

PREVALENCE OF OBESITY AND HYPERTENSION AMONG HEART FAILURE SUBJECTS IN COIMBATORE POPULATION

Anjana Jayesh¹, Mythili Gunasekaran², Pradeepa Mani³ & Sivakumar Chinnusamy⁴

¹BPT Student, PPG College of Physiotherapy Affiliated to the Tamil Nadu Dr M.G.R Medical University, Chennai

²Associate Professor, PPG College of Physiotherapy Affiliated to the Tamil Nadu Dr M.G.R Medical University, Chennai

³Vice Principal, PPG College of Physiotherapy Affiliated to the Tamil Nadu Dr M.G.R Medical University, Chennai

⁴Principal, PPG College of Physiotherapy Affiliated to the Tamil Nadu Dr M.G.R Medical University, Chennai

ABSTRACT

Background: Heart failure is characterized by the heart's inability to pump an adequate supply of blood to the heart. Without sufficient blood flow, all major body functions are disturbed. Heart failure is an important cause of morbidity and mortality.

Objectives: The study's primary objective was to find out the prevalence of obesity and hypertension among heart failure subjects by using BMI and sphygmomanometer.

Subjects and Methods: A survey study was used. A total of 213 heart failure subjects are selected according to the inclusion criteria. 200 subjects are included in the study with their cooperation. Out of which 122 subjects have obesity, 58 subjects have hypertension and 20 subjects have both obesity and hypertension. The participants age ranged between 35-50 years. Each subject was evaluated by anthropometric measures such as weight, height to calculate body mass index to determine obesity. Blood pressure was measured by using sphygmomanometer and Rose angina questionnaire were used to detect chest pain. The questionnaire method adopted was non-invasive and inexpensive. Duration of this study was 6 months. Obtained data were analyzed.

Result: A total of 200 subjects are included in this study, 65 females (60.5%) and 135 males (39.5%). Out of 200 heart failure subject 122 subjects were selected due to obesity, 58 subjects were selected due to hypertension and 20 subjects were selected due to both obesity and hypertension. Each subject was evaluated by anthropometric measures such as weight, height to calculate body mass index to determine obesity. Blood pressure is measured by using sphygmomanometer and Rose angina questionnaire is used to detect chest pain. 56 males and 66 females are detected obesity. the females have a higher prevalence of obesity compared to the males. The total number of heart failure subject with obesity is 122. Hypertension is detected in 49 males and 9 females. The males have a higher prevalence of hypertension compared to the females. The total number of heart failure subject with hypertension is 58. Several 15 males and 5 females have detected both obesity and hypertension so the males have a higher prevalence compared to the females. The total number of heart failure subject who have both obesity and hypertension is 20.

According to this study, the prevalence of heart failure due to obesity is 61%, hypertension 29% and both obesity and hypertension is 10%. It shows the study prevalence of subject with heart failure due to obesity is more compared to subjects with heart failure due to hypertension and both hypertension and obesity.

Conclusion: Obesity and hypertension are not only the risk factors of heart failure but these increases the risk of heart failure. Obesity shows more prevalence compared to other risk factors of heart failure.

KEYWORDS: Heart Failure, Obesity, Body Mass Index, Hypertension, Sphygmomanometer, Rose Angina Questionnaire

Article History

Received: 16 Jun 2024 | Revised: 16 Jun 2024 | Accepted: 25 Jun 2024

INTRODUCTION

Heart failure is the chronic condition of heart in which heart doesn't pump blood as well as it should. It can occur if the heart cannot pump or fill adequately. Certain heart conditions such as narrowed arteries in the heart (coronary artery disease) or high blood pressure (due to atherosclerosis), gradually leave the heart too weak or stiff to fill and pump blood properly. It is a collection of symptoms that weaken or stiffen the heart. Heart failure can affect the right or left side of the heart or both at the same time. There are mainly four type of heart failure.

