ORIGINAL ARTICLE

Corn (*Zea mays* L) Boiled Water Provides Good Evidence for Lowering of Lipid Profile (HDL-C, LDL-C, Triglycerides, and Total Cholesterol) in Dyslipidemia

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ABSTRACT

Introduction: Dyslipidemia is a significant factor in cardiovascular and other diseases. Corn can be used to treat dyslipidemia. This study is to determine the effect of boiled corn water on levels of HDL-C, LDL-C, triglycerides (TG), and total cholesterol (TC) in people with dyslipidemia in certain areas in Indonesia. **Methods:** We used a quasi-experimental pretest-posttest control group design. A sample of 40 people for each group was taken using a purposive sampling technique. The group was given the intervention of corn-boiled water @ 200cc twice daily for seven days. Blood lipid profile using fasting and examined by Fluorometric-enzymatic assay method. All procedures are carried out based on operational standards. Within-group comparisons used the Wilcoxon test, while between-group comparisons used the Mann-Whitney U and Independent T-Test. **Results:** The LDL-C control group experienced an increase of 65.1 mg/dL, and the entire group's lipid profile variation showed no difference between the pretest and posttest (p>.05). The intervention group showed an increase in HDL-C (0.1 mg/dL), a decrease in LDL-C (30.2 mg/dL), TG (27.0 mg/dL), and TC (35.6 mg/dL). Within-group comparison of the intervention group showed HDL-C (p.153), LDL-C (p.001), TG (p.023), and TC (p<.001). A between-group comparison showed HDL-C (p.101), LDL-C (p.034), TG (p.003), and TC (p.006). **Conclusion:** Whole corn boiled water provides good evidence that it is effective in lowering LDL-C, TG, and TC, as well as improving dyslipidemia in HDL-C patients. This intervention can be used as an alternative treatment for dyslipidemia in terms of nutrition.
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INTRODUCTION

Dyslipidemia is a disorder of lipid levels in the blood that occurs when there is a decrease in High-Density Lipoprotein-Cholesterol (HDL-C), an increase in Low-Density Lipoprotein-Cholesterol (LDL-C), and an increase in triglycerides. TG), and increased total cholesterol (TC) (1). The World Health Organization (WHO) stated that in 2008 in the adult age group, the prevalence of increased plasma cholesterol levels was 39%. The highest prevalence of elevated TC levels (≥ 190mg/dL) was in Europe (54%), North and South America (48%), while the lowest was in Southeast Asia (29%) and Africa (22.6%) (2). In high-income countries, metabolic problems such as increased cholesterol were a particular problem. However, dyslipidemia prevalence is increasing in low-income countries due to changes in diet and behaviour (3). Data for comparison of TC levels in 1980 and 2018 in several regions of the world almost show that women show higher results than men (4).

Research on 4,490 respondents in Saudi Arabia showed the incidence of dyslipidemia was around 20-40%, with the highest increase in TG (44%) (5). A study in Northern Ethiopia showed that of 321 adults, 66.7% had dyslipidemia (6). Whereas in China, 48.3% of 4,598 adults had dyslipidemia, with the highest increase in TG (33.3%) (7). Variations in the prevalence of dyslipidemia also occur in Asia, partly due to ethnic differences and the level of prescription lipid-lowering drugs. Differences are also reviewed regarding age, gender, place of residence, and economic status (8). Studies in India show the prevalence of dyslipidemia as much as 78%; the probability is higher in obese women (81.4%), while the TG is higher in obese men (9). The Korean national health and Nutrition Examination survey of 10,734 adolescents 10-18 years old showed a significant correlation between age, sex, and Body Mass Index (BMI) with changes in lipid profiles (10). Based on Basic Health Research data in 2018, the prevalence of dyslipidemia in Indonesia is still high, recorded as many as 72.8% of Indonesia's population aged 15 years and over have LDL levels of more than 100 mg/dL, and 28.8% have total cholesterol level of more than 200 mg/dL (11).

