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ASSOCIATION BETWEEN OBESITY AND CARDIOVASCULAR DISEASE IN ADOLESCENT, YOUNG AND ADULT POPULATION – A SURVEY BASED ANALYSIS

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ABSTRACT

Obesity plays an important role in the pathophysiology of metabolic and cardiovascular disease (CVD). Hence obesity can also be defined as excessive storage of energy in the form of fat causing adverse effects on various other diseases like cancer thereby increasing the mortality and morbidity of the increasingly overweight population.They are usually more prevalent among the minority groups like African - American and Hispanic populations. If a male has BMI equal to or greater than 25 then he is considered overweight and less than 25 considered normal. If his BMI is less than 18 then he is considered to be underweight . It poses a major risk factor for the development of stroke, myocardial infarction, hypertension, coronary artery disease and cancer related mortality world wide. The association between Obesity and hypertension, diabetes mellitus and sleep apnoea has shown to increase the incidence of CVD disorders. Obesity has been developed as a growing problem in today's world.

INTRODUCTION

The most common interrelated problems among the westernised and industrialised society are obesity, cardiovascular disease, hypertension, and diabetes mellitus. Obesity plays an important role in the pathophysiology of metabolic and cardiovascular disease.Hence obesity can also be defined as excessive storage of energy in the form of fat causing adverse effects on various other diseases like cancer thereby increasing the mortality and morbidity of the increasing overweight population.They are usually more prevalent among the minority groups like African - American and Hispanic population. It markedly enhances the development of type 2 diabetes and other cardiovascular diseases [(Sowers, 1998) ;(Johnson *et al.,* 2020)].Obesity is usually measured by Body Mass Index(BMI) where the person's weight (in Kgs) is divided by the square of height of that person (in Metres). If the person has a BMI of 30 or more he is considered to be obese. If he has BMI equal to or greater than 25 then he is considered overweight and less than 25 considered normal. If his BMI is less than 18 then he is considered to be underweight . It poses a major risk factor for the development of stroke, myocardial infarction, hypertension, coronary artery disease and cancer related mortality world wide [(Akil and Ahmad, 2011)].

Mississippi was considered to be the most obese in the USA. It might have arisen due to the racial,ethenic disparity and even based on the region and income of the people. Obesity is a fast growing problem in today's world that is associated with a high risk of premature death and adverse health effects and affects the heart either directly or indirectly. Therefore it is considered as an important independent Cardiovascular disease (CVD) risk factor. It plays an important role in atherosclerosis and coronary heart disease. Here , the total blood volume and cardiac output is increased and the cardiac workload is usually high [(Akil and Ahmad, 2011);(Sekar*et al.,* 2019)].It leads to structural and functional changes of heart thereby leading to heart failure. But, it also has a protective effect on the outcome of the underlying CVD and obesity paradox.Though BMI is used to calculate obesity, it does not give any information regarding fat distribution which is of high importance in cardiovascular risk[(Csige*et al.,* 2018);(Seppan*et al.,* 2018)].Hence, obesity can also be measured using various methods like waist - circumference ratio(WC), waist-hip ratio(WHC) and percent body fat assessment (Burns *et al.,* 2013).

Leptin, an adipocyte derived hormone controls the energy metabolism of the food taken. Increased levels of leptin may lead to CVD. C-reactive proteins resist the development of this leptin. The weight gain is typically associated with increase in arterial pressure. Burns *et al.,* did a 14 year follow up where, for every increase of BMI by Kg/m^2, the risk of heart failure increased 5% in men and 7% in women (Burns *et al.,* 2013). Romero et al took a systematic review of more than 250000 patients in 40 studies for about 3years and found that overweight and obese CVD patients are less prone to CV mortality which was found similar when compared to normal and underweight patients. But if BMI is above $35Kg/m^2$, then they are at risk [(Burns *et al.,* 2013);(Nivesh Krishna and YuvarajBabu, 2016)].

Cercato and Fonseca, 2019 found the risk of mortality among metabolically healthy people with obesity when compared with the metabolically unhealthy people with obesity and metabolically normal weight people using various criteria and found that metabolically healthy people with obesity did not have less risk to mortality and were similar to metabolically unhealthy people with obesity [(Cercato and Fonseca, 2019);(Kannan and Thenmozhi, 2016)]. Insulin, a pancreatic hormone may vary with the amount of adipose tissue and fat and insulin resistance may occur in obesity due complex mechanisms. Ghrelin, a gut peptide hormone possessing orexigenic action promotes adiposity [(Cercato and Fonseca, 2019);(Nandhini*et al.*, 2018)].

Thus the aim of the present study is to find the correlation between obesity and cardiovascular disease and thereby suggesting treatment methods.

MATERIALS AND METHODS

The study involved here was a survey done through an online study setting. A total of 100 people belonging to the South Indian population participated in this survey. The sampling method used in this study was a random sampling method and measures for minimising bias was done by categorising the people based on their age and gender.

The data was collected by preparing a well structured questionnaire comprising 15 questions and was circulated to the respondents through online survey planet link and google forms based on the knowledge on obesity and CVD disease. The values obtained were put in a spreadsheet, analysed statistically using SPSS software. The statistical test used was descriptive analysis with frequency distribution and the type of correlation analysis used was Chi - square test and thereby a detailed conclusion was made. The independent variable considered were education and height and the dependent variables considered were age, sex and occupation and results were obtained.

RESULTS AND DISCUSSION

From the survey study it was found that 43% of the people who participated were males and 57% were females of age ranging from 11-55 years old, indicating that females were more aware in maintaining their health when compared to males (Figure 1). 51% of the participants were students (Figure 2). Almost 76% of the people had their BP checked within the last 12 months thereby indicating that they are aware that hypertension might be a risk factor for developing CVD (Figure 3). The data showed that there was an association between different age groups with the duration of BP last checked and it was found that most participants of the age 10-20 years (30%) and more than 50 years (24%) checked their BP in the last 12 months, where the chi square test showed p value = 0.03; $p>0.05$ indicating statistically not significant (Figure 4). The data showed that females (40%) checked their BP in the last 12 months more than males (36%) but found no statistical significance between gender and the duration when they last checked their BP as the chi square test showed p value = 0.3; $p>0.05$ (Figure 5). The data showed that 97% were non-smokers as they were aware of the harmful effects of smoking which was

similar to study where 76% were non-smokers (Figure 6) [(Mullie and Clarys, 2011); (Subashriand Thenmozhi, 2016)]. Also it was found that most participants of the age between 10-20 years (50%) do not smoke but no statistical significance was found between age and habit of smoking among the participants as the chi square test shows p=0.2; p>0.05 (Figure 7). The data showed that females (56%) are found to be non smokers than males but no statistical significance was found between gender and habit of smoking as chi square test showed p = 0.4; p>0.05 indicating statistically not significant (Figure 8).

The survey data showed that 66% of the people considered pain in neck, chest, jaw and back region to be symptoms of heart attack which was similar to a study where 44% of participants considered them to be a symptom of heart disease (Figure 9). Participants of the age between 10-20 years (37%) had more knowledge on symptoms of heart attack but no statistical significance was found between age and knowledge on symptoms of heart attack as chi square value showed p = 0.4; p>0.05 (Figure 10). The observed data showed that females (39%) had more knowledge on symptoms of heart attack than males (29%) but no statistical significance was found between gender and knowledge on symptoms of heart attack as chi square value showed p value=0.6; p>0.05 (Figure 11). 96% have not experienced heart attack (Figure 12), but this contradicts a study where heart attack is the most common CVD experienced by the population irrespective of age and gender as the population in our study is limited [(Lynch *et al.*, 2006);(Sriram, Thenmozhi and Yuvaraj, 2015)]. Participants of the age between 10 to 20 years (50%) have never experienced heart attack, and also no statistical significance was found between age and occurence of heart attack as the chi square value showed p = 0.5; p>0.05 (Figure 13). The data showed that females (54%) had never experienced heart attack when compared to males (42%), but no statistical significance was found between gender and occurence of heart attack as the chi square value showed p=0.8; p>0.05 (Figure 14).

The present data showed that people considered obesity to be a risk factor for heart disease (Figure 15) which was similar to a study were almost all the respondents considered obesity to be a risk factor [(Chinju George And G Andhuvan, 2014);(Keerthana and Thenmozhi, 2016)]. Participants of the age 10-20 years (46%) considered obesity to be a risk factor for heart disease but no statistical significance was observed between age and knowledge of obesity as a risk factor as the chi square value showed p=0; p>0.05 (Figure 16). Females (47%) knew that obesity was a risk factor for heart disease more than males (42%) and a statistical significance was found between gender and knowledge of obesity as a risk factor as the chi square value showed p=0.06; p<0.05 (Figure 17). 83% of participants had high blood cholesterol while the rest 17% did not have high blood cholesterol levels (Figure 18), which was similar to a study where 20% of the participants had high blood cholesterol. Participants of the age 10 - 20 years (45%) did not have high blood cholesterol but no statistical significance was found between age and presence of high blood cholesterol as the chi square value showed p=0.4; p> 0.05 (Figure 19). Females (48%) did not have blood cholesterol when compared to males (35%)

but no statistical significance was found between gender and presence of high blood cholesterol as the chi square value showed p=0.4; p>0.05 (Figure 20).

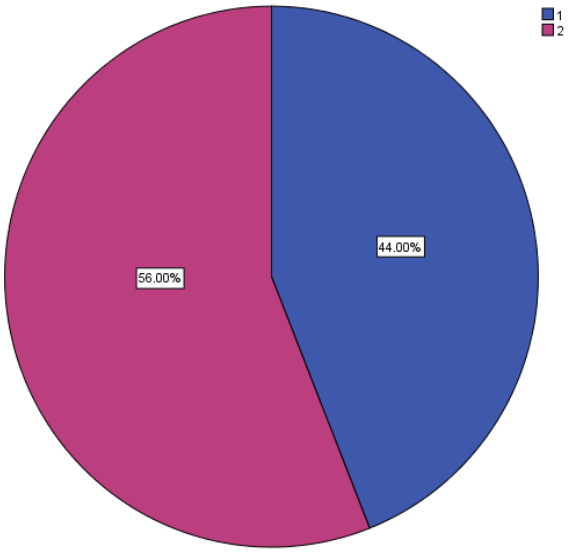

Figure 1: Showing the frequency distribution of gender in the survey study. 44% of the people who participated in the survey were males (dark blue colour) and 56% of the people who participated were female of the age 11 to 55 years (purple colour).

