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Effectiveness of Food Cholesterol Detect (FCD) Application on Total Cholesterol Levels of Hypercholesterolemia Patients

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Abstract

High cholesterol levels will cause blockages in blood vessels so that circulation is disrupted. The incidence of hypercholesterolemia is still quite high. The Food Cholesterol Detect application is one of the screening tools that can be used to determine the amount of cholesterol intake consumed through food. The purpose of this study was to determine the effectiveness of using the Food Cholesterol Detect application on the total cholesterol levels of patients with hypercholesterolemia. This research design uses quasi-experiments before and after using the application with a one group pre-post test design. Data analysis used univariate and bivariate analysis to see the relationship between the dependent variable (total cholesterol levels of hypercholesterolemia patients) and the independent variable. The characteristics of respondents were mostly in the age group of 30-49 years, approximately 44.3%,. Most of the hypercholesterolemia patients have normal nutritional status based on BMI, namely (50%). Cholesterol levels are mostly female, namely (62.9%) having high borderline total cholesterol levels of 200-239 mg/dl. Cholesterol intake in food consumed shows that all respondents, both men and women, 100% have a high intake of cholesterol in food ≥ 200 mg / hr. There is a difference in the average total cholesterol levels of hypercholesterolemia patients before using the Food Cholesterol Detect Application, which is 234.432 mg/dl, while after use it is 203.892 mg/dl. There is an effect of the effectiveness of the Food Cholesterol Detect Application on reducing total cholesterol levels.

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INTRODUCTION

Heart disease is often called cardiovascular disease, The Indonesian Ministry of Health (2014) defines cardiovascular disease as a disease with disorders of the heart and blood vessels such as coronary heart disease, heart failure, hypertension and stroke. Heart disease Refers to a group of conditions that affect the normal function of the heart. This condition can affect the heart's ability to heat blood effectively, cause impaired blood circulation, and potentially become a serious threat to health.

Cardiovascular disease requires rapid treatment as it can cause death (1). Cardiovascular risk factors are unhealthy nutrition, dyslipidemia, physical inactivity, hyperglycemia, high blood pressure, obesity, specific population, gender, renal dysfunction, race/ethnicity, thrombosis/smoking, and genetics/family hypercholesterolemia (2). High blood pressure, smoking, stress, overweight/obesity, lack of physical activity and unhealthy diet are also risk factors for cardiovascular events (3).

In Indonesia, the prevalence of cardiovascular disease with sudden death is around 28.8 million and 18 million patients show no symptoms (4). Cardiovascular disease is the leading cause of death in Asia (5). Deaths from cardiovascular diseases are mainly caused by coronary heart disease (6). Age, hypertension, obesity-induced blood pressure, and elevated plasma cholesterol are risk factors for coronary heart disease (7). Hypercholesterolemia is a major risk factor for cardiovascular disease (8). Untreated hypercholesterolemia is associated with a 3.2 times greater risk of death from coronary heart disease compared to the general population (9).

Hypercholesterolemia can markedly increase cardiovascular risk (10). Hypercholesterolemia is an autosomal dominantly inherited genetic disease characterized by an increase in the plasma density of low-density lipoprotein cholesterol (LDL-C) in the blood (11). Hypercholesterolemia can be primary, secondary to disease or multifactorial. The primary form, can be genetic or idiopathic (12). Health professionals recommend a healthy lifestyle, balanced diet and exercise to patients with elevated LDL-c (13). To achieve an optimal healthy life, it is necessary to get used to healthy living behaviors, regular exercise, healthy eating habits, adequate sleep, and smoking cessation (14). A good diet will lower LDL-c and improve overall lipid balance (15). The main problem is that it is difficult to determine the food that should be consumed per day (16).

Total cholesterol levels in the body can be detected using several tools or applications. Generally, it is controlled by using an application that recommends food for web-based hypercholesterolemia patients which is intended for patients to consume dietary foods that are guided by a variety of balanced nutritional foods, by determining nutritional needs only from carbohydrates, protein and fat (17).