Dyslipidemia is a significant factor in cardiovascular and other diseases (12). Patients with dyslipidemia are twice as likely to experience cardiovascular disease as normal lipids (13). More than a third of cardiovascular disease and stroke deaths are due to elevated LDL-C. Ischemic Heart Disease (IHD) affects as many as 8.54 million people globally in years, of which 3.78 million are associated with high levels of LDL-C. In the same year, it was also known that there were 2.73 million deaths due to ischemic stroke, and 0.61 million were also associated with high LDL-C levels (14). Dyslipidemia also increase the risk of atherosclerosis, myocardial infarction, stroke, and death from cardiovascular disorders in people with diabetes mellitus or pre-diabetes (13, 15). any adverse effects caused by dyslipidemia require attention, and these conditions must be controlled.

Management of dyslipidemia can be done with dietary intervention, lifestyle change approaches, pharmacological therapy, treatment specificities, and novel treatment options (16). Pharmacotherapy is the standard of choice in cases of chronic dyslipidemia with high lipid levels (17). Consumption of dyslipidemia drugs should not be arbitrary. The decision to start pharmacological treatment depends on age, severity, and the presence of other individual or family cardiovascular disease (CVD) risk factors. In pharmacological therapy indications, the patient must be referred for hospital consultation beforehand. Previously, initial efforts to treat dyslipidemia with lifestyle changes were recommended, including dietary modifications for 3-6 months and reassessment for pharmacological therapy decisions (16). Health providers can play a role in managing dyslipidemia with a nutritional approach and lifestyle changes. Instant foods, high in fat and complex processing, increase the risk of dyslipidemia, in contrast to fruits and vegetables, which have the effect of lowering the bad fat profile (18).

Corn is an example of a plant that can treat dyslipidemia. Corn contains much fibre (19), flavonoids (20), tannins (21), other nutrients such as vitamins (A, B, E, and K), minerals (Mg, P, and K), and phenolic acids (ferulic acid, coumaric acid, and citric acid) (22). These substances are primarily helpful for the management of dyslipidemia. Previous studies have shown that corn can reduce harmful lipids (cholesterol, LDL-C, triglycerides) and increase good lipids (HDL-C). The difference is that previous studies were conducted with samples from rats (23, 24), using certain parts of the corn fruit, such as corn husks (24) and corn silk (25), as well as using processed corn products such as corn oil (26, 27, 28, 29).

The author has researched using boiled water of whole corn with skin and hair, and the results showed a significant effect on increasing HDL-C and decreasing LDL-C, TG, and TC (30). Whole corn is selected and given while it is still warm so that the concentration of the ingredients that are effective in improving the lipid profile is more optimal, in line with previous research by Yuniarti showed that whole corn (Zea mays) boiled water along with the skin lowers cholesterol levels in rats (31). Previous studies used respondents with normal lipid profile levels with three groups (1 control group with normal BMI and two intervention groups with normal and excessive BMI) (30). Researchers are interested in continuing the results of this study by applying it to people with dyslipidemia and all respondents in the category of excess dietary level. Corn is a plant that is easy to grow in Indonesia and can be grown all year round, so it can be bought quickly and cheaply. This study aims to determine the effect of boiled corn water on the lipid profile of HDL-C, LDL-C, TG, and TC in people with dyslipidemia.

MATERIALS AND METHODS

Study design

The study used a quasi-experimental with a pretest-posttest control group design. The study was conducted from February 21 to August 16, 2022, in the working area of the Kramat Sari Community Health Center, West Pekalongan, Central Java, Indonesia, namely Pasir Kraton Kramat Village and Pasir Sari Village.

Samples

The research population is people with excessive nutritional status and experiencing dyslipidemia. Calculation of the sample using the formula (32),

$$n = \sigma^2 \frac{2\,(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})^2}{(\mu_1 - \mu_2)^2}$$

With the description n=number of samples, Z1-α/2=significance level α (α = 0.05 is 1.96), Z1-β=desired power (β=0.10 is 1.28), σ=outcome standard deviation of the studied, μ1=Mean pressure lipid profile treatment, μ2=mean lipid profile of the control group. Researchers used the results of the research by Sumarni et al. (30)

with σ=4.8, μ1=65.8, and μ2=67.95. Based on the calculations, a sample of 105 people was obtained and divided into two groups of 53 samples, with the final number of samples of 40 people. Samples were selected according to the inclusion criteria, were willing to be respondents, aged 26 to 65 years, had TC levels >200 mg/dL, did not smoke, did not take drugs that affect the lipid profile, and followed the entire treatment process. People who were sick during the study, consumed alcohol and suffered from diabetes mellitus and hypertension were the exclusion criteria for the study. The sampling technique used is purposive sampling. All respondents received contact materials such as drink tumblers and transportation substitutes during the data collection.

