Artikel Penelitian

CORRELATION BETWEEN WAIST-HIP RATIO AND WAIST CIRCUMFERENCE AS A PREDICTOR PARAMETER IN FRAMINGHAM RISK SCORE FOR HARD CORONARY HEART DISEASE AND KIDNEY FUNCTION (CARDIO-RENAL SYNDROME)

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Abstract

Cardio-renal syndrome reflects the intricate link between heart and kidney health, where the dysfunction of one organ worsens the other. In coronary heart disease, the Framingham Risk Score (FRS) is a key tool for estimating the 10-year risk of myocardial infarction (MI) or death. Abdominal obesity, often measured by waist-hip ratio (WHR), has emerged as an important cardiovascular risk factor, potentially enhancing existing predictive models. This study aimed to evaluate the correlation between FRS for Hard Coronary Heart Disease and kidney function (Cardio-Renal Syndrome) and to assess WHR as a predictive parameter for FRS. This study conduct a cross-sectional study among 52 employees of Yayasan Kalam Kudus, it analyzed the correlation between FRS ("10-year risk of MI or death" and "Average 10-year risk of MI or death"), kidney function decline, waist circumference, and WHR using Spearman's correlation. Significant correlations were found between "10-year risk of MI or death" and kidney function decline (r: -0.381; p: 0.005), waist circumference (r: 0.274; p: 0.050), and WHR (r: 0.333; p: 0.016). Similarly, "Average 10-year risk" correlated with kidney function decline (r: -0.376; p: 0.006) and WHR (r: 0.291; p: 0.036). The study highlights a meaningful link between FRS, kidney function, and abdominal obesity. These findings support the inclusion of WHR and waist circumference in coronary risk assessments, particularly for populations at risk of cardio-renal syndrome.

***Keywords**: Cardio-Renal Syndrome, Coronary Heart Disease, Framingham Risk Score, Kidney Function, Waist-Hip Ratio*

INTRODUCTION

Cardio-renal syndrome is an acute or chronic problem of the heart or kidney that could affect each other organ.. There are five subtypes of cardio-renal syndrome; sharp decline in cardiac function resulting acute decrease in renal function, chronic cardiac dysfunction resulting sustained reduction of renal function, sharp decline in renal function resulting acute reduction in cardiac function, chronic decline in kidney function resulting chronic cardiac dysfunction, and systemic disease that result in both cardiac and renal dysfunction (Kousa *et al*., 2023).

Framingham risk score (FRS) is one of some predictive tools for coronary heart disease that are valuable for estimating 10-year risk of myocardial infarction or even death. The FRS are including six risk factors such as; age, gender, high total cholesterol (TC), low high density lipoprotein cholesterol (HDL), smoking habits, and high systolic blood pressure (Jahangiry *et al*., 2017). In one study, FRS was found to be a predictor of developing chronic kidney disease, especially when combined with traditional kidney function markers such as serum creatinine (SCr) and cystatin C (CysC) (McMahon & Waikar, 2013).) another study suggest that there is a significant negative relationship between eGFR with FRS, showing that the higher the FRS score, the lower the GFR (Jin *et al*., 2014).

Coronary Heart Disease (CHD) and declining kidney function share several common risk factors, including obesity, smoking, high blood pressure, and diabetes (Kazancioğlu, 2013; Lanfer *et al*., 2014). Obesity, defined as excessive or abnormal fat accumulation that poses significant health risks, is commonly measured using the Body Mass Index (BMI), which classifies individuals with a BMI over 30 as obese. While BMI provides a general indicator of obesity, it does not measure fat distribution, which is crucial in determining central obesity (*Obesity*, 2024). Central obesity, or abdominal obesity, focuses on visceral fat accumulation around the abdomen and is a stronger predictor of metabolic and cardiovascular risks. It is measured using waist circumference, with values exceeding 90 cm for men and 80 cm for women (Ajiboye *et al*., 2019; Tarantino & Finelli, 2014). Waist-hip ratio (WHR) is another type of measurement by dividing the waist circumference to hip circumference. This measurement is associated with an increased risk of myocardial infarction (MI), stroke, and premature death, whereas these diseases are not associated with general obesity measurements such as BMI and waist circumference. The WHR with thresholds of more than 0.9 for men and 0.85 for women is considered obese (World Health Organisation (WHO), 2008). These measurements highlight the significant health risks associated with fat distribution, linking central obesity to increased risks of coronary heart disease and kidney function decline (Bray *et al*., 2018).

There hasn't been much research conducted to see if there is a relationship between Framingham Risk Score (FRS) and kidney function to waist-hip ratio and waist circumference. Therefore, this study aim to find out the potential and the correlation of waist-hip ratio and waist circumference as a predictive parameters for FRS in assessing Coronary Heart Disease and Kidney function (Cardio-renal syndrome).