There is also a similar application, namely an expert system application for diagnosing data base and web-based cholesterol disease based on the symptoms of the disease felt by the patient (18). Application for wireless non-invasive cholesterol monitoring using smart contact lenses, which enables quantitative recording of cholesterol in tear fluid in real time for monitoring hyperlipidemia patients using smart phones (19). Cholesterol measurement using a non-invasive cholesterol meter using TCRT-5000 sensor (20). The tools/applications used are mostly applications used to see total cholesterol levels in the body without having the advantage of being an early detection tool if someone is indicated to have excess food that is high in cholesterol, determining nutritional status based on BMI and how to prevent it.

The Food Cholesterol Detect application is an application designed by utilizing access to internet usage resulting in changes throughout people's daily lives (21). The pervasive nature of the internet has led to a surge in the need for web-based learning and teaching (22). One of the developments that can be used for smartphones or

laptops is an application in the form of a website. Nowadays, websites are widely used around the world as a medium of information communication (23). A unique, more attractive, and functional website makes it easier to navigate (24). Using the website by typing the intended link in the webbrowser, the application will open immediately (25). *The Food Cholesterol Detect application* has the advantage of providing convenience to people who want to know the foods consumed during the day that contain cholesterol, whether they are in accordance with the recommended nutritional needs or vice versa, and educate what foods are recommended or not besides that it can also determine a person's nutritional status based on BMI (26). The application also provides alerts to reduce the consumption of foods that are high in cholesterol, if excess consumption is detected. The purpose of this study was to determine the effectiveness of the Food Cholesterol Detect Application on Total Cholesterol Levels of Patients with Hypercholesterolemia.

METHODS

This study is a quasi-experimental study, namely the researcher gave direct treatment to the subjects with the aim of determining the total cholesterol levels of hypercholesterolemia sufferers with the Food Cholesterol Detect Application before and after using the Application. The design used is one group pre-post test design. The population taken was hypercholesterolemia sufferers in the working area of the Sabokingking Health Center and the Nagaswidak Health Center, Palembang City, South Sumatra in 2023. Samples were taken using the accidental sampling technique with the following criteria: a) Aged > 20 years; b) Male and female; c) Total cholesterol levels above ≥ 200 mg / dL; d) Not pregnant; e) Not suffering from DM; f) Can communicate well; g) Willing to be a respondent and sign the informed consent.

The tools used in this study were the informed consent form, questionnaire form, Easy Touch GCU Cholesterol Testing Tool, Foot Scale and Microtoise, Food Cholesterol Detect Application. Data on respondent characteristics, total cholesterol levels, cholesterol intake, nutritional status of respondents before and after using the Food Cholesterol Detect Application were analyzed descriptively while the differences in changes in total cholesterol levels, before and after being given treatment were analyzed using the Paired T test parametric test if the data was normally distributed, and the Wilcoxon non-parametric test if the data was not normally distributed.

RESULTS AND DISCUSSION

A. Overview of Respondents

Table 1. Respondents' Characteristics, Nutritional Status, Total Cholesterol Level, Cholesterol Intake in Food

Respondent Characteristics	Male		Female	
	n	%	n	%
Gender				
Total	**4**	**5.4**	**70**	**94.6**
Age (Year)				
19-29	0	0	9	12.9
30-49	1	25	31	44.3
50-64	3	75	28	40
≥ 65	0	0	2	2.9
Body Weight (Kg)				
30-40	0	0	1	1.4
41-50	1	25	13	18.6
51-60	0	0	24	34.3
61-70	1	25	19	27.1
71-80	2	50	13	18.6
Height (cm)				
140-150	0	0	13	18.6
151-160	0	0	47	67.1
161-170	3	75	10	14.3
171-180	1	25	0	0
Nutrition Status				
Very thin	1	25	1	1.4
Skinny	0	0	3	4.3
Normal	3	75	35	50
Fat	0	0	24	34.3
Obesity level I	0	0	5	7.1
Obesity level II	0	0	2	2.9
Total cholesterol level				
Normal < 200 mg/dl	0	0	0	0
Bordeline high 200-239 mg/dl	2	50	44	62.9
High ≥ 240 mg/dl	2	50	26	37.1
Cholesterol intake in the food consumed				
Normal < 200 mg/hr	0	0	0	0
High ≥ 200 mg/hr	4	100	70	100

