JURNAL BIOMEDIKA DAN KESEHATAN
(JOURNAL OF BIOMEDIKA AND HEALTH)

Vol. 6 No. 1 (2023) pp. 71-80 e-ISSN: 2621-5470

ORIGINAL ARTICLE

The Association Between Waist-To-Hip Ratio and Dietary Fat Consumption and the Risk of Cardiovascular Events in Productive Age

Hubungan Rasio Lingkar Pinggang Panggul dan Asupan Lemak dengan Risiko Kejadian Kardiovaskular pada Usia Produktif

Adriani Thahara [1], Ika Krisnawati[2]

[1] Medical Undergraduate Programme, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia
[2] Internal Medicine Department, Faculty of Medicine, Universitas Trisakti, Jakarta, Indonesia

thahara.adriani@gmail.com

https://doi.org/10.56186/jbk.71-80

ABSTRACT

BACKGROUND

Every year, cardiovascular disease (CVD) is the leading cause of death in the globe. The Framingham Risk Score forecasts the likelihood of cardiovascular diseases occurring within the next decade. Waist-to-Hip Ratio (WHR) is an anthropometric measurement representing abdominal fat and is regarded as superior to Body Mass Index (BMI) for predicting cardiovascular risk. Excessive fat intake will increase the risk of CVD. The purpose of this study is to determine the association between WHR and fat consumption and the risk of cardiovascular events in the productive age

METHOD

This cross-sectional observational study included 173 participants aged 30-64 at RW 12, Dutamas, Grogol Pertamburan, between September and November 2018. Using main data to determine the measures of WHR, BMI, data for FRS calculations, and 3x24-hour food recall interviews, data were collected using consecutive non-random sampling and non-random non-consecutive sampling. IBM SPSS 23 was utilized for the data analysis.

RESULTS

There were 62 male respondents and 111 female respondents. Both men and women are at risk of a high WHR measurement. However, men are more likely to be found with obesity in comparison to women. Both men and women presented a high fat intake of ≥80% RDA. In the FRS test with WHR and fat intake, results show a p-value of <0.05 for men and women; meanwhile, the FRS test with BMI resulted in p> 0.05 for men and p<0.05 for women.

CONCLUSION

There was a relationship between the Waist-to-Hip Ratio (WHR) and fat intake with the risk of cardiovascular events.

Keywords: Waist-to-Hip Ratio; visceral fat; fat intake; cardiovascular events; *Framingham Risk Score*

ABSTRAK

LATAR BELAKANG

Penyakit kardiovaskular (PKV) menjadi penyebab nomor satu kematian di dunia setiap tahunya. *Framingham Risk Score* memprediksi kemungkinan kejadian kardiovaskular dalam 10 tahun kedepan. Rasio Lingkar Pinggang Panggul (RLPP) merupakan salah satu antropometri yang mencerminkan lemak bagian perut dan dianggap lebih baik daripada Indeks Masa Tubuh (IMT) dalam memprediksikan risiko kardiovaskular. Asupan lemak yang tinggi akan meningkatkan risiko PKV. Penelitian ini bertujuan untuk mengidentifikasi hubungan antara RLPP asupan lemak dengan risiko kejadian kardiovaskular pada usia produktif.

METODE

Metode penelitian ini adalah *cross-sectional* yang melibatkan 173 peserta berusia 30-64 tahun di RW 12, Dutamas, Grogol Pertamburan selama bulan September dan November 2018. Menggunakan data primer untuk menentukan ukuran RLPP, IMT ,data untuk kalkulasi FRS, dan wawancara *foodrecall* 3x24 jam, pemilihan sampel menggunakan teknik consecutive non-random sampling. Analisis data menggunakan *IBM SPSS 23*.

HASIL

Di dapatkan 62 responden laki-laki dan 111 responden perempuan. Baik Laki-laki maupun perempuan lebih banyak yang memiliki WHR beresiko. Meskipun demikian, laki-laki lebih banyak mengalami obesitas daripada perempuan. Laki-laki maupun perempuan lebih banyak dengan asupan lemak mencapai ≥80% AKG. Pada uji FRS dengan WHR dan asupan lemak dapatkan nilai $p < 0,05$ untuk laki-laki dan perempuan sedangkan uji FRS dengan IMT di dapatkan $p>0,05$ untuk laki-laki dan $p<0,05$ untuk perempuan.

