

CORRELATION OF WAIST-HIP RATIO WITH EXTENT OF CORONARY ARTERY DISEASE

SHAHID M¹, ALI L², RAMZAN M^{1*}, SHAHZAD A¹, KHALID R¹, HASHMI KA¹

¹Department of Cardiology, Ch. Pervaiz Elahi Institute of Cardiology (CPEIC), Multan, Pakistan

²Department of Cardiology, Nishtar Medical University and Hospital (NMU & H), Multan, Pakistan

*Corresponding author email address: drramzan123@yahoo.com

(Received, 10th October 2022, Revised 29th January 2023, Published 7th February 2023)

Abstract: *This study aimed to assess the association between the waist-hip ratio and the extent of coronary artery disease by coronary angiography. A cross-sectional study was conducted in the Department of Cardiology, CPE Institute of Cardiology, Multan, from 09-Oct-2020 to 08-Apr-2021. One hundred fifty patients with CAD planned for coronary angiography (CAG) were included. Data regarding the patient's age, gender, and detailed clinical histories, such as co-morbid conditions such as hypertension, family history of CAD, diabetes mellitus, smoking, and waist-hip ratio, were collected for each patient. All patients underwent coronary angiography. In each patient, a Gensini score was calculated, and the mean value of the Gensini score was noted. The mean age of patients included in this study was 52.48±7.48 years. The mean waist-hip ratio was 0.83±0.10. The mean Gensini score was 36.68±6.84. There were 100 (66.6%) male and 50 (33.3%) female patients. Diabetes was found in 55 (36.6%), and hypertension in 81 (54.00%). Out of 150, 65 (43.3%) patients were smokers. A family history of CAD was found in 36 (24%). There was a significant correlation between the waist-hip ratio and the Gensini score, with a correlation coefficient of 0.679 and p-value <0.0001. Based on the results, it can be concluded that the waist-hip ratio is associated with the risk of coronary artery diseases, especially coronary artery disease.*

Keywords: Waist-hip ratio, Gensini score, coronary artery disease

Introduction

Cardiovascular diseases are one of the leading causes of death globally, with a mortality rate of 30% worldwide (Sarrafzadegan and Mohammadi, 2019). Among these cardiovascular diseases, coronary artery disease comprises 45% of these deaths (Ralapanawa and Sivakanesan, 2021). Asian people, especially those of the Subcontinent, have the highest mortality rate caused by cardiovascular diseases, and this risk is likely to become twice over time (Misra et al., 2017). However, this risk is not limited to the region; South Asian immigrants in the eastern regions are at high risk of developing cardiovascular disorders than Native Eastern individuals (Cainzos-Achirica et al., 2019).

Obesity and diabetes are the most common risk factors for cardiovascular diseases (Powell-Wiley et al., 2021). Central obesity increases the risk of CVD more than general obesity. It leads

to adipose deposition, causing systemic inflammation and, in turn, increasing the risk of CVD. Waist and hip circumferences measure different body composition and fat distribution aspects and have independent and often opposite effects of CVD risk factors (Dhar et al., 2020). The risk of CVD morbidity and mortality is increased with a larger waist ratio. Hossain et al. (Hossain et al., 2017) reported that waist-hip circumference is a significant risk factor for coronary artery disease. A mean Gensini score of 26.20±13.96 was noted in CAD patients having a normal waist-hip ratio versus 57.55±28.8 in patients with a high waist-hip ratio. They found a significant correlation between the waist-hip ratio and the mean Gensini score (r=0.71, p=0.001). While a study by Salvatici et al. (Quininir Salvatici et al., 2017) reported a modest correlation between WHR and Gensini score (r=0.21, p=0.001).

Many studies have been conducted to evaluate the association between obesity and coronary artery disease with respect to body mass index, which is not a good predictor of visceral obesity. Limited data is available about studies conducted to investigate the relationship between waist-hip ratio and severity of CAD internationally and in Pakistan, where the prevalence of CAD is significant. This study aims to assess the association between the waist-hip ratio and the extent of coronary artery disease by coronary angiography.