In this study, the most of respondents were female, namely 70 respondents (94.6%) and male, namely 4 respondents (5.4%). The characteristics of respondents' age showed that most of the respondents were female, totaling 70 people with the highest age range in the first 30-49 years, totaling 31 people (44.3%) The results of this study are in line with those conducted by Sri Ujiani (2015) which showed that there was no significant relationship between gender factors and cholesterol levels. The results of the study Sri Ujiani (2015) also showed that there was no significant relationship between gender factors and cholesterol levels, but women have a greater risk of experiencing increased cholesterol levels (27).

Based on nutritional status, it shows that male respondents who have a very thin nutritional status are 1 respondent (25%), and normal are 3 people (75%). As for female respondents, there is a very thin nutritional status

of 1 respondent (1.4%), and normal are 35 respondnets (50%). Nutritional status is a state of the body that is the end result of the balance between nutrients that enter the body and their use. One way to maintain the nutritional status of adults is to measure the Body Mass Index.

Based on the results of statistical tests obtained p-value of α 0.05 = 0.034. This indicates a relationship between nutritional status according to BMI and cholesterol levels. Based on total blood cholesterol levels, it shows that as many as 2 people (50%) of male respondents have high total cholesterol levels 200-239 mg/dl, and 2 people (50%) others have high total cholesterol levels ≥ 240 mg/dl. Meanwhile, 44 female respondents (62.9%) had high total cholesterol levels of 200-239 mg/dl and 26 people (37.1%) had high total cholesterol levels ≥ 240 mg/dl. While female respondents as many as 44 people (62.9%) had high bordeline total cholesterol levels of 200-239 mg/dl and 26 people (37.1%) had high total cholesterol levels ≥ 240 mg/dl.

The results showed that most respondents (62.9%) had high bordeline total cholesterol levels of 200-239 mg/dl in this study were female. This is in line with research (28) stated that the distribution of cholesterol levels based on gender obtained hypercholesterolemia was more common in women (54.17%). Respondents with high cholesterol are mostly women with threshold high cholesterol levels as much as (53.2%) and high cholesterol levels, namely (46.8%) (29). This gender factor does not have a significant relationship with cholesterol levels but women have a high risk of having high cholesterol levels (30).

B. Average Nutritional Status of Hypercholesterolemia Patients Based on BMI Before and After Using the Food Cholesterol Detection Application

Hypercholesterolemia is a cholesterol level that is above normal ≥200 mg/dl. Based on the research conducted, the minimum, maximum, and average values of nutritional status (BMI) in the group of people with hypercholesterolemia before and after using the Food Cholesterol Detect application were obtained (Table 2).

Table 2. Average Distribution of Patients with Hypercholesterolemia Based on BMI Before and After Using the Food Cholesterol Detect Application

Nutrition Status	Mean ±SD	Minimum	Maksimum
Before	24.768±4.171	14.60	35.68
After	24.750±4.193	14.60	36.169

The nutritional status (IMT) of the group before the use of the Food Cholesterol Detect application was the highest 35.68, IMT, the lowest 14.60, with an average of 24.768. While after the use of the Food Cholesterol Detect application, the highest BMI was 36.169, the lowest BMI was 14.60, with an average of 24.750.

This research data shows that the nutritional status of hypercholesterolemia patients after using the Food Cholesterol Detect application is normal nutritional status with an average trend of 24,750. Nutritional status is a description of the state of the body from the final result of the balance of nutrients that enter and use in the body. Body Mass Index (BMI) measurement is a method used to monitor nutritional status in adults (Trevisan et al., 2019). This research is in line with research conducted by (32), which states that most of the hypercholesterolemia patients have normal nutritional status, namely the group with high borderline cholesterol levels as many as 18 people (38.3%) and the high cholesterol group as many as 29 people (38.3%), high cholesterol (61.7%). Based on the results of statistical tests obtained p-value of α 0.05 = 0.034. This indicates a relationship between nutritional status according

to BMI and cholesterol levels. Previous research states that there is no relationship between BMI and cholesterol levels of respondents with a p value = 0.576 and a correlation value of -0.127 which shows a very weak correlation (33). High cholesterol is not always influenced by BMI or obesity, but can be influenced by other factors such as smoking, drug consumption, exercise, and food consumption (34).