KESIMPULAN

Terdapatkan hubungan antara Rasio Lingkar Pinggang Panggul dan asupan lemak dengan risiko kejadian kardiovaskular.

Kata kunci: Rasio lingkar pinggang panggul; lemak viseral; asupan lemak; kejadian kardiovaskular; *Framingham Risk Score*

INTRODUCTION

Cardiovascular disease (CVD), including coronary heart disease, ischemic stroke, hemorrhagic stroke, mild stroke, peripheral vascular disease, and heart failure, has become a serious challenge for all clinicians worldwide because CVD is the number one cause of death in the world every year. The main risk factor for CVD is hypertension; most people are unaware that the y have hypertension before the occurrence of further complications, so CVD is often considered a "silent killer". [1,2]

Abdominal fat is divided into retroperitoneal fat and intraperitoneal fat, or visceral fat, which surrounds the mesentery and omental fat mass. Visceral fat is a risk factor for various non-communicable diseases, including CVD. Still, examining visceral fat is not easy and expensive, so the measurement of visceral fat is limited in field conditions and at the community level. [3] In anticipation of the continued increase in the death rate from CVD, we as clinicians need to find parameters that can be used to measure the risk of CVD, which can be done quickly and precisely. [4]

WHO also said that another anthropometry is needed to complement BMI in identifying individuals at risk due to the accumulation of abdominal fat. WHR is obtained by measuring waist

circumference divided by hip circumference, describing body fat distribution, especially abdominal fat, which includes subcutaneous adipose tissue (subcutaneous fat) and visceral adipose tissue (visceral fat). Increased visceral adipose tissue is associated with various metabolic abnormalities such as decreased glucose tolerance, reduced insulin sensitivity, lipid profile abnormalities, and risk factors for type 2 diabetes mellitus and cardiovascular disease..[4] Gadekar et al. stated that the Waist Hip Circumference Ratio (WHR) measurement is a simple parameter, cheap, and easy to do to replace the measure of visceral fat.[3]

A person's nutritional state also influences fat accumulation in the body. Poor nutrition is one of the risks of cardiovascular disease (CVD).[5] Based on the 2010 RISKESDAS, the average consumption of fat for the Indonesian population is 25.6%, this means more than 25% of total energy or exceeds the recommended general guideline for balanced nutrition. Regulation of the Minister of Health number 30 of 2013 states that total fat/oil consumption of more than 67 grams per person daily will increase the risk of hypertension, stroke, diabetes and heart attack. The body will form cholesterol from food sources that contain saturated fat; cholesterol levels that exceed the normal threshold can cause heart disease.[6]

Krachler et al. conducted the first study on the relationship between time trends in individual food intake (reported) and waist and hip circumference at the population level; they stated that there was a relationship between fat intake and central obesity.[7] Moslehi et al. stated that visceral fat accumulation was influenced by the proportion intake of macronutrients (carbohydrates, fat, protein) without being affected by total energy intake.[8] Research conducted by Yulianti et al. found a significant relationship between energy intake, saturated fat, unsaturated fat, and cholesterol with the total cholesterol/HDL levels ratio.[4] Meanwhile, Sunu et al. did not find a significant relationship between macronutrient adequacy rates and the ratio of total cholesterol/HDL.[6]