The burden of heart failure in India appears high and estimates of prevalence range from 1.3 to 4.6 million, with an annual incidence of 491 600- 1.8 million. Heart failure is a global pandemic affecting at least 26 million people worldwide and is increasing in prevalence. Almost 1.4 million persons with congestive heart failure are under 60 years of age. Congestive heart failure is present in 2% of persons age 40 to 59. More than 5% of persons age 60 to 69 have congestive heart failure. Congestive heart failure annual incidence approaches 10 per 1000 populations after 65 years of age. Heart failure happens at any age. It happens both men and women, men often develop it at younger age than women. The chance of developing heart failure increasing after the age of 65. Men have a higher incidence of heart failure, but the overall prevalence rate is similar in both sexes. Since women survive longer after the onset of heart failure. The prevalence of systolic heart failure and diastolic heart failure was 5.5% and 36% respectively. According to the data from European society of cardiology registry, right sided heart failure only accounts for 2.2% of heart failure hospital admission. Left side heart failure is more common than right side heart failure. The European society of cardiology registry reports about 20% of cases of right ventricular failure being secondary to left sided heart failure.

Pathophysiologically, the heart may not provide tissues with adequate blood for metabolic needs, and cardiac-related elevation of pulmonary or systemic venous pressures which may result in organ congestion. This condition can result from abnormalities of systolic or diastolic function or both. Although a primary abnormality can be a change in cardiomyocyte function, there are also changes in collagen turnover of the extracellular matrix. Cardiac structural defects (congenital defects, valvular disorders), rhythm abnormalities (high heart rate), and high metabolic demands (due to thyrotoxicosis) also can cause heart failure. Mental confusion is also a symptom of heart failure and it is caused by reduced blood flow to the brain or a build-up of sodium in the blood. It is usually associated with a build-up of fatty deposits inside the arteries and increased risk of blood clot. It can also be associated with damaged to arteries in organs such as brain, heart, kidneys and eyes.

The common symptoms for heart failure include shortness of breath of activity or lying down, fatigue and weakness, swelling in the lower limb, rapid or irregular heartbeat, reduced ability to exercise, persistent cough or wheezing with white or pink blood-tinged mucus, swelling of the belly area, very rapid weight gain from fluid buildup, nausea and

lack of appetite, difficulty concentrating or decreased alertness and chest pain if heart failure is caused by a heart attack. Chest pain, fainting, panting or wheezing are the warning signs of heart failure. Chest pain: The increased pressure and strain on your heart can cause chest pain. Fainting: During heart failure, you're unable to pump enough oxygen-rich blood to your brain, which may cause fainting. Panting or wheezing: If your lungs are congested with fluid, it may become challenging to take a deep breath. Age, gender, diabetes, family history, obesity, medication will also be the reason of heart failure. The tests to diagnose heart failure include blood test (signs of disease that can affect heart failure), chest X-ray, Electrocardiogram (record electrical signals of heart), Echocardiogram (shows size and structure of heart and valves), stress test (measure the health of the heart), cardiac computerized tomography, magnetic resonance imaging, coronary angiogram and myocardial biopsy (to diagnose certain type of heart muscle diseases). Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health. More than 1 billion people worldwide are obese—650 million adults, 340 million adolescents and 39 million children. A body mass index (BMI) over 25 is considered overweight, and over 30 is obese. Obese individuals tend to have greater amounts of blood, which makes the heart pump harder and can lead to heart failure over time. Body mass index is commonly used for assessing underweight, overweight and obesity in adults. Body mass index is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults.

Hypertension is one of the main risk factors of heart failure. Overall prevalence for hypertension in India was 29.8%. Hypertension is also known as high blood pressure. Blood pressure is the force exerted by circulating blood against the walls of the body's arteries, the major blood vessels in the body. High blood pressure forces the heart to work harder to pump blood to the rest of the body. This causes the lower left heart chamber (left ventricle) to thicken. A thickened left ventricle increases the risk of heart attack, heart failure and sudden cardiac death.