Ethical Consideration

The researcher obtained information worthy of conducting research "Ethical Exemption" No. 458/EA/KEPK/2021 issued by the Health Research Ethics Committee Poltekkes, Ministry of Health Semarang. Researchers used a sample of people who had never done pharmacological therapy to manage dyslipidemia. The initial screening was conducted in community service activities, namely free cholesterol checks at the research site beforehand. The initial screening used peripheral blood tests on the fingers with a 3 in 1 autocheck tool. Researchers approached people with cholesterol levels > 200 mg/dl to be used as research samples. Before starting the study, the researcher explained the aims, objectives, processes, advantages and possible negative things that could happen to the respondents and their procedures. Respondents willing to participate in the study signed informed consent and still have the right to withdraw if they no longer want to participate.

Instruments

BMI check. The selection of respondents begins with selecting samples that have excess nutritional status. Researchers used a digital scale and Microtoise to measure the weight and height of the respondents. Measuring weight and height is carried out according to standard operating procedures. The measurement results are used to calculate BMI with the formula weight (kg) divided by height^2 (m^2).

Lipid profile examination

Respondents measured the lipid profile level by measuring 5cc of blood through the median cubital vein. Blood samples were collected and examined at the Gajah Mada Clinic laboratory, Pekalongan, Central Java, Indonesia. Lipid profiles analyzed were levels of TC (normal: 200mg/dL), HDL-C (normal >60mg/dL), LDL-C (normal <100mg/dL), and TG (normal <150mg/dL) (33), analyzed using the Fluorometric-enzymatic assay method (34). Blood collection and lipid profile analysis was performed according to standard operating clinical procedures and recorded in the observation sheet.

Corn Boiled Water

Researchers got corn directly from farmers in the area where the researchers live, with a planting period of two months. Previously, researchers confirmed that the fertilizer used by farmers was manure. Corn boiled water uses two whole corns (@±200gram), which are weighed digitally. The type of corn used is sweet corn (*Zea mays var. saccharata*). Corn washed previously is then placed in a pan containing 300cc of water; cooked until it boils and the water becomes 200cc (± 30 minutes using medium heat). The water used to boil the corn is the commercial mineral water of the same brand. Giving corn boiled water in warm conditions, stored using a thermos and drunk in a glass. Giving water in warm conditions follows previous research by Yanuarti (31). One hour before being distributed to respondents, boiled corn water is made to maintain quality. Corn-boiled water is made following standard operating procedures. The control group received 200cc of water using commercially bottled mineral water. The provision of corn-boiled and mineral water was carried out two times a day, every morning and evening, for seven consecutive days. Delivery time is 07.00-09.00 and 16.00-18.00.

Data Collection

Researchers used data from community service carried out previously with the theme of free cholesterol checks to select people who showed cholesterol results > 200 mg/dl. Furthermore, researchers coordinated with the Community Health Center to ensure that the community has never had dyslipidemia therapy by looking at the data at the Community Health Center. The researcher continued coordinating with the Head of Pasir Kraton Kramat Village, the Head of Pasir Sari Village, and the local Health Cadre to obtain samples and ensure they were according to the criteria. After getting the appropriate respondents, the researcher put all potential respondents into the chat group. The researcher determined the distribution of the control and intervention groups by region. Respondents from Pasir Kraton Kramat became the control group, and Pasir Sari became the intervention group. Before the research, the researcher collected all respondents to explain the research process, what can be done, and what cannot be done during the research process. The researcher also informed the respondents to report the diet they consumed through a recall sheet for documentation. The recall sheet aims to document respondents' diets during the research process to anticipate bias during the research process. The respondent's food consumption is measured every three days using a recall sheet sent via group chat.

Respondents fasted at least 8 hours before blood collection for lipid profile examination. Respondents came to the clinic to have their blood drawn, and the pretest blood collection was carried out 1-2 hours before the intervention was given. The whole boiled corn water was distributed to the respondent's house according to the schedule unless the first intervention was presented at the clinic after the blood collection. Respondents immediately drank boiled corn water after it was given in front of researchers or assistants. After the intervention process was completed, the next 24 hours, the respondent was subjected to a posttest lipid profile examination. The researcher was assisted by eight research assistants, namely final-year nursing students and nurses in the clinic. The data collection process for all respondents was carried out separately, and the researchers arranged a data collection schedule to make it more effective and efficient. The program for collecting respondent data can be seen in Table I.