The prevalence of central obesity is increasing yearly; nationally, in 2007, it was 18.8%, and it increased in 2013 to 26.6%. An individual is considered centrally obese if the WHR is ≥ 0.9 cm for males and ≥ 0.85cm for females or if BMI is more than 30kg/m2. Many people, especially in Indonesia, may not be aware of the dangers of central obesity or accumulation of visceral fat, which can lead them to become sufferers of CVD in the future.[9] In England, a meta-analysis was carried out on nine cross-sectional studies by Czernichow et al., which suggested the best relationship between excess fat and PKV based on WHR followed by LP and then BMI.[10] This is also supported by a prospective cohort study by Zhang et al. in women in the United States who were followed for 16 years that proved LP, WHR, RLPT those at risk associated with hypertension and hypercholesterolemia and there is a relationship between LP and WHR are at risk associated with increased CVD mortality even in women with normal weight.[11] But in Indonesia itself, there still needs to be more supporting research. For example, Yunita et al. found no relationship between WHR and lipid profile abnormalities in pre-geriatric and old ages. [12] Rokhmah et al. stated that there was no positive correlation between WHR and plasma blood glucose levels as measured by the Oral Glucose Tolerance Test (OGTT).[13]

Waist Hip Circumference Ratio (WHR) is an anthropometry that can describe visceral fat. Excess visceral fat indicates the occurrence of central obesity, which is one of the triggers of cardiovascular disease. Where based on RISKESDAS 2013 in DKI Jakarta, the incidence of CHD was 1.6%, heart failure was 0.3%, and stroke was 14.6% based on diagnosis and symptoms and was found mainly in the age group 44-54 years, 55-64 years, and 65 -74 years. In addition, fat intake is also associated with cardiovascular disease and affects waist and hip circumference. Therefore, parameters are needed to measure risk factors that can be used as a reference for the prevention of CVD.

Currently, research on factors that can cause cardiovascular disease continues to develop, one of which is the Framingham Study, a cohort study committed to identifying common factors or characteristics that contribute to cardiovascular disease; this study produces a score aimed at cardiovascular disease screening, namely the Framingham Risk Score. Therefore researchers are motivated to determine whether there is a relationship between waist-hip ratio (WHR) and fat intake with the risk of cardiovascular events, which will be measured by the Framingham Risk Score at productive age.

METHODS

The design used in this study was a cross-sectional design where all data was taken simultaneously. The research was conducted at RW.12, Duta Mas, Jelambar Baru, Grogol Petamburan, West Jakarta. This research was carried out within three months, namely September-November 2018. The subjects in this study were productive ages, namely ages 30-64 years for both men and women, where researchers would select samples using consecutive non-random sampling techniques. All subjects met the selection criteria were included in the study until the required number of subjects was met. Researchers made inclusion and exclusion criteria to get samples in this study to make the samples obtained more relevant to the problem. Research subjects who met the inclusion criteria were the subjects studied in this study. At the same time, subjects who fit into the exclusion criteria will not be studied. The inclusion criteria in this study were aged 30-64 years who were willing to be the research sample and were able to cooperate during the study, while the exclusion criteria included; Having or being diagnosed with cardiovascular disease; Currently taking anti-diabetic, hypolipidemic, and anti-thrombotic drugs; Pregnant women; and Women who use hormonal contraceptives. The sample required is 173, calculated using the infinite and finite population formula and adding a 15% dropout.

In this study, primary data was needed, in the form of the Hip Circumference Ratio (WHR), measured with the ABN brand roll meter. The risk of cardiovascular events will be calculated using the FRS with the required data in the form of age, gender, hypertension treatment, history of DM, and smoking status by answering interview questions and measuring systolic blood pressure by measuring the subject's blood pressure using an Omron tensimeter, total cholesterol levels. And total capillary blood HDL were measured using a LipidPro Cholesterol and Glucose Measuring tool. Data on fat intake were obtained by interviewing food recalls for 3x24 hours and analyzed using Nutrisurvey 2007 for Windows. Nutritional status (BMI) was measured using scales and a height meter.

Data analysis used IBM SPSS version 23 for univariate and bivariate analysis. Univariate analysis was used to describe the characteristics of each studied variable presented in the form of average standard deviation for normally distributed data. In contrast, data that were not normally distributed were presented as a median (minimum–maximum). In the bivariate analysis, comparative numerical methods were used. Before the test, a normality test will be carried out first. If the data is normally distributed, an independent T-test will be selected for variables with two groups and a one-way ANOVA test for more than two groups. Whereas for data that is not normally distributed, a Mann-Whitney test will be carried out for variables with two groups and the Kruskal Wallis test for variables with more than two groups. Respondent data will be grouped into male and female groups; each primary data will be distributed to calculate the risk of cardiovascular events based on the FRS so that a p-value will be obtained. Research Ethics obtained from the Research Ethics Committee of the Faculty of Medicine, University of Trisakti No. 24/KER-FK/VIII/2018.

