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Original article

Logit model in prospective coronary heart disease (CHD) risk factors prediction in Saudi population

Sawsan Babiker [a,b], Yousif Eltayeb [c], Neveen Sayed-Ahmed [d], Sitalnesa Abdelhafeez [e], El Shazly Abdul Khalik [f,g], M.Saif AlDien [h], Omaima Nasir [h,*]

[a] Department of Mathematics, Turabah University College, Taif University, P.O. Box 11099, Taif 21944, Saudi Arabia
[b] Department of Mathematics & Physics, Faculty of Education, Gezira University, P.O. Box 20, Madani, Sudan
[c] King Abdulaziz Cardiac Center, King Abdulaziz Medical City - Riyadh, P.O. Box 22490, Riyadh 11426, Saudi Arabia
[d] Department of Mathematics & Statistics, Faculty of Science, Taif University, P.O. Box 11099, Taif 21944, Saudi Arabia
[e] Directorate of Academic Affairs and Training, King Abdulaziz Specialist Hospital, P.O. Box. 10127, Taif, Saudi Arabia
[f] Department of Cardiology, King Abdulaziz Specialist Hospital, P.O. Box. 10127, Taif, Saudi Arabia
[g] Department of Cardiology Al Azhar University, Cairo, Egypt
[h] Department of Mathematics, Turabah University College, Taif University, P.O. Box 11099, Taif 21944, Saudi Arabia
[i] Department of Biology, Turabah University College, Taif University, P.O. Box 11099, Taif 21944, Saudi Arabia

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ABSTRACT

Analysis through logistic regression explored to investigate the relationship between binary or multivariable ordinal response probability and in one or more explanatory variables. The main objectives of this study to investigate advanced prediction risk factor of Coronary Heart Disease (CHD) using a logit model. Attempts made to reduce risk factors, increase public or professional awareness. Logit model used to evaluate the probability of a person develop CHD, considering any factors such as age, gender, high low-density lipoprotein (LDL) cholesterol, low high-density lipoprotein (HDL) cholesterol, high blood pressure, family history of CHD younger than 45, diabetes, smoking, being post-menopausal for women and being older than 45 for men. Logit concept of brief statistics described with slight modification to estimate the parameters testing for the significance of the coefficients, confidence interval fits the simple, multiple logit models. Besides, interpretation of the fitted logit regression model introduced. Variables showing best results within the scientific context, good explanation data assessed to fit an estimated logit model containing chosen variables, this present experiment used the statistical inference procedure; chi-square distribution, likelihood ratio, Score, or Wald test and goodness-of-fit. Health promotion started with increased public or professional awareness improved for early detection of CHD, to reduce the risk of mortality, aimed to be Saudi vision by 2030.

1. Introduction

Saudi vision for the future 2030 goals targeted as an essential aspect of a healthy and balanced lifestyle to enhance the quality of life for all and meet an attractive living environment, to increase the average life expectancy from 74 years to 80 years. The incidence rate, prevalence and poor CHD related outcomes within developing countries expected to continue high incidence (Gaziano et al., 2010), that illustrate the need for implementing successful primary prevention approaches worldwide to identify the risk areas for improvement in the 20th century (Pencina et al., 2009). Smoking, hypertension, diabetes mellitus, high dietary fat intake, and lack of physical exercise have documented as independent risk factors for CHD progression (Sabra et al., 2007).

Abbreviations: CHD, Coronary Heart Disease; BP, Blood Pressure; LDL, Low-density Lipoprotein; HDL, High-density Lipoprotein; HbA1c, Hemoglobin A1c; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; HDFQ, Heart Disease Facts Questionnaire; CVDs, Cardiovascular Diseases; SD, Standard Deviations; SE, Standard Error of the mean; LR, Likelihood-ratio; SPSS, Statistical Package for the Social Sciences.

* Corresponding author.
E-mail address: o.saeeed@tu.edu.sa (O. Nasir).

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Non-communicable diseases, such as CHD, are to continue causing large and complex risk to human life. Modern health-care systems face new challenges of rapid globalisation, urbanisation, societal ageing, and a rise in chronic diseases a result, mortality and morbidity rates are rapidly rising. Primary preventive measures against CHD risk factors must be targeted at a first health promotion stage even before any of these main underlying factors significantly affect an individual or the targeted community. Preventive steps would help decreases not only population absenteeism but also hospital and medication prices. While it is a burden on both developed and developing world health care systems

Lack of awareness and knowledge, misconceptions, and fear, which can discourage people. Measures to enhance public awareness regarding the factors causing CHD and suggested various lines of treatment, with advanced in medicine and medical research. Many major diseases such as heart disease, hypertension, and diabetes, among others, no longer pose a threat to human life and well-being. Coronary heart disease (CHD) is now one of the world's leading causes of morbidity and mortality (Murray and Lopez, 1997). It has been a significant part of routine clinical care for detecting a higher risk of heart disease and treatment with cholesterol-lowering statin therapy (National Cholesterol Education Program, 2002).

The Framingham heart study (FHS) was the first to coin the term ''risk factors'' as CHD. The FHS perfectly summarizes the risk factors that lead to the development of CHD offering crucial details on primary and secondary CHD prevention objectives. Although the Framingham risk function has directly applied in many populations, overestimation of CHD risk has reported in both countries with low CHD risk and those with a relatively high CHD incidence rate.

