variables. The mean age was 54.37±9.1 years, most participants were males (68.3%).Regarding the chest pain, about 47% of patients were asymptomatic, about 17% had atypical angina, about 29% had pain not angina related, and only 8% had typical angina. The mean systolic blood pressure at resting was 131.62±17.54 mm Hg. Cholesterol levels were 246.26±51.83 mg/dl. Most of the participants (85.1%) had fast blood sugar less than 120 mg/dl. The results of electrocardiogram at rest showed that half of the patients were normal, about 49% with potential to develop ventricular hypertrophy, and about 1% with abnormalities in T wave or ST segment. The mean level of

maximum heart rate during the stress test was 149.65±22.91. angina during exercise was experienced by about 33% of participants. The mean of old peaks was 1.04±1.16. slope of the ST segment was descending in 6.9% of participants, flat (46.2%), and ascending (46.9%). Results of the blood flow observed via the radioactive dyeshowed normal blood flow (54.8%), Reversible defect (38.6%), fixed defect (5.9%), and null (0.7%). The results showed that the number of main blood vessels colored by the radioactive dyeswas 0 for 57.8% of participants, 1 for 21.5%, 2 for 12.5%, 3 for 6.6%, and 4 for 1.7%. the results showed that 138 (45.5%) of participants had hear diseases, and 165 (54.5%) did no have heart disease.

Table 1: General characteristics of participants

Variable	Description
Age (M±SD)years	**54.37 ±9.1**
Gender (N, %): **- Males** **-Females**	 **207 (68.3%)** **96 (31.7%)**
Chest pain (N, %): **- Asymptomatic** **- Atypical angina** **- Pain without relation to angina** **- Typical angina**	 **143 (47.2%)** **50 (16.5%)** **87 (28.7%)** **23 (7.6%)**
Resting blood pressure (M±SD) mm Hg	**131.62±17.54**
Cholesterol (M±SD) mg/dl	**246.26±51.83**
Fast blood sugar (N, %): **- Yes** **- No**	 **45 (14.9%)** **258 (85.1%)**
Electrocardiogramon rest: - Probableleft ventricular hypertrophy - Normal - Abnormalities in the T wave or ST segment	 147 (48.5%) 152 (50.2%) 4 (1.3%)
Maximum heart rate during the stress test (M±SD)	**149.65±22.91**
Angina during exercise (N, %): **- Yes** **- No**	 **99 (32.7%)** **204 (67.3%)**
Old peak (M±SD)	**1.04±1.16**

Slope of the ST segment during the most demanding part of the exercise (N, %):	
- Descending	**21 (6.9%)**
- Flat	**140 (46.2%)**
- Ascending	**142 (46.9%)**
Results of the blood flow observed via the radioactive dye (N, %):	
- Null	**2 (0.7%)**
- Fixed defect (no blood flow in some part of the heart)	**18 (5.9%)**
- Normal blood flow	**166 (54.8%)**
- Reversible defect (a blood flow is observed but it is not normal)	**117 (38.6%)**
Number of main blood vessels colored by the radioactive dye (N, %):	
- 0	**175 (57.8%)**
-1	**65 (21.5%)**
- 2	**38 (12.5%)**
- 3	**20 (6.6%)**
-4	**5 (1.7%)**
Heart disease (N, %):	
- Yes	**138 (45.5%)**
- No	165 (54.5%)

The relationship between patients with heart diseases and those without heart diseases for study variable and their statistical significance

As it can be seen in table (2), the mean age of heart patients was 56.60±7.96 years, and for subjects without heart diseases was 52.50±9.55 years.The difference in means was statistically significant (p=0.000). Gender was also significantly associated with heart disease (p+=0.000). Chest pain was also significantly associated with heart disease (p=0.000). Resting blood pressure was 129.30±16.17 mm Hg for persons without heart disease and 134.40 mm Hg for patients with heart disease. The difference in means was significantly significant (p=0.012). Both cholesterol and fast blood sugar were not significantly associated with heart disease (p>0.05). All remaining variables were statistically associated with heart disease (p<0.05).

Table 2:The relationship between patients with heart diseases and those without heart diseases for study variable and their statistical significance

Variable	group	N	Mean	Std. Deviation	Significance
Age	No	165	52.4970	9.55065	0.000
	Yes	138	56.6014	7.96208	
Gender	No	165	.5636	.49744	0.000
	Yes	138	.8261	.38042	
Chest pain	No	165	1.3758	.95222	0.000
	Yes	138	.4783	.90592	
Resting blood pressure (M±SD) mm Hg	No	165	129.3030	16.16961	0.012
	Yes	138	134.3986	18.72994	
Cholesterol (M±SD) mg/dl	No	165	242.2303	53.55287	0.139
	Yes	138	251.0870	49.45461	
Fast blood sugar (N, %)	No	165	.1394	.34741	0.627
	Yes	138	.1594	.36740	
Electrocardiogram on rest	No	165	.5939	.50482	0.017
	Yes	138	.4493	.54132	
Maximum heart rate during the stress test (M±SD)	No	165	158.4667	19.17428	0.000
	Yes	138	139.1014	22.59878	
Angina during exercise	No	165	.1394	.34741	0.000
	Yes	138	.5507	.49923	
Old peak	No	165	.5830	.78068	0.000
	Yes	138	1.5855	1.30034	
Slope of the ST segment during the most demanding part of the exercise	No	165	1.5939	.59363	0.000
	Yes	138	1.1667	.56132	
Results of the blood flow observed via the radioactive dye	No	165	.3636	.84889	0.000
	Yes	138	1.1667	1.04346	
Number of main blood vessels colored by the radioactive dye	No	165	2.1212	.46575	0.000
	Yes	138	2.5435	.68476	
Heart disease	No	165	1.0000	.00000[a]	
	Yes	138	.0000	.00000[a]	
a. t cannot be computed because the standard deviations of both groups are 0.					

DISCUSSION:

The present study showed that several risk factors were involved among a sample of heart patients. Age was a significant risk factor for developing heart disease, and this is expected to impact the functionality of heart as an organ. This is in accordance with other studies (4-6).

Gender was significantly associated with heart disease. Previous studies indicated that female gender is more likely to develop heart diseases (7).

Chest pain was significantly associated with heart disease. This is in line with other studies that showed asymptomatic chest discomfort and

the presence of exercise-induced angina pectoris in both men and women were indicators of the presence of heart disease (8).

The results of this study showed that hypertension was significantly associated with cardiovascular disease. This is consistent with other studies that reported hypertension as one of significant risk factors for initiation of cardiovascular diseases. (9).

In this study, the level of cholesterol was not significantly associated with heart disease, however this result does not agree with previous studies in which cholesterol was a significant predictor of heart diseases (11, 12).

Blood fasting sugar was not significantly associated with heart diseases in his study. Other studies reported contradicting findings in which fasting glucose level was considered a significant predictor of heart diseases (13).

The electrocardiogram on rest including ventricular hypertrophy was significantly associated with heart disease. Gosse et al (14) reported that left ventricular hypertrophy is a predicting factor for cardiovascular diseases. The remaining risk factors are consistent with literature.

CONCLUSIONS:

The present study showed that classical risk factors for developing cardiovascular diseases are kept across studies in literature except cholesterol level and fast blood sugar.

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