RESULTS

Respondents were 173 people, with 35.9% of respondents being male and 64.1% being female. The results of the descriptive and bivariate research analysis are presented in Table 1. for the male group and Table 2. for the female group.

Table 1. Distribution of the risk of cardiovascular events (Framingham Risk Score) for men based on WHR, BMI, and fat intake (n=62)

		FRS		
		n (%)	**x̄ ± s.b**	***p***
WHR	No risk	23 (37,1%)	0,81±0,37	0,016*
	Risky	39 (62,9%)	1±0,32	
IMT	Normal	13 (21,7%)	0,95±0,47	0,842‡
	Overweight	20 (33,3%)	0,97±0,35	
	Obese	27 (45%)	0,96±0,35	
Fat intake	<80% RDA	20 (32,3%)	0,81±0,33	0,033*
	≥80% RDA	42 (67,7%)	1±0,35	

Note: * Un-paired t-test
‡ one way anova test

Men are said to be not at risk if the WHR < 0.90cm and are said to be at risk if the WHR is ≥ 0.90cm. It was found that 37.1% of men had non-risk WHR, and 62.9% had risky WHR. Data analysis was carried out using a comparative numerical method, the FRS in WHR was not normally distributed, so a log transformation was performed to normalize the data. The results of the log transformation showed the distribution of FRS at normal WHR or p > 0.05. Because it was normally distributed and consisted of 2 unpaired groups, an unpaired T-test was performed. The homogeneity test shows that p>0.05 means the data is homogeneous. Table 4 shows the p for FRS in WHR of 0.016 (p <0.05), meaning there is a significant relationship between WHR and the risk of cardiovascular events in men.

Body Mass Index (BMI) is classified into underweight (<18.5 kg/m2), normal (18.5-22.9 kg/m2), overweight (23-24.9 kg/m2), and obesity (≥25 g/m2) because in the male group, there were only two respondents with underweight BMI so it was considered as extreme data, underweight nutritional status was omitted in the data processing. The distribution of FRS on BMI is not normally distributed, and after log transformation, the data is normally distributed or p > 0.05. Because it was normally distributed and consisted of 3 unpaired groups, a one-way ANOVA test was performed. The homogeneity test shows that p>0.05 means the data is homogeneous. The one-way ANOVA test obtained p 0.842 (p > 0.05), which means that there is no significant relationship between BMI and the risk of cardiovascular events in men.

Fat intake refers to the 2013 Nutrition Adequacy Rate (RDA). For men and women, fat intake is divided into less than 80% of the RDA and fat intake that reaches 80% of the RDA. For men aged 30-49 years, the limit for fat intake (80% RDA) is 58.4 grams/day and for ages 50-64, 52 grams/day. There were 20 men with a fat intake <80% RDA and 42 men with a fat intake ≥80% RDA. FRS on fat intake is not normally distributed, so a transformation is performed to normalize the data. The results of the transformation obtained the FRS distribution at normal WHR or p> 0.05. Because it was normally distributed and consisted of 2 unpaired groups, an unpaired T-test was performed. The homogeneity test shows that p>0.05 means the data is homogeneous. Unpaired T-test showed p 0.033 (p <0.05), which means that there is a significant relationship between fat intake and the risk of cardiovascular events in men.

