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RESEARCH PAPER

Association of high-density lipoprotein profile with cardiovascular risk factors in metabolic syndrome patients

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Abstract

Cardiovascular disease is the number one cause of death in Indonesia. The increased risk of cardiovascular disease in obese patients is largely due to dyslipidemia. One of the important lipid profiles to observe is high-density lipoprotein (HDL). One form of early prevention that can be done is to predict the risk of cardiovascular disease in the future. The research wanted to determine the relationship of HDL profile with cardiovascular risk factors in patients with metabolic syndrome. The research design was cross-sectional. The research location used in this study was around the Surabaya area starting in March-June 2022. The research location was carried out in Rungkut District, Surabaya, Indonesia. The variables of this study were the risk of cardiovascular disease and HDL levels. Samples of patients at Siti Khodijah Throughout Hospital who met the criteria, among others: age 18-60 years and willing to follow all research procedures. The sampling technique used was purposive sampling. Subjects who met the criteria were then asked to fill out an informed consent. Subjects assessed the risk of cardiovascular disease with the Framingham Risk Score (FRS). Test the relationship between the risk of cardiovascular disease with HDL levels with Rank Spearman. The number of respondents involved in the study was 37 people. Most of the respondents have low HDL scores and high cardiovascular risk (12 people). The value of the Spearman correlation coefficient was 0.897, indicating that there was a relationship between the HDL profile and cardiovascular risk of 89.7%. The relationship between HDL profile with cardiovascular risk was strong, HDL values were associated with cardiovascular risk. Therefore, a patient with metabolic syndrome should pay more attention to the HDL value to prevent cardiovascular-related comorbidities.

1. Introduction

In the modern era, there is a change in people's consumption patterns which has an impact on increasing the prevalence of cardiovascular disease and the high cost of treatment due to cardiovascular disease which continues to increase (Joseph *et al*., 2017). Cardiovascular disease is the number one cause of death in Indonesia (Komalasari *et al*., 2019). Metabolic syndrome is a group of metabolic disorders in individuals that are associated with an increased risk of cardiovascular disease. The prevalence of metabolic syndrome has increased rapidly by 20-25% (Soleha and Bimandama, 2016).

Metabolic syndrome is closely related to atherosclerosis, which is a major cause of cardiovascular disease and accounts for 50% of all deaths. Important factors causing atherosclerosis are environmental and genetic (Wang *et al*., 2016). Cardiovascular disease is one of the leading causes of death worldwide, which is related socio-demographically, to increasing age, gender, and education (Ruan *et al*., 2018). Primary prevention of cardiovascular disease can be accomplished by identifying risk factors early so that targeted treatment can be effective in reducing the incidence of cardiovascular disease in high-risk individuals (Stewart *et al*., 2017; Adams *et al*., 2018).

Dyslipidemia is a cause of increased risk of cardiovascular disease in obesity, and as much as 50% of obese patients will experience dyslipidemia in the future (Spannella *et al*., 2019). One of the important lipid profiles to observe is HDL, which has an important role as an atheroprotection in the process of reverse

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cholesterol transport (RCT). Every 1 mg/dL decrease in HDL can lead to a 3-4% increase in cardiovascular risk (Ouimet *et al*., 2019).

Someone who has high-risk factors requires early prevention of asymptomatic cardiovascular disease. One of the most commonly used ways to predict the risk of cardiovascular disease in the future is the risk score FRS (Framingham Risk Score) (Jahangiry *et al*., 2017; Bavarsad *et al*., 2020). FRS is a calculation of the risk of atherosclerotic cardiovascular disease in the next 10 years for classic cardiovascular risk determinants such as age, gender, hypertension, diabetes mellitus, smoking, obesity, physical activity, and blood cholesterol levels (Jahangiry *et al*., 2017; Bavarsad *et al*., 2020). Therefore, this study wanted to determine the relationship of HDL profile with cardiovascular risk factors in patients with metabolic syndrome.

2. Materials and methods

2.1 Research design

The research design was cross-sectional. The research was carried out in Rungkut District, Surabaya, Indonesia between March to June 2022.

2.2 Research variable

The variables of this study were the risk of cardiovascular disease and HDL levels. Metabolic syndrome is a group of health disorders that occur together. A person is said to have metabolic syndrome if he experiences at least three of the five conditions, namely hypertension, hypercholesterolemia, high triglycerides, diabetes, and obesity. Cardiovascular risk and atherosclerosis were assessed from the Framinghan Risk Score.