Data Analysis

The data obtained were analyzed using the IBM SPSS 20 program. Characteristics of respondents (age, gender, work, education, and BMI) were presented using frequency and percentage distributions. A normality test was carried out using Shapiro-Wilk to determine which bivariate test was used. The relationship between respondent characteristics and baseline lipid profile was tested using Mann Whitney U for abnormally distributed data and Kruskal-Wallis H for normally distributed data. Wilcoxon was used to analyze within-group comparisons. Between-group comparisons used Independent T-Test for normally distributed data and Mann Whitney-U for abnormally distributed data. Figure 1 shows a summary of the research process.

Table I: Overview of collecting data schedule (N=80)

Group	Date	Event
Control	February 19, 2022	Meeting with all respondents
	February 21, 2022	Pretest lipid profile examination 10 people
	February 28, 2022	Posttest lipid profile examination 10 people
	March 1, 2022	Pretest lipid profile examination 10 people
	March 8, 2022	Posttest lipid profile examination 7 people
	March 9, 2022	Pretest lipid profile examination 10 people
	March 16, 2022	Posttest lipid profile examination 7 people
	March 17, 2022	Pretest lipid profile examination 10 people
	March 24, 2022	Posttest lipid profile examination 7 people
	June 2, 2022	Pretest lipid profile examination 13 people
	June 9, 2022	Posttest lipid profile examination 10 people
Inter-vention	June 11, 2022	Meeting with all respondents
	June 13, 2022	Pretest lipid profile examination 15 people
	June 20, 2022	Posttest lipid profile examination 11 people
	June 21, 2022	Pretest lipid profile examination 10 people
	June 28, 2022	Posttest lipid profile examination 6 people
	June 29, 2022	Pretest lipid profile examination 10 people
	July 6, 2022	Posttest lipid profile examination 8 people
	August 1, 2022	Pretest lipid profile examination 8 people
	August 8, 2022	Posttest lipid profile examination 6 people
	August 9, 2022	Pretest lipid profile examination 10 people
	August 16, 2022	Posttest lipid profile examination 9 people

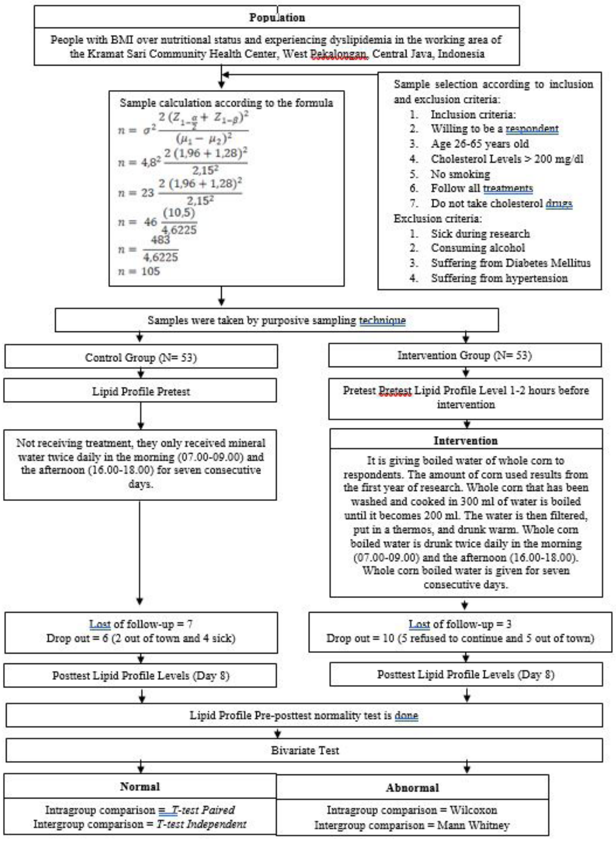

Figure 1: Summary of Research Process

RESULTS

Distribution of Characteristic Respondents and The Relationship with Baseline Lipid Profile

Table II shows that the two groups showed that in total respondents, the data obtained were the majority of men (52.5%), late adulthood (42.5%), working (65.0%), high school (72.5%) and obesity (80.0%). Table III shows the results of testing the relationship between the respondent's characteristic variables and the lipid profile of the pretest because the patient's condition has not been influenced by the intervention given. The results provided good evidence that gender was associated with HDL-C (p<.001) and TG (p.037). Age was not associated with HDL-C, TG, and TC (p >.05) but was associated with LDL-C (p.045). Occupation and education were unrelated factors with lipid profile (p >.05). Nutritional status was associated with HDL-C (p.001), TG (p.0.18), and TC (p.023).