Table 2. Distribution of the risk of cardiovascular events (Framingham Risk Score) for women based on WHR, BMI, and fat intake. (n=111)

Risk of Cardiovasvular		Framingham Risk Score		
		n (%)	x̃ (minimun-maximum)	**p**
WHR	No risk	52 (46.8%)	2.8(1-21.5)	0.008*
	Risky	59 (53.2%)	3.9(1.2-27.5)	
IMT	Underweight	7 (6.3%)	2 (2-8.6)	
	Normal	45 (40.5%)	2.8(1-18.5)	0.025‡
	Overweight	18 (16.2%)	2.8(1-21.5)	
	Obese	41 (37.0%)	3.9(1-27.5)	
Fat intake	<80% RDA	36 (32.4%)	2.8(1-11.7)	0.032*
	≥80% RDA	75 (67.6%)	3.9(1-27.5)	

Note: *Mann-whitney test
‡ Kruskal Wallis test

The limit of a person is said to be not at risk for women, namely if the WHR <0.85cm and at risk if the WHR ≥0.85cm. Unlike men, women were also more dominant in the risky WHR group, namely 53.2%. The distribution of FRS in WHR is not normally distributed, and after transformation, the data is also not normal. Because the distribution is abnormal and consists of 2 unpaired groups, the Mann-Whitney test was chosen to test these two variables. A p-value of 0.008 (p <0.05) was found, which means a significant relationship exists between WHR and the risk of cardiovascular events in women.

BMI of women with normal weight, which is equal to 46.8%, predominates, and as many as 37% of women are obese. The distribution of FRS on BMI is not normally distributed, and after transformation, the data is also not normal. Because the distribution was abnormal and consisted of 3 unpaired groups, the Kruskal-Wallis test was chosen to test these two variables. A p of 0.025 (p <0.05) was found, which means a significant relationship exists between BMI and the risk of cardiovascular events in women.

For women aged 30-49 years, the fat intake limit (80% RDA) is 48 grams/day; for those aged 50-64, it is 42.4 grams/day. There were 36 women with fat intake <80% RDA and 75 women with fat intake ≤80% RDA. The distribution of FRS on fat intake is not normally distributed, and after transformation, the data is also not normal. Because the distribution is abnormal and consists of 2 unpaired groups, the Mann-Whitney test was chosen to test these two variables. Obtained p of 0.032 (p <0.05), which means there is a significant relationship between fat intake and the risk of cardiovascular events in women.

DISCUSSION

This study conducted separate data analysis between male and female sex groups due to different waist-to-hip ratio (WHR) cut-offs and fat intake. As a result, women dominated in this study, as much as 64.2%, while men, as much as 35.8%; the respondents in this study were in the productive age range of 30-64 years.

Currently, obesity has become a worldwide epidemic and has been defined by WHO as one of the challenges in the world of health in the 21st century. Compared to general obesity, regional fat distribution is considered to be more associated with cardiovascular risk. Waist Hip Circumference Ratio (WHR) is anthropometric that describes fat distribution, especially visceral fat. At the same time, BMI is anthropometric that is more often used in everyday life, which is used to describe nutritional status and describe general obesity.[14]

In this study, it was found that the majority of respondents had WHR at risk in men (63%) and women (53.1%) and the results of the bivariate test between WHR and the risk of cardiovascular events, namely the Framingham Risk Score, showed that there was a significant relationship between men and women. In addition to WHR, this study also obtained Body Mass Index (BMI) data which describes nutritional status as a complement to WHR. The results of the bivariate test between BMI and the risk of cardiovascular events, namely the Framingham Risk Score, obtained a p-value of 0.842 for men and 0.025 for women, which means that there is a difference in the risk of cardiovascular events in the distribution of BMI in women, the majority of whom have normal weight but not men. The majority of men are obese.

WHR can describe excess visceral fat, which is associated with metabolic abnormalities because visceral adipose tissue has direct access to the liver via the portal circulation. The high release of fatty acids into the portal circulation results in insulin resistance and other metabolic syndromes that can trigger cardiovascular events in the future.[3,15]