2. Materials and methods

2.1. Study design

We have two main components, the first concerned with the data and knowledge analysed research method used in the research, and the second with the statistic, logit model. Sample identification with required technique adopted used and a questionnaire included information on traditional CHD risk factors. We collected a clear sample from the identified population, such as CHD patients treated at King Abdulaziz Hospital in Taif. By using the random sampling method, a random sample chosen to analyse the data. For access to the corresponding King Abdulaziz Hospital information, a written consent obtained from the Supervisor of King Abdulaziz Hospital Review Board for the sample included in the analysis and no direct contact was established.

2.2. The sample

Samples evaluated with risk factors of CHD from Saudi patients of King Abdulaziz Hospital in Taif province. King Abdulaziz Hospital is the reference hospital to which patients with various diseases admitted from many regions of Taif Province. The study for all collected data was through two different surveys and questionnaire. We based sample analysis on the logit model according to variables.

2.2.1. Patients sample

Samples include both men and women of Saudi patients having CHD with certain risk factors in which the dependent variable works (incidence of CHD). The factors mentioned affected the incidence of CHD are: (age, gender, high low-density lipoprotein (LDL) cholesterol, low high-density lipoprotein (HDL) cholesterol, high blood pressure, family history, diabetes, smoking, being postmenopausal for women and being older than 45 for men). We conducted the study from December 2016–201, patients were incident, diagnosed having CHD, and admitted to King Abdulaziz Hospital in Taif.

2.2.2. Control sample

The control sample were recruited randomly, residing in the same geographical region and admitted to the King Abd Alaziz Hospital, without a history of CHD diseases. The demographic and risk factors data were collected by means of an in-depth interview schedule, including information about the same as in cases.

2.3. Field work and data collection

A modified version of the Heart Disease Facts Questionnaire (HDFQ) used for measuring CHD knowledge, tool designed by (Wagner et al., 2005b), contains 25 true or false questions about CHD patients. The questionnaire tested for reliability, validity, comprehensible and consistent.

2.4. Statistical analysis

Statistical analysis performed on patients with various CHD diseases admitted from Taif Provence at King Abdulaziz Hospital in Taif, well known for its reputation, provided facilities, maintaining validated medical records and trained health care personnel. CHDs cases selected to include in this study were age 25–80 years. The questionnaire included information on traditional CHD risk factors, age, gender, high-density lipoprotein (LDL) cholesterol, low-density lipoprotein (HDL) cholesterol, high blood pressure, family history, diabetes, smoking. Data We conducted an analysis using SPSS 22, and STATA 12 packages. Means, standard deviations (SD) and standard error of the mean (SE), frequencies and percentages calculated. Variables analysed by logit regression model. The p-values of the likelihood-ratio (LR) test used.

Predictor variables for CHD determined using multiple conditional logit regression models to control for confounders and test interactions. The saturated model of multivariate analysis would contain all variables. The LR test will test for significance after extracting the highest p-value (0.25) one at a time. If the LR test shows that the variable is relevant, they reintroduce it into the model. The LR test will search for potential two-way interactions. The Hosmer-Leme show goodness-of-fit test will assess the last model's fitness, by logit model we measure the odds ratios and (95 per cent) confidence intervals correlated with independent variables of the prevalence of CHD.

3. Results

Table 1 and Fig. 1 shows the distribution of CHD observed according to gender, male and female in the study has equal risk factors of 50% in both with a statistically significant p-value.

Table 2, and Fig. 2, showed the distribution of the Study and Control according to age groups prone to CHD. 6 variables with age between 2 and 9, 67 were 40–59 age group, 34 were 60–79, 3 were 80 and above with the insignificance p-value (0.560) so that there is no difference between male and female in having CHD.

Table 3 and Fig. 3 showed systolic blood pressure levels 102 minimum range in the study group with a maximum of is 183 mm Hg (normal is < 120 mmHg).

In Table 4, and Fig. 4, values showed for DBP in study and control out of 110 only 95 were normal and 15 had high DBP in study and in control 85 were normal and 18 had high levels with the

Table 1
Distribution of the Study & Control according to gender.

Variables	Frequency (%)		χ^2	P -value
	Study	Control		
Male	55 (50%)	63 (61.2%)	69.427	0.00
Female	55 (50%)	40 (38.8 %)		
Total	110	103		

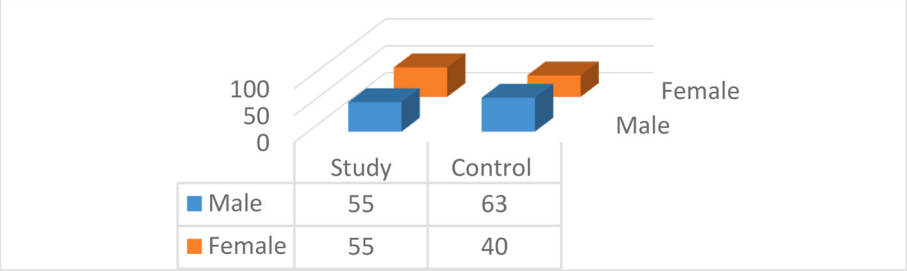

Fig. 1. Distribution of the Study & Control according to gender.

Table 2
Distribution of the Study & Control according to Age group.

