Association of Body Mass Index and Central Adiposity Indices with Ischemic Heart Disease in Tertiary Care Hospitals in Rawalpindi

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ABSTRACT

Objective: To ascertain the association of body mass index and abdominal adiposity with ischemic heart disease in different age groups and gender, and to assess which of the two factors have a stronger association with ischemic heart disease.

Study Design: Analytical cross-sectional study.

Place and Duration of Study: PEMH and Combined Military Hospital, Rawalpindi Pakistan, from Oct to Dec 2020.

Methodology. A sample size of 200 using Raosoft sample size calculator was taken with 85% response distribution and non – probability purposive sampling was done. All the measurements were recorded according to the guidelines by WHO.

Results: About 82(49.3%) male and 23(67.6%) of the female patients were observed to have increased body mass index. Increased waist circumference was observed in 128(77.1%) male and 33(97%) female patients. Only 5(3.01%) male and 1 female patient (2.94%) had both normal BMI and waist circumference whereas, 50(30%) male and 9(26.4%) female patients showed normal BMI but abnormal waist circumference. For waist circumference, waist hip ratio, waist height ratio and body adiposity index (males), independent sample t-test was applied; *p*-value <0.001 which infers that these measurements in ischemic heart disease patients differ significantly from general healthy population.

Conclusion: Our study showed significant association of body mass index and central adiposity indices with ischemic heart disease. More importantly, measures of abdominal adiposity were significantly associated with ischemic heart disease as majority of the patients showed abnormal central adiposity indices despite having a normal BMI.

Keywords: Body Mass Index, Central Adiposity Indices, Ischemic Heart Disease.

INTRODUCTION

Ischemic heart disease is a pathophysiological syndrome caused by imbalance in the myocardial perfusion and the demand. Globally in 2016, out of 56.9 million deaths, 9.4 million were due to ischemic heart disease i.e. 16.52%.[1]

Obesity is one of the leading causes of heart related ailments in particular and other morbidities in general. It is a condition of abnormal deposition of fat that proves detrimental to health. In 2014, WHO estimated that the overweight fraction amassed about 2 billion of the total adult population, out of which 600 million were obese.[2] Increased fat deposition around the abdomen can lead to metabolic syndrome that aggravates the chances of developing ischemic heart disease (IHD) and hence shortens the life span.[3] In a follow-up study with 3606 patients of metabolic syndrome, out of total 360 deaths (10%), 209 subjects (5.8%) died from cardiovascular diseases.[4]

Body mass index is a statistical measure of body fat estimated as weight in kilograms divided by square of height in meters. According to the CDC, "Factors such as age, sex, ethnicity, and muscle mass can influence the relationship between BMI and body fat.[5] In an evaluation carried out in Newcastle to determine the risk factors of coronary heart disease between South Asian and European group of people, waist-hip ratio of ≥0.95 was more common in the former, with central obesity prevailing in Pakistanis and Indians, as compared to Bangladeshis.[6] High existence of chronic heart disease (CHD) in South Asians was positively associated with the central obesity in this group.[7] Many researches proved abdominal obesity to be the most important risk factor for developing myocardial infarction in both genders.[8] A case control study also established the causal association of waist hip ratio (WHR) with the increased incidence of ischemic heart disease.[9]

Very little information is otherwise available on population's distributions of anthropometric measures of obesity and patterns of fat distribution in Pakistan.

In literature review, it was ascertained that WHR maintained an independent association to the total chances of IHD. It was also showed that all three measures of abdominal adiposity were better predictors in men as compared to women.[10]

BMI and visceral adiposity markers are cost-effective yet reliable markers of ischemic heart disease but the difference in these two factors in predicting the risk for ischemic heart disease is still unclear and less investigated. A study showed that WHR is independently related to total cholesterol and thus risk for IHD in both men and women.[11] Another study stated that association of abdominal adiposity with IHD varies with age, gender and ethnicity.[12]

Mostly studies were carried out by taking into account body mass index only of patients and general population, but in this study, we estimated other adiposity indexes also besides BMI to ascertain their significance also; to ascertain the association of body mass index and abdominal adiposity with ischemic heart disease in different age groups and gender, and to assess which of the two factors have a stronger association with ischemic heart disease.

