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Analysis Study of "Food Cholesterol Detect" Application Development in Early Detection of High Cholesterol Food Consumption

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ABSTRACT
The incidence of hypercholesterolemia in Indonesia is increasing daily, caused by a sinful lifestyle, lack of physical activity, and high consumption of foods high in fat. Patients with hypercholesterolemia have a cholesterol intake from food consumed by 46%. Related to these problems, we need a technology that can make it easier for people to manage the consumption of foods high in cholesterol by utilizing the sophistication of Smartphones. So researchers are interested in designing an application, "Food Cholesterol Detect", to detect early consumption of foods high in cholesterol. The system testing scenario is carried out using the system testing method of Black Box Testing. Trials on Users were conducted to assess the website-based Food Cholesterol Detect Application's appearance and the information presented. As for the test results, all of these website systems run well, and the test results on users, namely an average rating of 3-3.5 (good), and users feel helped by this application.
Keywords*: Cholesterol, Food Cholesterol Detect, Hypercholesterolemia, Smartphones*

ABSTRAK
Angka kejadian hiperkolestrolemia di Indonesia semakin hari semakin meningkat, yang disebabkan oleh pola hidup yang salah, kurangnya aktivitas fisik serta tingginya konsumsi makanan yang tinggi akan lemak. Penderita hiperkolesterolemia yang memiliki asupan kolesterol yang berasal dari makanan yang dikonsumsi sebesar 46%. Terkait permasalahan tersebut, dibutuhkan sebuah teknologi yang dapat mempermudah masyarakat mengatur konsumsi makanan tinggi akan kolesterol dengan memanfaatkan kecanggihan *Smartphone.* Maka peneliti tertarik untuk merancang sebuah aplikasi *"Food Cholesterol Detect"* dengan tujuan dapat mendeteksi dini konsumsi makanan tinggi kolesterol. Adapun skenario pengujian sistem yang dilakukan dengan menggunakan metode pengujian sistem berupa Black Box Testing. Uji Coba pada User (Pengguna) dilakukan untuk menilai *Aplikasi Food Cholesterol Detect* berbasis website dari sisi tampilan dan informasi yang disajikan. Adapun hasil uji coba semua sistem website ini berjalan dengan baik, dan hasil uji coba pada user yaitu rata-rata memberikan penilaian 3-3,5 (baik) dan user merasa terbantu dengan adanya aplikasi ini.
Kata Kunci: Deteksi kolesterol makanan, Hiperkolesterolemia, Kolesterol, Smartphone

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INTRODUCTION

Based on Riskesdas in 2018), nationally, the prevalence of high cholesterol levels (above normal) in residents aged ≥ 15 years is 15.8%. The prevalence of high cholesterol levels occurs in women as much as 9.9%, which is higher than in men, with a prevalence of 5.4%. The total cholesterol level needed by the body is 200 mg/dl. If it exceeds the normal total cholesterol level (> 200 mg/dl), it can cause disturbances in fat metabolism or hypercholesterolemia. Hypercholesterolemia is a condition in which cholesterol concentration in the blood increases, exceeding normal values (Guyton and Hall, 2012). Cholesterol plays an important role in the process of forming atherosclerosis. High cholesterol levels will interfere with the function of the endothelium, which is marked by increasing the production of free radicals so that they can deactivate nitric oxide. In chronic hyperlipidemia, lipoproteins are deposited in the intima, which can cause endothelial hyperpermeability.

If the arterial endothelial cells are exposed to free radicals, it will cause oxidation of LDL, resulting in the accelerated formation of arterial plaques in the endothelium. This situation is strengthened when followed by low HDL levels. Over time, the atheromatous plaque will rupture, resulting in oxidation and increased platelet attachment along with other cell elements. In the end, fat deposition turns fibrous into arteria, causing calcification, thrombosis, and bleeding resulting in cerebral infarction, one of the causes of stroke. LDL is atherogenic, while HDL levels are low, which will result in more and more atherosclerotic plaque formation and stroke in a person (Hasan, Rahmayani and Rudiyanto, 2022). The tendency for high cholesterol to occur is currently found in people who have normal nutritional status based on Body Mass Index (BMI) and Upper Arm Circumference, namely 53 people (58.9%) and 47 people (52.2%). Which is caused by eating patterns that are not good, in terms of consuming foods high in cholesterol (Terati *et al.*, 2022).

