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Total Cholesterol Blood Level Based on Isoflavone and Vitamin E Intake in Hypercholesterolemia

Bintanah S, Kusuma HS*, Moeis F, Purwanto AP and Nadia FS

Faculty of Nursing and Health, University of Muhammadiyah Semarang, Kedungmundu Raya Semarang, Indonesia

Abstract

Hypercholesterolemia is a condition whereby the blood cholesterol level exceeds normal values. Cholesterol in food can increase blood cholesterol level; fat, cholesterol, and antioxidant intake are known to have major roles in the progress of coronary heart disease. This study seeks to determine the correlation of isoflavone and vitamin E intake from foodstuffs to total blood cholesterol level in hypercholesterolemia patients. The research uses descriptive analytic methods. Isoflavone and vitamin E intake is recorded for 24 respondents through food recall and food frequency questionnaires. Total blood cholesterol levels for these respondents are then obtained from the medical records of Roemani Muhammadiyah Hospital Semarang. This study uses the Rank-Spearman test. The results are that 66.7% of respondents are male, 37.5% are 45-50 years old, 70.8% have ≥ 80 mg intake of isoflavones, but all respondents have <15 mg intake of vitamin E. There is a significant correlation between isoflavone/vitamin E intake and total blood cholesterol level (p-value=0.000, p-value=0.008). Thus, isoflavones and vitamin E intake may affect total blood cholesterol levels.

Keywords: Hypercholesterolemia; Isoflavone; Total blood cholesterol

Introduction

Cholesterols are complex compounds utilized in the human body to cover various functions such as the production of sex hormones, adrenal cortex hormones, vitamin D, and pancreatic bile that aids fat absorption in the gut. As such, cholesterols are fats that play an important role in bodily functions [1] and cannot be dissolved in blood. Cholesterols are transported to various bodily tissues with the assistance of compounds formed out of fats and proteins, namely lipoproteins [2]. There are two main types of cholesterols produced in the human body: HDL (High Density Lipoprotein) and LDL (Low Density Lipoprotein) [3].

An excess of blood cholesterol is known as hypercholesterolemia [4]. Data from the American Heart Association (AHA) estimates that over 100 million US residents have a relatively high total cholesterol level over 200 mg/dl, while over 34 million adult US residents have total cholesterol levels of over 240 mg/dl, which is high enough to require therapeutic intervention [5]. A public health study in Indonesia in 2013 revealed that 35.9% of residents over 15 years old have higher-than-normal cholesterol levels. In 2009, the Public Health Service of the Central Java Province reported that the prevalence of hypercholesterolemia in their jurisdiction was 26.1% among men and 25.9% among women. Data from the Roemani Muhammadiyah Hospital in Semarang showed that hypercholesterolemia was the 10th most prevalent disease among their outpatients in 2015; their medical records for 2015 had 224 hypercholesterolemia patients with a prevalence of 1.02% [6-10]. In the absence of proper management, hypercholesterolemia can significantly increase the risk of stroke and coronary heart disease [7]. World Health Organization (WHO) data shows that 20% of strokes and over 50% of heart attacks stem from high cholesterol levels. The prevalence in Indonesia increases by 28 percent annually and affects people in the productive age bracket under 40 [11-13].

Hypercholesterolemia treatment to reduce the risk of cardiovascular diseases must involve pharmacological, non-pharmacological, and combined pharmacological/non-pharmacological approaches in order to achieve a more reasonable total cholesterol level below 200 mg/dl, an LDL cholesterol level under 100 mg/dl, and an HDL cholesterol level over 45 mg/dl of blood [12], (Indonesian Cardiovascular Specialists' Associaton, 2013). Non-pharmacological treatments to prevent dyslipidemia include weight control, low-cholesterol diets, regular exercise, and consumption of foodstuffs that contain antioxidants capable of reducing serum cholesterol levels [13]. Research on the best antioxidants against oxidative stress has shown that vitamin E has greater effect than vitamins A and C in reducing fat peroxidation [14]. One early prevention method that can reduce the risk of degenerative and cardiovascular diseases is increasing the intake of natural antioxidants that are relatively affordable, easily available, and non-toxic in addition to having a high anti-atherogenic potential, such as isoflavones and vitamin E. Isoflavones are antioxidants from the flavonoid group (1,2-diarylpropane) with a potential to reduce cholesterol levels. Isoflavones' cholesterol reduction mechanism takes place through the catabolism of fatty cells for energy generation, which increases LDL clearance from the bloodstream and reduces the blood's cholesterol content [15]. Isoflavones consist of genistein, daidzein, and glycitein – soy proteins capable of reducing the risk of cardiovascular diseases by binding blood lipids.