Jawad et al. conducted a study to determine which was the best between BMI, LP, and WHR to predict the risk of coronary heart disease in the next ten years, which is none other than the scoring system issued by the Framingham heart study in the Arab population, the results of this study show a curve ROC for the three anthropometrics exceeds 20% with WHR being the best predictor of coronary heart disease risk in the next ten years.[16] Research conducted by Moy et al., who tested the Framingham Risk Score with anthropometric indices such as BMI, LP, and WHR, stated that a relationship existed between WHR and with Framingham Risk Score.[17] In addition, research conducted by Sunarti found a significant relationship between WHR and CHD events in Sukoharjo District Hospital.[18] There was a significant relationship between BMI in women, the majority of whom had normal weight, and the risk of cardiovascular events according to a cohort study conducted by Zhang et al., who stated that LP and WHR are at risk associated with increased CVD mortality even in women with normal weight.[11]

BMI has been commonly used as an indicator of obesity nutritional status, a risk factor for heart disease. Rahayu's research on BMI and coronary heart disease showed that there was no significant relationship between BMI and the incidence of coronary heart disease.[19] WHR has been widely used as a predictor of metabolic disorders in women. But not for men.[20] This is not in accordance with this study because, in men, there is also a difference in the risk of cardiovascular events in the non-at-risk WHR group and the at-risk WHR group. On the other hand, a study conducted by Eun Gyong Yoo found that a high waist circumference ratio is a tool for predicting cardiometabolic disease associated with excess visceral fat in adolescents.[21] Ying Lee et al. conducted a meta-analysis to determine which obesity indicator is the best for predicting cardiovascular risk, including BMI, LP, WHR, and high waist circumference ratio and obtained the results of measurements of central obesity, especially the high waist circumference ratio, which is better than general obesity measurements, namely BMI for predicting cardiovascular risk.[22]

Based on the results of this study, it was shown that there were differences in the risk of cardiovascular events between the WHR groups who were not at risk and risk in men and women. In contrast, differences in the risk of cardiovascular events between the BMI groups were only found in women. These results indicate that in addition to BMI, WHR is needed as an anthropometry that describes excess visceral fat to measure the risk of cardiovascular events in productive age.

There is now much evidence of the link between macronutrient consumption and health, including recommendations for limiting the intake of total fat and saturated fat as a preventive measure for the risk of cardiovascular events. Fat consumption exceeding the recommended increase has a 2.5 times greater risk of experiencing metabolic syndrome.[23] In this study, food consumption data were collected from respondents through 3x24 hour food recall interviews,

which were then analyzed using Nutrisurvey 2007 to obtain each respondent's total daily fat intake. The total fat intake obtained will be adjusted according to gender and age with the recommendation for fat intake in the 2013 Nutrition Adequacy Rate (RDA) issued by the Ministry of Health of the Republic of Indonesia. Total fat intake is grouped into fat intake that is less or does not reach 80% RDA and a group whose total fat intake is ≥ 80% RDA. The group with a total fat intake ≥80% RDA in men and women became dominant in this study, namely 67.8% for men and 67.5% for women. These results are in accordance with the food consumption of the Indonesian people, which is still not in accordance with the message of balanced nutrition, where the consumption of food and drinks high in sugar and high fat in rural and urban communities is still relatively high. General Guidelines for Balanced Nutrition (PUGS).[3]

Fatty foods contain triglycerides and cholesterol, which the body will later metabolize through exogenous pathways. Excessive fat consumption can lead to obesity; as a response to obesity, in both men and women, there will be an increase in the release of free fatty acids into the blood, which will cause various metabolic abnormalities and trigger cardiovascular events.[24] After conducting bivariate analysis on total fat intake data, Respondents with a risk of cardiovascular events found differences in the risk of cardiovascular events in the group consuming fat <80% RDA and ≥80% RDA. These results align with Rahma and Wirjatmadi's case-control study, which showed a significant relationship between dietary fat intake and the incidence of coronary heart disease. Coronary heart disease is a cardiovascular disease that is often found in society. Where the underlying pathophysiology of this disease is the process of atherosclerosis, one of the causes of which is the accumulation of fat in the blood. Excess fat intake will increase the level of fat in the blood, which will cause fat accumulation in the walls of the heart's blood vessels, and blockages can occur.[25] Wiardani et al. also found significant differences in the pattern of fat consumption in urban communities in Denpasar, where groups of people with metabolic syndrome consume total fat, saturated fat, and cholesterol.[23] On the other hand, a study conducted by Zuraida involved 14,493 adult male and female respondents. In Lampung Province showed no relationship between the consumption of fatty foods and heart disease; these results were considered due to the difficulty of respondents in describing fatty foods.[26]