Analysis of Corn Effects on Lipid Profile

Table IV presents data analysis on the effect of corn on lipid profiles in both groups. The control group showed a slight decrease in HDL-C (0.1 mg/dL), TG (1.5 mg/dL), and TC (1.2 mg/dL), while LDL-C showed an increase (65.1 mg/dL). The control group also showed no difference in pretest and posttest lipid profiles, with details of HDL-C (p.799), LDL-C (p.940), TG (p.112), and CT (p.400). Another result was obtained in the intervention group; boiled corn water effectively increased HDL-C by 0.1

Table II: Distribution of characteristic Respondents (N=80)

Variables		Control Group	Intervention Group	Total
		n (%)	n (%)	N (%)
Gender	Men	34 (85.0)	8 (20.0)	42 (52.5)
	Women	6 (15.0)	32 (80.0)	38 (47.5)
Age (year)	Early adulthood	16 (40.0)	4 (10.0)	20 (25.0)
	Late adulthood	12 (30.0)	22 (55.0)	34 (42.5)
	Early elderly	8 (20.0)	12 (30.0)	20 (25.0)
	Late elderly	4 (10.0)	2 (10.0)	6 (7.5)
Work's	Yes	34 (85.0)	18 (45.0)	52 (65.0)
	No	6 (15.0)	22 (55.0)	28 (35.0)
Education	Highschool	26 (65.0)	32 (80.0)	58 (72.5)
	Diploma	4 (10.0)	0 (0.0)	4 (5.0)
	Bachelor	10 (25.0)	8 (20.0)	18 (22.5)
BMI	Overweight	4 (10.0)	12 (30.0)	16 (20.0)
	Obese	36 (90.0)	28 (70.0)	64 (80.0)

mg/dL (p.153). Furthermore, it is known that giving boiled corn water is effective in reducing LDL-C levels (30.2 mg/dL), TG (27.0 mg/dL), and TC (35.6 mg/dL). The results within the intervention group showed that there was an effect of boiled corn water on LDL-C (p.001), TG (p.023), and TC (p <.001). The between-group lipid profile analysis results showed no difference in HDL-C (p.101). The opposite results were obtained in LDL-C, TG, and TC, indicating a significant difference between the control and intervention groups with p.034, p.003, and p.006.

DISCUSSION

This study proves that boiled whole corn water effectively reduces bad fats, namely LDL-C, TG and TC, in people with dyslipidemia. Although the corn-boiled water had no statistically significant effect on the level of HDL-C, a slight increase of HDL-C was observed in the post-test data. The results also showed substantial differences between the control and intervention groups in LDL-C, TG, and TC. The study's results support the research of Sumarni et al. (30) that corn-boiled water effectively reduced TG and TC, with the highest decrease in TC for the overweight group. The difference can be seen from the sample used; Sumarni et al. used respondents regardless of their lipid profile and three groups with normal and excessive BMI. The results also seem different; previous studies of increasing HDL-C were seen to be higher, with statistical values showing a significant and insignificant effect on LDL-C. The study's results were also in line with Yanuarti (31), using the same intervention, namely whole corn boiled water, which showed effective results in lowering cholesterol levels in hypercholesterolemia Rattus norvegicus. Previous research only examined the effect of corn-boiled water on total cholesterol levels, while this study also examined the effect of HDL-C, LDL-C, and TC.