A smartphone is one of the most sophisticated and efficient equipments known as a smartphone, which is the answer to the need to keep up with human developments. Smartphones have become a necessity for almost everyone. Related to this background, we need a technology that can make it easier for people to manage the consumption of foods high in cholesterol by utilizing the sophistication of Smartphones. One development that can be used for smartphones or laptops is an application in the form of a website. PHP is used to build a

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website, which is a programming language that is open source and integrated with HTML (Hypertext Markup Language), which is the structure of website pages (Candra and Wulandari, 2021). With this, the researchers created a design for the early detection of cholesterol levels based on the food consumed. The application can be accessed via a website entitled Food Cholesterol Detect, where the application is useful as self-education in the early detection of the consumption of foods high in cholesterol. So that people can understand and regulate whether the menu they will consume is what is recommended, especially foods that are high in cholesterol, and people can easily control the food they will eat if it is detected that cholesterol intake from food has exceeded the recommended one. So that can maintain blood cholesterol levels within normal limits so that it can maintain blood cholesterol levels within normal limits. Therefore, researchers are interested in conducting research, analyzing the development of the "Food Cholesterol Detect" application in the early detection of high cholesterol food consumption for people with hypercholesterolemia or not suffering from hypercholesterolemia in 2 Public Health Center, namely Sekip and Social areas of Palembang City.

METHOD

This research is a quantitative descriptive study, with a display design used to design the interface on the android application in determining the status of cholesterol intake in foods eaten by hypercholesterolemia sufferers and those who do not suffer from hypercholesterolemia. In the Food Cholesterol Detect application, 414 food ingredients/menus contain cholesterol-based data input and 208 data-based instructions for household sizes.

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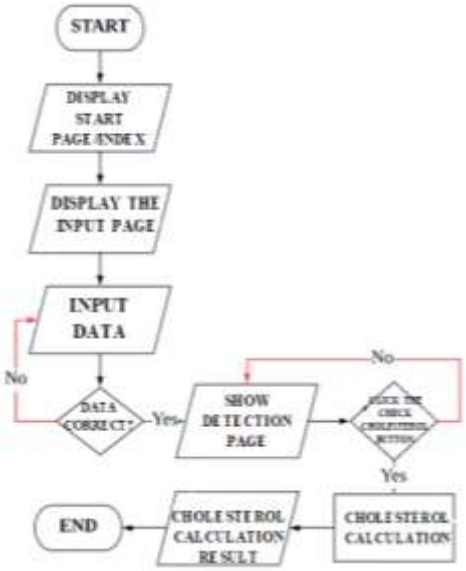

Picture 1. Flowchart

The design of this system uses a flowchart system, which is a chart with certain symbols that describe the sequence of processes in detail and the relationship between a process (instruction) and other processes in a program. The following is a flowchart of the Food Cholesterol Detect system

Application Testing

The Food Cholesterol Detect application test is carried out by testing each process and the possibility of errors that occur for each process. The population which testing with this application is hypercholesterolemia sufferers and those who do not suffer from hypercholesterolemia in 2 Community Health Centers, namely the Sekip and Social Health Centers in Palembang City, South Sumatra Province, in 2022. The number of samples is 90 people using the formula Notoatmodjo, 2010 by taking samples using the accidental sampling technique. This research has passed ethical review No: 0375/KEPK/Adm2/V/2022 dated 11 May 2022 Palembang Poltekkes.

The system used in testing this application is Blackbox or what is commonly called structural testing involving detailed technical knowledge. The test results on this system are as follows:

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Application Main Menu Testing

Table 1. Testing the Login Menu

Input data	Which are expected	Observation	Conclusion
Pressing Enter button	The login interface appears, by entering the name and password	Login successfully	[√] Accepted [ ] Rejected
Pressing button List	Show interface to register for an account by entering your username, email, password, and cellphone number	Login successfully	[√] Accepted [ ] Rejected

History Input Menu Testing

Table 2. Testing the History Input Menu

Input data	Which are expected	Observation	Conclusion
After logging in	Show user history input interface. in this view, several columns will appear to enter history such as Name, Age, Gender, Cholesterol Level, BW, Height	Login successfully	[√] Accepted [ ] Rejected

Home Menu Testing

Table 3. Testing the History Input Menu

Input data	Which are expected	Observation	Conclusion
Cholesterol push button	A food recall will appear that has been consumed for 1 day by the user according to the food history that has been input.	Opened successfully	[√] Accepted [ ] Rejected

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Side Menu Test

Table 4. Side Menu Testing

Input data	Which are expected	Observation	Conclusion
Cholesterol push button	Information about: a. Cholesterol b. Household Size and Size in grams of Foodstuffs	Opened successfully	[√] Accepted [ ] Rejected