In this study, due to time constraints, we did not obtain diabetes mellitus data by carrying out diabetes mellitus diagnostic guidelines but by asking and answering whether a doctor had previously diagnosed diabetes mellitus. After this, clinicians can make WHR and daily fat intake parameters that can be measured every time they get a patient, especially patients who already have risk factors for cardiovascular disease. This study is expected to be a reference for further studies in the cardiovascular field, especially in the prevention of CVD.

CONCLUSION

There are differences in the risk of cardiovascular events described by the Framingham Risk Score (FRS) in the WHR group in men and women. There was no difference in the risk of cardiovascular events described by the Framingham Risk Score (FRS) in the male BMI group. There are differences in the risk of cardiovascular events described by the Framingham Risk Score (FRS) in the BMI group in women. There are differences in the risk of cardiovascular events Framingham Risk Score (FRS) on fat intake in men and women.

ACKNOWLEDGEMENT

Thanks to RW 12 Dutamas for allowing this research to take place.

AUTHORS CONTRIBUTION

Conceptualization and design: AT and IK; data analysis: AT; All authors have read and agreed to the published version of the manuscript.

FUNDING

None

CONFLICT OF INTEREST

The authors declare that there is no known conflict for this work

REFERENCES

1. Risk Factors For Cardiovascular Disease (CVD). Heart UK the cholesterol charity. Available at: https://www.gpwebsolutions-host.co.uk/1046/files/2018/04/risk-factors-for-chd.pdf
2. Global Atlas on Cardiovascular Disease Prevention and Control. Mendis S, Puska P, Norrving B editors World Health Organization in Collaboration with the World Heart Federation and World Stroke Organization, Geneve 2011:2-7.
3. Gadekar Maj, Dudeha Lt, Basu Lt, Vashisht Maj, Mukhreji Air. Correlation of Visceral Body Fat with waist-hip ratio, waist circumference and body mass index in healthy adults: A cross sectional study. Elsevier 2017;941:1-6.
4. Waist Circumfrence and Wais-Hip-Ratio. Report of a WHO Expert Consultation. Geneva 2008. Available at: https://www.who.int/publications/i/item/9789241501491.
5. Pedoman Gizi Seimbang. Kementrian Kesehatan Republik Indonesia. 2014. Available at: https://drive.google.com/file/d/0ByNVq5MFhBMEd0Q3X3hiV3kzMFk/view?resourcekey=0-0zP8BC3J8oJW0nKOwn8LyQ
6. Yuliantini Emy, Sari Ayu P. Nur, Edy. Hubungan Asupan Energi, Lemak, dan Serat dengan Rasio Kadar Kolesterol Total-HDL. Penelitian Gizi dan Makanan 2015;38(2):139-47.
7. Krachler Benno, Eliasson Mats, Stenlund Hans, Johansson Ingegerd, Hallmans Goran, Lindah Bernt. Reported Food Intake and Distribution of Body Fat: a Repeated cross-sectional study. Nutrion Journal 2006;5(34):1-11
8. Moslehi Nazzain, Ehsani Benhaz, Mirmiran Parvin, Hojjat Parvane, Azizi Fereidoun. Assosiation of Dieatary Porpotions od Macronutrients with Visceral Adiposity Index: Non-Substitution and Iso-Energetic Substition Models in a Prospective Study. Nutrients 2015;7:8859-70.
9. Risk Factors For Cardiovascular Disease (CVD). Heart UK the cholesterol charity.
10. Czernichow S, Kengne A, Stamatakis E, Hammer M, Batty D, Galan B, et al. Body Mass Index, Waist Circumference, and Waist hip ratio: which is the best better discriminator of cardiovascular disease mortality risk? Evidence from an individual-participants from nine cohort studies. Obes Rev 2011;12(9):680-7.
11. Zhang C, Rexrode KM, Van Dam RM, Li TY, Hu FB. Abdominal Obesity and the Risk of All-Cause, Cardiovascular and Cancer Mortality Sixteen Years of Follow-Up in US Women. American Heart Association. Circulation 2008;117:1658-67.
12. Linawati Y, Virginia DM. Korelasi Lingkar Pinggang Panggul (WHR) Terhadap Profil Lipid pada Pra-Geriatri dan Geriatri. Jurnal Farmasi dan Sains Komunitas 2014; 11(2): 58-63.
13. Rokhmah FD, Handayani D. Al-Rasyid H. Korelasi lingkar pinggang dan rasio lingkar pinggang-panggul terhadap kadar glukosa plasma menggunakan tes toleransi glukosa oral. Jurnal Gizi Klinik Indonesia 2015;12(1): 28-35
14. H stine, Scheuer F Kristine, P Annelotte, E Marit, Jorgensen, et al. Abdominal fat distribution and cardiovascular risk in men and women with difference levels of glucose tolerance. J Clin Endocrinol Metab 2015; 100(9):3340-7.
15. Sudoyo AW, Setiyohadi B, Alwi I, Simadibrata M, Setiati S. Buku Ajar Penyakit Dalam. Jilid II edisi IV. Jakarta: Pusat Penerbitan Ilmu Penyakit Dalam FKUI. 2006. 2551-3.
16. Al Lawati JA, Barakat MN, Al Lawati AM, Mohammed AJ. Optimal cut-points for body mass index, waist circumference and waist-to-hip ratio using the Framingham coronary heart disease risk score in an Arab population of the Middle East. Diabetes and Vascular Research 2008;5(4):304-9.
17. Moy FM, Atiya AS, Wong ML. Framingham Risk Scores and Anthropometric Measurements in Predicting Cardiovascular Risks among Malay Men. Malays J nutr 2008;14(1):57-63.
18. Elvia Maryani, Sunarti. Rasio Lingkar Pinggang dan Panggul dengan Penyakit Jantung Koroner di RSUD Kabupaten Sukoharjo. Buku Penelitian Sistem Kesetan 2013;16(1):73-82.