2.3 Population and research sample

The population was all patients with at least three of the five conditions, namely hypertension, hypercholesterolemia, high triglycerides, diabetes and obesity (BMI 25 kg/m^2). Samples of patients at Siti Khodijah Throughout Hospital who met the criteria, among others: age 18-60 years and willing to follow all research procedures. The sample size in this study was calculated based on the formula: n=N/[(1+N)/e2], where; n = number of samples needed in the study; N = number of a population; e = error rate of the sample in the study (5%). The minimum number of samples was 31 people. The sampling technique used was purposive sampling.

2.4. Research methods and analysis

Subjects who met the criteria were then asked to fill out an informed consent. Subjects assessed the risk of cardiovascular disease with the Framingham Risk Score (FRS). Test the relationship between the risk of cardiovascular disease with HDL levels with Rank Spearman (ordinal data scale).

3. Results and discussion

The number of respondents involved in the study was 37 people. Most of the respondents were male (91.89%). The highest age range was early adulthood with 13 people (35.14%) and late adulthood with 13 people (35.14%), and an average of 36.71 years. All respondents had a BMI above normal and the majority were obese (72.97%). HDL values that were below the normal range were 19 people (51.35%). Cardiovascular risk with the FRS (Framingham risk score) assessment from the respondents was high (54.05%) and intermediate (45.95%) (Table 1).

Table 1. Characteristics of respondents.

Characteristics	N (37)	%
Gender		
Male	34	91.89
Female	3	8.11
Age (years), mean ± SD	36.71±8.99	
Late adolescence (17-25)	4	10.81
Early adulthood (26-35)	13	35.14
Late adulthood (36-45)	13	35.14
Early seniors (46-55)	7	18.92
BMI (body mass index)		
Overweight (23.0-29.9)	10	27.03
Obesity (≥30)	27	72.97
Average	32.2	
HDL Level (mg/dL)		
Normal (45-60)	18	48.65
Low (>45)	19	51.35
Average	45.45	
FRS (%)		
High (≥20)	20	54.05
Intermediate (10-19)	17	45.95
Low (<10)	0	0.00

One of the proatherogenic effects of obesity is dyslipidemia and more than 50% of obese patients will experience dyslipidemia. This will affect the risk of cardiovascular disease which continues to increase in obese patients (Spannella *et al*., 2019). The prominent dyslipidemia in obesity is low HDL levels (Zhang *et al*., 2019). Indonesia is one of the countries in the Asia Pacific which ranks 3rd with an HDL value <40 mg/dL with a prevalence of 23-66% (Lin *et al*., 2018). The binding of cardiovascular risk in patients with metabolic syndrome was exacerbated by the sedentary lifestyle of today's society, such as low physical activity (Lorensia *et al*., 2021; Lorensia *et al*., 2022), smoking habits

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(Lorensia, Pratama and Hersandio *et al*., 2021), and weight gain (Suryadinata *et al*., 2020).

Food intake can cause varied responses to plasma lipid levels between individuals caused by genetic factors (Huo *et al*., 2013; Hannon *et al*., 2020). One of the important genes in lipid homeostasis is peroxisome proliferator-activated receptor Alpha (PPAR-α). PPAR-α is one of the important genetic factors because it functions as a major regulator of fatty acid metabolism, lipoproteins, and energy balance (Azhar, 2010). PPAR-α activation can be carried out by natural and synthetic ligands. PPAR-α activation using synthetic ligands (fibrates) to increase HDL efficiently is still limited (Han *et al*., 2017).

The cross-tabulation between HDL level and cardiovascular risk can be seen in Table 2. Most of the respondents have low HDL scores and high cardiovascular risk (12 people) (Table 2). The value of the Spearman correlation coefficient was 0.897, indicating that there was a relationship between the HDL profile and cardiovascular risk of 89.7%. The relationship between HDL profile with cardiovascular risk was strong, HDL values were associated with cardiovascular risk.

Table 2. Cross tabulation between HDL level and cardiovascular risk.