Hypertension is measured by using a sphygmomanometer. A sphygmomanometer is an instrument used to measure blood pressure which is also known as a blood pressure meter or blood pressure gauge or blood pressure monitor. The word sphygmomanometer is derived from the Greek word 'sphygmos' meaning beating of the heart or the pulse and manometer means the device used for measuring the pressure or tension. It consists of an inflatable rubber cuff which is applied to the arm and connected to a column of mercury next to a graduated scale, enabling the determination of systolic and diastolic blood pressure by increasing and gradually releasing the pressure in the cuff.

The Rose Angina Questionnaire (RAQ) was developed in 1962 to detect ischemic heart pain (angina pectoris and myocardial infarction) for epidemiological field-surveys. The Rose Angina Questionnaire has been used in many countries to detect coronary heart disease (CHD) in epidemiological research. The Rose Angina Questionnaire, also called as London School of Hygiene Cardiovascular Questionnaire. This questionnaire is either orally or in writing.

METHODOLOGY

Study Design: The study was a survey study.

Methods: A total of 213 heart failure subjects were selected according to the inclusion criteria. 200 subjects were included in the study with their cooperation. Out of which 122 subjects have obesity, 58 subjects have hypertension and 20 subjects have both obesity and hypertension. The participants' age ranged between 35-50 years. Each subject was evaluated by anthropometric measures such as weight, height to calculate body mass index to determine obesity. Blood pressure was

measured by using sphygmomanometer and Rose angina questionnaire were used to detect chest pain. The questionnaire method adopted was non-invasive and inexpensive. Duration of this study was 6 months. Obtained data were analyzed.

RESULT

A total of 200 subjects were enrolled for this study, out of which 122 subjects have obesity, 58 subjects have hypertension and 20 subjects have both obesity and hypertension. The participants age ranged between 35-50 years. Each subject was evaluated by anthropometric measures such as weight, height to calculate body mass index to determine obesity. Blood pressure is measured by using sphygmomanometer and Rose angina questionnaire is used to detect chest pain. The questionnaire method adopted was non-invasive and inexpensive. Duration of this study was 6 months. Obtained data was analyzed.

56 males and 66 females are detected obesity. the females have a higher prevalence of obesity compared to the males. The total number of heart failure subject with obesity is 122. Hypertension is detected in 49 males and 9 females. The males have a higher prevalence of hypertension compared to the females. The total number of heart failure subject with hypertension is 58. Several 15 males and 5 females have detected both obesity and hypertension so the males have a higher prevalence compared to the females. The total number of heart failure subject who have both obesity and hypertension is 20.

According to this study, the prevalence of obesity among heart failure is 61%, hypertension 29% and both obesity and hypertension is 10%. It shows the study prevalence of obesity among heart failure subjects is more compared to subjects with heart failure due to hypertension and both hypertension and obesity.

Table 1: Demographic Data

S. No.	Age	Male	Female
1.	35-40 Years	42	27
2.	41-45 Years	45	34
3.	46-50 Years	34	18
Total		121	79

Table shows the subject distribution according to age and gender. 42 male subjects and 27 female subjects between the age group of 35 to 40; 45 male subjects and 34 female subjects between the age group of 41 to 45; and 34 male subjects and 18 female subjects between the age group of 46 to 50 years of age. And the total number of males is 121 and females is 79.

Table 2: Obesity

S. No	Age	Male	Female
1.	35-40 Years	24	24
2.	41-45 Years	18	30
3.	46-50 Years	14	12
Total		56	66

Table shows the distribution of subjects with obesity according to age and gender. 24 male subjects and 24 female subjects between the age group of 35 to 40; 18 male subjects and 30 female subjects between the age group of 40 to 45; and 14 male subjects and 12 female subjects between the age group of 46 to 50 years of age. And the total number of males is 56 and females is 66. the females have a higher prevalence of obesity compared to the males. The total number of heart failure subject with obesity is 122.