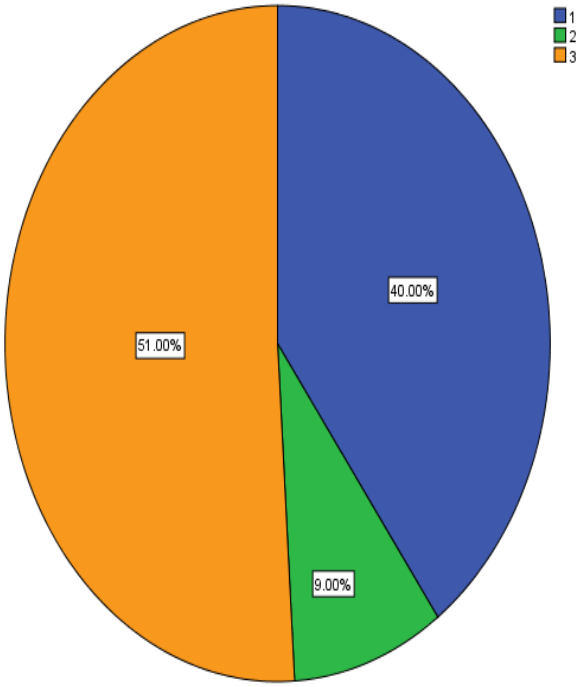

Figure 2: Showing the frequency distribution of nature of employment. 51% of the participants were students represented by orange colour, 9% were unemployed represented in green and the rest 40% were employed and represented in dark blue.

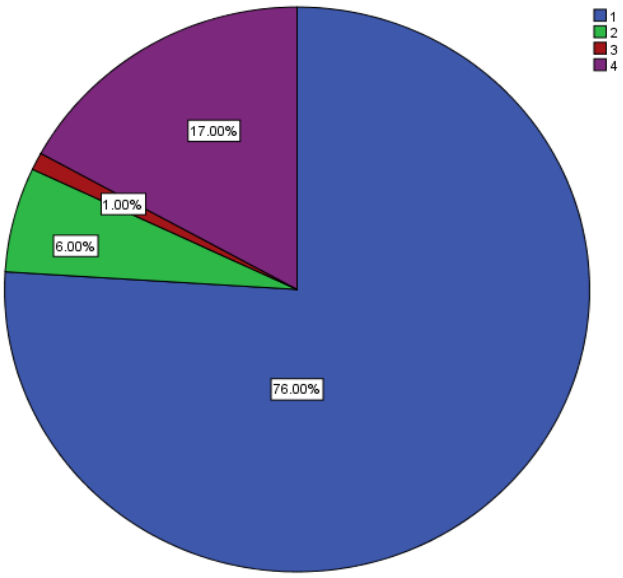

Figure 3: Showing the frequency distribution of the duration when they had last checked their BP.76% of the people had checked their BP only before 12 months represented in dark blue, 17% of the people didn't know when they last checked represented in purple colour, 6% had checked their BP last for more than a year represented in green and 1% of the people had checked between 1 to 5 years and represented in red.

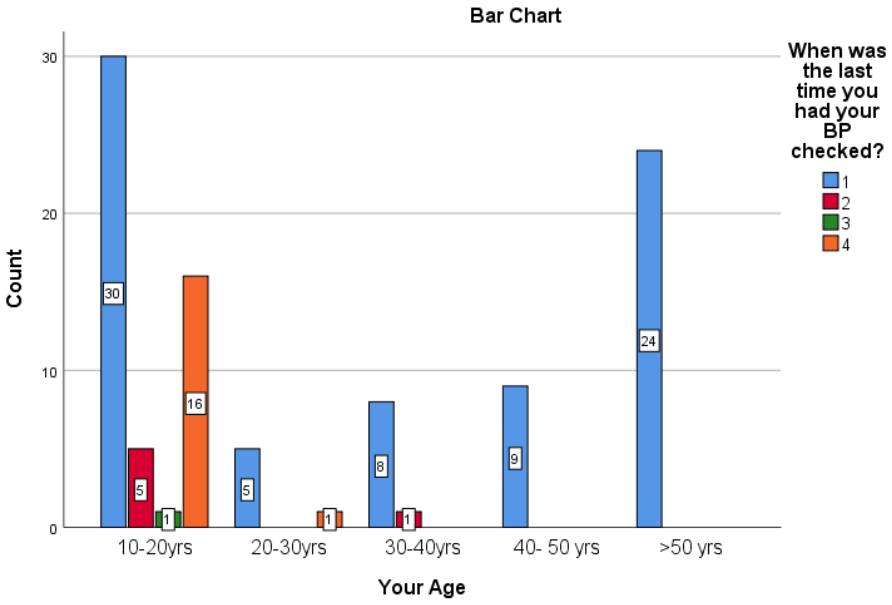

Figure 4: Bar graph showing correlation of different age groups with the duration of BP last checked. P value = 0.03; p>0.05 (statistically not significant) using chi square analysis. X axis - shows different age groups. Y axis - shows number of participants.

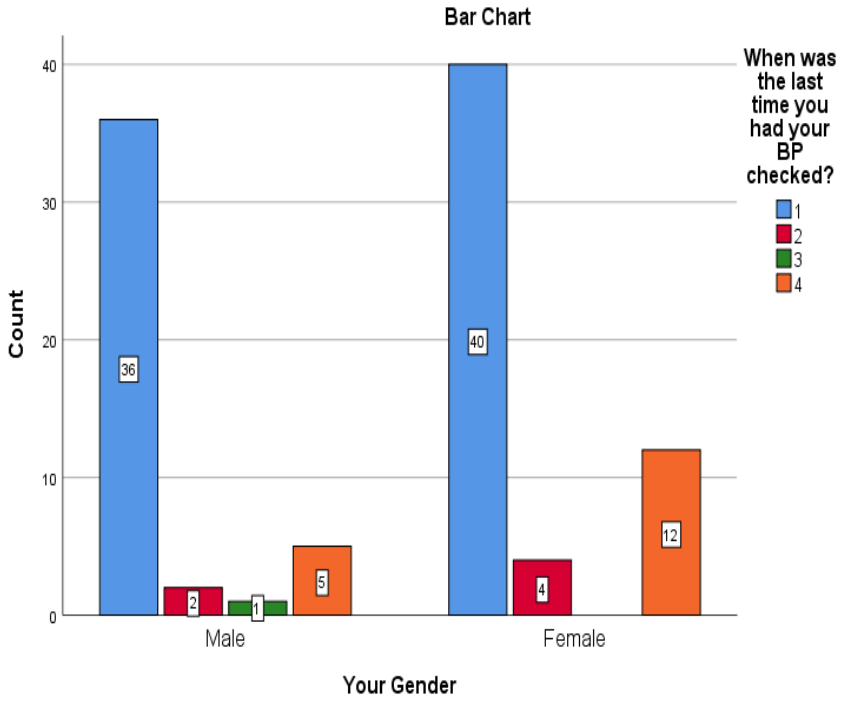

Figure 5: Bar graph showing correlation between gender and the duration of BP when checked last; p value = 0.3; p>0.05 (statistically not significant). X axis - gender. Y axis - number of participants.

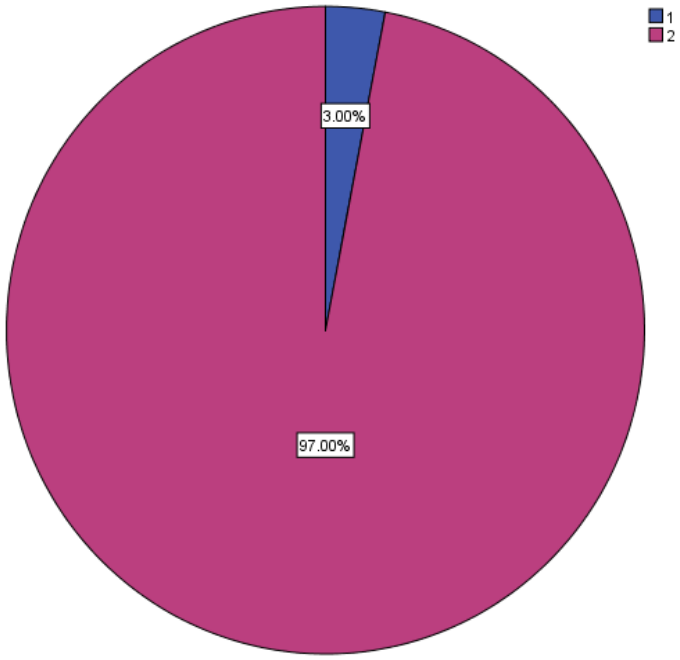

Figure 6: Shows the frequency distribution of the smoking habit among the participants. 97% of the people who attended the survey did not smoke as they were of the consequences represented in purple while the rest 3% smoked in spite of knowing the consequences, represented in blue.

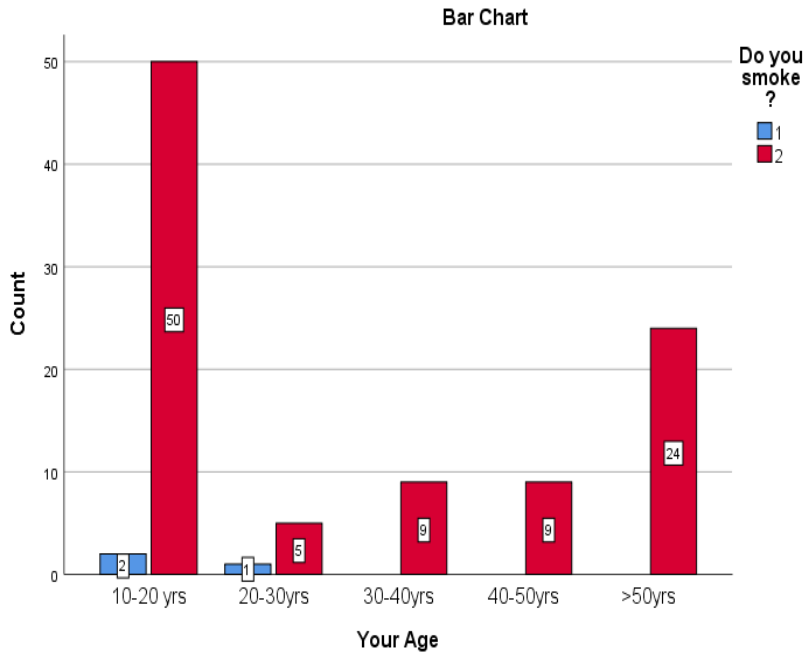

Figure 7: Bar graph showing correlation between age and habit of smoking ; p value = 0.2; p>0.05 (statistically not significant). X axis - shows different age groups. Y axis - number of participants.