METHODOLOGY

It was an analytical cross-sectional study conducted from October'2020 till December'2020 at tertiary care hospitals i.e. Military and Combined Military Hospital of Rawalpindi, with institutional ethical review approval number ERC/ID/48.

Inclusion Criteria: Patients diagnosed with ischemic heart disease of either gender with age ranging from 19 to 70 years and who gave consent, presenting in Outpatient Departments were included in the study.

Exclusion Criteria: Pregnant females, patient with known diabetes mellitus and those who did not give consent were excluded from the study.

1st 200 subjects were included through non-probability convenience sampling. Sample size was taken from a similar study conducted by Mostafa Q. Alshamiri et al.[13] Two hundred adult cardiac patients who visited outpatient cardiology departments make up the study sample. Because only two centers were included and the inclusion and exclusion criteria were strictly adhered to, the study population was small. Keeping it as the foundation, 200 people were chosen for the sample. Participants had to have ischemic heart disease and be cardiac patients who were at least 18 years old in order to meet the inclusion criteria. This criterion was established because the patients had

aberrant central adiposity, a sign indicating a higher risk of heart disease.

Self-devised closed ended questionnaire was used and all the parameters including height, weight, waist circumference and hip circumference were measured according to WHO guidelines; using a flexible, non-stretchable plastic tape measure at two sites for every patient for waist circumference: 1. At the horizontal plane on the superior border of the iliac crest (WC-NIH); and 2. At the horizontal plane midway between the lowest rib and the iliac crest (WC-WHO); then measure the distance around the largest part of hips — the widest part of buttocks for hip circumference; for height made sure legs were straight, arms were at sides, and shoulders were level and participant was looking straight ahead and that the line of sight was parallel with the floor and took the measurement while the child or teen stands with head, shoulders, buttocks, and heels touching the flat surface; and weight is measured by weight machine after asking the participant standing flat on their feet and weight should be evenly distributed on feet, with shoulders relaxed, legs straight, and arms at sides.

Data was entered and analyzed using Statistical Package for the social sciences (SPSS) version 25:00. Values of demographics and body mass index, waist-to-hip ratio, waist-to-height ratio and body adiposity index were computed using frequency tables, pie charts and to determine association, independent sample t-test was applied. The *p*-value ≤0.05 was considered as significant.

RESULTS

Out of the 200 patients, 166(83%) were male and 34(17%) were female. 115(57.5%) participants in the study were of age group 51–60 years.

Female patients exhibited a higher mean BMI i.e. 28.4 kg/m² as compared to male patients (25.4 kg/m²). Gender statistics with different adiposity indexes were shown in Table-I to compare the variations between the two subsamples.

Table-II shows 58.4% (n=31) of IHD patients had increased BMI in age-group of 41-50 years while 52.17% (n=60) showed increased BMI in age-group of 51-60 years. This shows that IHD patients have invariably increased BMI irrespective of their age.

Relation between body mass index and individual central adiposity indices (AI) was demonstrated by grouping the subjects into categories of normal BMI and AI; normal BMI and abnormal AI;

abnormal BMI and normal AI and abnormal BMI and AI and calculating the frequencies for each category. To summarise, 30% (n=50) male and 26.4% (n=6) female patients had normal BMI and abnormal waist circumference; 6.02% (n=10) male and 29.4% (n=10) female patients had normal BMI and abnormal waist-to-height ratio. Whereas 41.56% (n=69) male and 5.8% (n=2) female subjects had normal BMI but abnormal waist-to-hip ratio and 31.92% (n=53) male and 5.8% (n=2) female subjects had normal BMI but abnormal body adiposity index.