Table 3: Hypertension

S. No.	Age	Male	Female
1.	35-40 Years	12	2
2.	41-45 Years	20	2
3.	46-50 Years	17	5
Total		49	9

Table shows the distribution of subjects with hypertension according to age and gender. 12 male subjects and 2 female subjects between the age group of 35 to 40; 20 male subjects and 2 female subjects between the age group of 40 to 45; and 17 male subjects and 5 male subjects between the age group of 46 to 50 years of age. And the total number of males is 49 and females is 9. the males have a higher prevalence of hypertension compared to the females. The total number of heart failure subject with hypertension is 58.

Table 4: Both Obesity and Hypertension

S. No.	Age	Male	Female
1.	35-40 Years	6	1
2.	41-45 Years	7	2
3.	46-50 Years	3	1
Total		16	4

Table shows the distribution of subjects with both obesity and hypertension according to age and gender. 6 male subjects and 1 female subjects between the age group of 35 to 40; 7 male subjects and 2 female subjects between the age group of 40 to 45; and 15 male subjects and 1 male subjects between the age group of 46 to 50 years of age. And the total number of males is 15 and females is 5. the males have a higher prevalence compared to the females. The total number of heart failure subject with both obesity and hypertension is 20.4.

DISCUSSION

Heart failure is a chronic condition in which the heart doesn't pump blood as well as it should. It can occur if the heart cannot pump or fill adequately. The patient may have trouble in breathing, swollen legs, neck veins that stick out, and sound from fluid buildup in the lungs. Obesity and hypertension are some of the risk factors of heart failure.

Natl Med J India, et al, 2014 conducted the study on heart failure: epidemiology and prevention in India. They conservatively estimate the prevalence of heart failure in India due to coronary heart disease, hypertension, obesity, diabetes and rheumatic heart disease to range from 1.3 to 4.6 million, with an annual incidence of 491 600–1.8 million. The population of India is ageing due to recent successes against communicable diseases such as the number of people greater than 60 years old will increases from 62 million in1996 to 113 million in 2016. The lifetime risk for heart failure increase with the aging populations and the prevalence of heart failure is also increases. According to this study the burden of heart failure in India appears high, and estimates of prevalence range from 1.3 million to 4.6 million, with an annual incidence of 491 600 – 1.8 million.

Emer Joyce, et al, 2016 This study evaluated the prevalence, profile, and prognosis of severe obesity in a large contemporary acute heart failure population. They will take 795 participants with body mass index measured at time of admission and complete follow-up were identified from enrolment in 3 contemporary acute heart failure trials (DOSE [Diuretic Strategies Optimization Evaluation], CARRESS-HF [Cardiorenal Rescue Study in Acute Decompensated Heart Failure], and ROSE [Renal Optimization Strategies Evaluation in Acute Heart Failure]). Patients were divided into 4 BMI categories according to standard World Health Organization criteria, as follows:128 patient with normal weight: 18.5 to 25

kg/m²; 209 patient with overweight: 25 to 29.9; 301 patient with mild-to-moderate obese: 30 to 39.9 kg/m²; and 157 patient is severely obese: ≥ 40 kg/m². The relationship between BMI and 60-day composite outcome was investigated. Patients with severe obesity (19.7%) were younger and hypertensive.

Raghupathy Anchala, et al, 2014 conducted the study to evaluate the prevalence of hypertension. Overall prevalence for hypertension in India was 29.8%. Significant differences in hypertension prevalence were noted between rural and urban parts. Regional estimates for the prevalence of hypertension were as follows: 14.5%, 31.7%, 18.1%, and 21.1% for rural north, east, west, and south India; and 28.8%, 34.5%, 35.8%, and 31.8% for urban north, east, west, and south India, respectively. Overall estimates for the prevalence of awareness, treatment, and control of blood pressure were 25.3%, 25.1%, and 10.7% for rural Indians; and 42.0%, 37.6%, and 20.2% for urban Indians. About 33% urban and 25% rural Indians are hypertensive.