Variables	Frequency (%)		χ^2	P -value
	Study	Control		
20–39 year	6 (5.5%)	10 (9.7 %)	4.874	0.560
40–59 year	67 (60.9%)	56 (54.4 %)		
60–79 year	34 (30.9 %)	34 (33.0 %)		
80 and above	3 (2.7%)	3 (2.9 %)		
Total	110	103		

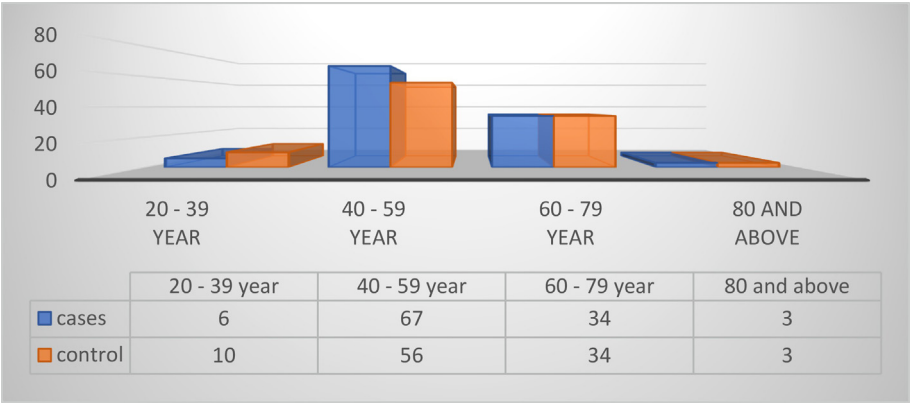

Fig. 2. Distribution of the Study & Control according to Age group.

Table 3
Distribution of the Study & Control according to Systolic Blood Pressure (SBP).

Variables	Frequency (%)		χ^2	P -value
	Study	Control		
Normal	42 (38.2%)	52 (50.5%)	3.266	0.071
High	68 (61.8%)	51 (49.5%)		
Total	110	103		

significant p value of 0.439, the frequency of systolic and diastolic blood pressure in Table 4 and Fig. 4 under Table 5, and Fig. 5. Distribution of the Study & Control group according to blood pressure (BP).

In the study group, 12 had low normal BP (SBP100 – 129 and DBP 60–79), 49 has High normal hypertension (SBP 130–139 and DBP 80–89), 49 has high hypertension (SBP > 140 and DBP > 90). In control 12 had low normal BP (SBP100 – 129 and DBP 60–79),

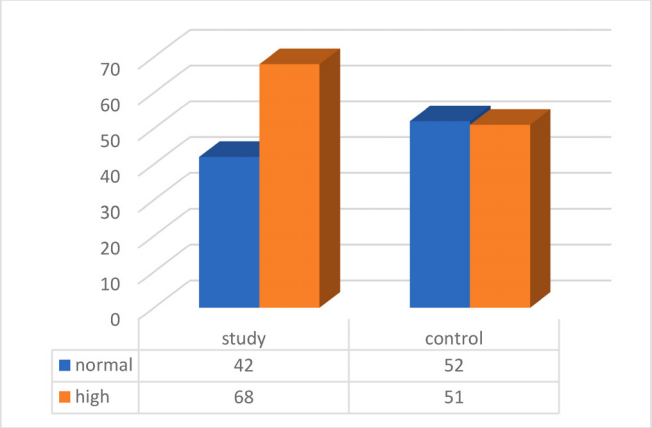

Fig. 3. Distribution of the Study & Control group according to SBP.

Table 4
Distribution of the Study & Control according to DBP.

Variables	Frequency (%)		χ^2	P -value
	Study	Control		
Normal	95 (86.4%)	85 (82.5%)	0.599	0.439
High	15 (13.6%)	18 (17.5%)		
Total	110	103		

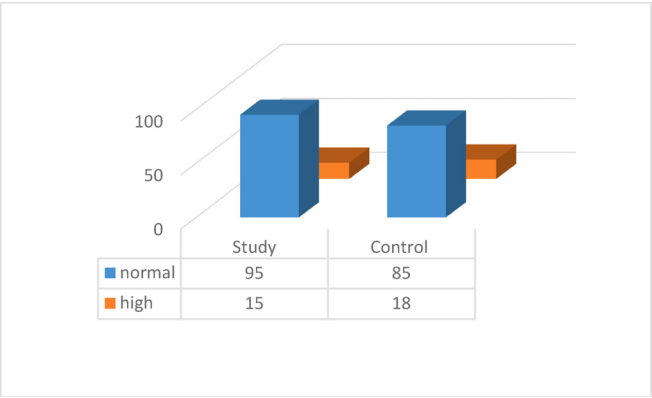

Fig. 4. Distribution of the Study & Control group according to (DBP).

Table 5
Distribution of the Study & Control according to frequency of (SBP & DBP).

Variables	Frequency (%)		χ^2	P -value
	Study	Control		
SBP100 – 129 and DBP 60–79	12 (10.9%)	12 (11.7%)	11.137	0.004
SBP 130–139 and DBP 80–89	49 (44.5%)	24 (23.3%)		
SBP > 140 and DBP > 90	49 (44.5%)	67 (65.0%)		
Total	110	103		

24 has High normal hypertension (SBP 130–139 and DBP 80–89), 67 has high hypertension (SBP > 140 and DBP > 90). With significant p- value of 0.004.

Table 6 and Fig. 6, showed the Body mass index 21.7 is a minimum range in the study group with a maximum of 51.9 (normal range is 18.5–24.9). The variables evaluated according to the BMI, in the study group 20 were normal, 28 were overweight, and 62 were obese. In control 3 were under weight, 23 were normal, 31 were overweight, and 62 were obese, with the p value of 0.138.

Table 7 and Fig. 7 showed the difference in waist circumference (normal is 88 to 102 cm) in study group maximum of 129 cm, out of 110, 23 has <88 cm, 22 variables had waist Circumference from 88c to 02 cm, and 65 variables had waist circumference over 102 cm.