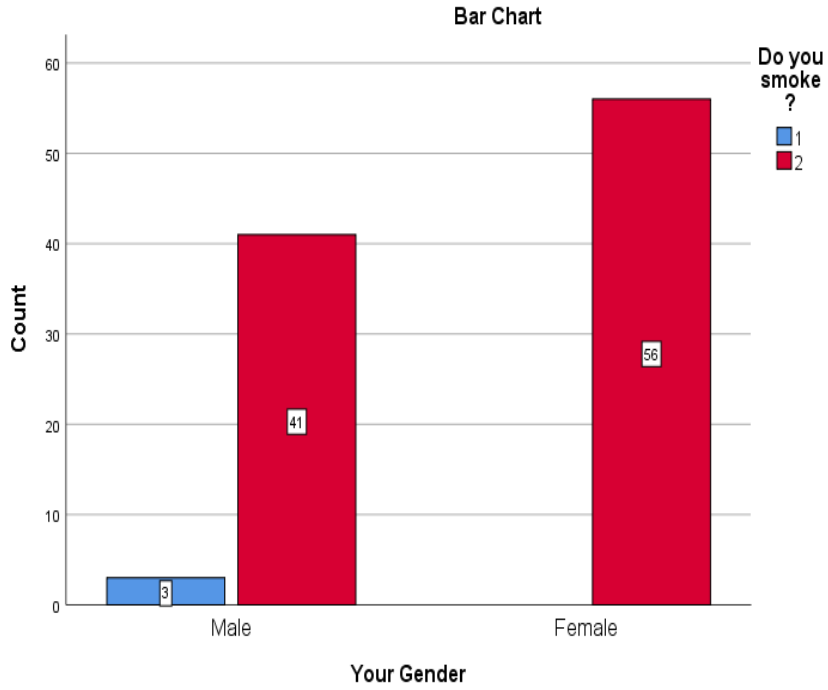

Figure 8: Bar graph showing correlation between gender and habit of smoking ; p value = 0.4; p>0.05 (statistically not significant). X axis - gender. Y axis - number of participants.

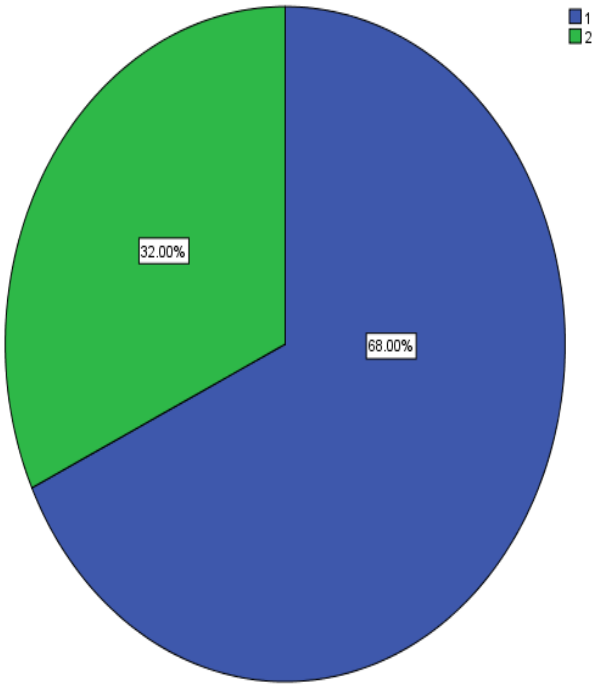

Figure 9: Shows the frequency distribution of the knowledge on symptoms of heart attack. 68% of the people considered pain in neck, chest, jaw and back region as symptoms of heart attack (blue); 32% of the people did not consider them to be symptoms of heart attack (green).

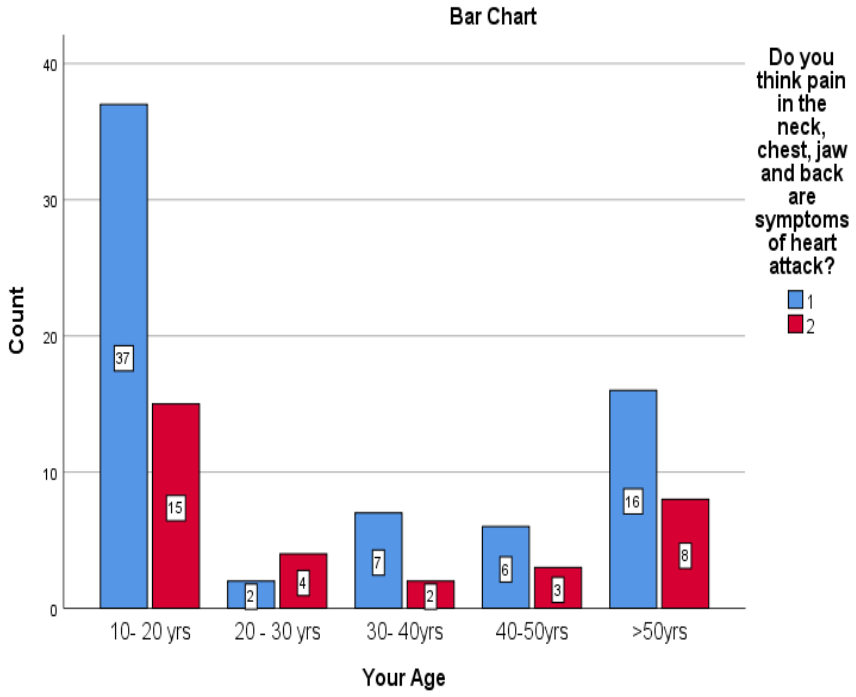

Figure 10: Bar graph showing correlation between age and knowledge on symptoms of heart attack; p value = 0.4; p>0.05 (statistically not significant). X axis - shows different age groups. Y axis - number of participants.

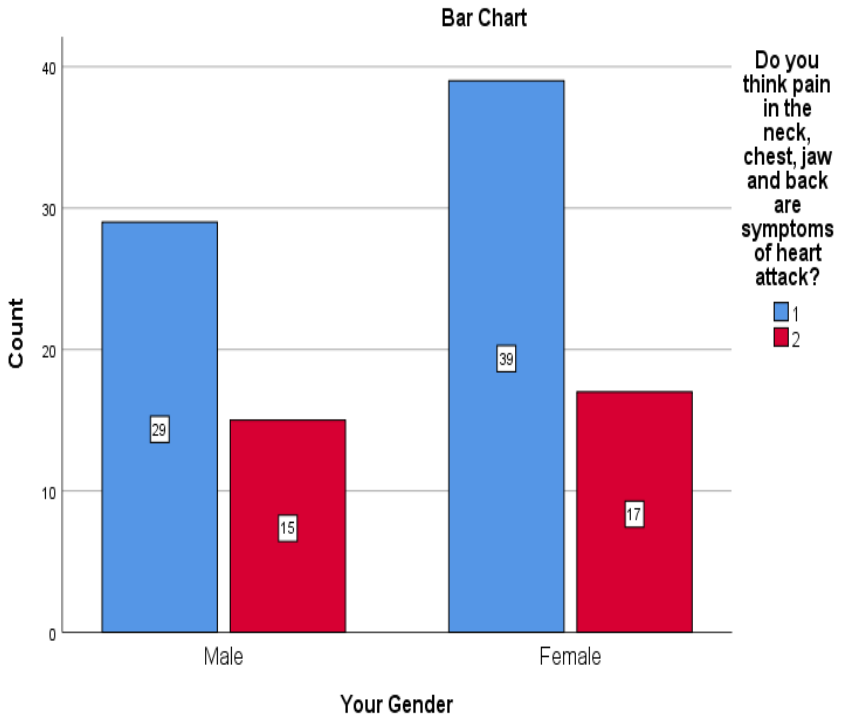

Figure 11: Bar graph showing correlation between gender and knowledge on symptoms of heart attack ; p value = 0.6; p>0.05 (statistically not significant). X axis - gender. Y axis - number of participants.

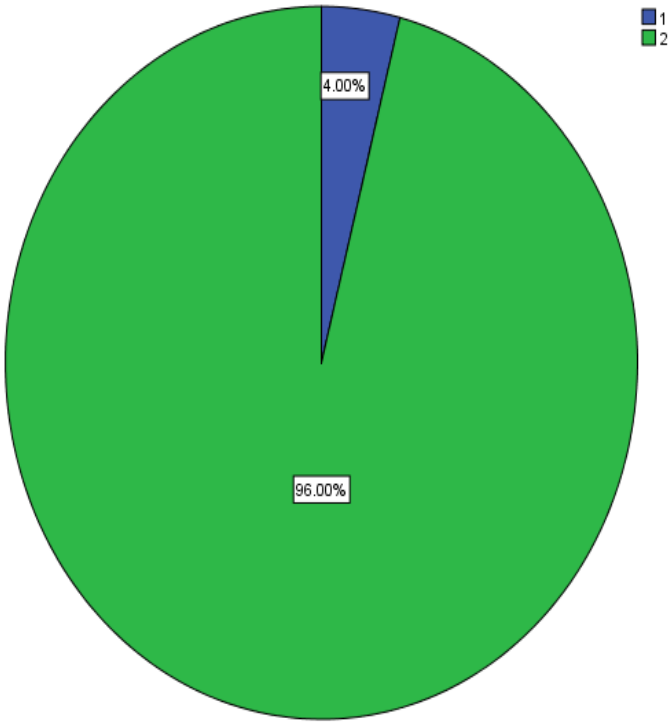

Figure 12: Shows the frequency distribution of experience3 of cardiac arrest. 96% said that they did not experience heart attack represented in green while the rest 4% did not experience and represented in blue.

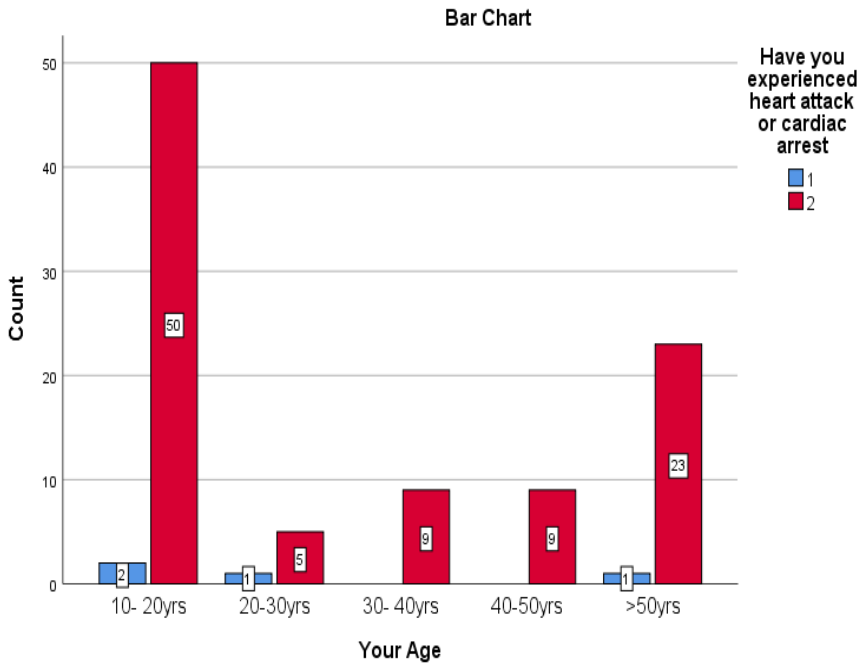

Figure 13: Bar graph showing correlation between age and experience of heart attack ;p value = 0.5; p>0.05 (statistically not significant). X axis - shows different age groups. Y axis - number of participants.