Rajeev Ahirwar, et al, 2018 conducted the study reported that globally, more than 1.9 billion adults are overweight and 650 million are obese. Approximately 2.8 million deaths are reported as a result of being overweight or obese. Due to the consumption of energy dense food, sedentary life style, lack of health care services and financial support, the developing countries are facing high risk of obesity and their adverse consequences. In India, more than 135 million individuals were affected by obesity. The prevalence of obesity in India varies due to age, gender, geographical environment, socio-economic status, etc. According to ICMR-INDIAB study 2015, prevalence rate of obesity and central obesity varies from 11.8% to 31.3% and 16.9%-36.3% respectively. In India, abdominal obesity is one of the major risk factors for cardiovascular disease. Various studies have shown that the prevalence of obesity among women were significantly higher as compared to men. Obesity is one of the main medical and financial burdens for the government. This problem of obesity can be preventable by spreading public awareness about obesity and its health consequences. Governmental agencies should promote the benefits of healthy life style, food habits and physical activity. The aim of this article is to report the prevalence of different regions of India and highlight the problem areas in obesity.

All the above studied discussed that the prevalence of hypertension and obesity among heart failure subjects.

This study done to evaluate the prevalence of obesity and hypertension among heart failure subjects in Coimbatore population. A total of 200 subjects are included in this study, 65 females (60.5%) and 135 males (39.5%).

Out of 200 heart failure subject 122 subjects were selected due to obesity, 58 subjects were selected due to hypertension and 20 subjects were selected due to both obesity and hypertension. The participants age ranged between 35-50 years. 42 male subjects and 27 female subjects were selected between the age group of 35 to 40; 45 male subjects and 34 female subjects were selected between the age group of 41 to 45; and 34 male subjects and 18 male subjects were selected between the age group of 46 to 50 years of age.

Each subject was evaluated by anthropometric measures such as weight, height to calculate body mass index to determine obesity. Height is measured by using a stadiometer and weight is measured by using a weight machine. Then the collected data of each person is applied to the formula to detect the BMI of each one. 24 male subjects and 24 female subjects detected obesity between the age group of 35 to 40; 18 male subjects and 30 female subjects were detected between the age group of 40 to 45; and 14 male subjects and 12 male subjects are between the age group of 46 to 50 years of age. And the total number of males is 56 and females is 66. the females have a higher prevalence of obesity compared to the males. The total number of heart failure subject with obesity is 122.

Blood pressure is measured by using sphygmomanometer, the patient must be in a comfortable position connecting the cuff tubing to the sphygmomanometer tubing, and securing it. Rest the patient's arm on a surface that is level with their arm. And then the stethoscope was placed over the brachial artery that is in the bend of the elbow. Pump up the cuff slowly and listens for when the pulse disappears in each patient. 12 male subjects and 2 female subjects detected hypertension between the age group of 35 to 40; 20 male subjects and 2 female subjects are between the age group of 40 to 45; and 17 male subjects and 5 male subjects were detected between the age group of 46 to 50 years of age. And the total number of males is 49 and females is 9. the males have a higher prevalence of hypertension compared to the females. The total number of heart failure subject with hypertension is 58.

6 male subjects and 1 female subject were detected with both obesity and hypertension between the age group of 35 to 40; 7 male subjects and 2 female subjects are between the age group of 40 to 45; and 15 male subjects and 1 male subject is between the age group of 46 to 50 years of age. And the total number of males is 15 and females is 5. the males have a higher prevalence compared to the females. The total number of heart failure subject who have both obesity and hypertension is 20.

Rose angina questionnaire is used to detect chest pain. The questionnaire method adopted was non-invasive and inexpensive. Duration of this study was 6 months. Obtained data were analyzed and their result have concluded the prevalence of subject with heart failure due to obesity is more compared to subjects with heart failure due to hypertension and coronary artery disease. According to this study, the prevalence of obesity among heart failure is 61%, hypertension 29% and coronary artery disease is 10%. So, in Coimbatore obesity among heart failure subjects are higher compared to hypertension and subjects with obesity and hypertension.

LIMITTATION

- The study focused only on obesity and hypertension and no other risk factors of heart failure.
- The study was done with a small group of people compared to the total population of Coimbatore district.
- The study was limited to particular age group.