Table 8 and Fig. 8. Shows that 72 variables has diabetes, 38 has no diabetes in the study group, whereas in control 63 has diabetes and 40 has no diabetes, with significant p value 0.305, comparing these results with Table 1. HbA1C is 5.3 a minimum range in study group with maximum of 14.60 (levels of 6.5% of higher mean of diabetes, Fasting Serum Glucose minimum range is 11 in study group with maximum of 512.0 (70 to 99 mg/dl is normal).

Table 9 and Fig. 9 showed a distribution of the study and control group according to family history CHD or stroke. 32 were having family history CHD or stroke, 78 had no family history of CHD in study group, and in control 35 had CHD family history and 68 had no family history. The p value observed was 0.442.

Table 10 and Fig. 10 showing the distribution of the Study & Control group according to Smoking, in study group smoking habits were 46 and non-smoking were 64 in the control group 75 were smoking habits and 28 were non-smoking with p- value of 0.000. As risk factor the study data showed in Table 10 and Fig. 10 the smoking and non-smoking variables.

In Table 11 and Fig. 11 showed dyslipidaemia in 45 variables and 65 has no dyslipidaemia in study group, however 52 had dyslipidaemia, 51 has no dyslipidaemia in control, with p value of 0.161.

The comparison of means of anthropometric and laboratory parameters among patient's showed in Table 12, cholesterol a minimum range is 95 in study group with maximum of 280 mmol/l, in control group cholesterol a minimum range is 104 in study group with maximum of 280 mmol/l, (<200 mmol/l is normal range) showed very high. Table 12. HDL Cholesterol a minimum range in study group is 13.90 with maximum of 62.0 in control a minimum range is 13.90 with maximum of 84.10 (normal range for women < 50 mg/dl, for men < 40 mg/dl), LDL Cholesterol a minimum range in study group is 51.0 with maximum of 237.0. In control, a minimum range is 54.0 with a maximum of 237.0 (normal range is < 100 mg/dl) (Tables 13–15).

4. Discussion

Considering a distribution of CHD according to gender in the study group shows 50% expression of CHD risk factors, corresponding to Table 1. Women with clinically manifest CHD are typically more expressed in older age than men, most traditional risk factors shared by both men and women, nevertheless, it differs in the relative weighting of these factors (Maas and Appelman, 2010).

Smoking increases the risk of CHD. In the study group, the patients who see yes was 64, while in the control group only 28 were smoking, with a p-value of 0.000, women are more adversely affected by smoking than men, with the average amount of cigarettes smoked a day having a greater negative effect (Allen et al., 2014). smoking causes hormonal effects, oestrogen- dependent vasodilation of the endothelial wall (Miller and Duckles, 2008). Cholesterol has a minimum range of 95 in the study group with a maximum of 104, in control has a minimum range and a maximum of 280 mmol/l (<200 mmol/l is normal range) showing very high. Also, dyslipidaemia in 45 variables and 65 has no dyslipidaemia in the study group, however, 52 have dyslipidaemia, 51 has no dyslipidaemia in control, with a p-value of 0.161.

High levels of HDL Cholesterol and LDL Cholesterol in this study a condition of dyslipidemia means abnormal levels of cholesterol

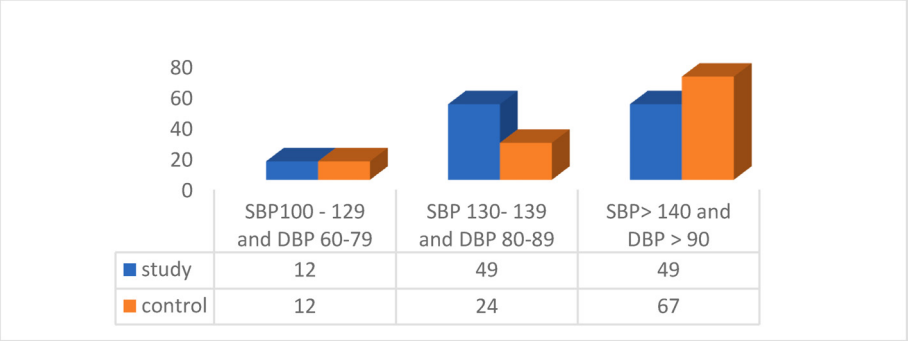

Fig. 5. Distribution of the Study & Control according to frequency of (SBP & DBP).

Table 6
Distribution of the Study & Control group according to BMI.

Variables	Frequency (%)		χ^2	P -value
	Study	Control		
Under weight	0 (00.0%)	3 (2.9%)	5.508	0.138
Normal	20 (18.2%)	23 (22.3%)		
Over weight	28 (25.5%)	31 (30.1%)		
Obesity	62 (56.4%)	46 (44.7%)		
Total	110	103		

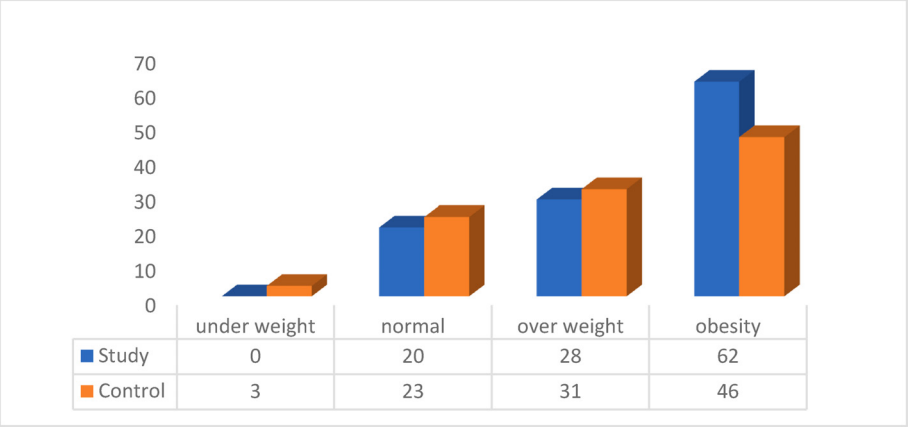

Fig. 6. Distribution of the Study & Control group according to BMI.