METHOD

A cross-sectional study was conducted among 52 employees of Yayasan Kalam Kudus Kosambi Baru. The study analyzed the correlation between FRS (specifically "10-year risk of MI or death" and "Average 10-year risk of MI or death") and kidney function decline, waist circumference, and waist-hip ratio. Spearman's correlation test was applied to assess the correlation.

RESULTS AND DISCUSSION

This study involved 52 people who had met the inclusion criteria. In this study, most of the respondents were female (59.6%), with the average age of the respondents was 39.73 years. It is shown that the average waist-to-hip ratio was 0.893 and the average of waist circumference was 95.19 cm. The average of Glomerulus Filtration Rate panel from the data collected was 102.65 mL/min while the Framingham Risk Score (FRS) shows that the average of 10-year risk of MI or death is 0.2% with the average risk of MI or death in the population from the data that have been collected is 1%. (Table 1)

Table 1. Respondents Characteristics

Parameter	Results
Age (years)	39.73 (12.66)
Gender (%)	
Male	21 (40.4)
Female	31 (59.6)
Waist Circumference (cm)	95.19 (10.59)
Waist-hip ratio	0.893 (0.06)
Glomerulus Filtration Rate (mL/min)	102.65 (16.33)
10-year risk of MI or death (%)	0.2 (0-8.2)
Average risk of MI or death (%)	1.00 (1-20)

The spearman's rank correlation analysis showed a significant correlation between the "10-year risk of MI or death" with the kidney function decline (r: -0.381; p-value: 0.005), waist circumference (r: 0.274; p-value: 0.050), and waist-hip ratio (r: 0.333; p-value: 0.016). Similarly, there were significant correlation between the "average 10-year risk of MI or death" with the kidney function decline (r: -0.376; p-value: 0.006), waist-hip ratio (r: 0.291; p-value: 0.036), and not significant correlation with the waist circumference (r: 0.227; p-value: 0.106). (Table 2)

Table 2. Correlation Between "10-year risk of MI or death" and Kidney Function Decline, Waist Circumference, and Waist-hip Ratio

		Glomerulus Filtration Rate	Waist Circumference	Waist-hip Ratio
10-year risk of MI or death	Correlation Coefficient	-0.381	0.274	0.333
	Sig. (2-tailed)	0.005	0.050	0.016
Average 10-year risk of MI or death	Correlation Coefficient	-0.376	0.227	0.291
	Sig. (2-tailed)	0.006	0.106	0.036

These findings reveal a correlation between 10-year risk of MI or death and kidney function decline, waist circumference, and waist-hip ratio, highlighting the potential of waist circumference and waist-hip ratio as a predictor parameter of FRS in predicting the cardio-renal syndrome. This relationship illustrates the capability of waist circumference and waist-hip ratio of being a predictor parameters, emphasizing the necessity for further investigation into the application of waist circumference and waist-hip ratio for the replacement or the part of FRS.

The Framingham Risk Score (FRS) includes age, gender, total cholesterol (TC), HDL-C, systolic blood pressure, and smoking as its key parameters (Jahangiry *et al*., 2017). Age and gender are closely linked to the increased incidence and mortality of coronary heart disease (CHD). Aging contributes to higher oxidative stress, which raises the risk of obesity, diabetes, and frailty, factors that, in turn, elevate the likelihood of developing CVD. While age is an independent risk factor for CVD, gender plays a significant role, as women face a greater risk of CVD after menopause. This is due to the decline in sex hormones, such as estrogen and testosterone, which occur after menopause. These hormones are known to have cardioprotective effects, helping to prevent the development of CVD (Rodgers *et al*., 2019).

Additionally, total cholesterol (TC) and HDL-C play a role in the development of CVD (Hu *et al*., 2024). Combination between high TC and low HDL-C increases the risk of CVD, especially atherosclerosis, which results from abnormal lipid metabolism. Conversely, low TC and high HDL-C reduce the risk of developing CVD (Hu *et al*., 2024).

Systolic blood pressure (SBP) plays a crucial role in the Framingham Risk Score (FRS), as elevated SBP increases the likelihood of developing cardiovascular disease (CVD). Chronic hypertension is an independent risk factor for CVD, primarily because it causes the left ventricle to become hypertrophied. This enlargement of the heart increases its oxygen demand, prompting the development of new blood vessels to supply the myocardium. However, these newly formed vessels in the myocardium are less effective than those in the subepicardial region, which can result in insufficient blood supply, leading to ischemia and, eventually, infarction (Picariello *et al*., 2011). On the other hand, smoking contributes to a similar mechanism as elevated SBP. Nicotine from smoking stimulates the sympathetic nervous system, increasing heart activity and raising the oxygen demand in the myocardium (U.S. Department of Health and Human Services, 2010).