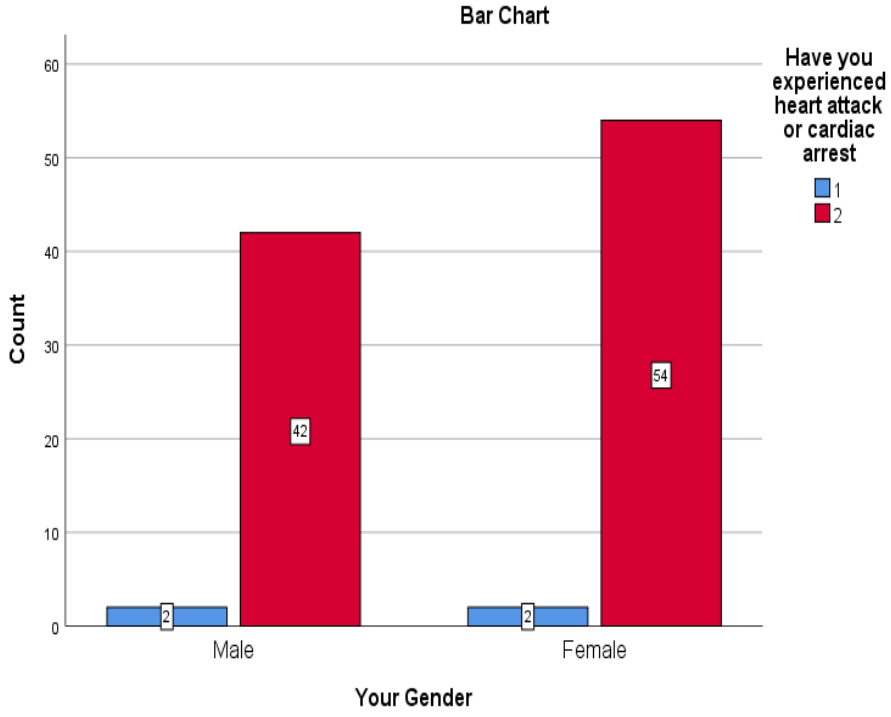

Figure 14: Bar graph showing correlation between gender and experience of heart attack ;p value = 0.8; p>0.05 (statistically not significant). X axis - gender. Y axis - number of participants.

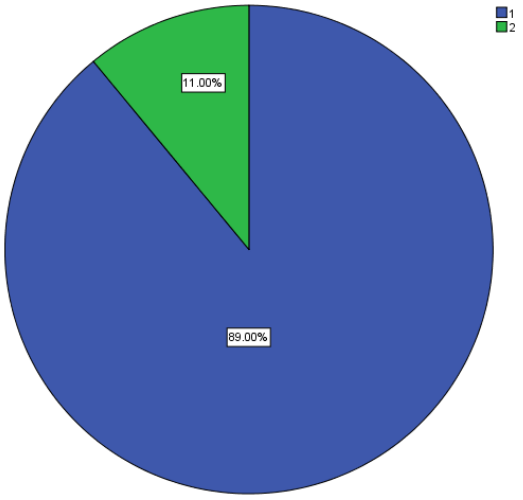

Figure 15: Shows the frequency distribution of knowledge of obesity as a risk factor for heart disease. 89% considered obesity as a risk factor for heart disease represented in blue while the rest 11% did not consider and represented in green.

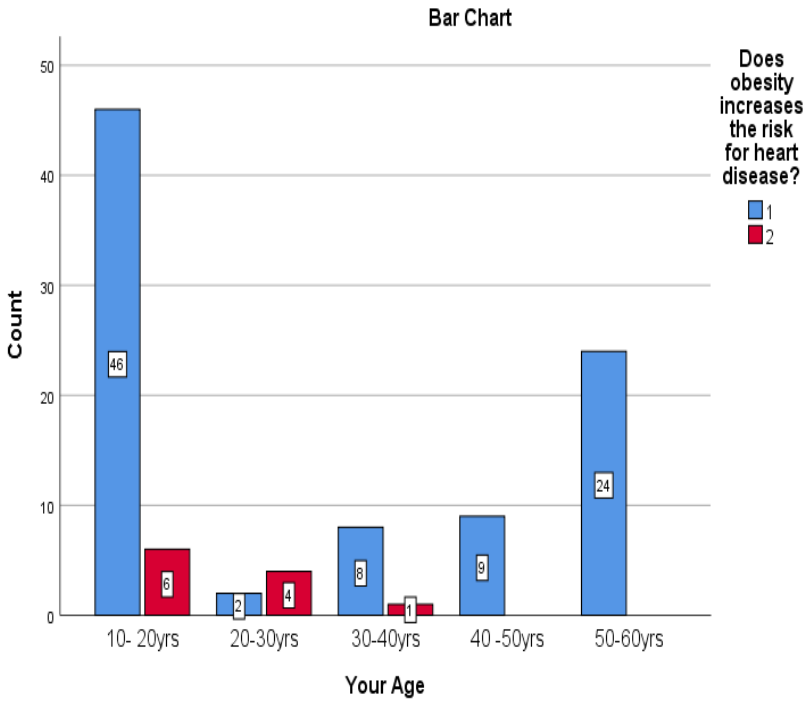

Figure 16: Bar graph showing correlation between age and knowledge of obesity as a risk factor for heart disease ;p value = 0; p>0.05 (statistically not significant). X axis - shows different age group, Y axis - number of participants.

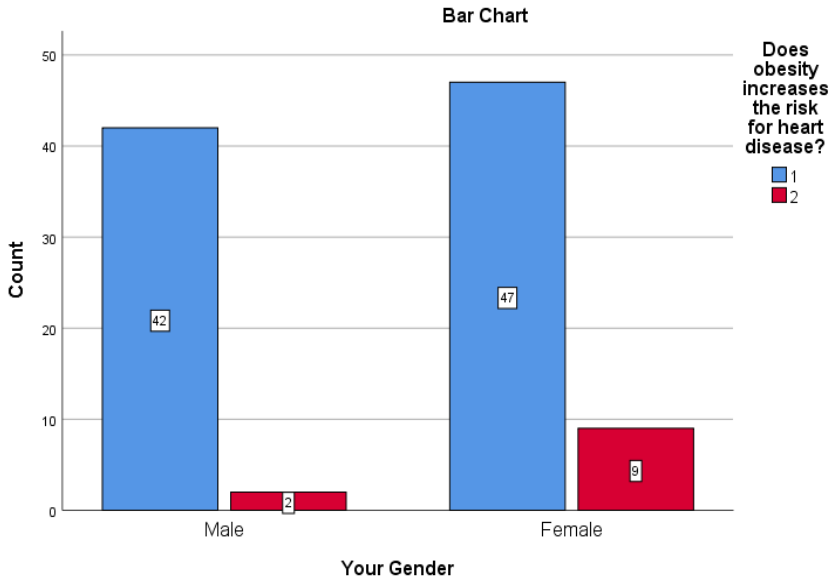

Figure 17: Bar graph showing correlation between gender and knowledge of obesity as a risk factor for heart disease ;p value = 0.06; p<0.05 (statistically significant). X axis - gender, Y axis - number of participants.

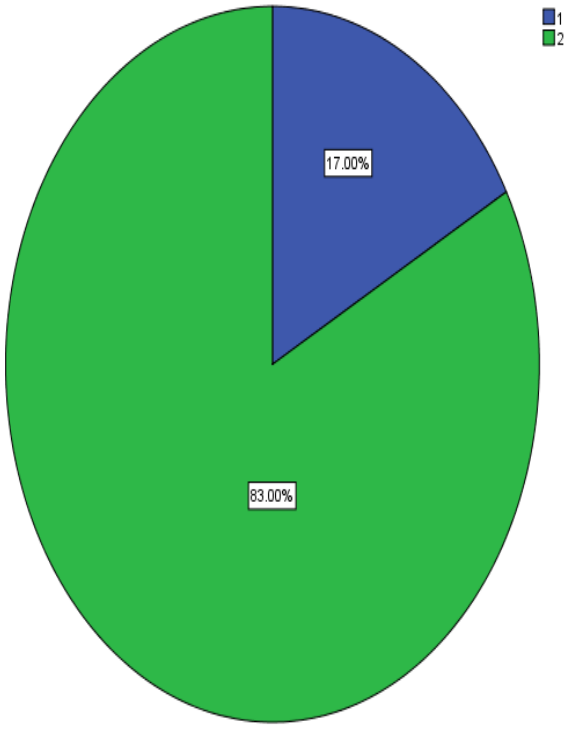

Figure 18: Shows the frequency distribution of the presence of high blood cholesterol . 83%did not have high blood cholesterol and represented in green while the rest 17% had high cholesterol and represented.

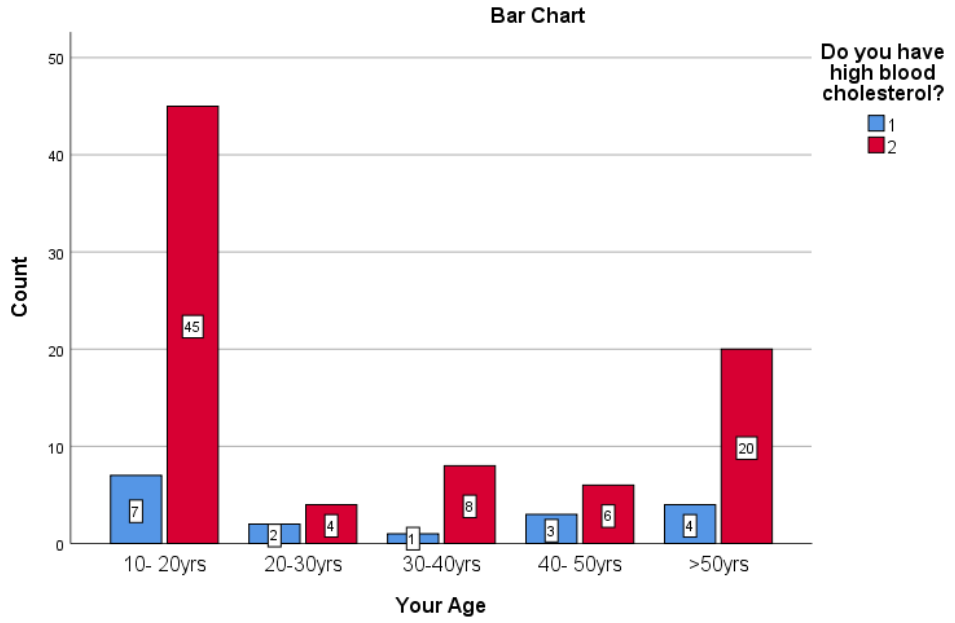

Figure 19 : Bar graph showing correlation between age and presence of high blood cholesterol; p value = 0.4; p>0.05 (statistically not significant). X axis - shows different age group, Y axis - number of participants.

