Original article:

Vitamin E and Fiber Intake with HDL and LDL Levels in Overweight Female Students at Islamic Boarding School University

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Abstract

Background: Excess fat will trigger a pathogenic response in adipose and adipocyte tissue. Characterized by an increase or decrease in lipid fractions in blood plasma. An alternative effort to normalize lipid fraction abnormalities in the blood is by regulating intake of micronutrients (vitamin E and fiber). Vitamin E is known as a fat-soluble antioxidant and soluble fiber in the small intestine will form a gel that acts as a fat binder so that blood lipid profile levels will decrease. ***Objective:*** To see the relationship between vitamin E and fiber intake with HDL and LDL levels in overweight female students ***Methods:*** This cross-sectional study was conducted with 50 samples using purposive sampling techniques, namely students of Universitas Darussalam Gontor who met the inclusion and exclusion criteria. Fiber and vitamin E intake were obtained using the Semiquantitative Food Frequency Questionnaire (SQ-FFQ). HDL and LDL levels are obtained from the results of blood tests. ***Results:*** Our results showed a significant relationship between fiber intake with HDL levels with a p value of 0.009 and vitamin E intake with LDL levels with a p value of 0.000 While fiber intake with LDL levels did not have a significant relationship, as well as the relationship between vitamin E intake and HDL levels. ***Conclusion:*** Our data suggests that overweight persons should increase consumption of fiber and vitamin E to improve their blood lipid profile.

Keywords: Fiber, vitamin E, HDL, LDL, overweight female

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Introduction

The world faces major nutritional and public health challenges, one of which is the problem of being overweight.[1] More than 1.9 billion people over the age of 18 are overweight. In Indonesia, the incidence of being overweight has increased significantly from 2017 by 8.6% to 13.6% in 2018.[2] With more weight indicators, namely BMI 25.1 to <27.0. Based on data obtained from Riskesdas, East Java Province, there were 10.9% of the population overweight in 2013 which increased to 13.75% in 2018.[3] The situation when a person is overweight is left will end up increasing the accumulation of adipose tissue and causing obesity.[4]

Excess fat will trigger a pathogenic response in adipose and adipocyte tissue.[5] Characterized by an increase or decrease in lipid fractions in blood plasma. lipid fraction abnormalities that occur when there is an increase in total cholesterol, triglycerides, and LDL levels, and a decrease in HDL levels. The lipid profile in the blood consists of various fractions including total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, and triglycerides (TG).[6]

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An alternative effort to normalize lipid fraction abnormalities in the blood is by regulating micronutrient intake.[7] These nutrients include vitamin E and fiber. Vitamin E is known as a fat-soluble antioxidant, antioxidants have a positive effect related to oxidative stress, which is a process related to overweight, cardiovascular changes, and degenerative diseases, by suppressing insulin resistance.[8] In addition, the benefits of antioxidants can inhibit the oxidation process. Low intake of vitamin E can results in decreased production of nitric oxide which will affect decreased vasodilating ability when antioxidant levels are greater than free radicals, cholesterol and fat found in blood vessels will easily experience oxidation.[9] According to research, the soluble fiber in the small intestine will form a gel that acts as a binder for fat, cholesterol, and bile acids, resulting in bile acids in the liver decreases, then the liver will pull cholesterol from the blood to produce bile acids so that blood cholesterol levels will decrease.[10] That means dietary fiber intake has an influence on cholesterol levels in blood plasma. Based on the above observations, we proposed this study to see the relationship between vitamin E and fiber intake with HDL and LDL levels in overweight female students of Universitas Darussalam Gontor, Indonesia, which is a leading private university. The majority are female students coming from families with middle to upper social status and having a modern lifestyle; hence, it is assumed to have a fairly high risk of overweight. Moreover, no such study has ever been conducted on overweight students of the country.

Methods

This cross-sectional, observational study was conducted, between October 2022 and February 2023, at University of Darussalam Gontor, Indonesia. Blood sample examination was carried out at Widodo Medika laboratory, Ngawi, Indonesia. In this study, purposive sampling techniques will be used, namely students of Universitas Darussalam Gontor Putri Campus who meet the inclusion and exclusion criteria. the sample became 50 people.

The tool used is a GEA medical digital scale type EB 9360 to measure weight. Portable statiometer to measure height was used to determine the nutritional status of respondents. Vitamin E and fiber intake by interviewing using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) form to determine micronutrient intake, then calculated using nutrisurvey software, selection of food ingredients based on food available at Darussalam Gontor University, Indonesia. SQ-FFQ data converted into average frequency, and anthropometric measurements to determine categories classified as overweight.