Previous research has been done using parts of corn to lower cholesterol. Xu et al. (24) used corn husks for intervention; the results are similar to this study corn husks are effective in reducing TC, LDL-C, and TG. Different things can be seen from the sample used, Xu et al. using trans-fatty acids fed mice and significant effect on HDL-C. Furthermore, Cha et al. (35) and Budiman & Puspasari (25) used corn silk for their interventions. Cha et al. proved that corn silk extract reduced cholesterol levels in experimental rats by increasing cholesterol metabolism in the liver. Budiman & Puspasari only

Table III: The Relationship between Respondent Characteristics and Pretest Lipid Profile (N=80)

Variables		N (%)	HDL-C		LDL-C		TG		TC	
			Mean±SD	*p*	Mean±SD	*p*	Mean±SD	*p*	Mean±SD	*p*
Gender	Men	42 (52.5)	62.4±3.4	**<.001**¶	139.2±20.9	.110¶	218.1±66.6	**.037**¶	246.6±17.2	.113¶
	Women	38 (47.5)	68.4±0.7		149.7±31.9		177.4±38.0		253.6±28.5	
Age (year)	Early adulthood	20 (50.0)	63.7±4.2	.132	135.8±14.5	**.045**	219.4±57.9	.111	243.9±12.6	.340
	Late adulthood	34 (85.0)	66.9±3.5		142.4±27.0		195.8±67.4		247.8±26.0	
	Early elderly	20 (50.0)	63.5±3.7		163.8±26.8		176.2±38.5		262.5±25.4	
	Late elderly	6 (15.0)	67.0±2.7		117.1±26.0		222.3±43.1		240.3±19.3	
Work's	Yes	52 (65.0)	64.5±4.0	.081¶	138.5±16.8	.129¶	210.9±61.9	.072¶	246.3±13.0	.268¶
	No	28 (35.0)	66.7±3.4		154.7±37.9		176.3±43.3		256.7±34.9	
Education	Highschool	58 (72.5)	65.1±3.9	.448	146.4±31.1	.368	197.1±66.0	.386	251.9±26.6	.512
	Diploma	4 (5.0)	68.5±0.7		137.3±1.0		208.5±2.1		247.5±7.1	
	Bachelor	18 (22.5)	65.1±4.4		138.7±8.1		202.2±33.1		244.22±10.0	
BMI	Overweight	16 (20.0)	63.7±3.7	**.001**¶	137.3±24.7	.070¶	208.04±45.5	**.018**¶	243.8±21.1	**.023**¶
	Obese	64 (80.0)	67.6±2.9		154.5±27.5		184.9±72.3		259.1±23.9	

p=*p*-value; SD=Standard Deviation; TC= Total Cholesterol; TG= Triglycerides; ¶Mann Whitney-U; Kruskal-Wallis H

Table IV: Analysis of the effect of Corn on Lipid Profile (N=80)

Variables (mg/dL)	Control Group				Intervention Group				*p*	D Mean††	*p*††
	Pretest Mean±SD	Posttest Mean±SD	D Mean	*p*†	Pretest Mean±SD	Posttest Mean±SD	D Mean	*p*†			
HDL-C	65.7±3.9	63.6±4.7	-0.1	.799#	66.8±3.3	66.9±3.0	0.1	.153#	.080¶	0.2	.101¶
LDL-C	136.3±14.6	201.4±15.1	65.1	.940#	152.2±33.7	122.0±29.6	-30.2	**.001**#	.058¶	95.3	**.034***
TG	210.4±46.6	208.9±46.2	-1.5	.112#	187.6±66.7	160.6±42.1	-27.0	**.023**#	.052¶	25.5	**.003**¶
TC	243.5±8.8	242.3±8.8	-1.2	.400#	256.5±30.7	220.9±33.7	-35.6	**<.001**#	.064¶	34.4	**.006**¶

p=*p*-value; SD=Standard Deviation; TC= Total Cholesterol; TG= Triglycerides; D = Difference; †within group comparison; between group pretest comparison; †† between group posttest comparison; #Wilcoxon; ¶Mann Whitney U; *T-Test Independent analyzed aspects of the lipid profile in one study group and found a significant TC-reducing effect in people given corn silk boiled water. Moon et al. (36) found different results where HDL-C showed significant results, while TC and LDL-C were not significant. Moon et al. used interventions from Corn Peptide Consumption and rats as samples.