Methodology

A cross-sectional study was conducted in the Department of Cardiology, CPE Institute of Cardiology, Multan, for six months, from 9th October 2020 to 8th April 2021. A total of 50 coronary artery disease patients aged 40-70 years scheduled for coronary angiography were included in the study. The sample size was calculated by Medcalc software by taking the expected correlation coefficient between waist-hip ratio and severity of CAD 0.71 and by taking the significance level (α) 0.05 and the power of the test ($1-\beta$) 0.90. Patients who had undergone CABG surgery or PCI were not included in the study. All the patients gave informed consent to participate in the study. The Ethical Board of the hospital approved the study design. Data regarding the patient's age, gender, and detailed clinical histories, such as comorbid conditions such as hypertension, family history of CAD, diabetes mellitus, smoking, and waist-hip ratio, were collected for each patient. After the angiography, the Gensini score was calculated accordingly. All the data were analyzed by SPSS version 23. Continuous variables like age and waist-hip ratio were represented by mean and standard deviation. Categorical variables were presented as percentage and frequency. Pearson's correlation was used to assess the association between the Gensini score and waist-hip ratio. Pearson's correlation was again calculated after the effect modifier stratification to assess the association between the hip-waist ratio and CAD. A p-value of ≤ 0.05 was regarded as significant.

Results

The mean age of patients included in this study was 52.48 ± 7.48 years. The minimum age was 40, and the maximum age was 70 years. The mean waist-hip ratio was 0.83 ± 0.10 . The minimum ratio was 0.54 years, and the maximum age was 0.99. The mean Gensini score was 36.68 ± 6.84 . The minimum score was 27, and the maximum score was 50 (Table I).

There were more males as compared to females. There were 33 (66.0%) male and 17 (34.0%) female patients (Figure I). On the frequency of diabetes mellitus, 18 (36.0%) patients were diagnosed with diabetes, and 32 (64.0%) were not diagnosed with diabetes (Figure II). Hypertension was found in 27 (54.00%), and it was not found in 23 (46.0%) patients (Figure III). 22 (44.0%) out of 50 patients were smokers (Figure IV). Family history of CAD was found in 12 (24.0%), and it was not found in 38 (76.00%) patients (Figure V). There was a significant correlation between the waist-hip ratio and the Gensini score, with a correlation coefficient of 0.679 and p-value < 0.0001 (Table II). Stratification of age was performed; in patients aged 40-50, the correlation coefficient between the waist-hip ratio and Gensini score was 0.58, with an insignificant p-value of 0.782. Similarly, in patients aged 51-70 years, the correlation coefficient was 0.71. This difference was also statistically insignificant, with a p-value of 0.079 (Table II).

Stratification of gender was also performed; in males, the correlation coefficient between the waist-hip ratio and Gensini score was 0.74, with an insignificant p-value of 0.617. Similarly, in female patients, the value of the correlation coefficient was 0.56. This difference was also

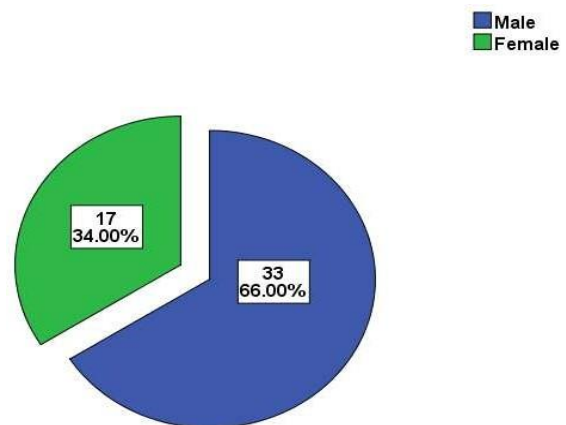


Figure 1 Distribution of gender.

statistically insignificant, with a p-value of 0.151. Stratification was also performed based on hypertension, smoking, diabetes, and a family history of CAD. No association was

found between these variables on the correlation between the waist-hip ratio and the Gensini score (Table III).