Table 7
Distribution of the Study & Control group according to Waist Circumference.

Variables	Frequency (%)		χ^2	P -value
	Study	Control		
Less than 88	23 (20.9%)	13 (12.6%)	6.353	0.042
88–102	22 (20.0%)	35 (34.0%)		
Greater than 102	65 (59.1%)	55 (53.4%)		
Total	110	103		

and other lipids in blood, however high levels increase the risk of heart disease (Huxley et al., 2002). HDL Cholesterol a minimum range in study group is 13.90 with maximum of 62.0 in control, a minimum range is 13.90 with maximum of 84.10 (normal range for women <50 mg/dl, for men <40 mg/dl). LDL Cholesterol minimum range in the study group is 51.0 with a maximum of 237.0. In control, a minimum range is 54.0 with a maximum of 237.0 (normal range is <100 mg/dl). When evaluating DBP minimum range in study group with49 (mm Hg) maximum of 109 mm Hg (normal range is 80). Values showed for DBP in the study and the control out of 110 only 95 were normal, 15 had high DBP in the study, and in control 85 were normal, 18 had high. Extremely low diastolic blood pressure related to an increased risk of cardiovascular complications. (Li et al., 2021). SBP levels in the study

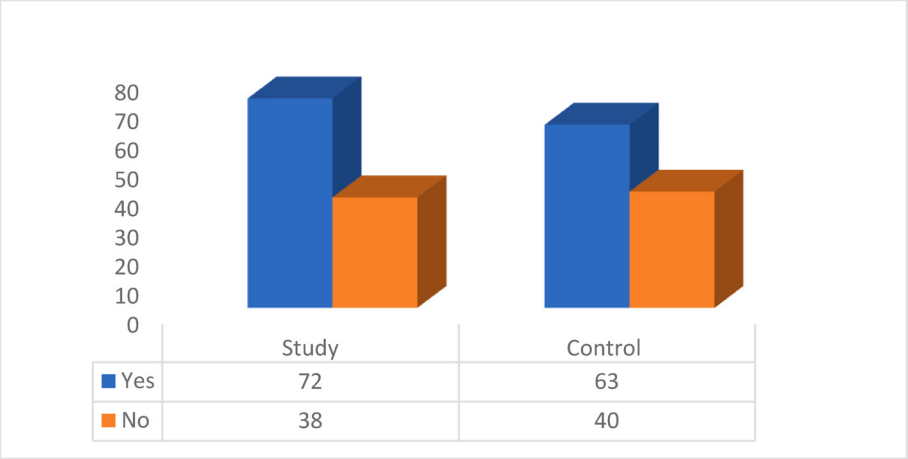

Fig. 7. Distribution of the Study & Control group according to Waist Circumference.

Table 8
Distribution of the Study & Control group according to Diabetes.

Variables	Frequency (%)		χ^2	P -value
	Study	Control		
Yes	72 (65.5%)	63 (61.2%)	2.373	0.305
No	38 (34.5%)	40 (38.8%)		
Total	110	103		

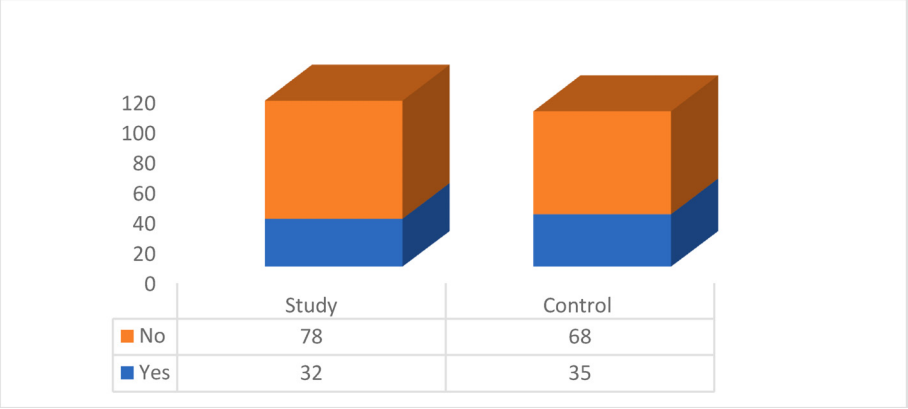

Fig. 8. Distribution of the Study & Control group according to Diabetes.

Table 9
Distribution of the Study & Control group according to Family history CHD or stroke.

Variables	Frequency (%)		χ^2	P -value
	Study	Control		
Yes	32 (29.1%)	35 (34.0%)	0.590	0.442
No	78 (70.9%)	68 (66.0%)		
Total	110	103		

group with a maximum of is 183 mm Hg (normal is <120 mmHg), the distribution of 68 were high in study and control group 51were high. Explore the cardiovascular disease (CVD) risk profiles of various populations with elevated SBP (Navar et al., 2016).