Notification Menu Testing

Table 5. Testing the Notification Menu

Input data	Which are expected	Observation	Conclusion
Hit the notification button	A notification interface appears about: a. Cholesterol intake from food consumed: normal people: < 200 mg/day people with hypercholesterolemia: ≥200 mg/day b. Recommendations for food ingredients that are recommended and those that are not recommended Note: This notification will appear after the user has finished inputting the food consumed for 1 day	Successfully Unlocked	[√] Accepted [ ] Rejected

RESULTS AND DISCUSSION

Based on the design in the previous chapter, the display results of the application that has been made will be explained, which is used to clarify the views in the Food Cholesterol Detect application. Then the results of its implementation can be seen in the results of the program that has been made. The following is an explanation of each display that is in each program

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Display On Application Menu

Picture 2. Index/Start Page

On the index / initial page, there is a further button that links to the next page, namely the input page

Input page

Picture 3. Input page

On the USER input page, you can fill in your biodata: name, gender, age, weight, and height. On the USER Input page, you must fill in all available data and then submit. If one is not filled in, an error will be written, and you cannot continue to the next page, namely the Detection page. On the input page, there are two buttons, namely SUBMIT (used to send data to the detection page) and RESET (used to clear data that has been filled in or replace data, so there is no need to delete one by one)

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Detect Page

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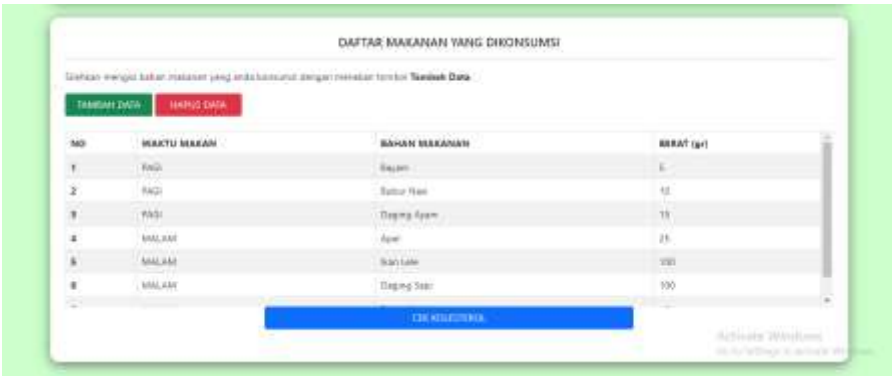
Picture 4. URT Exchange Food Ingredients Guidelines Menu

After Submitting, the USER enters pages 3 or the detection page. On this page there are: Guidelines for Household Size Exchange Foodstuffs, List of foods consumed, Contact person, and Logout button. In the menu for household size exchange food ingredients, the user can use it to determine how much food he consumes in grams. For example, if the user has eaten an apple this morning, then the user can press the search button to find the size/portion of apples. After that, the user gets an estimate of the food ingredients with standard household sizes and converts them into grams. For example, one apple weighs 85 grams. The weight will be needed to fill in the data on the Food List consumed.



Picture 5. Consumed Food List Menu

Furthermore, the user can add data on what food ingredients he has consumed on the menu of the list of foods consumed. The user can add data by clicking the ADD DATA button and selecting the time to eat, such as breakfast, morning snack, lunch, afternoon snack, and dinner. For example, the user has breakfast with one apple. Then the user clicks add data, selects the time to eat, namely breakfast, and enters the ingredients consumed, for example, apples, and enters the weight of the apples that have been checked on the menu of exchange ingredients (85 grams). After that, click the SAVE button to save it in the list of foods consumed.

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Picture 6. Cholesterol Check Results menu with the Normal category

If the user has filled in the data on food ingredients consumed for a full day, the user can check cholesterol from the food he has consumed for a full day by clicking the CHECK CHOLESTEROL button. The cholesterol-checking results will appear

Picture 7. Cholesterol Check Results menu with the High category

The Cholesterol Check Results menu will display total cholesterol, BMI results, and categories derived from the calculation between weight and height that has been filled in on the input page. In this menu, total cholesterol is divided into two categories, namely the Normal category (Total cholesterol <200 mg/day) and the High category (total cholesterol≥ 200 mg/day).