During blood draw, respondents were satisfied 8-10 hours before data collection and blood samples for lipid profile examination, then could only drink water until the time of data collection the next day. Blood tests are carried out by Widodo Medika clinical laboratory officers. After that, the blood is put into a test tube, then taken to the laboratory of Widodo Medika Ngawi. Each blood sample was taken as much as 3cc from any convenient vein. Examination of HDL and LDL levels using the Pictus 400 Diatron Clinical Chemistry Analyzer. The reagents used in this examination used the seimitzu brand.

Results

Table 1 shows that only 14% of the participants had enough intake of vitamin E, while only 12% had enough fiber intake. Among the participants, 28% had abnormal HDL levels and 58% had abnormal LDL levels in blood. Table 2 shows that

Table 1. Distribution of respondents based on intake of fiber, vitamin E, HDL, LDL, and overweight students

Characteristics	Frequency	Percentage
Vitamin E intake		
Enough	7	14
Less	43	86
Fiber intake		
Enough	6	12
Less	44	88
HDL levels		
Normal (HDL levels >60 mg/dL)	36	72
Abnormal (HDL levels <50 mg/dL	14	28
LDL levels		
Normal (LDL levels <100mg/dL)	21	42
Abnormal (LDL levels ≥100 mg/dL	29	58

female students who had normal HDL levels with adequate vitamin E intake were 6 subjects (85.7%). There was no relationship between vitamin E intake and HDL levels (p>0.05). Meanwhile, female students who had normal HDL levels with sufficient fiber intake were 11 subjects (52.4%). There was an association between fiber intake and HDL levels (p<0.05). Table 3 shows that female students who had abnormal LDL levels with less vitamin E intake were 43 subjects (100%). There was a relationship between vitamin E intake and LDL levels (p<0.05). Meanwhile, female students who had abnormal LDL levels with less fiber intake were as many as 24 subjects (82.8%). There was no relationship between fiber intake and LDL levels (p>0.05).

Table 2. Analysis of the relationship between vitamin E and fiber intake with HDL levels

		HDL levels				p-value
		Normal		Abnormal		
		Frequency	Percentage	Frequency	Percentage	
Vitamin E intake						
	Enough	6	85,7	1	14,3	0.384
	Less	30	69,8	13	30,2	
Fiber intake						
	Enough	11	52,4	10	47,6	0.009
	Less	25	86,2	4	13,8	

Chi-square test was done to reach p-value.

Table 3. Analysis of the relationship between vitamin E and fiber intake and LDL levels

		LDL levels				p-value
		Normal		Abnormal		
		Frequency	Percentage	Frequency	Percentage	
Vitamin E intake						
	Enough	7	100	0	0	0.000
	Less	0	0	43	100	
Fiber intake						
	Enough	2	9,5	19	90,5	0.603
	Less	5	17,2	24	82,2	

Chi-square test was done to reach p-value.

Discussion

The relationship of vitamin E intake with LDL and HDL levels: The study showed that vitamin E intake was statistically significant to LDL levels (p=0.000) with an average vitamin E intake of 7.59 mg/day, while vitamin E intake was not statistically meaningful to HDL. This is in line with Krisnansari as by giving supplementation of vitamin E 400 IU for 20 days in the diet in patients with dyslipidemia. Supplementation of 400 IU of vitamin E significantly improved the LDL cholesterol profile (p=0.000) but had no significant effect on HDL cholesterol.[11] Similarly, Rukamasari found at Slamet Garut Hospital that vitamin C and vitamin E supplementation can reduce total cholesterol, LDL, and triglyceride levels but cannot increase HDL levels (p=0.046).[12]

Vitamin E is a fat-soluble antioxidant. Vitamin E is absorbed in the small intestine by diffusion, vitamin E has no specific carrier proteins in plasma, absorbed vitamin E combines into chylomicrons, which rapidly move to plasma lipoproteins where it binds nonspecifically. Vitamin E is captured by the liver and combines with Very-Low-Density Lipoprotein (VLDL) with the form α-tocopherol, then resecreted.[13] Most of the remaining VLDL-rich triglycerides will return to the liver, some of which are converted by lipoprotein lipase into LDL. During

this process, vitamin E also spontaneously transfers to high-density lipoprotein HDL. Plasma tocopherol is more widely distributed by LDL and HDL.[13]