C. Average Total Cholesterol Levels in Patients with Hypercholesterolemia Before and After Using the Food Cholesterol Detect Application

Based on the research conducted, the minimum, maximum and average values of total blood cholesterol levels in the hypercholesterolemia patient group were obtained before and after using the Food Cholesterol Detect application (Table 3)

Table 3. Average Distribution of Total Cholesterol Levels in Patients with Hypercholesterolemia Before and After the Use of Food Cholesterol Detect Application

Total Blood Cholesterol Level	Mean ±SD	Minimum	Maksimum
Before	234.432±29.236	201	321
After	203.892±32.160	130	385

The highest total blood cholesterol level of the hypercholesterolemia group before using the Food Cholesterol Detect application was 321 mg/dl, the lowest value was 201 mg/dl and with an average of 234.432 mg/dl. While after the use of the Food Cholesterol Detect application, the highest total cholesterol level was 385 mg/dl, the lowest value was 130 mg/dl and with an average of 203,892 mg/dl.

Data on total blood cholesterol levels in the group of hypercholesterolemia patients in this study showed a downward trend after using the Food Cholesterol Detect Application with an average value of 203,892 mg/dl. One of the factors affecting cholesterol reduction is the sample's understanding of the content provided when using the application, thus increasing knowledge and motivation to change eating habits and affecting changes in cholesterol intake. This is supported by interviews conducted during the study with respondents, they stated that this application really helped them in choosing foods that are low in cholesterol, so they avoid these foods and become patterned in the selection of what food ingredients are recommended and not recommended in their daily food composition.

D. Average Cholesterol Intake in Foods Consumed in Patients with Cholesterolemia Before and After the Use of Food Cholesterol Detect Application

Based on the research conducted, the minimum, maximum and average values of cholesterol intake in foods consumed in the group of people with cholesterolemia before and after using the Food Cholesterol Detect application were obtained (Table 4)

Table 4. Average Distribution of Cholesterol Intake in Foods Consumed by Patients with Cholesterolemia Before and After the Use of Food Cholesterol Detect Application

Cholesterol Intake	Mean ±SD	Minimum	Maksimum
Before	492.487±182.201	219.70	492.48
After	169.483±88.741	41.60	169.48

Cholesterol intake in foods consumed in the group of people with cholesterolemia before the use of the Food Cholesterol Detect application the highest was 492.48, the lowest value was 219.70 and the average value was 492.487. While after the use of the Food Cholesterol Detect application, the highest value was 169.48, the lowest value was 41.60 and the average value was 169.483. While after using the Food Cholesterol Detect application, the highest score is 169.48, the lowest score is 41.60 and the average value is 169.483.

Cholesterol intake in foods consumed by hypercholesterolemia patients in this study after the use of the Food Cholesterol Detect application has decreased with an average value of 169.483. There is a relationship between energy intake and total cholesterol levels. High energy intake also causes fat accumulation, especially triglycerides (35). Cholesterol can increase if you often eat foods with high fat content, especially fat from animals such as; beef brains, red meat offal, seafood, egg yolks, cheese, or fast food (36). Decreasing cholesterol levels in the blood can be done by consuming foods that are rich in fiber, because fiber has the ability to hold fat in the intestines, blocking the absorption of fat by the body, so that it can help reduce cholesterol levels in the intestines. Unhealthy lifestyles such as rarely exercising and often consuming high-fat foods, as well as lack of knowledge about the dangers of hypercholesterolemia . (37)

E. Mean Difference in Total Blood Cholesterol Levels Before and After Using the Food Cholesterol Detect App

In this study conducted, the average difference between the initial and final blood total cholesterol in respondents was obtained (Table 5).