Cardiovascular disease, particularly coronary heart disease (CHD), can exacerbate cardiac dysfunction through mechanisms that also impact kidney function. Fluid overload from reduced cardiac output increases venous pressure, transmitting back to the efferent arterioles, reducing glomerular filtration pressure, and causing kidney damage. CHD activates systems such as the Sympathetic Nervous System (SNS), the Renin-Angiotensin-Aldosterone System (RAAS), and vasoconstrictive substances like Angiotensin II, Adenosine, Arginine Vasopressin, and Endothelin, leading to reduced renal blood flow, hypoperfusion, and glomerular filtration rate (GFR) decline. This initiates necrosis, apoptosis, and progressive kidney dysfunction, underlying type 1 cardio-renal syndrome(*Cardiorenal Syndrome*, 2023; *Cardiovascular (Heart) Diseases: Types and Treatments*, 2024; Gloria Kang GJ, Ewing-Nelson SR, Mackey L, Schlitt JT, Marathe A, Abbas KM, 2018). In chronic heart failure, repeated acute decompensated heart failure (ADHF) episodes, diuretic and ACE inhibitor use, and drug-induced hypovolemia further impair kidney function, accelerating atherosclerosis and macrovascular/microvascular changes, characteristic of type 2 cardio-renal syndrome(Gloria Kang GJ, Ewing-Nelson SR, Mackey L, Schlitt JT, Marathe A, Abbas KM, 2018). Elevated natriuretic peptides (ANP and BNP) in chronic heart failure are rendered less effective due to natriuretic peptide receptor downregulation, impairing the cGMP signaling pathway. Concurrently, reduced nitric oxide (NO) bioavailability from oxidative stress and inflammation leads to vasoconstriction, vascular stiffness, and impaired hemodynamic function, perpetuating the cycle of cardiac and renal decline. (Adachi *et al*., 1997; Gloria Kang GJ, Ewing-Nelson SR, Mackey L, Schlitt JT, Marathe A, Abbas KM, 2018).

Excess body weight, in this case abdominal obesity, is a significant risk factor for coronary heart disease (CHD). It also plays a role in the decline of kidney function, primarily by triggering conditions like diabetes and hypertension, which are among the most substantial risk factors. Abnormal obesity is usually measured by waist circumference, with measurements exceeding 90 cm for men and 80 cm for women (Ajiboye *et al*., 2019). Body Mass Index (BMI) alone isn’t enough to accurately assess or manage the health risks linked to excess body fat in adults. It’s important to look beyond BMI and consider additional measures, like waist circumference, to get a clearer picture of a person’s cardiometabolic health.

Additionally, central obesity could be measured by the waist-hip ratio, with values greater than 0.9 for men and 0.85 for women. Waist-hip ratio measurement was shown to have association with increasing risk of heart disease (Ajiboye *et al*., 2019; World Health Organisation (WHO), 2008). The fat stored in the hips, thighs, and buttocks, known as gluteal-femoral fat, is primarily subcutaneous. Unlike visceral fat, this type of fat releases fatty acids into the bloodstream at a much slower and at more controlled rate. This steady release helps prevent sudden spikes in circulating free fatty acids (FFAs), which can otherwise lead to inflammation, elevated blood pressure, and endothelial dysfunction. These factors contribute to cardiovascular disease (CVD). Gluteal-femoral fat acts as a metabolic buffer by safely storing excess circulating FFAs and triglycerides. This prevents lipid "spillover" into other tissues like the liver, heart, or skeletal muscles. By trapping lipids, this fat depot reduces the risk of dyslipidemia (abnormal cholesterol levels), which is a significant contributor to heart disease. Besides that, hip and thigh fat cells are generally larger and more stable than visceral fat cells, making them less prone to rapid turnover and inflammation. The stable nature of gluteal-femoral fat reduces the release of harmful molecules and improves metabolic health (Yim *et al*., 2008).

By reviewing the evidence, we can adopt WHR as a routine part of evaluating and managing obese patients. This approach ensures a more comprehensive and effective strategy for addressing health risks (Ross *et al*., 2020). In this situation, waist-hip ratio measurement and waist circumference are emerging as significant predictors that potentially add value to existing risk models as it is associated with heart disease (Kovesdy *et al*., 2017).

This study has several limitations that should be considered. The cross-sectional design limits the ability to conclude causality, meaning that while associations were observed, it is unclear whether one factor directly influences another. The relatively small sample size may also have reduced the ability to detect more subtle patterns, potentially impacting the reliability of the results. The study population was also limited to employees from a single institution, which may only partially represent broader, more diverse populations. This could affect the generalizability of the findings to other groups with varying demographic or cultural backgrounds. Future studies with larger, more diverse populations and longitudinal designs are needed to confirm these results and better understand the relationships observed.

CONCLUSION

The study identifies a significant correlation between the Framingham Risk Score for Hard Coronary Heart Disease and kidney function, waist-hip ratio, and waist circumference. These findings suggest that waist-hip ratio and waist circumference could serve as valuable predictors of coronary risk. This underscores the importance of incorporating abdominal obesity measurements into cardiovascular risk assessments, particularly in populations at higher risk for cardio-renal syndrome.

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