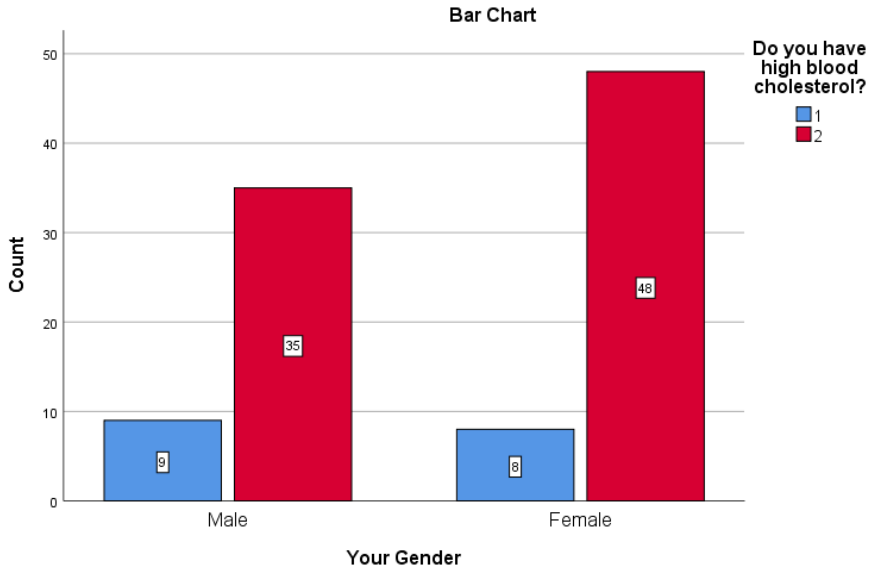

Figure 20: Bar graph showing correlation between gender and presence of high blood cholesterol; p value = 0.4; p>0.05 (statistically not significant). X axis - gender, Y axis - number of participants.

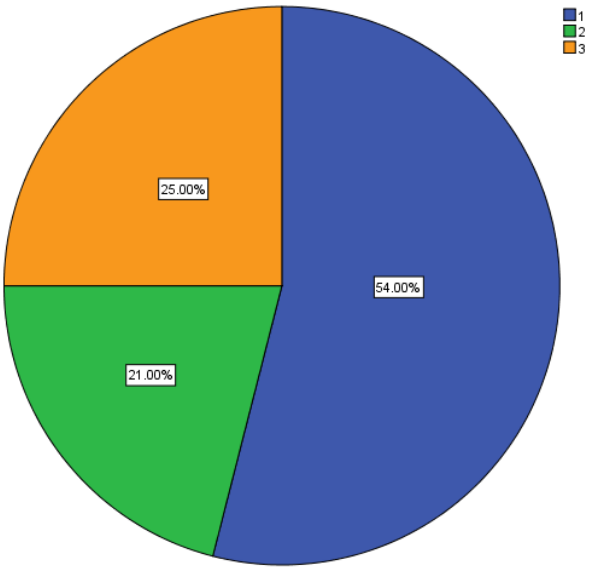

Figure 21: Shows the frequency distribution of knowledge of high BP. 54% considered BP of 140/90 high represented in blue, 21% did not consider high and represented in green while the rest 25% weren't sure and represented in orange.

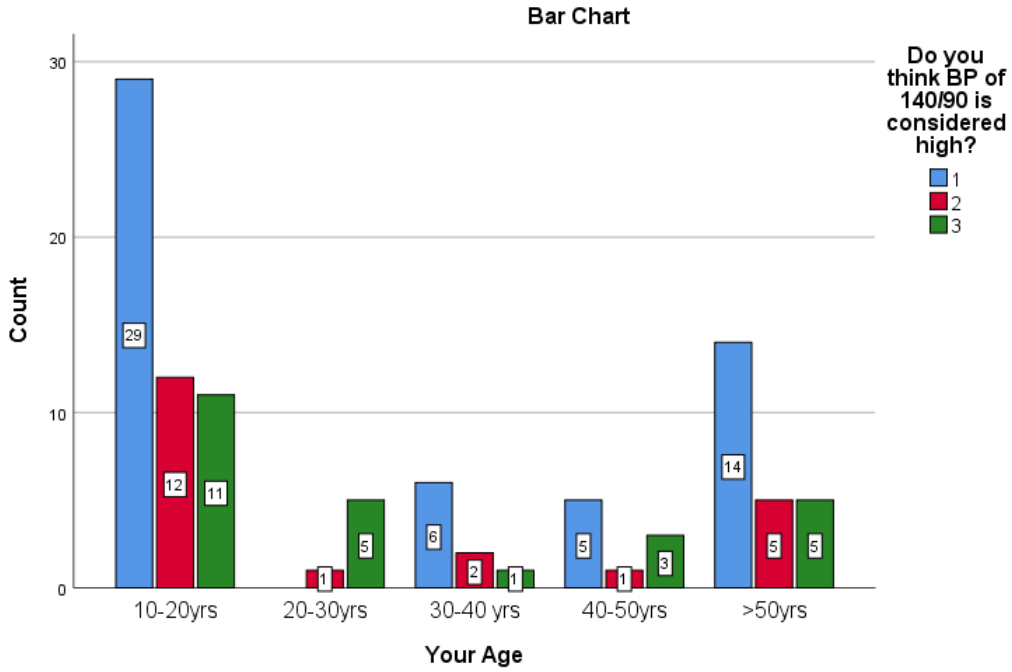

Figure 22: Bar graph showing correlation between age and knowledge on high blood pressure. p value = 0.04; p>0.05 (statistically not significant). X axis - shows different age group, Y axis - number of participants.

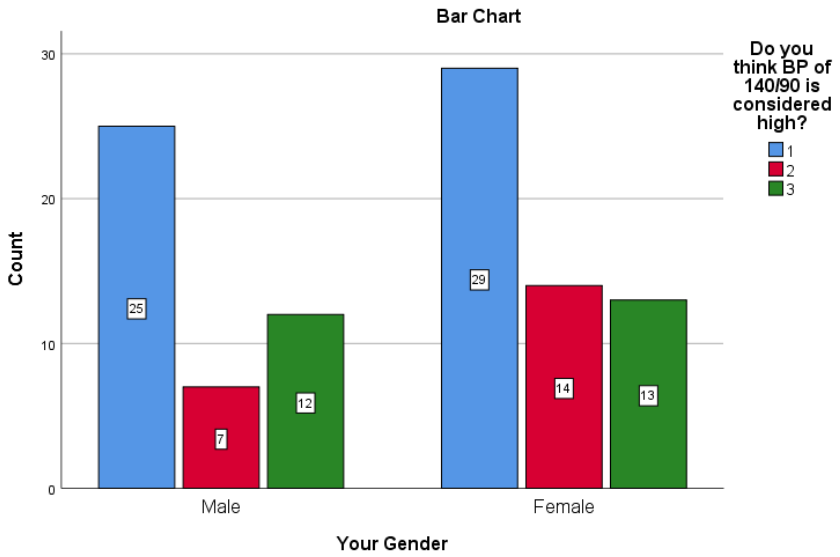

Figure 23: Bar graph showing correlation between gender and knowledge on high blood pressure. p value = 0.5; p>0.05 (statistically not significant). X axis - gender, Y axis - number of participants.

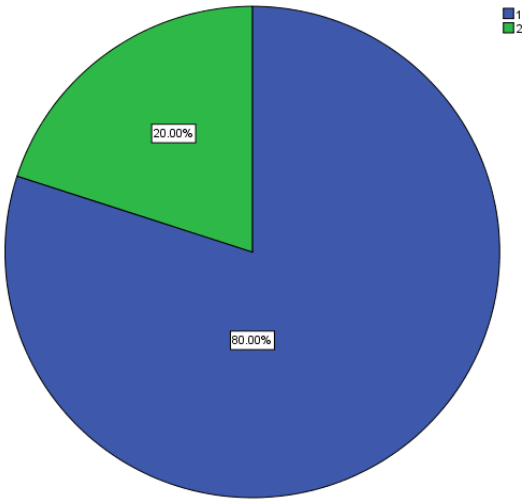

Figure 24: Shows the frequency distribution of overweight to be considered as a risk factor for heart disease. 80% considered overweight to be a risk factor and represented in blue for high blood cholesterol while the rest 20% did not and represented in green

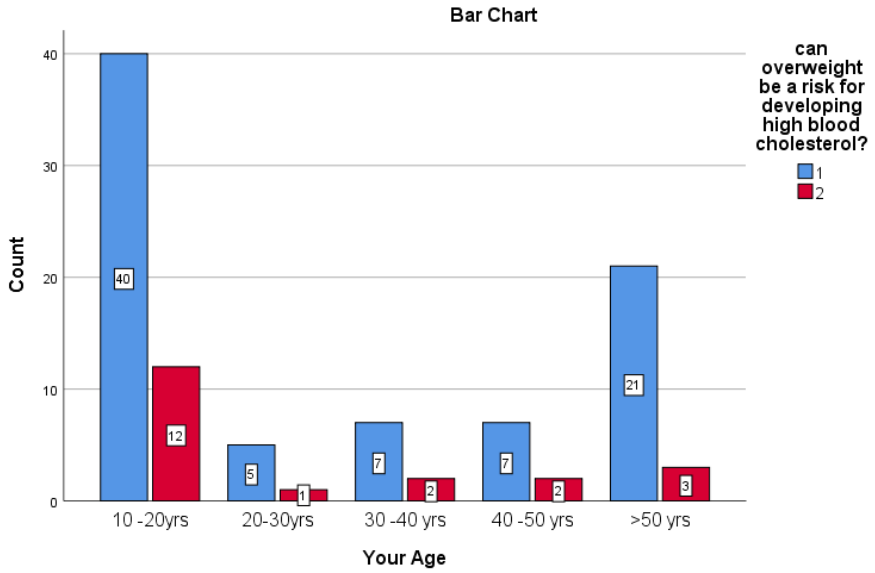

Figure 25: Bar graph showing correlation between age and knowledge of overweight as a risk for high blood cholesterol; p value = 0.8; p>0.05 (statistically not significant).X axis - shows different age group, Y axis - number of participants.

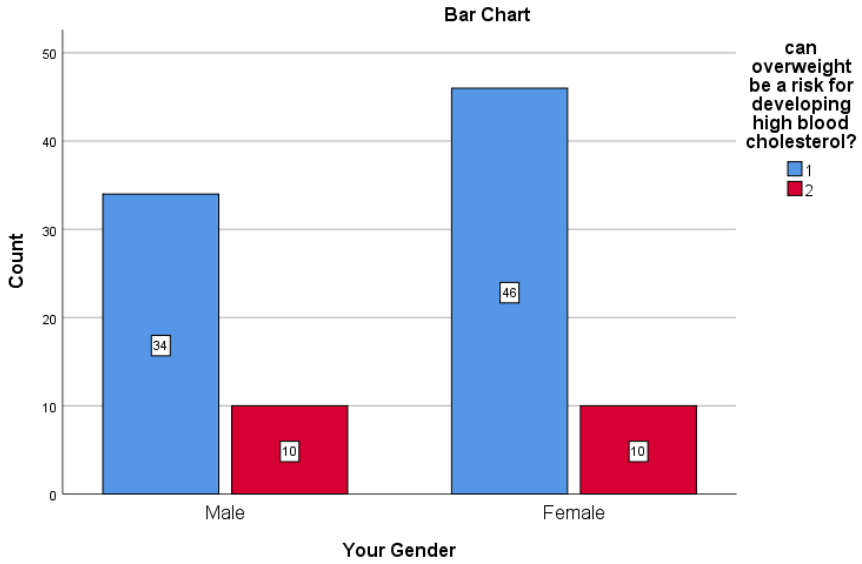

Figure 26: Bar graph showing correlation between gender and knowledge of overweight as a risk for high blood cholesterol; p value = 0.5; p>0.05 (statistically not significant). X axis - gender, Y axis - number of participants.