Table 5. Distribution of Mean Differences in Total Blood Cholesterol Levels Before and After Using the Food Cholesterol Detect Application

Inspection	Initial Mean ±SD	Final Mean ±SD	Difference	p-value
Total Blood Cholesterol	234.432 ± 29.236	203.892 ± 32.160	30.54	0.000

Total blood cholesterol levels in respondents decreased significantly after using the Food Cholesterol Detect Application which was given for 14 days. The average decrease in total blood cholesterol levels after the intervention was 203,892 mg/dL. The results of statistical tests (Wilcoxon test) obtained a Sig. (2-tailed) value in the treatment group of 0.000 which is <0.05, so it can be concluded that there is an effect of using the Food Cholesterol Detect application on reducing the total cholesterol levels of hypercholesterolemia patients.

F. Effectiveness of Food Cholesterol Detect Application on Reducing Total Blood Cholesterol Levels

To answer the researcher's hypothesis on the use of the Food Cholesterol Detect application to reduce total cholesterol levels in respondents who have cholesterol, the Wilcoxon test was conducted on the average reduction in cholesterol levels before and after the intervention of hypercholesterolemia patients.

Table 6. Mean Difference in Reduction of Total Blood Cholesterol Levels Before and After Using the Food Cholesterol Detect App

Inspection	Δ	*p*	t
Total Blood Cholesterol	30.54	0.000	7.871

The statistical test results (Wilcoxon test) of 74 respondents obtained a p-value <0.05, which means that there is a difference between the average total cholesterol before and after. When viewed from the average difference in total cholesterol reduction before and after, it is 30.54 mg/dl. This means that there is an effect of using the Food Cholesterol Detect application on reducing total cholesterol levels in the blood in hypercholesterolemia patients.

The results of statistical tests (Wilcoxon test) obtained a Sig (2-tailed) value in the treatment group of 0.000 which is <0.05 so that there is an effect of the effectiveness of the Food Cholesterol Detect application on reducing total cholesterol levels in the blood of hypercholesterolemia sufferers. The decrease in cholesterol levels is due to the fact that respondents are accustomed and exposed to a low cholesterol, high fiber diet and are able to apply it in their daily diet, such as changing ingredients or changing food processing methods (38). This is supported by similar studies based on the results of the Wilcoxon test analysis before and after low cholesterol and high fiber diet counseling, showing that there are differences in cholesterol intake with the results of p-value <0.05 (38).

Android and website-based nutrition education media with the theme of balanced nutrition for students has been successfully developed by showing a good level of acceptance and liking (39). and users feel helped by this application (40). The Food Detect Cholesterol application can be accessed via the website http://foodcholesterol.my.id/, where the application is useful as self-education in detecting early consumption of foods that are high in cholesterol content, especially hypercholesterolemia sufferers can easily control the food they will eat. So it can be concluded that through the use of the Food Cholesterol Detect Application, hypercholesterolemia sufferers can maintain blood cholesterol levels within normal limits.

An information system that meets these needs is an option, an information system to manage data entered by respondents can be accessed online. This system can improve performance, provide real-time data and information that can be accessed at any time (41). This is in line with research (42) which states that there is a significant effect of web-based nutrition education media on students' knowledge, attitudes and actions. Providing web-based nutrition education should be carried out gradually and continuously to achieve positive eating behavior changes and prevent a decrease in eating behavior in students, so that it can be applied sustainably in everyday life (43).

Nutrition education for hypercholesterolemia patients aims to change behavior or motivate a person, including by providing an understanding of measuring nutritional status, calculating the nutritional needs of each individual, the types of foods that should be consumed and should be avoided. In other words, knowledge of nutrition and food makes individuals more confident in choosing healthy foods (44). The nutrition counseling material on the Food Cholesterol Detect Application provided is essentially the same, namely limiting cholesterol intake in food. Individuals are more likely to take action when they have sufficient knowledge to do so.

CONCLUSION

The use of the Food Cholesterol Detect application can reduce the total cholesterol levels of patients with hypercholesterolemia. This application can be developed again by adding data based on high cholesterol content food ingredients derived from the menu or archipelago cuisine commonly consumed by people in each region.

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