Further directions of this study

- The study can be done using even other survey methods.
- Data about prevalence and severity can be added on further studies.
- Further study can be done based on the risk factors.

CONCLUSION

Obesity and hypertension are not only the risk factors of heart failure but these increases the risk of heart failure. Obesity shows more prevalence compared to other risk factors of heart failure.

CONFLICTS OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING

Nothing to report

ACKNOWLEDGEMENT

First and foremost, I thank THE ALMIGHTY for showering me with his divine blessing, enriched love and matchless grace, which gave me the inner strength and guidance that carried me throughout my study. I'm, deeply indebted to each of my parents, for their unconditional love, sincere prayers, unstinted support and care without which I would not have accomplished anything. I express my sincere gratefulness to Chairman Dr. L. P. THANGAVELU, M.S., F.R.C.S., and Correspondent Mrs. SHANTHI THANGAVELU, M.A., P.P.G group of institutions, Coimbatore, for their encouragement and providing the source for the success of this study. With due respect, my most sincere thanks to the Principal Dr. C. SIVA KUMAR M.P.T PhD who gave me his precious time and with his vast experience, he helped me to complete this dissertation successfully. I wish to express my deep sense of indebtedness and heartfelt thanks to the Vice principal PROFESSOR M. PRADEEPA M.P.T (PhD) for assisting my valuable ideas and guiding me through the course of my word. I express my special thanks to my Guide Ms MYTHILI G MPT ASSISTANT PROFESSOR for offering me perceptive inputs and guiding me to work and without her tireless guidance, support and constant encouragement this project would not have come through. My heartfelt thanks to all the PHYSIOTHERAPY FACULTY members for their guidance and encouragement for my study. I am privileged to express my thanks to my dearest friends for their marvelous support, help and motivation and encouragement throughout the whole study.

AUTHORS CONTRIBUTIONS

Ms. ANJANA KJ conducted this study and collected data, and reviewed the final manuscript draft **Ms. MYTHILI G** has carried out of the data curation and prepared the original draft

REFERENCE

1. Moore K. *Heart Failure: Symptoms, Causes, and Types* [Internet]. Healthline. 2012. Available from: <https://www.healthline.com/health/heart-failure>
2. Groenewegen A, Rutten FH, Mosterd A, Hoes AW. *Epidemiology of heart failure*. *European Journal of Heart Failure*. 2020 Jun;22(8):1342–56.
3. Huffman MD, Prabhakaran D. *Heart failure: epidemiology and prevention in India*. *The National Medical Journal of India* [Internet]. 2010;23(5):283–8. Available from: <https://pubmed.ncbi.nlm.nih.gov/21250584/>
4. Mary Anne Dunkin. *What You Should Know: Myocarditis* [Internet]. WebMD. WebMD; 2009. Available from: <https://www.webmd.com/heart-disease/myocarditis>
5. Bright RA, Lima FV, Avila C, Butler J, Stergiopoulos K. *Maternal Heart Failure*. *Journal of the American Heart Association*. 2021 Jul 20;10(14).
6. Piano MR. *Alcohol's Effects on the Cardiovascular System*. *Alcohol research: current reviews* [Internet]. 2017;38(2):219–41. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5513687/>
7. Tomasoni D, Adamo M, Metra M. *August 2020 at a glance: focus on neurohormonal antagonists and electrolytes*. *European Journal of Heart Failure*. 2020 Aug 1;22(8):1289–90.