HDL Level (mg/dL)	Framingham risk score (FRS)		Total
	High (≥20)	Intermediate (10-19)	
Normal (45-60)	8	10	18
Low (>45)	12	7	19
TOTAL	20	17	37

Previous research demonstrated that HDL function plays a much more important role in atheroprotective effects than HDL-C levels. Plasma HDL is a heterogeneous group of particles with diverse structures and biological activities, and very high levels of HDL-C are not always protective. HDL functionality depends on genetic, environmental, and lifestyle factors and can be modified in several disease states. Increases HDL functionality and potentially reduces cardiovascular risk (Kosmas *et al*., 2018). In addition, other studies that also support the relationship between HDL levels and cardiovascular risk, namely the Framingham study and other studies that followed it could show that HDL-C is an independent cardiovascular risk factor and that elevated HDL-C (Ali *et al*., 2012; Bartlett *et al*., 2016; Farrer, 2018; Hedayatnia *et al*., 2020).

4. Conclusion

There was a strong relationship between HDL profile with cardiovascular risk factors in metabolic syndrome patients. Therefore, a patient with metabolic syndrome should pay more attention to the HDL value to prevent cardiovascular-related comorbidities.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgments

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The effect of oyster mushroom (*Pleurotus ostreatus*) beta-glucan extract on brain-derived neurotrophic factor and neuron in high-fat-high-fructose diet-induced male Sprague Dawley rats was evaluated by Nastiti *et al.*

Effect of combination of germinated brown rice and oyster mushroom on the inflammatory response and glycemic control in hyperglycemic aged rat model

Andarini S., Maulidiana A.R., Rahmawati I.S. and Handayani D.

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The effect of combination of germinated brown rice and oyster mushroom on the inflammatory response and glycemic control in hyperglycemic aged rat model was studied by Andarini *et al.*

Chemical composition and organoleptic evaluation of steamed sponge cake made of composite wheat and edamame bean flour (*Glycine max* (L.) *Merr.*) for pregnant women

Kurniawati, A.D., Rofiuddzikri, B., Amalia, R., Salsabila, E.H., Agustin, I.R., Tsuraya, A.H., Millania, D.N., Rahmawati, I.R., Rahmi, Y., Ventianingsih, A.D.I., Harti, L.B., Maulidiana, A.R., Wani, Y.A. and Arfiani, E.P.

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Kurniawati *et al.* evaluated the chemical composition and organoleptic properties of steamed sponge cake made of composite wheat and edamame bean flour (*Glycine max* (L.) *Merr.*) for pregnant women.

Brown rice-based diet substitution to improve gut microbiota profile, short-chain fatty acid levels, and metabolic markers of type 2 diabetes patients

Samichah, Sulistyowati, E., Andarini, S., Rudijanto, A., Kusumastuty, I. and Handayani, D.

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Samichah *et al.* studied on the substitution of brown rice-based diet to improve gut microbiota profile, short-chain fatty acid levels, and metabolic markers of type 2 diabetes patients.

Brown rice improves dietary inflammatory index score, fasting blood glucose level and tumour necrosis factor alpha in diabetes mellitus patients

Nugroho, F.A., Latif, A.N.H., Utami, R.W., Kusumastuty, I., Cempaka, A.R. and Handayani, D.

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Nugroho *et al.* studied on brown rice to improve dietary inflammatory index score, fasting blood glucose level and tumour necrosis factor alpha in diabetes mellitus patients.

Energy density, nutrient density and nutrient-to-price ratio of Indonesian foods

Rahmawati, W., Wirawan, N.N., Fahmi, I., Cempaka, A.R. and Andarini, S.

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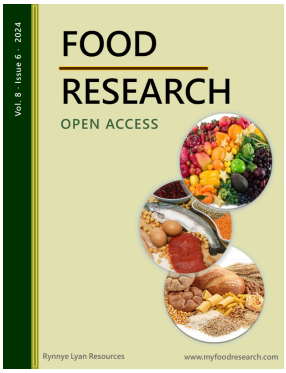

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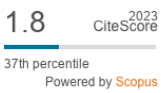

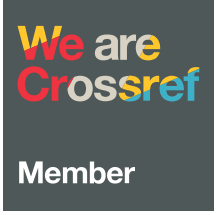

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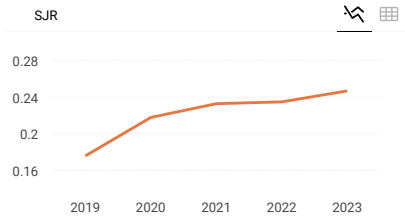