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BAHAN MAKANAN YANG DIANJURKAN DAN TIDAK DIANJURKAN BAGI PENDERITA HIPERKOLESTEROLEMIA

Sumber	Bahan Makanan yang dianjurkan	Bahan Makanan yang tidak dianjurkan
Karbohidrat	Beras, utamakan beras tumbuk/beras merah, pasta, macaroni, roti tinggi serat (whole wheat bread) cereal, ubi, kentang, kue buatan rumah sendiri dengan menggunakan sedikit minyak /lemak tak jenuh, corn flakes, melba toast, fat-free crackers, bagels, pita bread	Produk makanan jadi : pie, cake, croissant, pastries, muffin, cheese breads, donat biscuit , potatoes, cream pasta bakery berlemak, dan kue berlemak lain
Protein Hewani (beteai 3-4 porsi/hari)	Ikan, Unggas tanpa kulit, daging sunus seperti sapi dan domba dengan potongan tipis Hindarangan laut dan kerang-kerangan konsumsi sepertunya	Daging jeroan,daging angsa, daging bebek, ikan goring, daging kambing, daging babi jeroan otak, sardine, corned beef, bacon, sosis, salami
Telur	Putih telur, telur dengan substansi bebas kolesterol atau telur rendah kolesterol	Kuning telur (2-4 butir/minggu)
Susu dan olahan (2-3 porsi/hr)	Susu skim, yoghurt rendah lemak, keju rendah lemak (keju cottage, parsial skim mozzarella, part skim keju ricotta) susu rendah lemak (1% lemak susu)	Susu whole, susu kental manis, krim yoghurt dari susu penuh, keju (cheddar, feta, blau, swiss, American camembert) dan es krim, milkshakes, kremer
Protein Nabati	Tempe, tahu, dan kacang-kacangan seperti lentil, kacang polong, kacang fava dan kedelai	Sumber protein nabati dimasak dengan santan dan digoreng dengan minyak jenuh, seperti kelapa dan kelapa sawit dan kelapa
Sayuran	Semua sayuran dalam bentuk segar, direbus dikukus, direbus, dikuns menggunakan minyak jagung, minyak kedelai atau unsalted butter yang dibuat dari minyak tidak jenuh ganda : dimasak dengan santan ervar	Sayuran yang dimasak dengan mentega, minyak kelapa atau minyak kelapa sawit atau minyak kelapa sawit dan santan kental ataupun krim
Buah	Semua buah dalam keadaan segar atau bentuk jus	Buah yang diawet dengan gula, seperti buah kaleng dan buah kering jeli, selai sorbet, es loli
Gula dan Pemanis	Pemanis tanpa kalori, sukrosa, madu, permen, coklat, soop strobeli, pudding dengan susu bebas lemak	Es krim, fruktosa, minuman ringan (soft drink), susu coklat
Sumber Lemak dan dressing (6-8 sdt/porsi/hr)	Minyak jagung, sedelai, kacang tanah, Bunga matahari dan wijen ; margarin tanpa garam (unsalted butter) yang dibyuat dari minyak tidak jenuh ganda ; mayones dan salad dressing tanpa garam yang dibuat dari minyak tidak jenuh ganda, saui tomat, cuka, minyak zaitun, mustard, fat free sour cream	Minyak kelapa dan minyak kelapa sawit ; mentega dan margarin padat (lemak trans) kelapa, santan, krim, lemak babi/lard, bacon, Cocoa mentega, mayones dan dressing dibuat dengan telur, lemak babi dan lemak bacon
Cara Memasak	Memanggang, merebus, mengukus, menggoreng dengan sedikit minyak, membakar	Menggoreng dengan banyak minyak, diolah dengan santan
Minuman	Minuman berkarbonasi, soft drink, kopi, teh dan cocoa mixed	Coklat, es krim, fruktosa, minuman ringan (soft drink)

Picture 8. MaterialsFoods That Are Recommended And Not Recommended For Patients With Hypercholesterolemia

On the list of foods consumed, there is a DELETE DATA button, which the user uses to check/control the total cholesterol he has consumed the next day again. Moreover, after clicking the delete data button, the food list data consumed will be reset and start over from 0. After the user gets the total cholesterol results, the next menu will display food ingredients recommended and not recommended for people with hypercholesterolemia

Picture 9. Person contact

The next display is the Contact Person (WhatsApp and Email) if the user has questions or wants further consultation. After completing this display, the user can click the LOGOUT button to exit the detection page. Moreover, the user is redirected back to the home page.