In accordance to distribution of the Study & Control group according to BP. In study group, 12 had low normal BP (SBP100 – 129 and DBP 60–79), 49 has High normal hypertension (SBP 130–139 and DBP 80–89), 49 has high hypertension (SBP > 140 and DBP > 90). In control 12 had low normal BP (SBP100 – 129 and DBP 60–79), 24 has High normal hypertension (SBP 130–139 and DBP 80–89), 67 has high hypertension (SBP > 140 and DBP > 90). With significant p- value of 0.004.

The Framingham Heart Study found that having a DBP of 70 mm Hg and an SBP of 120 mm Hg correlated with a CVD risk equal to an

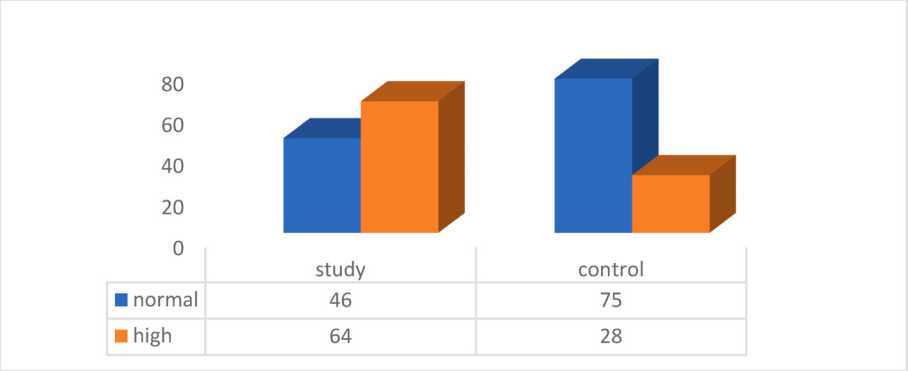

Fig. 9. Distribution of the Study & Control group according to Family history CHD or stroke.

Table 10
Distribution of the Study & Control group according to Smoking.

Variables	Frequency (%)		χ^2	P -value
	Study	Control		
Yes	46 (41.8%)	75 (72.8%)	20.830	0.000
No	64 (58.2%)	28 (27.2%)		
Total	110	103		

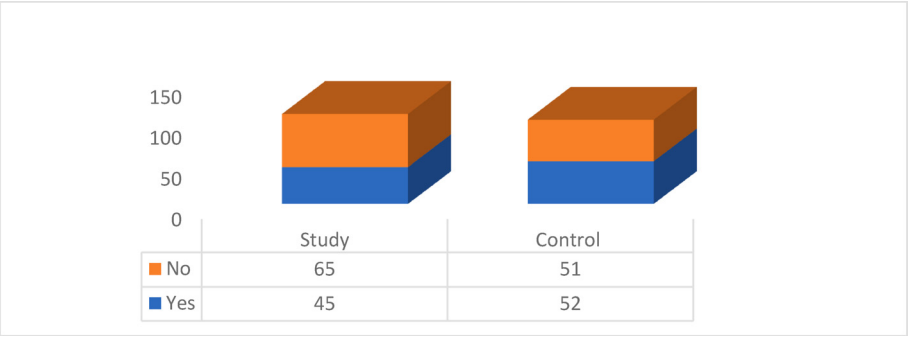

Fig. 10. Distribution of the Study & Control group according to Smoking.

Table 11
Distribution of the Study & Control group according to Dyslipidaemia.

Variables	Frequency (%)		χ^2	P -value
	Study	Control		
Yes	45 (40.9%)	52 (50.5%)	1.967	0.161
No	65 (59.1%)	51 (49.5%)		
Total	110	103		

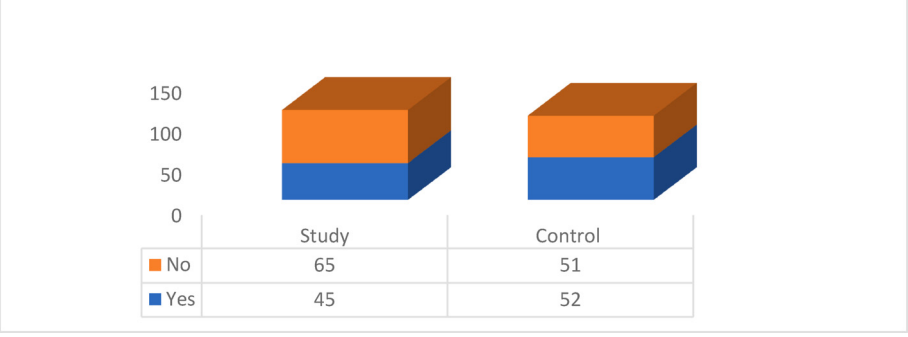

Fig. 11. Distribution of the Study & Control group according to Dyslipidaemia.

Table 12
Study & Control Group according to: Comparison of means of anthropometric and laboratory parameters among patient's.