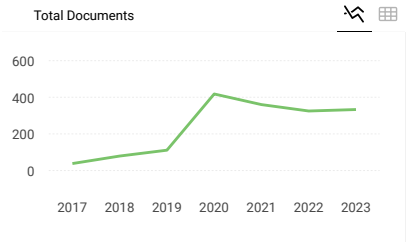

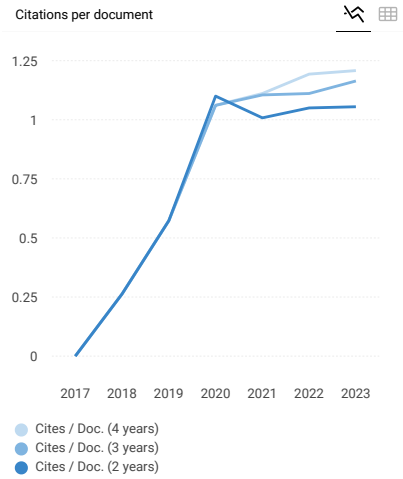

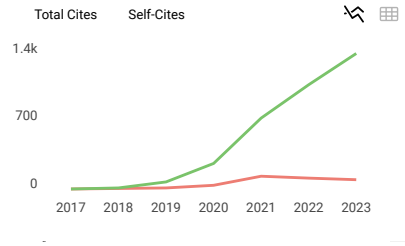

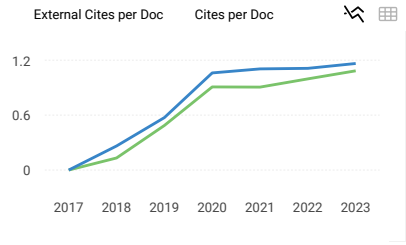

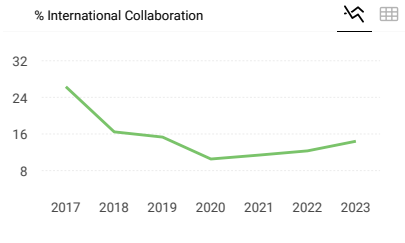

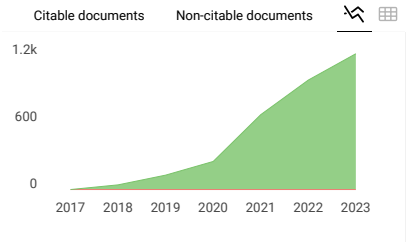

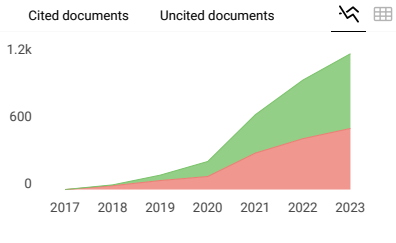

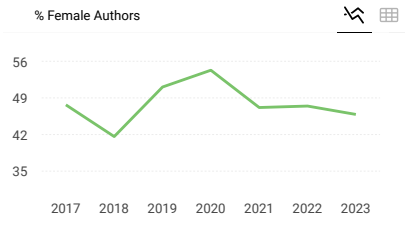

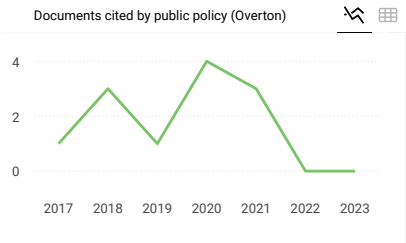

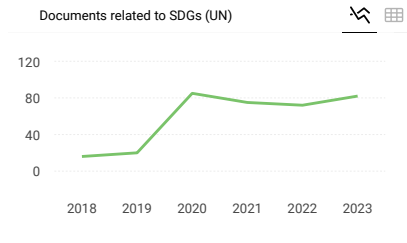

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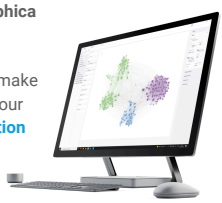

Metrics based on Scopus® data as of March 2024

Tai Ngo Van 3 years ago

Dear Mr/Mrs,
I am Ngo Van Tai, a researcher in Thailand. I would like to ask the current index status as SJR is a static image of Food Research journal (ISSN: 2550-2166).
Thanks for your support.
Best regards,

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Tai Ngo Van, thank you very much for your comment. We suggest you consult the Scopus database directly. Keep in mind that the SJR is a static image (the update is made one time per year) of a database (Scopus) which is changing every day.
The Scopus' update list can also be consulted here:
https://www.elsevier.com/solutions/scopus/how-scopus-works/content
Best Regards, SCImago Team