Vitamin E as a fat-soluble antioxidant can donate a hydrogen ion out of the hydroxyl group (OH) in its ring structure to the free radicals of fat peroxidation. The direct reaction between vitamin E and fat peroxidation free radicals forms a more stable and perfectly oxidized tocopheryl (quinine) that reduces the fat peroxidation free radical chain. This cuts off fat peroxidation so that lipid cells are not damaged and would be more easily recognized by the next receptors that would lead to their metabolization in the body's cells, especially in the liver and gut [16].

***Corresponding author:** Hapsari Sulistya Kusuma, Faculty of Nursing and Health, University of Muhammadiyah Semarang, Kedungmundu Raya Semarang, Indonesia, Tel: +6285641536553; E-mail: hapsa31@yahoo.co.id

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The issue raised in this study is the relationship between the intake of isoflavone/vitamin E-rich foodstuffs and total blood cholesterol levels among hypercholesterolemic outpatients at the Roemani Muhammadiyah Hospital, Semarang.

Research Method

This study is an explanatory study that seeks to discover the relationship between the research variables and use cross sectional design. The general aim of this study is to find out the relationship between the intake of isoflavone/vitamin E-rich foodstuffs and total blood cholesterol levels among hypercholesterolemic outpatients at the Roemani Muhammadiyah Hospital, Semarang. This study utilizes the observational method with a cross-sectional approach. The study population consists of all hypercholesterolemia outpatients at the Roemani Muhammadiyah Hospital in Semarang. The 24 research subjects are chosen through simple random sampling according to inclusion criteria (male and female, cholesterol blood level > 200 mg/dl, 45-75 years old, not using contraception, not pregnant). Data on their isoflavone and vitamin E intakes was obtained through food recall and food frequency questionnaires. Food frequency questionnaires are the method to know the frequency of food ingredients consumed. Data on total cholesterol levels was obtained from the medical records of the Roemani Muhamadiyah Hospital, Semarang. The data is then statistically analyzed with the Rank-Spearman method. This study has been approved by the Ethics Committee of the Faculty of Medicine, Diponegoro, Semarang, with approval No. 855 / EC / FK-RSDK / VIII / 2016 [17-20].

Results and Discussion

Characteristics of research subjects

The respondents in this study are hypercholesterolemia subjects/patients with blood cholesterol levels over 200 mg/dl under outpatient care at the Internist's Clinic in the Roemani Muhammadiyah Hospital, Semarang, numbering 24 male and female respondents. The respondent characteristics assessed in the study are sex, age, vitamin E intake, isoflavone intake, and total blood cholesterol level.

Table 1 show that most hypercholesterolemics in the sample are male, numbering 16 subjects (66.7%). The most common age range is 45-50 years with a percentage of 37.5%. These results agree with the study by Ida ayu et al, which found that 64.7% of hypercholesterolemics were male. Increasing age brings reduced elimination of cholesterol through gallbladder bile and also a reduction of the receptor that mediates LDL clearance from blood plasma, thus increasing blood cholesterol level. A rise in cholesterol level along with increasing age also correlates with growth hormone (GH) deficiency since this hormone affects cholesterol metabolism. According to Dinata et al. men over years old with total blood cholesterol levels over 200 mg/dl face a higher risk of contracting cardiovascular diseases such as atherosclerosis. Meanwhile, Lorraine et al explained that atherosclerosis usually occurs over the age of 40 and is clinically defined as ischemia and myocardial disfunction with occlusion of more than 75% of blood vessel lumen. According to Nababan , the risks of cholesterols increase along with increasing age. This indicates that age can affect cholesterol levels; older subjects would tend to have higher total blood cholesterol levels than younger ones.