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Trial Results (Black Box Testing):

Test on Home Page (Index)

Table 6. Testing on the Home Page (Index)

No. Scenario	Test Scenario	Expected results	Conclusion
1.	Press the "CONTINUE" button	The system will move the website page to the Input page	Valid

Testing on Page Input

Table 7. Tests on the Input Page

No. Scenario	Test Scenario	Expected results	Conclusion
1.	Fill in all the data in the input form correctly, then press the "SUBMIT" button	The system will receive the input data and then enter the Detection page	Valid
2.	Do not fill in some data in the input form, then press the "SUBMIT" button	The system will point to fields that have not been filled in and ask for data input	valid
3.	Fill in the data in the input form, then press the "RESET" button	The data filled in the input form will be deleted	Valid
4.	Type the URL of the detection page without filling in the data and pressing the "SUBMIT" button	The system will deny access to the detection page and will return to the input page	valid

Test on Detect Page

Table 8. Black Box Search for Foodstuffs

No. Scenario	Test Scenario	Expected results	Conclusion
1.	Fill in the Search Food Ingredients field and press the "Search" button	The system will display data based on the words entered into the search field	Valid
2.	Do not fill in the Search Food Ingredients field and press the "Search" button	There is no change in the data display, the data displayed remains the same, namely all existing data	valid

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Table 9. Black Box Add Data

No. Scenario	Test Scenario	Expected results	Conclusion
1.	Press the "ADD DATA" button	The system will display a pop-up form to fill in the data to be added	Valid
2.	Fill in all the fields in the Add Data pop-up form and press the “Save” button	The system will save the added data and the display will return to the Detect page and the newly added data will enter the table	valid
3.	Do not fill in some of the fields in the Add Data pop-up form and press the "Save" button	The system will point to fields that have not been filled in and ask for data input	Valid
4.	Pressing the “X” icon on the Add Data pop-up form	The system will close the pop-up and return to the Detect page	valid
5.	Pressing the “Cancel” button on the Add Data pop-up form	The system will close the pop-up and return to the Detect page	valid

Table 10. Black Box Delete Data

No. Scenario	Test Scenario	Expected results	Conclusion
1.	Press the "DELETE DATA" button	The system will delete all food data that has been entered	Valid

Table 11. Black Box Cholesterol Check

No. Scenario	Test Scenario	Expected results	Conclusion
1.	Pressing the "CHECK CHOLESTEROL" button	The system will display the results of checking cholesterol and BMI and will display a table of food ingredients that are recommended and not recommended for people with hypercholesterolemia	Valid

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Table 12. Black Box Logout

No. Scenario	Test Scenario	Expected results	Conclusion
1.	Pressing the "Logout" button	The system will return to the Home page (Index)	Valid

In this study, black box testing, which is applied to the Food Cholesterol Detect website, is used to test every feature. Tests are carried out on all website pages, namely the initial/index page, input page, and detection page, as well as the searching feature, adding data, deleting data, checking cholesterol, and logging out. Based on the test results, the website or application implemented in this study runs well and reaches a valid conclusion in each website testing scenario.

Test Results on Users (Users)

User trials were conducted to assess the Android-based Food Cholesterol Detect Application's appearance and the information presented. This trial was carried out by explaining to respondents how to use the Food Cholesterol Detect application. Respondents were asked to fill out a questionnaire about cholesterol in the food consumed and try the application shown to them by sharing the Food Cholesterol Detect link, namely http://foodcholesterol.my.id/. After explaining the application's use, they distributed questionnaires to 90 respondents who visited the Social Health Center and Sekip Health Center in the Palembang City area. Respondents were asked to fill out a questionnaire about cholesterol in the foodstuffs they consumed and socialize the application shown to them. The questions included the respondent's knowledge of calculating the adequacy of cholesterol from the food consumed and the application media to carry out the calculation.

Table 13. Questionnaire Results

Question	Category	n	%
Do you know what is meant by cholesterol and what foods are high in cholesterol?	Yes	75	83.33
	No	15	16.67
Are you aware of the relationship between the food you eat and cholesterol?	Yes	68	75.56
	No	22	24.44

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Have you ever heard of an internet/desktop-based application for calculating the need for cholesterol in the food you eat?	Yes	0	0
	No	90	100
Have you ever seen an application model like this, the Food Cholesterol Detect application	Yes	0	0
	No	90	100