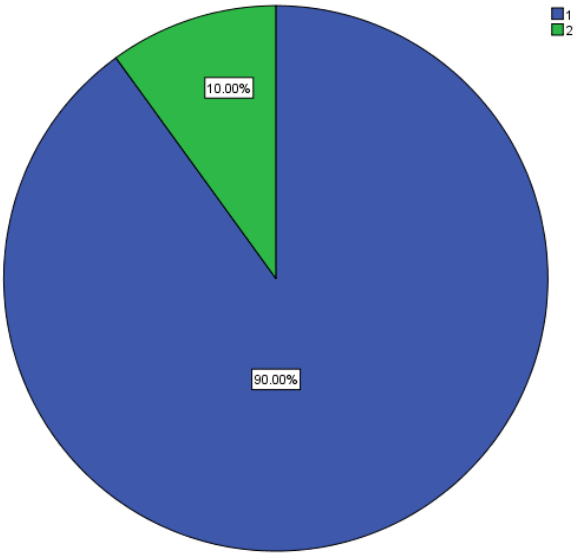

Figure 27: Shows the frequency distribution of the effect of physical activity on heart disease. 90% thought that physical activity reduced heart disease (blue) and the rest 10% did not consider (green).

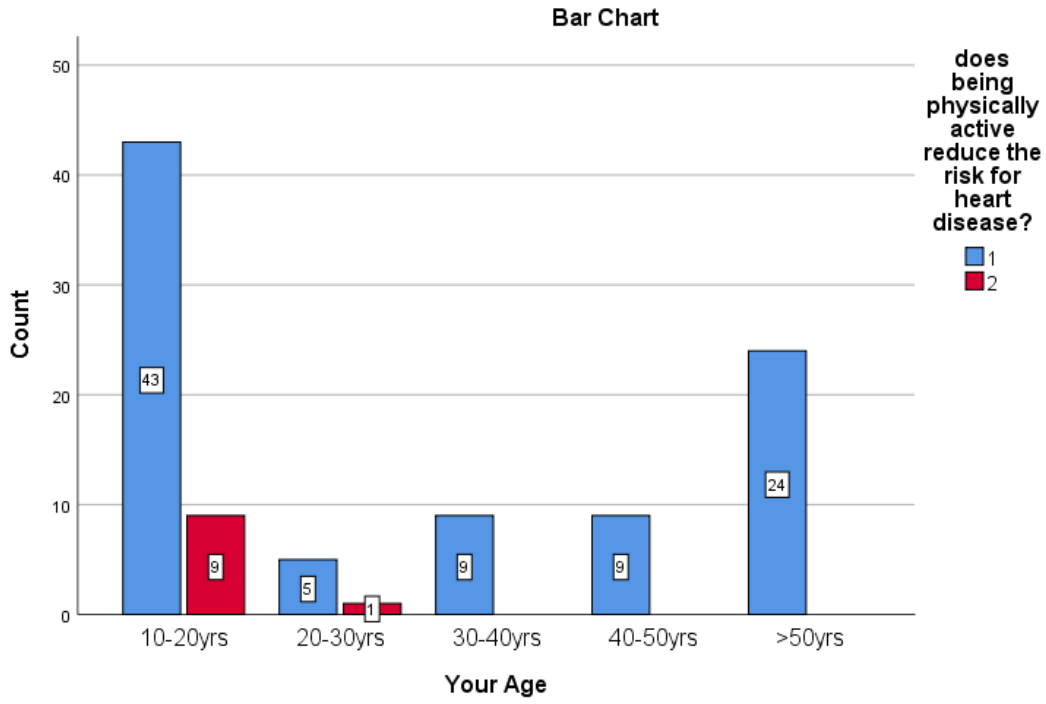

Figure 28: Bar graph showing correlation between age and effect of physical activity on heart disease; p value = 0.09; $p<0.05$ (statistically significant). X axis - shows different age groups, Y axis - number of participants.

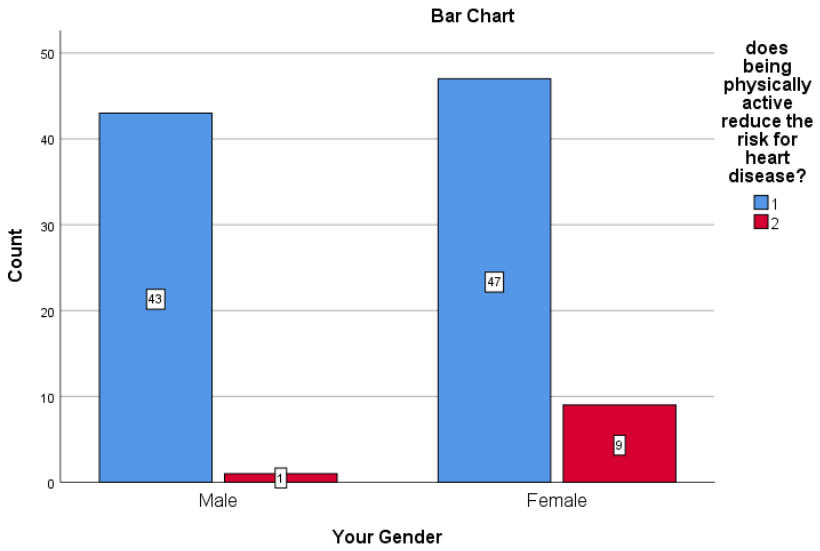

Figure 29: Bar graph showing correlation between gender and effect of physical activity on heart disease; p value = 0.02;p>0.05 (statistically not significant). X axis - gender, Y axis - number of participants.

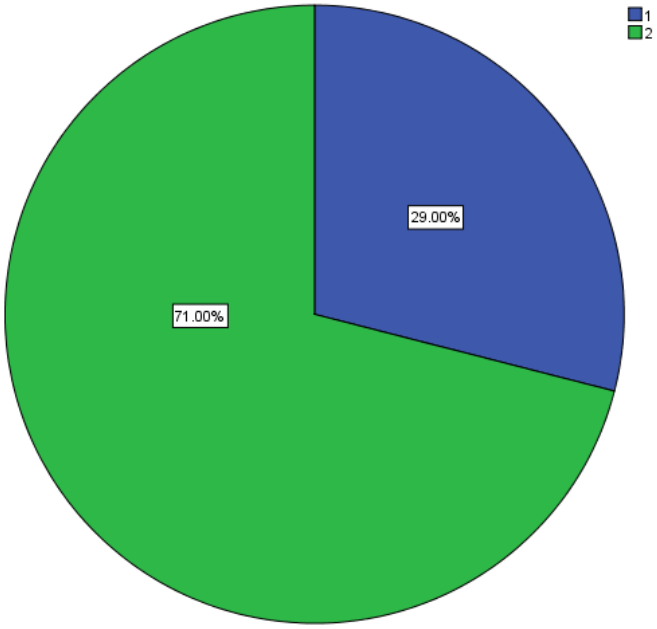

Figure 30: Shows the frequency distribution of the effect of healthy diet on the participants. 71% said that all people need to follow a healthy diet and represented in green whereas the remaining 29% said that people with high blood cholesterol alone need to follow a healthy diet and represented in blue.

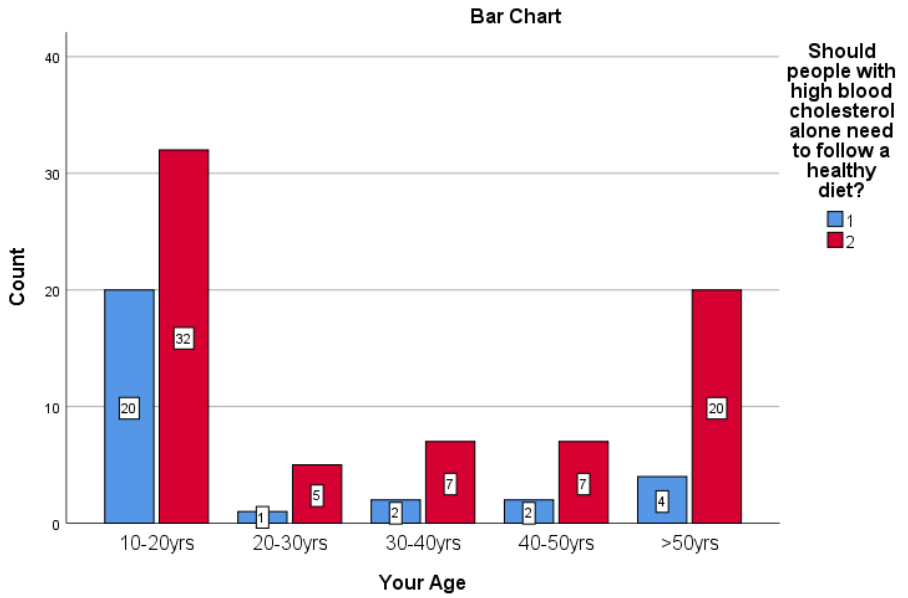

Figure 31: Bar graph showing correlation between age and effect of healthy diet; p value = 0.3; p>0.05 (statistically not significant). X axis - shows different age groups, Y axis - number of participants.

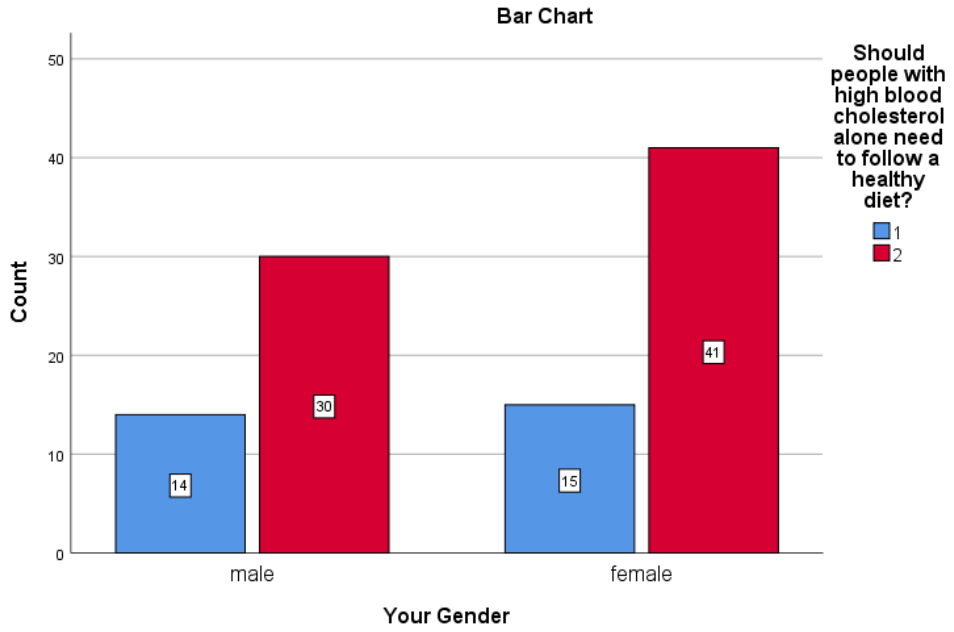

Figure 32: Bar graph showing correlation between gender and effect of healthy diet; p value = 0.5; p>0.05 (statistically not significant). X axis - gender, Y axis - number of participants.