S **Syamsul Rahman** 3 years ago

Please enlighten me, if searching on Scopus Food Research it says 22% it means you are in Q4, but on the Food Research page it says Q3 with SJR 0.2

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Syamsul,
Thank you for contacting us.
As you probably already know, our data come from Scopus, they annually send us an update of the data. This update is sent to us around April / May every year.
The calculation of the indicators is performed with the copy of the Scopus database provided to us annually. However, the methodology used concerning the distribution of Quartiles by Scopus is different from the one used by SCImago.
For every journal, the annual value of the SJR is integrated into the distribution of SJR values of all the subject categories to which the journal belongs. There are more than 300 subject categories. The position of each journal is different in any category and depends on the performance of the category, in general, and the journal, in particular. The distribution by Quartiles cannot be considered over the journals' total amount within a Category. In the case of SCImago, the distribution has to be considered with the formula Highest-SJR minus Lowest-SJR divided into four.
Best Regards,
SCImago Team

T **Tamiur Yazew** 3 years ago

Dear,

Thank you for your updated and quality journal.

I have submitted two manuscripts in the Food research journal. The editor of this journal sent me the acceptance letter for the two manuscripts. Howevver, they asked me to pay charge for the manuscripts. I am also working as a revierwer of this journla. I have edite two papers and sent it the editor. I am currently revewing a paper and it is ready to send back to the editor of this journal.

But I am from poor country, Ethiopia and I am unable to pay it. the condition in Ethiopia may also not allow me due to lack accessibility of this 150 USD.

So, please would you hel me by considering my issue into considerartion!

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Tamiur, thank you very much for your comment. Unfortunately, we cannot help you with your request, we suggest you contact the journal's editorial staff so they could inform you more deeply. Best Regards, SCImago Team

K **Kamal** 4 years ago

Hi, Editorial Team members,
I would like to know the topic related to the "hygienic practices along the supply chain of fisheries" is considered or not to review of your Journal. Early response is highly appreciated

reply

SCImago Team

Melanie Ortiz 4 years ago

Dear Kamal,
thank you for contacting us.
We are sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.
Unfortunately, we cannot help you with your request, we suggest you visit the journal's homepage or contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

Y **yani purbanang** 4 years ago

Hi,
This journal is written with Scopus index from 2017-2019, What is the index status in 2021 ??
Thank you for your explanation

reply

SCImago Team

Melanie Ortiz 4 years ago

Dear Yani,
Thank you very much for your comment.
All the metadata have been provided by Scopus /Elsevier in their last update sent to SCImago, including the Coverage's period data. The SJR for 2019 was released on 11 June 2020. We suggest you consult the Scopus database directly to see the current index status as SJR is a static image of Scopus, which is changing every day.
Best Regards, SCImago Team

S **Sigit Susanto** 4 years ago

Whether the supply chain on Runner products could be submitted to this FR Journal?thanks very much

reply

SCImago Team

Melanie Ortiz 4 years ago

Dear Sigit,
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Best Regards, SCImago Team

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Association of high-density lipoprotein profile with cardiovascular risk factors in metabolic syndrome patients

by Amelia Lorensia

Submission date: 09-Dec-2024 03:46PM (UTC+0700)
Submission ID: 2546081750
File name: ia_Lorensia_Association_of_high-density_lipoprotein_profile.docx (39.68K)
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FOOD RESEARCH

RESEARCH PAPER

Association of high-density lipoprotein profile with cardiovascular risk factors in metabolic syndrome patients

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Abstract

Cardiovascular disease is the number one cause of death in Indonesia. The increased risk of cardiovascular disease in obese patients is largely due to dyslipidemia. One of the important lipid profiles to observe is high-density lipoprotein (HDL). One form of early prevention that can be done is to predict the risk of cardiovascular disease in the future. The research wanted to determine the relationship of HDL profile with cardiovascular risk factors in patients with metabolic syndrome. The research design was cross-sectional. The research location used in this study was around the Surabaya area starting in March-June 2022. The research location was carried out in Rungkut District, Surabaya, Indonesia. The variables of this study were the risk of cardiovascular disease and HDL levels. Samples of patients at Siti Khodijah Throughout Hospital who met the criteria, among others: age 18-60 years and willing to follow all research procedures. The sampling technique used was purposive sampling. Subjects who met the criteria were then asked to fill out an informed consent. Subjects assessed the risk of cardiovascular disease with the Framingham Risk Score (FRS). Test the relationship between the risk of cardiovascular disease with HDL levels with Rank Spearman. The number of respondents involved in the study was 37 people. Most of the respondents have low HDL scores and high cardiovascular risk (12 people). The value of the Spearman correlation coefficient was 0.897, indicating that there was a relationship between the HDL profile and cardiovascular risk of 89.7%. The relationship between HDL profile with cardiovascular risk was strong, HDL values were associated with cardiovascular risk. Therefore, a patient with metabolic syndrome should pay more attention to the HDL value to prevent cardiovascular-related comorbidities.