Table-I: Central Adiposity Indices Distribution in Sample Population (n=200)

	Gender	n	Mean±SD
Waist circumference in cm	male	166	97.94±10.56
	female	34	101.12±15.38
Hip circumference	male	166	100.09±8.81
	female	34	105.85±14.18
WHR	male	166	.97±.057
	female	34	.65±.1
Waist to height ratio	male	166	.57±.065
	female	34	37.31±7.45
BAI	male	166	27.24±4.48
	female	34	2.11±1.12
Waist circumference range	male	166	.77±.42
	female	34	.97±.17
Waist to hip ratio	male	166	.91±.27
	female	34	.85±.35

Table-II: Age-Specific BMI in Sample Population (n=200)

Age Ranges (years)	Underweight <18.5 n(%)	Normal 18.5-24.9 n(%)	Overweight >25 n(%)
20-30	2(1%)	1(0.5%)	3(1.5%)
31-40	2(1%)	9(4.5%)	15(7.5%)
41-50	1(0.5%)	21(10.5%)	31(15.5%)
51-60	1(0.5%)	54(27%)	60(30%)

Table-III: Independent Sample t-test of Adiposity Indices in Participants

Parameters	Study groups		p-value
	Male (n=166)	Female (n=34)	
Waist circumference in cm	97.94+10.56	101.12+15.38	0.074
Hip circumference	100.09+8.81	105.85+14.18	0.02
WHR	0.97+0.05	0.65+0.1	0.00
Waist to height ratio	0.57+0.065	37.31+7.45	0.00
BAI	27.25+4.48	2.18+1.12	0.00
Waist circumference range	0.77+0.42	0.97+0.17	0.00
Waist to hip ratio	0.91+0.27	0.85+0.36	0.03

For hip circumference, waist-to-hip ratio, waist-to-height ratio, body adiposity index, waist circumference range and waist to hip ratio, p-value <0.05 which infers that these measurements in ischemic heart disease patients are significantly different from general population.

DISCUSSION

In our study, majority of the participants were in the age group of 51-60 years which is consistent with the fact that with aging, there is incremental acquisition of CVD risk factors and consequent increased incidence of ischemic heart disease. A study on profiles of patients with anterior wall myocardial infarction showed that the mean age of the patients involved was 52.2+10.7 years.[14]

According to WHO and United Nations statistics for 4 countries, UK, USA, Japan and France, mortality rate of IHD was higher in men as compared to women.[2] Our study comprised 83% (n=166) of male IHD patients whereas female IHD patients were 17% (n=34) of total study sample which showed that the incidence is evidently higher in males because estrogen is protective in women till the age of menopause. This is why the highest mortality due to ischemic heart disease in women globally, is reported in the age >80 years.[15]

Our study reported that 30% (n=60) of IHD patients were self-employed that included businessmen and shopkeepers who had a sedentary lifestyle with lack of exercise. A prospective study, over a period of 10 years, done for prediction of risk of IHD in healthy Pakistanis aged above 40 years, showed that cumulative IHD risk >30% over the course of study was significantly lower in farmers i.e. people having a physically challenging job.[16]

54.5% (n=109) of our total study sample showed increased body mass index which is supported by the worldwide studies proving that increased BMI increases the risk of ischemic heart disease. In a study conducted in India, prevalence of IHD increased with higher BMI (p<0.05). It was 25% among patients with BMI ≥30 and 6.8% among patients with BMI 18.5-23.5.[17] It has been shown that there is graded relation of BMI with ischemic heart disease with a 14 percent increased risk of incident ischemic heart disease per unit of increase in BMI.[18] On the contrary, BMI has also been proven to have variable effects according to the fitness levels of the individuals i.e. lean v/s fat body mass and therefore, does not provide accurate risk factor information regarding IHD.[19]

Majority of the males (77.1%) and females (97.1%) had deranged waist circumference in our study with a mean WC of 98.48+11.54 cm. In a study conducted in

Karachi, coronary artery disease was found to be most common in people with waist circumference of 91.87+9.9 cm[20] which was similar to the results of our study.