19. Rahayu MS. Hubungan indeks masa tubuh dengan penyakit jantung coroner di rumah sakit umum cut meutia kabupaten aceh utara. Jurnal Kedokteran Malikussaleh 2016; 2(1): 9-16.
20. Wirawan N. Sensitifitas IMT dan Lingkar Pinggang Panggul dalam Mengklasifikasikan Kegemukan pada Wanita. Indonesian Journal Of Health and Nutrion 2016; 3(1): 49-59
21. Yoo Eun Gyong. Waist-to-height ratio as a screening tool for obesity and cardiometabolic risk. Korean J Pediatr 2016;59(11):425-31.
22. Lee CM, Huxley RR, Wildman RP,Woodward M. Indices of abdominal obesity are better discriminators of cardiovascular risk factors than BMI: a meta-analysis. Journal of Clinical Epidemiology 2008; 61(7):646-53.
23. Sargowo, D, Andarini S. The Relationship Between Food Intake and Adolescent Metabolic Syndrome. Jurnal Kardiologi Indonesia 2011;32(1):14-23.
24. Thekkethil P, Nedungadi, Deborah J, Clegg. Sexual dimorphism in body fat distribution and risk for cardiovascular disease. Journal of Cardiovascular 2009; 2:321-7.
25. Rahma HH. Wirjatmadi RB. Hubungan Asupan Zat Gizi Makro dan Profil Lipid Dengan Kejadian Penyakit Jantung Koroner Pada Pasien Lansia di Rumah Sakit Islam Jemusari Surabya. Media Gizi Indonesia 2017;12(2):129-33.
26. Zuraida R. Faktor Risiko Pola Makan dan Hubunganya dengan Penyakit Jantung Pada Pria dan Wanita Dewasa di Provinsi Lampung. Jurnal Kedokteran Unila 2015;5(9):18-22.