1. Introduction

In the modern era, there is a change in people's consumption patterns which has an impact on increasing the prevalence of cardiovascular disease and the high cost of treatment due to cardiovascular disease which continues to increase (Joseph *et al.*, 2017). Cardiovascular disease is the number one cause of death in Indonesia (Komalasari *et al.*, 2019). Metabolic syndrome is a group of metabolic disorders in individuals that are associated with an increased risk of cardiovascular disease. The prevalence of metabolic syndrome has increased rapidly by 20-25% (Soleha and Bimandama, 2016).

Metabolic syndrome is closely related to atherosclerosis, which is a major cause of cardiovascular disease and accounts for 50% of all deaths. Important factors causing atherosclerosis are environmental and genetic (Wang *et al.*, 2016). Cardiovascular disease is one of the leading causes of death worldwide, which is related socio-demographically, to increasing age, gender, and education (Ruan *et al.*, 2018). Primary prevention of cardiovascular disease can be accomplished by identifying risk factors early so that targeted treatment can be effective in reducing the incidence of cardiovascular disease in high-risk individuals (Stewart *et al.*, 2017; Adams *et al.*, 2018).

Dyslipidemia is a cause of increased risk of cardiovascular disease in obesity, and as much as 50% of obese patients will experience dyslipidemia in the future (Spannella *et al.*, 2019). One of the important lipid profiles to observe is HDL, which has an important role as an atheroprotection in the process of reverse

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cholesterol transport (RCT). Every 1 mg/dL decrease in HDL can lead to a 3-4% increase in cardiovascular risk (Ouimet *et al*., 2019).

Someone who has high-risk factors requires early prevention of asymptomatic cardiovascular disease. One of the most commonly used ways to predict the risk of cardiovascular disease in the future is the risk score FRS (Framingham Risk Score) (Jahangiry *et al*., 2017; Bavarsad *et al*., 2020). FRS is a calculation of the risk of atherosclerotic cardiovascular disease in the next 10 years for classic cardiovascular risk determinants such as age, gender, hypertension, diabetes mellitus, smoking, obesity, physical activity, and blood cholesterol levels (Jahangiry *et al*., 2017; Bavarsad *et al*., 2020). Therefore, this study wanted to determine the relationship of HDL profile with cardiovascular risk factors in patients with metabolic syndrome.

2. Materials and methods

2.1 Research design

The research design was cross-sectional. The research was carried out in Rungkut District, Surabaya, Indonesia between March to June 2022.

2.2 Research variable

The variables of this study were the risk of cardiovascular disease and HDL levels. Metabolic syndrome is a group of health disorders that occur together. A person is said to have metabolic syndrome if he experiences at least three of the five conditions, namely hypertension, hypercholesterolemia, high triglycerides, diabetes, and obesity. Cardiovascular risk and atherosclerosis were assessed from the Framinghan Risk Score.

2.3 Population and research sample

The population was all patients with at least three of the five conditions, namely hypertension, hypercholesterolemia, high triglycerides, diabetes and obesity (BMI 25 kg/m^2). Samples of patients at Siti Khodijah Throughout Hospital who met the criteria, among others: age 18-60 years and willing to follow all research procedures. The sample size in this study was calculated based on the formula: n=N/[(1+N)/e2], where; n = number of samples needed in the study; N = number of a population; e = error rate of the sample in the study (5%). The minimum number of samples was 31 people. The sampling technique used was purposive sampling.

2.4. Research methods and analysis

Subjects who met the criteria were then asked to fill out an informed consent. Subjects assessed the risk of cardiovascular disease with the Framingham Risk Score (FRS). Test the relationship between the risk of cardiovascular disease with HDL levels with Rank Spearman (ordinal data scale).