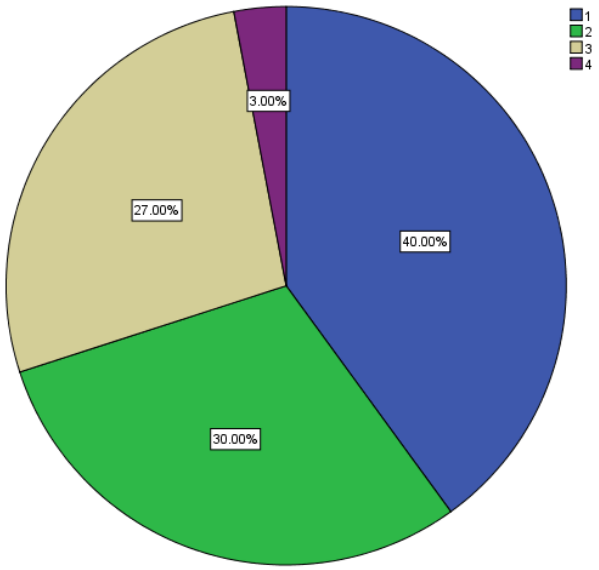

Figure 33: Shows the frequency distribution of duration of physical activity. 40% of the participants do physical activity everyday (blue), 30% do it mostly (green), 27% do it rarely and (grey) and the rest 3% do not do (purple).

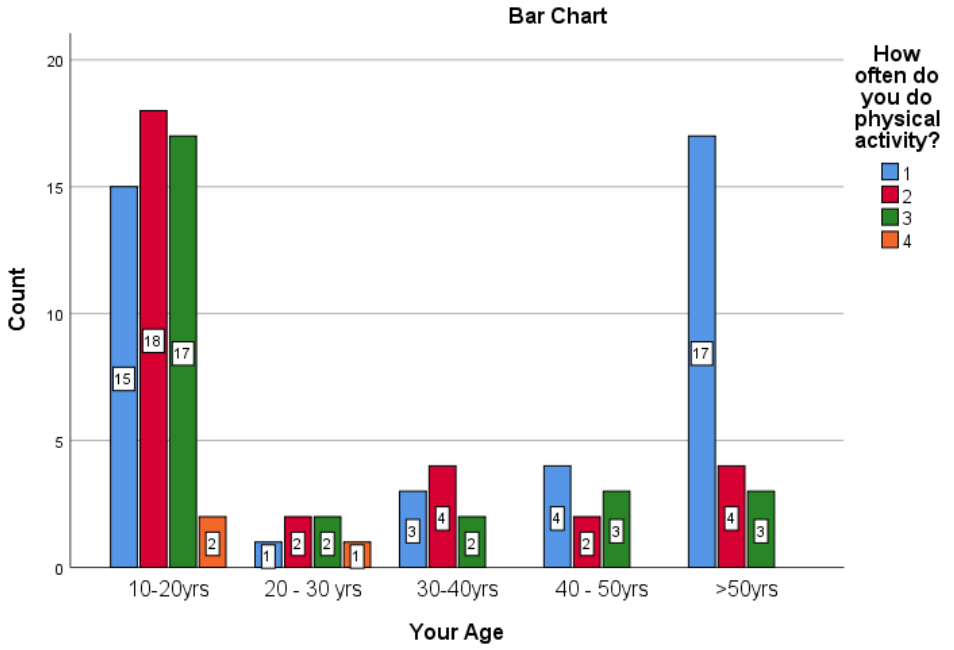

Figure 34: Bar graph showing correlation between age and duration of physical activity; p value = 0.09; $p<0.05$ (statistically significant). X axis - shows different age group, Y axis - number of participants.

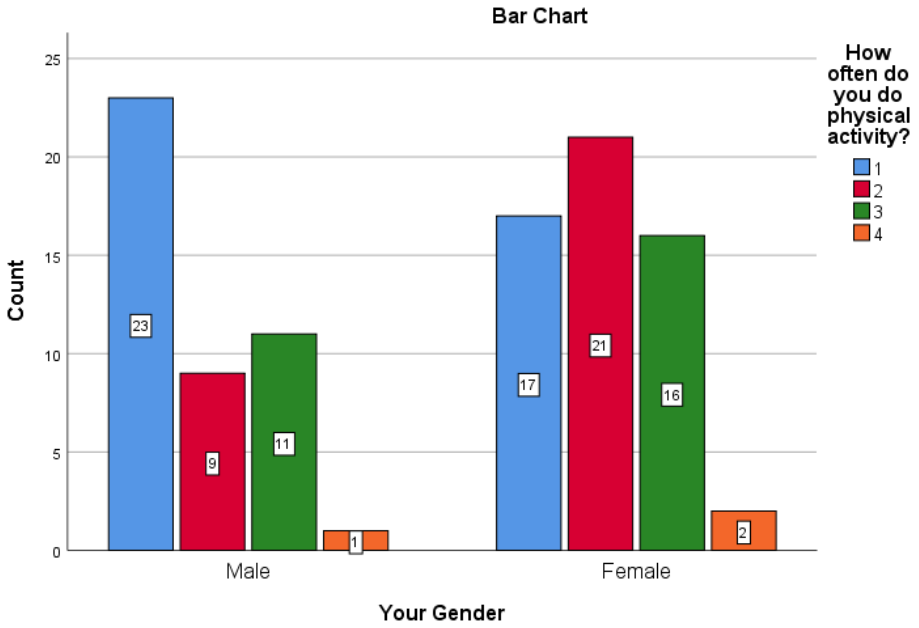

Figure 35: Bar graph showing correlation between gender and duration of physical activity; p value = 0.1; p>0.05 (statistically not significant), X axis - gender, Y axis - number of participants.

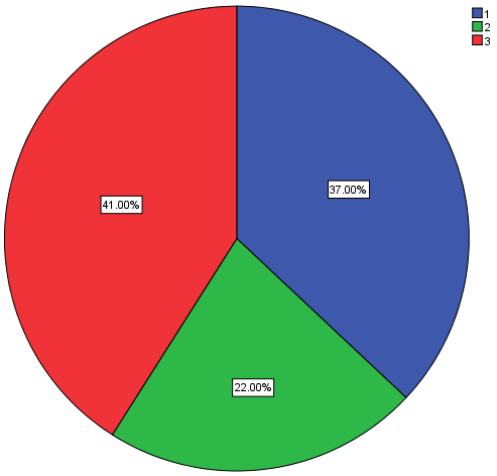

Figure 36: Shows the frequency distribution of BMI of participants. 37% has BMI less than 25 and represented in blue, 41% has BMI more than 25 and represented in red, 22% has BMI equal to 25 and represented in green.

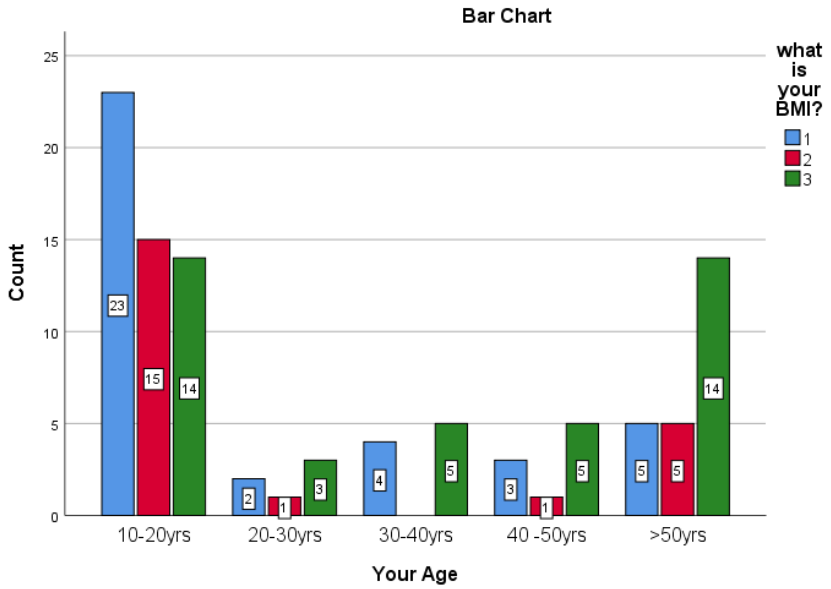

Figure 37: Bar graph showing correlation between age and BMI; p value = 0.1; p>0.05 (statistically not significant). X axis - shows different age group, Y axis - number of participants.

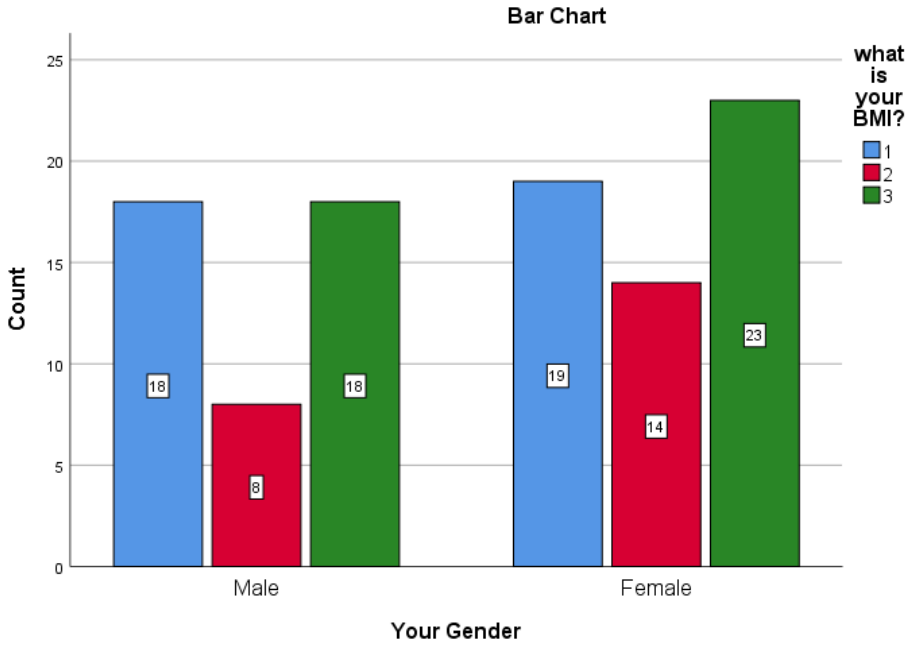

Figure 38: Bar graph showing correlation between gender and BMI; p value = 0.6; p>0.05 (statistically not significant). X axis - gender, Y axis - number of participants.