The results of the questions from the questionnaire about cholesterol and high-cholesterol food ingredients obtained data from around 83.33% of respondents. Most of them already knew what cholesterol was and what food ingredients were high in cholesterol. Based on interviews conducted during the study, the average respondent obtained this information from TV, the internet, books, doctors and nutritionists, and other media such as leaflets and booklets that discussed cholesterol. This research is also in line with research conducted by (Supono, Karmilasari and Wulandari, 2015) which states that 86.67% of respondents know the relationship between nutrition and the elderly from doctors, books, the internet, television, and other media). Gibney, 2009), state that a comprehensive program can have an important effect on nutritional knowledge. Android and the website are comprehensive educational media, so they have become effective media in nutrition education. For questions regarding the relationship between food consumed and cholesterol, data obtained from about 75.56% of respondents already knew there was a relationship between food consumed and cholesterol. Based on the interviews, respondents provided information that foods such as fried, coconut milk, and those containing fat and oil can cause cholesterol. This is in line with research conducted by Aisyah, Komalyna and Setyobudi (2022) which states that as many as 93.3% of hypercholesterolemic sufferers consume fried foods > 3 times per day.

Based on risk factor analysis with OR = 7 and (95% CI 0.705 – 69.490), respondents who often eat fried foods have a seven times greater risk of suffering from hypercholesterolemia than respondents who rarely consume fried foods. Frying food can cause the formation of trans fatty acids, which can increase LDL and reduce HDL (Hanum, 2016). According to research of Yoeantafara and Martini (2017), respondents who frequently consumed high-fat foods had a 2.06 times greater risk of suffering from

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hypercholesterolemia than respondents who rarely consumed high-fat foods. In the study, foods high in fat included animal foods (beef, fried chicken, mutton, tilapia fish, beef offal, chicken eggs, duck eggs) and other processed products (lard, margarine, butter, fried foods, coconut milk, chocolate bars, ice cream, and milk.). Most of these foods contain saturated fat. The content of saturated fat in food can increase cholesterol levels, while unsaturated fats can reduce blood cholesterol and triglyceride levels (Fatimah dan Kartini, 2011).

To questions regarding internet/desktop-based applications regarding calculating the need for cholesterol in the food consumed, as well as whether the respondent has seen an application model like this (Food Cholesterol Detect Application), all respondents answered that they had never used and seen an Application such as the Food Cholesterol Detect Application. Respondents stated that they are greatly assisted in the application of early detection of cholesterol intake from the food consumed. The Food Cholesterol Detect application has been equipped with information on the total cholesterol consumed by the respondent and can calculate the respondent's BMI. Of course, there are directions/recommendations for food ingredients for people with hypercholesterolemia.

Table 14. Results of Respondents' Assessment of the Application

Trials	Aspect	Average Score Range (Range 1-4)
Appearance	Layout	3 (Good)
	Picture	3.5(Good)
Information	Completeness of Information	3.5 (Good)

The results of the respondents' assessment of this application are good, showing an average assessment result of 3-3.5 (good). As explained by Narimawati (2007) regarding the criteria for evaluating respondents to applications that have been made and have been tested on respondents, it can be said to be good and suitable for use as a media for socialization with the average percentage of respondents' ratings belonging to the good category. This research is also supported by research conducted by Perdana, Madanijah and Ekayanti (2017) regarding the development of android- and website-based nutritional education media and their influence on behavior regarding balanced nutrition of elementary school students, which can provide information quickly and

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easily because it can be used anywhere and can be accessed anytime. Therefore, the use of this Android-based mobile application is very effective when used to disseminate nutrition information.

Technological developments are now increasingly widespread and growing rapidly to help people enjoy the various conveniences produced by this technology (Pratiwi *et al.*, 2018). This technology that uses android is not only used by young people but also parents/older people can use it. So there is no age limit for using this Android smartphone. Thus, with the existence of an Android smartphone, it is now possible to be used as a medium for outreach in the health sector, one of which is in the field of nutrition that we are developing, namely Food Cholesterol Detect (detects cholesterol in food).

CONCLUSION

The results of the research regarding the Application Development Analysis Study "Food Cholesterol Detect" in the Early Detection of High Cholesterol Food Consumption can be drawn the following conclusions:

1. Tests on The Android-based website implemented in this study went very well and reached a valid conclusion in each website testing scenario
2. Trials were conducted on respondents by distributing questionnaires and socializing the use of the application, in general respondents stated a positive response was shown by the average assessment result of 3-3.5 (good), namely from the display in the form of a layout with a value of 3 (good) and an image with value 3.5. As for completeness of information with an average value of 3.5 (good). The existence of this application has many benefits for respondents because it is easy to use so that respondents can independently detect early consumption of foods that contain high cholesterol.

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