Table I: Descriptive statistics of age, Gensini score, and waist-hip ratio

Variable	Mean	Standard deviation	Minimum	Maximum
Age	52.48	7.48	40	70
Gensini score	36.68	6.84	27	50
Waist-hip ratio	0.83	0.10	0.54	0.99

Table II: Correlation of Waist-Hip Ratio and Gensini Score

Age Group	Waist-hipRatio	GensiniScore	Correlation Coefficient (r)	P-value	
40-50 Years	Mean	0.82	36.68	0.679	<0.001
	S.D.	0.10	6.84		

Table III: Stratification of age, gender, hypertension, smoking, diabetes, and family history to determine the effect on correlation of Waist-hip Ratio and Gensini Score, respectively

Variable	Waist-hip Ratio	Gensini Score	Correlation Co. (r)	P value	
Age					
40-50 Years	Mean	0.80	34.17	0.58	0.782
	S.D.	0.10	5.81		
51-70 Years	Mean	0.85	38.81	0.71	0.079
	S.D.	0.10	7.02		
Gender					
Male	Mean	0.83	37.54	0.74	0.617
	S.D.	0.10	7.04		
Female	Mean	0.82	35.00	0.56	0.151
	S.D.	0.10	6.59		
Hypertension					
Yes	Mean	0.82	36.37	0.70	0.434
	S.D.	0.10	6.79		
No	Mean	0.83	37.04	0.66	0.828
	S.D.	0.11	7.04		
Smoking					
Yes	Mean	0.81	36.91	0.74	0.058
	S.D.	0.12	6.77		
No	Mean	0.84	36.50	0.66	0.793
	S.D.	0.08	7.03		
Diabetes					
Yes	Mean	0.84	37.78	0.82	0.426
	S.D.	0.09	6.55		
No	Mean	0.82	36.06	0.62	0.933
	S.D.	0.11	7.02		
Family history of CAD					
Yes	Mean	0.87	40.50	0.74	0.270
	S.D.	0.08	6.46		
No	Mean	0.81	35.47	0.64	0.628
	S.D.	0.11	6.58		

[Citation: Shahid, M., Ali, L., Ramzan, M., Shahzad, A., Khalid, R., Hashmi, K.A. (2023). Correlation of waist-hip ratio with extent of coronary artery disease. *Biol. Clin. Sci. Res. J.*, 2023: 201. doi: <https://doi.org/10.54112/bcsrj.v2023i1.201>]