As depicted in our results, out of all central adiposity indices, waist-to-hip ratio is best correlated with ischemic heart disease which is supported by studies that prove abdominal obesity (as measured by WHR) was a strong independent predictor of IHD across the entire range of measures.[21]

Describing obesity on basis of waist-to-hip ratio instead of BMI increases the estimate of ischemic heart disease attributable to obesity in most ethnic groups.[22] Low BMI and a high WHR were significantly related to a higher mortality according to statistics by Mayo Clinic.[19] A study in Pakistan found the direct relation of waist to height ratio with hypertension, a comorbid of IHD.[23]

Similarly, 84(42%) of our subjects had a positive smoking history and study on heart disease epidemic in Pakistan, showed that odd's ratio for relation between CAD and tobacco use, in subjects of or over 40 years, was 2.12.[24] Similarly, 44.5% (n=89) of our subjects had hypertension. A study concluded that more than, 58.5% patients in their sample were suffering from hypertension.[25] Hence, hypertension proves to be an important sequelae in development of IHD.

CONCLUSION

Body mass index and abdominal adiposity, are positively associated with ischemic disease but IHD has a better relation with measures of central adiposity (waist-to-hip ratio, waist-to-height ratio, waist circumference, body adiposity index) than with BMI.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

TS & MUD: Data acquisition, data analysis, critical review, approval of the final version to be published.

AH & MN: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MZ & RN: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Nowbar AN, Gitto M, Howard JP, Francis DP, Al-Lamee R. Mortality from ischemic heart disease: Analysis of data from the World Health Organization and coronary artery disease risk factors From NCD Risk Factor Collaboration. Circ Cardiovasc Qual Outcomes 2019; 12(6): e005375. https://doi.org/10.1161/CIRCOUTCOMES.118.005375

2. Hansen L, Netterstrøm MK, Johansen NB, Rønn PF, Vistisen D, Husemoen LL, et al. Metabolically healthy obesity and ischemic heart disease: a 10-year follow-up of the Inter99 study. J. Clin. Endocrinol. Metab 2017; 102(6): 1934-1942. https://doi.org/10.1210/jc.2016-3346

3. Nimptsch K, Konigorski S, Pischon T. Diagnosis of obesity and use of obesity biomarkers in science and clinical medicine. Metab. Clin. Exp 2019; 92: 61-70. https://doi.org/10.1016/j.metabol.2018.12.006

4. Hess PL, Al-Khalidi HR, Friedman DJ, Mulder H, Kucharska-Newton A, Rosamond WR, Lopes RD, Gersh BJ, Mark DB, Curtis LH, Post WS. The metabolic syndrome and risk of sudden cardiac death: the atherosclerosis risk in communities study. J. Am. Heart Assoc 2017; 6(8): e006103. https://doi.org/10.1161/JAHA.117.006103

5. Markowitz, J.S. (2018). Body Mass Index (BMI). In: Mortality and Its Risk Factors Among Professional Athletes. SpringerBriefs in Public Health. Springer, Cham. https://doi.org/10.1007/978-3-319-77203-5_5

6. Kalra, A., Bhatt, D.L., Rajagopalan, S. et al. Overview of Coronary Heart Disease Risk Initiatives in South Asia. Curr Atheroscler Rep 19, 25 (2017). https://doi.org/10.1007/s11883-017-0662-1

7. Barroso TA, Marins LB, Alves R, Gonçalves AC, Barroso SG, Rocha GD. Association of central obesity with the incidence of cardiovascular diseases and risk factors. Int J Cardiovasc Sci 2017; 30: 416-424. https://doi.org/10.5935/2359-4802.20170073

8. Hamjane N, Benyahya F, Mechita MB, Nourouti NG, Barakat A. The complications of overweight and obesity according to obesity indicators (body mass index and waist circumference values) in a population of Tangier (northern Morocco): A cross-sectional study. Diabetes Metab. Syndr.: Clin. Res. Rev 2019; 13(4): 2619-2624. https://doi.org/10.1016/j.dsx.2019.07.033

9. Harwalkar VS, Kulkarni T. A study on relationship of body mass index (bmi) and waist-to-hip ratio (whr) to coronary artery disease risk factors in cases and controls. J. evol. med. dent. sci 2017; 6(78): 5519-5524.