Variables	Descriptive Statistics											
	N		Minimum		Maximum		Mean		Std. Error		95% Confidence Interval	
	Study Group	Control Group	Study Group	Control Group	Study Group	Control Group	Study Group	Control Group	Study Group	Control Group	Study Group	Control Group
Age (years)	110	103	24.0	24.0	90.0	90	55.52	55.26	1.11	1.231	(54.99, 56.10)	(54.33, 56.16)
Cholesterol total (mmol/l)	110	103	95.0	104.0	280.0	280.0	173.72	171.25	4.26	4.019	(171.56, 176.14)	(169.31, 173.24)
SBP (mmHg)	110	103	102.0	102.0	183.0	190.0	141.25	138.45	1.77	2.090	(140.61, 141.75)	(137.12, 139.82)
DBP (mmHg)	110	103	49.0	49.0	109.0	118.0	76.45	77.53	1.08	1.159	(76.09, 76.82)	(77.06, 78.05)
Hemoglobin (g/dl)	110	103	9.30	9.30	18.20	18.20	13.92	15.05	0.17	0.178	(13.81, 14.05)	(14.97, 15.13)
Waist Circumference (cm)	110	103	78.0	79.0	129.0	128.0	103.61	105.14	1.39	1.315	(103.19, 104.00)	(104.71, 105.61)
Body mass index (kg/m^2)	110	103	21.7	19.03	51.90	51.9	31.44	30.29	0.59	0.690	(31.27, 31.57)	(30.05, 30.61)
Heart rates (bpm)	110	103	47.0	44.0	120.0	120.0	77.05	76.097	1.25	1.313	(76.50, 77.72)	(75.03, 77.08)
Creatinine (mg/dl)	110	103	0.01	0.04	5.40	2.42	1.050	1.027	0.08	0.036	(0.96, 1.14)	(0.99, 1.06)
HDL Cholesterol (mg/dl)	110	103	13.90	13.90	62.0	84.10	41.27	38.01	0.96	1.149	(40.86, 41.69)	(37.69, 38.33)
LDL Cholesterol (mg/dl)	110	103	51.0	54.0	237.0	237.0	109.27	109.37	3.53	3.633	(107.59, 111.07)	(107.72, 111.14)
HbA1c	110	103	5.30	5.0	14.60	14.0	9.24	8.1350	0.23	0.199	(9.11, 9.36)	(8.03, 8.24)
Fasting Serum Glucose (mg/dl)	110	103	11.0	70.0	512.0	512.0	172.19	154.79	8.54	7.392	(168.27, 175.73)	(150.16, 159.28)

Blood Pressure (BP), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), High Density Lipoprotein (HDL), Low density lipoprotein (LDL), Hemoglobin A1c (HbA1c).

Table 13
Correlation Matrix.

		Gender (Male)	HbA1C	Gender (Male)	SBP100 – 129 & DBP 60–79	SBP 130–139 &DBP 80–89	HbA1C	SBP	Smoking (Yes)
Step 2	Gender (Male)	**1.000**	−0.943						
	HbA1c	−0.943	**1.000**						
Step 3	Gender (Male)			**1.000**	−0.161	−0.230	−0.889		
	SBP100 – 129 and DBP 60–79			−0.161	**1.000**	0.297	−0.050		
	SBP 130–139 and DBP 80–89			−0.230	0.297	**1.000**	−0.079		
	HbA1c			−0.889	−0.050	−0.079	**1.000**		
Step 4	Gender (Male)			**1.000**	−0.345	−0.327	−0.487	−0.846	
	SBP			−0.846	0.308	0.275	−0.011	**1.000**	
	SBP100 – 129 and DBP 60–79			−0.345	**1.000**	0.360	0.000	0.308	
	SBP 130–139 and DBP 80–89			−0.327	0.360	**1.000**	−0.063	0.275	
	HbA1c			−0.487	0.000	−0.063	**1.000**	−0.011	
Step 5	Gender (Male)			**1.000**	−0.295	−0.290	−0.458	−0.794	−0.087
	SBP			−0.794	0.229	0.233	−0.098	**1.000**	−0.125
	SBP100 – 129 and DBP 60–79			−0.295	**1.000**	0.333	−0.033	0.229	0.122
	SBP 130–139 and DBP 80–89			−0.290	0.333	**1.000**	−0.087	0.233	−0.013
	Smoking (Yes)			−0.087	0.122	−0.013	0.020	−0.125	**1.000**
	HbA1c			−0.458	−0.033	−0.087	**1.000**	−0.098	0.020

additional 20 mm Hg of SBP, proving the significance of broad artery stiffness as a CVD risk factor in the elderly (Franklin and Wong, 2013).

Waist Circumference 78 cm, a minimum range in study group with maximum of 129 cm, out of 110, 23 has <88 cm, 22 variables have waist circumference from 88c – 02 cm are overweight), 65 variables have waist circumference over 102 cm are obese. We found waist circumference assessment of abdominal obesity to substantially correlated with the risk of CVD incidents. It linked a centimetre increase in waist circumference to a 2% increase in potential CVD risk. It should include these basic abdominal obesity interventions in CVD risk assessments (De Koning et al., 2007).

Table 14
Estimated coefficients for a multiple logit model.