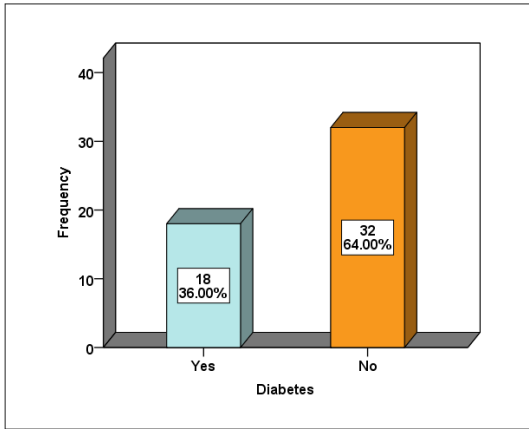


Figure II: Frequency of diabetes

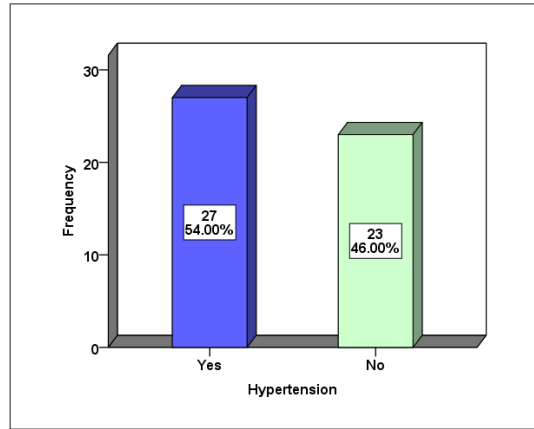


Figure III: Frequency of hypertension

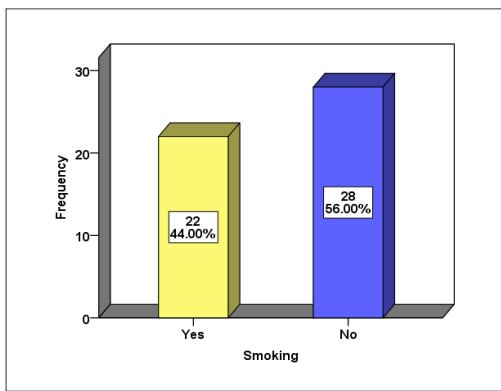


Figure IV: Frequency of smoking

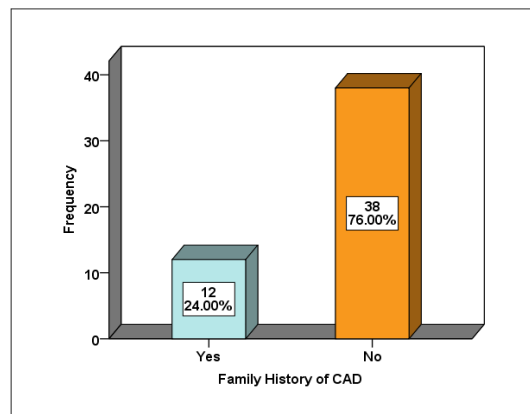


Figure V: Family history of CAD

Discussion

Cardiovascular diseases are a common cause of death in the South Asian region, especially Pakistan, with the older population, i.e., older than 60 years, mostly affected by it. Among these prevalent cases of CVD, half of the patients have coronary heart disease. Framingham Heart Study conducted on people aged 40 to 94 years old highlighted this risk of CHD in older populations (Lloyd-Jones et al., 1999). The subjects were not diagnosed with any coronary disease at the start of the study. The risk of CHD for people of 40 years was calculated as 49% in males and 32% in females. The risk factors of heart disease can be prevented throughout lifetime. A study reported nine risk factors for myocardial infarction, including dyslipidemia, obesity, alcohol addiction, hypertension, psychosocial factors, and smoking, that caused 90% of the disease cases (Li et al., 2022). Most CVD patients are

diagnosed with at least one of these risk factors besides age and sex.

Our study was conducted to evaluate the association between waist-hip ratio and coronary artery disease. BMI does not explain fat distribution, a significant risk factor for CAD. The waist-hip ratio is related to fat distribution and hence determines the severity of CAD and the development of diabetes (Baghbani-Oskouei and Gholampourdehaki, 2020; Rashiti et al., 2017). The International Diabetes Federation and AHA have recommended waist circumference thresholds determining diabetes and CVD (Alberti, 2009). A study by Cameron et al. on the Australian population for 5 years reported that a high waist circumference increased the risk of CVD in males only when BMI and several other variables were readjusted (Cameron et al., 2009). Another cohort study conducted on CVD-free men with a follow-up of 10 years

[Citation: Shahid, M., Ali, L., Ramzan, M., Shahzad, A., Khalid, R., Hashmi, K.A. (2023). Correlation of waist-hip ratio with extent of coronary artery disease. *Biol. Clin. Sci. Res. J.*, 2023: 201. doi: <https://doi.org/10.54112/bcsrj.v2023i1.201>]

revealed that waist-hip ratio, waist circumference, and BMI were directly correlated with risk of CVD with waist-hip ratio was important in predicting CAD; however, BMI did not have a predictive role (Dwivedi et al., 2020).

In our study, there was a significantly positive correlation between WHR and the severity of CAD, with a Pearson correlation value of 0.679 ($p < 0.0001$). Gill et al. also reported that the waist-hip ratio was the most important and superior variable for predicting risk factors and mortality of CVD (Gill et al., 2021). Most studies assessing the predictive value of waist-hip ratio and waist circumference demonstrated that WHR was a more important marker.

Our study has some limitations, including a small sample size and a short study period.

Conclusion

Waist-hip ratio is associated with the risk of coronary artery diseases, especially coronary artery disease.

Conflict of interest

The authors declared absence of conflict of interest.

References

Alberti, K. G. (2009). International diabetes federation task force on epidemiology and prevention; national heart, lung, and blood institute; American heart association; world heart federation; international atherosclerosis society; international association for the study of obesity: harmonizing the metabolic syndrome: a joint interim statement of the international diabetes federation task force on epidemiology and prevention; national heart, lung, and blood institute; American heart association; world heart federation; international atherosclerosis society; and international association for the study of obesity. *Circulation* **120**, 1640-1645.

Baghbani-Oskouei, A., and Gholampourdehaki, M. (2020). Anthropometric measures and the risk of coronary artery disease. *Caspian Journal of Internal Medicine* **11**, 183.