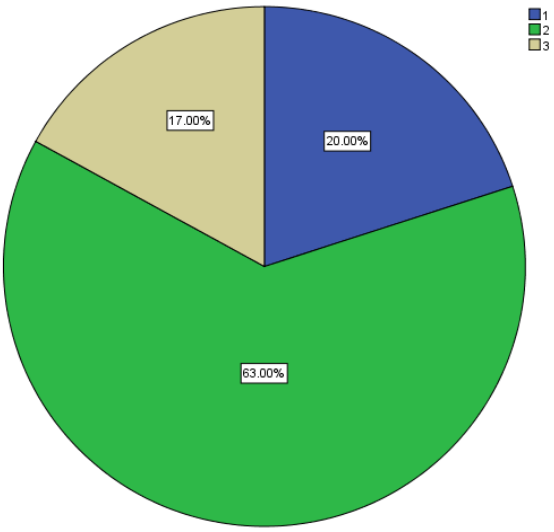

Figure 39: Shows the frequency distribution of nature of the lifestyle of participants. 63% considered their lifestyle to be stressful (green), 20% found it very stressful (blue) and 17% were free from stress (grey).

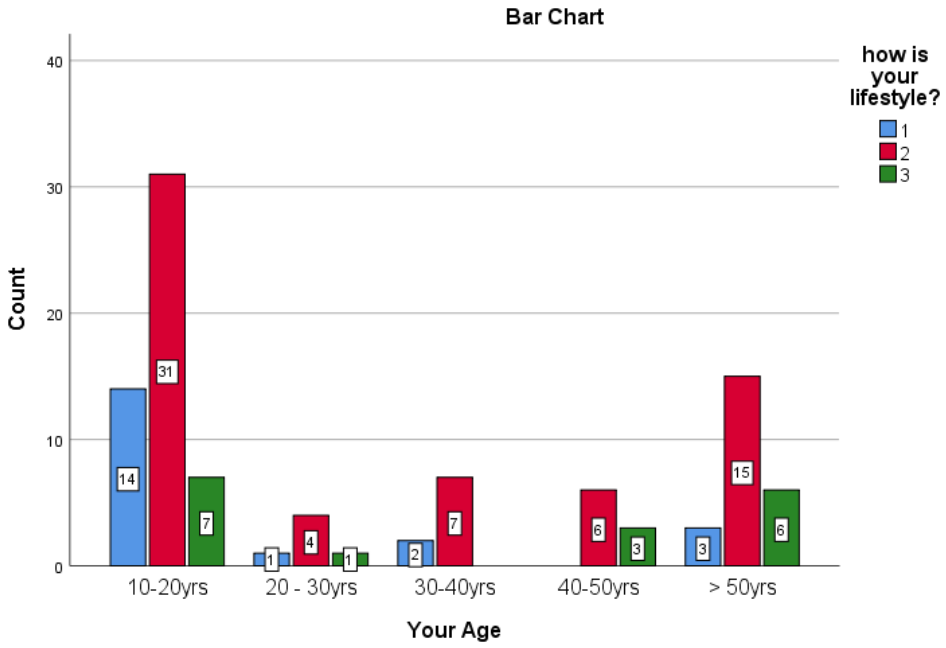

Figure 40: Bar graph showing correlation between age and nature of lifestyle; p value = 0.3; p>0.05 (statistically not significant). X axis - shows different age groups, Y axis - number of participants.

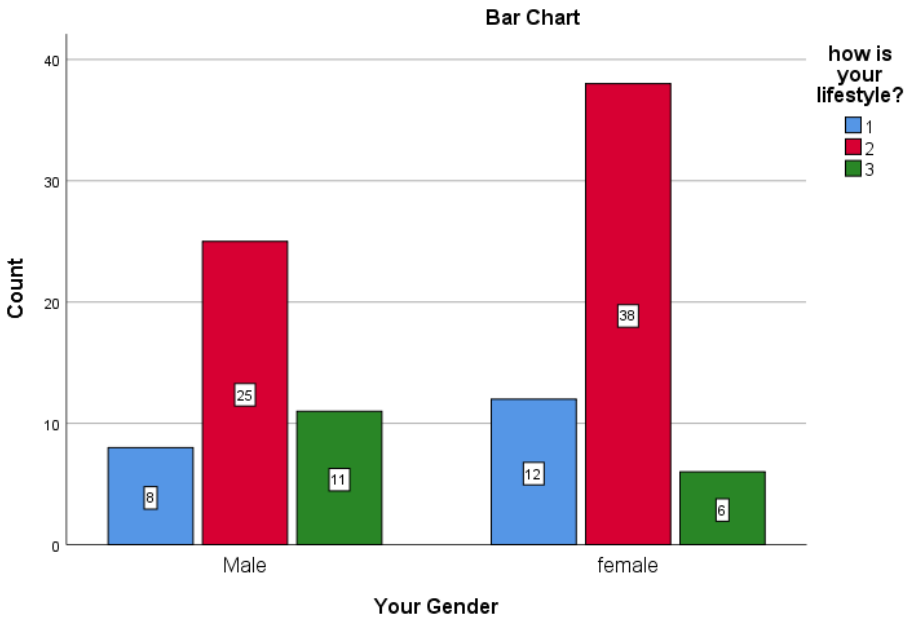

Figure 41: Bar graph showing correlation between gender and nature of lifestyle; p value = 0.1; p>0.05 (statistically not significant). X axis - gender, Y axis - number of participants.

It was found that 54% of the people considered BP of 140/90 to be high which according to a study is found to be similar as hypertension is defined as high blood pressure if systolic pressure was >140mmHg and diastolic pressure was >90mmHg (Figure 21) [(F. Azizi, 2004);(Menon and Thenmozhi, 2016)]. Participants of the age between 10-20 years (29%) and more than 50 years (14%) considered BP of 140/90 to be high but no statistical significance was found between age and knowledge on high blood pressure as the chi square value showed p = 0.04; p> 0.05 (Figure 22). Females (29%) had more knowledge of hypertension than males (25%), but no statistical significance was found between gender and knowledge on high blood pressure as the chi square value showed p = 0.5; p> 0.05 (Figure 23).

The survey study showed that 80% considered overweight to be a risk factor which according to a study is similar as presence of low amount of HDL and high amount of LDL leads to thickening of walls of arteries causing blood cholesterol thereby leading to increase in CVD (Figure 24) [(Burke *et al.*, 2008);(Menon and Thenmozhi, 2016; Pratha, AshwathaPratha and Thenmozhi, 2016)]. Participants of the age between 10-20 years (40%) considered overweight to be a risk factor for high blood cholesterol but no statistical significance was found between age and knowledge on overweight as a risk factor for high blood cholesterol as the chi square value showed p=0.8; p>0.05 (Figure 25). The data showed that females considered overweight to be a risk factor for high blood cholesterol than males (34%) but no statistical significance was found between gender and knowledge on overweight as a risk factor for high blood cholesterol as the chi square value showed p=0.5; p> 0.05 (Figure 26).

From the data it was found that 90% of the people considered physical activity reduced heart disease which was similar to a study were 90% of the respondents also thought that doing physical exercise might lower heart disease (Figure 27) [(Chinju George And G Andhuvan, 2014);(Keerthana and Thenmozhi, 2016)]. Participants of the age 10 - 20 years (43%) considered that being physically active reduces the risk of cardiovascular disease and shows a statistical significance between age and awareness of physical activity on heart disease as the chi square value showed $p=0.09$; $p<0.05$ (Figure 28). The data showed that females (47%) had greater awareness of physical activity on heart disease than males (43%) but no statistical significance found between gender and awareness of physical activity on heart disease as the chi square value showed $p=0.02$; $p>0.05$ (Figure 29). 71% considered that all people need to follow a healthy diet whereas the remaining 29% considered that people with high blood cholesterol alone need to follow a healthy diet (Figure 30). Participants of age 10-20 years (32%) and more than 50 years (20%) considered all people need to follow a healthy diet but no statistical significance found between age and awareness of physical activity on heart disease as the chi square value showed $p=0.3$; $p>0.05$ (Figure 31). The data showed that females (41%) considered all people need to follow a healthy diet when compared to males (30%) but no statistical significance found between gender and awareness of physical activity on heart disease as the chi square value showed $p=0.5$; $p>0.05$ (Figure 32).

The survey study showed that 40% of people do physical activity everyday, 30% do mostly, 27% do rarely and 3% does not do any physical activity (Figure 33). But it contradicted a study where 51% of the people do it 0-2 times a week, only 8% do it more than 5 times a week while the rest 25% do it 3 - 5 times a week [(Eisenmann*et al.*, 2007);(Thejeswar and Thenmozhi, 2015)]. Participants of the age 10-20 years (18%) do physical activity mostly and more than 50 years (17%) do physical activity everyday and show a statistical significance between age and duration of physical activity (Figure 34). Among the participants, males (23%) do physical activity everyday while females (21%) do physical activity only, and there was no statistical significance found between gender and duration of physical activity as the chi square value showed $p=0.1$; $p>0.05$ (Figure 35). The data showed that 39% showed BMI less than 25; 39% showed BMI equal to 25 and 22% had BMI equal to 25 (Figure 36) which was similar to a study where 29% had BMI within 18.5 to 24.9 BMI category [(Wilson *et al.*, 2002);(Samuel and Thenmozhi, 2015);(Hafeez and Thenmozhi, 2016);(Choudhari and Thenmozhi, 2016)]. Participants of the age 10 - 20 years (23%) had their BMI less than 25 and more than 50 years (14%) had their BMI equal to 25 but no statistical significance found between age and BMI as the chi square value showed $p=0.1$; $p>0.05$ (Figure 37). The data showed that females (23%) had BMI equal to 25 when compared to males (18%) but no statistical significance found between gender and BMI as the chi square value showed $p=0.6$; $p>0.05$ (Figure 38).

From the survey study it was found that 63% of participants considered their lifestyle to be stressful, 20% considered to be very stressful and 17% considered to be free from stress (Figure 39). Participants of the age 10-20

years (31%) considered their life to be very stressful but no statistical significance found between age and their level of stress as the chi square value showed p=0.6; p>0.05 (Figure 40). The data showed that females (38%) considered their lifestyle to be more stressful than males (25%), but no statistical significance found between gender and their level of stress as the chi square value showed p=0.1; p>0.05 (Figure 41).

Limitations

Limited sampling size and different aspects and levels of occupation and level of age taken.

Future Scope

The way of living among people has elevated considerably and hence awareness needs to be created to prevent CVD disease.

CONCLUSION

Obesity is a chronic metabolic disorder associated with cardiovascular disease and increased mortality and morbidity. The observations from the present study suggests that a strong association is found between obesity and cardiovascular diseases. Hence, it provides information to understand the problem, thereby creating awareness and discovering new methods to control cardiovascular diseases and help people lead a healthy lifestyle.

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CONFLICT OF INTEREST

The authors declare that there was no conflict of interest.

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