Vitamin E can increase protection against LDL; hence, it is not easily oxidized. Unoxidized LDL causes an increase in HDL. oxidation of LDL by macrophages, endothelial cells, and smooth muscle as well as by metal ion ions, can be suppressed by the administration of vitamin E.[14] Protection of endothelial cells with vitamin E can markedly reduce their ability to oxidize LDL.[15] According to daily value recommendations, vitamin E intake should be 15g/day, but in this study, vitamin E intake is still less where the average is 7.59 mg/day. There is no relationship between vitamin E intake and HDL levels because respondents rarely consume food sources that contain high antioxidant activity in the form of α-tocopherol compounds such as chickpeas, seeds, peanuts, carrots, and spinach. The results of the study are in line with the results of Rachmawati et al.[16] showing no relationship between vitamin E intake and HDL levels at the Outpatient Installation of Dr. Moewardi Hospital obtained p=0.506. This is because most respondents have vitamin E intake of less than 100%. The average intake of a vitamin E in this study was 9.59 6,503 mg / day. Kurniasari's study[17] also found no relationship between vitamin E intake and HDL levels with p=0.510. This is because the average intake of a vitamin E is 7.27 mg/day with a minimum value of 3 mg / day and a maximum value of 15.4 mg/day.

The relationship of fiber intake with LDL and HDL levels: The study showed that fiber intake was statistically significant to HDL levels (p=0.009) with an average fiber intake of 19.47 g/day, while fiber intake was not statistically meaningful to LDL. This is in line with Wulandari et al.[18] showing that there is a significant difference in HDL cholesterol levels before and after being given red bean yogurt (p=0.000). It can be concluded that the consumption of red bean yogurt at a dose of 225 ml/day for 14 days has a significant effect on HDL cholesterol levels. Evidence showed changes in lipid profile before and after mung bean juice intervention in dyslipidemia patients.[19] The intervention was carried out through of the treatment group given mung bean juice as much as 200 ml 2 times a day for 14 days. The fiber contained in green beans is a water-soluble fiber that binds fat in the intestine, and can reduce blood cholesterol levels by 5% or more. Green bean fat contains 26% saturated fat and 73% unsaturated fatty acids and is safe for consumption in people who are overweight and suffer from heart disease.[20] Orviyanti et al.[21] studied on dyslipidemic rats that were given red bean juice, milk yogurt, and red bean yogurt as much as 4 ml for 28 days, red bean juice and milk yogurt can increase HDL cholesterol levels. This is because red beans contain highly resistant starch. Resistant starch can improve lipid profiles because it has both soluble and undissolved fiber properties. Red beans that have been processed will have more antioxidant activity. The process of processing red beans will hydrolyze isoflavones into a free isoflavone compound called aglycon. Aglicone has higher activity in improving the lipid profile.[22] Soluble fiber can lower total and LDL cholesterol compared to insoluble fiber. Dissolved fiber stimulates increased excretion of bile acids into the intestine. This results in the absorption of cholesterol and other fats slowing down, resulting in increased production of short-chain fatty acids by fermentation assisted by colonic bacteria (lactobacillus). These short-chain fatty acids can bind bile acids in the intestine. Reduced bile acids will slow down fat absorption. It can be stated that there is a decrease in cholesterol levels in the blood, especially LDL.[23]

Fruits and vegetables can raise HDL cholesterol and lower LDL cholesterol which can inhibit oxidation; hence, LDL is not able to penetrate artery walls. According to the RDA recommendation fiber intake should be 32g/day, but in this study, fiber intake was still lacking where the average was 19.7g/day. The absence of a relationship between fiber intake and LDL levels is suspected because respondents' fiber intake is still relatively low, the amount of fiber intake to be able to reduce LDL levels and total cholesterol is 20-25 g/day.[24] Yusira[25] stated that there was no significant relationship between fiber intake and LDL levels in CHD patients at Dr. M. Yunus Hospital Bengkulu with p=0.194 results. This is because the patient's fiber intake is relatively low, judging from the results of the 3×24 hour food recall analysis.

Conclusion

Our data suggests that there is no relationship between vitamin E intake with HDL levels; however, vitamin E intake is strongly associated with blood LDL levels in overweight individuals. There is a relationship between fiber intake and HDL levels; however, no relationship was observed between fiber intake and LDL levels. Based on the results of the study, we may suggest for overweight individuals to increase consumption of fiber and vitamin E which can be obtained from vegetables, fruits, and whole grains to improve nutritional status and blood lipid profiles.

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Authors' contribution: AMD conceptualized and designed the study, prepared the draft of the manuscript and reviewed of the manuscript. KP assisted in drafting of the manuscript, reviewed of manuscript. ARF conducted the study, data analysis and interpretation and reviewed the manuscript.

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