Cainzos-Achirica, M., Fedeli, U., Sattar, N., Agyemang, C., Jennum, A. K., McEvoy, J. W., Murphy, J. D., Brotons, C., Elosua, R., and Bilal, U. (2019). Epidemiology, risk factors, and opportunities for prevention of cardiovascular disease in individuals of South Asian ethnicity living in Europe. *Atherosclerosis* **286**, 105-113.

Cameron, A. J., Dunstan, D. W., Owen, N., Zimmet, P. Z., Barr, E. L., Tonkin, A. M., Magliano, D. J., Murray, S. G., Welborn, T. A., and Shaw, J. E. (2009). Health and mortality consequences of abdominal obesity: evidence from the AusDiab study. *Medical journal of Australia* **191**, 202-208.

Dhar, S., Das, P., Bhattacharjee, B., Awal, A., Ahsan, S., Shakil, S., Ahmed, S., Bashiruddin, A., Mahmud, I., and Al-Amin, M. (2020). Predictive Value of Waist Height Ratio, Waist Hip Ratio and Body Mass Index in Assessing Angiographic Severity of Coronary Artery Disease in Myocardial Infarction Patients. *Mymensingh Medical Journal: MMJ* **29**, 906-913.

Dwivedi, A. K., Dubey, P., Cistola, D. P., and Reddy, S. Y. (2020). Association between obesity and cardiovascular outcomes: updated evidence from meta-analysis studies. *Current cardiology reports* **22**, 1-19.

Gill, D., Zuber, V., Dawson, J., Pearson-Stuttard, J., Carter, A. R., Sanderson, E., Karhunen, V., Levin, M. G., Wootton, R. E., and Klarin, D. (2021). Risk factors mediating the effect of body mass index and waist-to-hip ratio on cardiovascular outcomes: Mendelian randomization analysis. *International Journal of Obesity* **45**, 1428-1438.

Hossain, M. A., Akanda, M. A. K., Ullah, M., Barai, L. C., Uddin, A. N., Huda, R. M., Hossain, M. A., Haque, M. M., Islam, A. K. M. R., and Siddiqui, M. K. R. (2017). Association of Waist-Hip Ratio with angiographic severity of coronary artery disease in patients with acute ST-segment elevation myocardial infarction. *Bangladesh Heart Journal* **32**, 70-76.

- Li, S., Liu, Z., Joseph, P., Hu, B., Yin, L., Tse, L. A., Rangarajan, S., Wang, C., Wang, Y., and Islam, S. (2022). Modifiable risk factors associated with cardiovascular disease and mortality in China: a PURE substudy. *European Heart Journal* **43**, 2852-2863.
- Lloyd-Jones, D. M., Larson, M. G., Beiser, A., and Levy, D. (1999). Lifetime risk of developing coronary heart disease. *The Lancet* **353**, 89-92.
- Misra, A., Tandon, N., Ebrahim, S., Sattar, N., Alam, D., Shrivastava, U., Narayan, K. V., and Jafar, T. H. (2017). Diabetes, cardiovascular disease, and chronic kidney disease in South Asia: current status and future directions. *bmj* **357**.
- Powell-Wiley, T. M., Poirier, P., Burke, L. E., Després, J.-P., Gordon-Larsen, P., Lavie, C. J., Lear, S. A., Ndumele, C. E., Neeland, I. J., and Sanders, P. (2021). Obesity and cardiovascular disease: a scientific statement from the American Heart Association. *Circulation* **143**, e984-e1010.
- Quininir Salvatici, L., Stockins, B., Lanas, F., Potthoff, M., Neira, V., and Miranda, R. (2017). P4407Waist-hip ratio but not body-mass index correlates with the prevalence and severity of coronary disease determined by Gensini score. *European Heart Journal* **38**.
- Ralapanawa, U., and Sivakanesan, R. (2021). Epidemiology and the magnitude of coronary artery disease and acute coronary syndrome: A narrative review. *Journal of Epidemiology and Global Health* **11**, 169.
- Rashiti, P., Behluli, I., and Bytyqi, A. R. (2017). Assessment of the correlation between severity of coronary artery disease and waist-hip ratio. *Open access Macedonian journal of medical sciences* **5**, 929.
- Sarrafadegan, N., and Mohammadi, N. (2019). Cardiovascular disease in Iran in the last 40 years: prevalence, mortality, morbidity, challenges and strategies for cardiovascular prevention. *Archives of Iranian medicine* **22**, 204-210.



Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. © The Author(s) 2023