3. Results and discussion

The number of respondents involved in the study was 37 people. Most of the respondents were male (91.89%). The highest age range was early adulthood with 13 people (35.14%) and late adulthood with 13 people (35.14%), and an average of 36.71 years. All respondents had a BMI above normal and the majority were obese (72.97%). HDL values that were below the normal range were 19 people (51.35%). Cardiovascular risk with the FRS (Framingham risk score) assessment from the respondent was high (54.05%) and intermediate (45.95%) (Table 1).

Table 1. Characteristics of respondents.

Characteristics	N (37)	%
Gender		
Male	34	91.89
Female	3	8.11
Age (years), mean ± SD	36.71±8.99	
Late adolescence (17-25)	4	10.81
Early adulthood (26-35)	13	35.14
Late adulthood (36-45)	13	35.14
Early seniors (46-55)	7	18.92
BMI (body mass index)		
Overweight (23.0-29.9)	10	27.03
Obesity (≥30)	27	72.97
Average	32.2	
HDL Level (mg/dL)		
Normal (45-60)	18	48.65
Low (>45)	19	51.35
Average	45.45	
FRS (%)		
High (≥20)	20	54.05
Intermediate (10-19)	17	45.95
Low (<10)	0	0.00

One of the proatherogenic effects of obesity is dyslipidemia and more than 50% of obese patients will experience dyslipidemia. This will affect the risk of cardiovascular disease which continues to increase in obese patients (Spannella *et al*., 2019). The prominent dyslipidemia in obesity is low HDL levels (Zhang *et al*., 2019). Indonesia is one of the countries in the Asia Pacific which ranks 3rd with an HDL value <40 mg/dL with a prevalence of 23-66% (Lin *et al*., 2018). The binding of cardiovascular risk in patients with metabolic syndrome was exacerbated by the sedentary lifestyle in today's society, such as low physical activity (Lorensia *et al*., 2021; Lorensia *et al*., 2022), smoking habits

https://doi.org/10.26656/fr.2017.8(S6).6

(Lorensia, Pratama and Hersandio *et al*., 2021), and weight gain (Suryadinata *et al*., 2020).

Food intake can cause varied responses to plasma lipid levels between individuals caused by genetic factors (Huo *et al*., 2013; Hannon *et al*., 2016). One of the important genes in lipid homeostasis is peroxisome proliferator-activated receptor Alpha (PPAR-α). PPAR-α is one of the important genetic factors because it functions as a major regulator of fatty acid metabolism, lipoproteins, and energy balance (Azhar, 2010). PPAR-α activation can be carried out by natural and synthetic ligands. PPAR-α activation using synthetic ligands (fibrates) to increase HDL efficiently is still limited (Han *et al*., 2017).

The cross-tabulation between HDL level and cardiovascular risk can be seen in Table 2. Most of the respondents have low HDL scores and high cardiovascular risk (12 people) (Table 2). The value of the Spearman correlation coefficient was 0.897, indicating that there was a relationship between the HDL profile and cardiovascular risk of 89.7%. The relationship between HDL profile with cardiovascular risk was strong, HDL values were associated with cardiovascular risk.

Table 2. Cross tabulation between HDL level and cardiovascular risk.

HDL Level (mg/dL)	Framingham risk score (FRS)		Total
	High (≥20)	Intermediate (10-19)	
Normal (45-60)	8	10	18
Low (>45)	12	7	19
TOTAL	20	17	37

Previous research demonstrated that HDL function plays a much more important role in atheroprotective effects than HDL-C levels. Plasma HDL is a heterogeneous group of particles with diverse structures and biological activities, and very high levels of HDL-C are not always protective. HDL functionality depends on genetic, environmental, and lifestyle factors and can be modified in several disease states. Increases HDL functionality and potentially reduces cardiovascular risk (Kosmas *et al*., 2018). In addition, other studies that also support the relationship between HDL levels and cardiovascular risk, namely the Framingham study and other studies that followed it could show that HDL-C is an independent cardiovascular risk factor and that elevated HDL-C (Ali *et al*., 2012; Bartlett *et al*., 2016; Farrer, 2018; Hedayatnia *et al*., 2020).

4. Conclusion

There was a strong relationship between HDL profile with cardiovascular risk factors in metabolic syndrome patients. Therefore, a patient with metabolic syndrome should pay more attention to the HDL value to prevent cardiovascular-related comorbidities.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgments

Thank you to the Ministry of Education, Culture, Research, and Technology for funding as a funder in the Master Thesis Research grant.

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