Variable		B	S.E.	Wald	df	p-value	$\hat{OR}$	95% CI for$\hat{OR}$	
								Lower	Upper
Step 1[a]	Gender (Male)	−0.627	0.167	14.113	1	0.000	0.534	0.385	0.741
Step 2[b]	Gender (Male)	−3.620	0.534	45.974	1	0.000	0.027	0.009	0.076
	HbA1c	0.346	0.058	36.187	1	0.000	1.414	1.263	1.583
Step 3[c]	Gender (Male)	−3.845	0.568	45.871	1	0.000	0.021	0.007	0.065
	BP			11.143	2	0.004			
	SBP100 – 129 and DBP 60–79	0.582	0.554	1.104	1	0.293	1.789	0.604	5.299
	SBP 130–139 and DBP 80–89	1.285	0.385	11.138	1	0.001	3.614	1.699	7.686
	HbA1c	0.310	0.059	27.212	1	0.000	1.363	1.213	1.532
Step 4[d]	Gender (Male)	−5.856	1.341	19.063	1	0.000	0.003	0.000	0.040
	SBP	0.019	0.008	5.866	1	0.015	1.019	1.004	1.035
	BP			13.674	2	0.001			
	SBP100 – 129 and DBP 60–79	0.940	0.595	2.492	1	0.114	2.559	0.797	8.219
	SBP 130–139 and DBP 80–89	1.477	0.401	13.603	1	0.000	4.380	1.998	9.603
	HbA1c	0.230	0.078	8.768	1	0.003	1.259	1.081	1.466
Step 5[e]	Gender (Male)	−5.329	1.242	18.402	1	0.000	0.005	0.000	0.055
	SBP	0.020	0.007	7.549	1	0.006	1.021	1.006	1.035
	BP			12.357	2	0.002			
	SBP100 – 129 and DBP 60–79	0.723	0.603	1.437	1	0.231	2.061	0.632	6.722
	SBP 130–139 and DBP 80–89	1.426	0.406	12.356	1	0.000	4.162	1.879	9.218
	Smoking (Yes)	−0.981	0.375	6.823	1	0.009	0.375	0.180	0.783
	HbA1c	0.217	0.079	7.655	1	0.006	1.243	1.065	1.450

[a] Variable(s) entered on step 1: gender.
[b] Variable(s) entered on step 2: HbA1C.
[c] Variable(s) entered on step 3: BP group.
[d] Variable(s) entered on step 4: SBP.
[e] Variable(s) entered on step 5: smoking.

Table 15
Estimated coefficients for a multiple logit regression reduced model*.

Variable	**B**	**S. E.**	**Wald**	**p-value**	$\hat{OR}$	**95% CI for**$\hat{OR}$
Age	2.343	1.265	10.196	0.017	1.663	(0.873, 24.23)
BP (SBP > 130, DBP > 80)	1.687	0.459	13.504	0.000	5.401	(2.197, 13.280)
Smoking (Yes)	−1.671	0.391	18.291	0.000	0.188	(0.087, 0.404)
WC > 88	1.736	0.760	7.717	0.021	5.675	(1.280, 25.149)
Haemoglobin	−0.354	0.078	20.663	0.000	0.702	(0.603, 0.818)
HDL Cholesterol	0.051	0.019	7.545	0.006	1.052	(1.015, 1.091)
HbA1c	0.234	0.079	8.825	0.003	1.263	(1.083, 1.474)

Blood Pressure (BP), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Waist Circumference (WC), High Density Lipoprotein (HDL), Hemoglobin A1c (HbA1c).

The study data showed 7. 72 variables have diabetes, 38 has no diabetes in the study group, whereas in control 63 has diabetes and 40 has no diabetes, diabetes mellitus has an excess risk of CHD mortality and morbidity (Iciar et al., 2014). Comparing these results with Table 1. HbA1C is 5.3 minimum range in the study group with a maximum of 14.60 (levels of 6.5% of the higher mean of diabetes. Glycated haemoglobin is the predictor of CHD (Ewid et al., 2019), the association of HbA1C with CHD (Zhao et al., 2014).

Fasting Serum Glucose minimum range is 11 in the study group with a maximum of 512.0 (70 to 99 mg/dl is normal). Women's risk of coronary heart disease increased dramatically when their fasting glucose levels were low (≥110 mg/dL). When compared to normal glucose levels (<100 mg/dL), Men's risk of coronary heart disease significantly increased in a diabetic glucose spectrum, while women's risk significantly increased (≥126 mg/dL).

The hazard ratio of coronary heart disease correlated with fasting serum glucose level was higher in women than in men (Ahn et al., 2018). The Body mass index 21.7 is a minimum range in the study group with a maximum of 51.9 (normal range is 18.5–24.9). The variables evaluated according to the BMI, in the study group 28 were overweight and 62 were obese. In control 31 were overweight, 62 were obese, with the p value of 0.138, the risk of CHD associated with excess weight measured by BMI (Flint et al., 2010).

In the study group the minimum range of age 24 in study and control group with a maximum of 90 showed the distribution of the Study & Control group according to Age group, 67 variables with the age between 40 and 59 age group, were prone to CHD, serum total cholesterol increases as the age increases (Jousilahti et al., 1999). Also, the distribution of the Study & Control group according to Family history CHD or stroke, 32 were having family history CHD or stroke and in control 35 had CHD family history. Compared with family history of coronary artery disease, variables have higher lifetime risk for both CHD and CVD mortality resulting in significantly higher lifetime risk estimates (Bachmann et al., 2012).

5. Conclusion

The study showed that difference variables as age, blood pressure, smoking, increase waist circumstance, haemoglobin, high-density lipoprotein, Cholesterol and HbA1c considered as significant risk factors for coronary heart disease. We showed a high association between high blood pressure, increase in waist circumference and coronary heart disease.

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Data Availably

All original data sheet available on request from the corresponding author.

CRediT authorship contribution statement

Sawsan Babiker: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft. **Yousif Eltayeb:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft. **Neveen Sayed-Ahmed:** Conceptualization, Data curation, Formal analysis, Writing – original draft. **Sitalnesa Abdelhafeez:** Data curation, Formal analysis, Methodology, Writing – original draft. **El Shazly Abdul Khalik:** Methodology, Writing – original draft. **M.Saif AlDien:** Data curation, Methodology. **Omaima Nasir:** Conceptualization, Data curation, Methodology, Writing – original draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Further Reading

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