8. Fruh SM. Obesity: Risk factors, complications, and strategies for sustainable long-term weight management. *Journal of the American Association of Nurse Practitioners*. 2017;29(1): S3–14.
9. T R Y. A Study On The Association Of Coronary Artery Disease And Smoking By A Questionnaire Method A Study On The Association Of Coronary Artery Disease And Smoking By A Questionnaire Method [Internet]. 2011. Available from: https://www.jcdr.net/articles/pdf/1281/1641_9_4_11_nitr.pdf
10. Savarese G, Becher PM, Lund LH, Seferovic P, Rosano GMC, Coats AJS. Global burden of heart failure: a comprehensive and updated review of epidemiology. *Cardiovascular Research*. 2022 Feb 12;118(17).
11. Simkova SS, Dvorackova O, Velemínsky M. Assessment of healthy lifestyles in relation to BMI. *Neuro Endocrinology Letters* [Internet]. 2022 Dec 31 [cited 2023 Nov10];43(7-8):393–9. Available from: <https://pubmed.ncbi.nlm.nih.gov/36720128/>
12. Joarder AI, Arzu J, Khaled FI, Chowdhury MT, Kabir FI, Mandal MM, et al. Assessment of Risk Factors of Heart Failure: A Case Control Study. *Mymensingh medical journal: MMJ* [Internet]. 2020 Oct 1 [cited 2023 Nov 10];29(4):945–50. Available from: <https://pubmed.ncbi.nlm.nih.gov/33116100/>
13. Chopra V, Mittal S, Bansal M, Singh B, Trehan N. Clinical profile and one-year survival of patients with heart failure with reduced ejection fraction: The largest report from India. *Indian Heart Journal*. 2019 May 1;71(3):242–8.
14. Meijers WC, de Boer RA. Common risk factors for heart failure and cancer. *Cardiovascular Research*. 2019 Feb 4;115(5):844–53.
15. Ahirwar R, Mondal PR. Prevalence of obesity in India: A systematic review. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*. 2019 Jan;13(1):318–21.
16. Reilly JJ. Obesity in childhood and adolescence: evidence based clinical and public health perspectives. *Postgraduate Medical Journal* [Internet]. 2018 Jul 1;82(969):429–37. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2563774/>
17. Chaturvedi V, Prarakh N, Seth S. Heart failure in India: the INDUS. *journal of the practice of Cardiovascular science* 2(1):28. 2016;
18. Joyce E, Lala A, Stevens SR, Cooper LB, AbouEzzeddine OF, Groarke JD, et al. Prevalence, Profile, and Prognosis of Severe Obesity in Contemporary Hospitalized Heart Failure Trial Populations. *JACC: Heart Failure* [Internet]. 2016 Dec 1 [cited 2020Oct20];4(12):923–31. Available from: <https://heartfailure.onlinejacc.org/content/4/12/923.abstract>
19. Harikrishnan S, Sanjay G, Anees T, Viswanathan S, Vijayaraghavan G, Bahuleyan CG, et al. Clinical presentation, management, in-hospital and 90-day outcomes of heart failure patients in Trivandrum, Kerala, India: the Trivandrum Heart Failure Registry. *European Journal of Heart Failure*. 2015 May 23;17(8):794–800.
20. Anchala R, Kannuri NK, Pant H, Khan H, Franco OH, Di Angelantonio E, et al. Hypertension in India. *Journal of Hypertension* [Internet]. 2014 Jun;32(6):1170–7. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4011565/>

21. Huffman M, Prabhakaran D. Heart failure: Epidemiology and prevention in India. *The National medical journal of India [Internet]*. 2014;23(5):283–8. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3913650/>
22. Huffman MD, Prabhakaran D. Heart failure: epidemiology and prevention in India. *The National Medical Journal of India [Internet]*. 2010;23(5):283–8. Available from: <https://pubmed.ncbi.nlm.nih.gov/21250584/>
23. Lavie CJ, Alpert MA, Arena R, Mehra MR, Milani RV, Ventura HO. Impact of Obesity and the Obesity Paradox on Prevalence and Prognosis in Heart Failure. *JACC: Heart Failure*. 2013 Apr;1(2):93–102.
24. Mohan Poudel, Bhandari R, Malla G, Baral D, Samyog Uprety, Chaudhary RN, et al. Rose Angina Questionnaire: Validation in emergency department to detect myocardial infarction in a tertiary hospital of eastern Nepal. *Hong Kong Journal of Emergency Medicine*. 2019 Mar 26