Characteristics	N	%
Sex		
Male	16	66.7
Female	8	33.3
Total	24	100.,0
Age (years)		
45-50	9	37.5
51-55	7	29.2
56-60	3	12.5
61-70	4	16.7
71-75	1	4.2
Total	24	100.0

Table 1: Characteristics of Research Subjects.

Most (70.8%) respondents had adequate isoflavone intake of ≥80 mg per day. According to Koswara, average isoflavone consumption per day is around 25-45 mg, and this is in line with the evidence for adequate isoflavone intake among this study's subjects. On the other hand, most subjects appear to have inadequate vitamin E intake. Recommended vitamin E sources include apples, celery, bean sprouts, bran, milk, meat, vegetable oils, and yeast (Table 2) [21-26].

Relationship of isoflavone-rich food intake to total blood cholesterol level

The statistical analysis in this study started with a data normality test between isoflavone-rich food intake and total blood cholesterol level. The Shapiro-Wilk test revealed *p*-values of 0.002 for isoflavone intake and 0.031 for total blood cholesterol level, so the data on isoflavone intake and total cholesterol intake are not normally distributed. The correlation test used in the study is the Rank-Spearman nonparametric test, which resulted in r=-0.714 and p-value=0.000 (p-value<0.05). It can be concluded that there is a significant relationship between isoflavone-rich food intake and total blood cholesterol level [26-30].

The average isoflavone intake among respondents is 92.84 ± 20.85 mg per day, with a minimum of 67.72 mg per day and a maximum of 156.89 mg per day. Both male and female respondents tend to consume more than the minimum recommended intake for isoflavone (≥80 mg). According to Koswara, isoflavones in the form of the soy proteins genistein, daidzein, and glycitein are capable of reducing the risk of cardiovascular disease by binding blood lipids [30-34].

Relationship of vitamin E-rich food intake to total blood cholesterol level

The statistical analysis in this study started with a data normality test between vitamin E-rich food intake and total blood cholesterol level. The Shapiro-Wilk test produced a *p*-value of 0.547>0.05 for vitamin E intake so this variable is deemed to have normal distribution, while the *p*-value for total blood cholesterol level is 0.031<0.05 and thus it is not deemed to have normal distribution. The correlation test used in the study is the Rank-Spearman non-parametric test, which produced a p-value of 0.008 (p-value<0.05) with a correlation coefficient (r) of -0.530, which indicates that there is a significant correlation between vitamin E intake and total blood cholesterol level.

The study shows that the average vitamin E consumption among the subjects is 11.4442 ± 1.87 mg per day, with a minimum of 8.45 mg per day and a maximum of 14.75 mg per day. All respondents

Asupan Isoflavon	Jumlah		Rerata Asupan
	N	%	
< 80 mg/hr	7	29.2	92,84 mg±20,86
≥ 80 mg/hr	17	70.8	
Asupan Vitamin E			
< 15 mg	24	100	11,44 mg ±1,88
≥ 15 mg	0	0	

Table 2: Respondents' Isoflavone and Vitamin E Intakes.

experience vitamin deficiency, with the intake among both male and female respondents being less than the recommended daily intake (15 mg/day). According to Muchtadi, vitamin E can act as a scavenger of free radicals that enter the body or are formed in the body in the course of normal metabolic processes.

The results of this study concur with those of Krisnansari et al which indicated a reduction in total blood cholesterol level subsequent to vitamin E supplementation to the tune of 400 IU or 268 mg once per day over 30 days.

All the respondents in this subject consume less vitamin E than the daily recommended intake and most have high total cholesterol levels of >200 mg/dL. This deficiency stems from the respondents' dietary habits, whereby they consume only ½ - 1½ portions per day of important vitamin E sources such as broccoli, cabbages, carrots, cauliflowers, kale, sprouts, spinach, and water spinach. Vitamin E-rich foodstuffs include sunflower oil, peanut oil, margarine, soy oil, sprouts, asparagus, and spinach. However, the consumption of fatty meats and egg yolk is not recommended for hypercholesterolemia and coronary heart disease patients despite the high vitamin E content in these foodstuffs since they also contain large amounts of cholesterol.

Conclusion

The respondents have adequate isoflavone intakes of ≥80 mg/day but inadequate vitamin E intakes of <15 mg/day. Isoflavone and vitamin E intake can affect total blood cholesterol levels.

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