10. Hajian-Tilaki K, Heidari B. Comparison of abdominal obesity measures in predicting of 10-year cardiovascular risk in an Iranian adult population using ACC/AHA risk model: A population based cross sectional study. Diabetes Metab. Syndr.: Clin. Res. Rev 2018; 12(6): 991-997. https://doi.org/10.1016/j.dsx.2018.06.012

11. Rost, S., Freuer, D., Peters, A. et al. New indexes of body fat distribution and sex-specific risk of total and cause-specific mortality: a prospective cohort study. BMC Public Health 18, 427 (2018). https://doi.org/10.1186/s12889-018-5350-8

12. Kouli GM, Panagiotakos DB, Kyrou I, Georgousopoulou EN, Chrysohoou C, Tsigos C, et al. Visceral adiposity index and 10-year cardiovascular disease incidence: the ATTICA study. Nutr Metab Cardiovasc Dis 2017; 27(10): 881-889. https://doi.org/10.1016/j.numecd.2017.06.015

13. Mostafa Q. Alshamiri, Faisal Mohd A Habbab, Saad Saeed AL-Qahtani, Khalil Abdullah Alghalayini, Omar Mohammed Al-Qattan, Fayez El-shaer. "Waist-to-Height Ratio (WHtR) in Predicting Coronary Artery Disease Compared to Body Mass Index and Waist Circumference in a Single Center from Saudi Arabia", Cardiol Res Pract vol 2020, Article ID 4250793, 2020.

14. Jafary MH, Samad A, Ishaq M, Jawaid SA, Ahmad M, Vohra EA. Profile of acute myocardial infarction (AMI) in Pakistan. Pak. J. Med. Sci 2007; 23(4): 485.

15. Moran AE, Forouzanfar MH, Roth GA, Mensah GA, Ezzati M, Murray CJ, et al. Temporal trends in ischemic heart disease mortality in 21 world regions, 1980 to 2010: the Global Burden of Disease 2010 study. Circulation 2014; 129(14): 1483-1492. https://doi.org/10.1161/CIRCULATIONAHA.113.004042

16. Khan MA, Ahmad M, Safdar S, Subhani A, Minhas MU, Sajjad S, et al. Social stratification predicts the risk of ischemic heart disease: A cross sectional study in Pakistani population above 40 years. 2013; 7(31): 2273-2278.

17. Mandal S, Saha JB, Mandal SC, Bhattacharya RN, Chakraborty M, Pal PP. Prevalence of ischemic heart disease among urban population of Siliguri, West Bengal. Indian J Community Med 2009; 34(1): 19.

18. Jee SH, Pastor-Barriuso R, Appel LJ, Suh I, Miller III ER, Guallar E. Body mass index and incident ischemic heart disease in South Korean men and women. Am. J. Epidemiol 2005; 162(1): 42-48.

19. Goel K, Thomas RJ, Squires RW, Coutinho T, Trejo-Gutierrez JF, Somers VK, et al. Combined effect of cardiorespiratory fitness and adiposity on mortality in patients with coronary artery disease. Am. Heart J 2011; 161(3): 590-597.

20. Qureshi SA, Rehman MM, Azmi MB, Hasnat S. Most Prevalent Diseases with Relation of Body Mass Index and Waist Circumference in Karachi, Pakistan. J Dow Univ Health Sci 2011; 5(3): 85-91.

21. Pais P, Pogue J, Gerstein H, Zachariah E, Savitha D, Jayprakash S, et al. Risk factors for acute myocardial infarction in Indians: a case-control study. The Lancet 1996; 348(9024): 358-363.

22. Yusuf S, Hawken S, Ounpuu S, Bautista L, Franzosi MG, Commerford P, et al. Obesity and the risk of myocardial infarction in 27,000 participants from 52 countries: a case-control study. The Lancet 2005; 366(9497): 1640-1649.

23. Khan A, Haq FU, Pervez MB, Saleheen D, Frossard PM, Ishaq M, et al. Anthropometric correlates of blood pressure in normotensive Pakistani subjects. Int. J. Cardiol 2008; 124(2): 259-262.

24. Jafar TH, Jafary FH, Jessani S, Chaturvedi N. Heart disease epidemic in Pakistan: women and men at equal risk. Am. Heart J 2005; 150(2): 221-226.

25. Sharif S, Anwar N, Farasat T, Naz S. ABO blood group frequency in ischemic heart disease patients in Pakistani population. Pak. J. Med. Sci 2014; 30(3): 593.

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