Research using processed corn products in corn oil to lower cholesterol levels has also been done before. Previously, research on the benefits of corn on biochemical factors in diabetic rats showed a decrease in LDL-C, TG, and TC, as well as an increase in HDL-C (23). Subsequent studies using human subjects showed results similar to this study. Randomized control trial study by Wagner et al. (37) showed that the results of the corn oil diet showed significant results for all three lipid profiles and not significant for HDL-C. These results are consistent with this study; differences appear in the type of control group used; Wagner et al. gave an olive/sunflower oil mixture to the control group to compare its effect on lipid profiles. Other RCT studies have shown that corn oil is more effective at reducing lipid profiles than other interventions, such as extra-virgin olive oil (27, 28) and coconut oil (29). The differences appear in the type of lipid profile assessed and treated in the control group. Previous research added several types of lipid profiles, and the control group received intervention by giving other products as a comparison.

Corn (Zea Mays L.) is helpful as a source of nutrition and can prevent and reduce the risk of chronic disease because the substances it contains include fibre (19), flavonoids (20), tannins (21), vitamins (A, B, E, and K), minerals (Mg, P, and K) (22) and phytochemicals (38, 39). Corn's important phytochemicals include carotenoids, phenolic compounds (ferulic acid, coumaric acid, and citric acid), phytosterols (40), and antioxidants (41). The content of corn which plays an essential role in overcoming hypercholesterolemia is phytosterols; in 100 grams of corn, there is 14.8 mg of phytosterols with details of Sitosterol (9.9 mg), Stigmasterol (1.5 mg), and Campesterol (3.4 mg) (39). Phytosterols have various ways of influencing the absorption of cholesterol molecules and the metabolism of cholesterol in enterocytes. Phytosterols act in the gut to reduce cholesterol absorption and lower LDL cholesterol concentrations without absorption (42).

Studies with properly formulated phytosterols suggest that ≤300 mg of phytosterols in a single dose, or 830 mg of phytosterols/day, may significantly affect cholesterol metabolism (43). People who consume around two g/day of phytosterols can lower LDL-C by as much as 15%. Phytosterols also increase endogenous biliary cholesterol recirculation, an essential step in cholesterol elimination (44). This research was carried out through two seasons, namely dry and rainy, where the soil's water content can affect corn's content, but researchers have difficulty finding scientific sources about this. To minimize the limitations that the content in corn can cause, the researchers used the same corn variety, namely Zea mays var. saccharate and fresh corn. The use of fresh corn after being harvested aims to avoid differences in corn content due to the effects of storage and humidity (45, 46).

The control group showed no difference between the pretest and posttest because they only received mineral water as an intervention. Mineral water does not significantly affect the lipid profile, in contrast to previous studies showing that mineral or bicarbonate water with specific amounts of criteria effectively reduces lipid profiles (47, 48). Although there was no difference in lipid profile in the control group, there was an increase in LDL-C values of 65.1 mg/dl. Studies show that an increase in LDL-C can be caused by a person's genetics, activity, and lifestyle (49, 50). This increase in value needs to be watched out for and given special attention considering its effect on the risk of cardiovascular disease and other diseases (12, 13). The results of the within-intervention group showed significant differences in LDL-C, TG, and TC. These results strengthen that corn-boiled water can be a non-pharmacological intervention option for people with lipid disorders. Corn is one of the staple foods in many countries in the world. The amount of corn is abundant in Indonesia. It can be found quickly and cheaply in all regions, so it can be an alternative initial treatment for dyslipidemia before deciding to undergo standard therapy in the form of taking drugs.

This study has several limitations; Respondents live in different places and are far from each other, so it is difficult to carry out blood tests and interventions together. To overcome this, the researcher arranges and communicates a research schedule to respondents. The COVID-19 pandemic limits researchers from randomizing because there are still restrictions from the government to prevent COVID-19 transmission. The entire data collection process follows the COVID-19 prevention protocol. All officers and respondents always wear masks, wash their hands before and after the intervention, and do not cause crowds by not collecting respondents in one place but visiting their homes individually. The determination of groups based on the village origin of the respondents became a further limitation of this research because this caused an imbalance for each respondent based on the characteristics of the respondents. The sampling technique used by researchers allows for selection bias.

CONCLUSION

The study results provide reasonable evidence that corn-boiled water effectively improves lipid profiles. The given intervention succeeded in lowering LDL-C, TG, and TC. The good news also appears in HDL-C because there is an increase despite the small amount. Corn-boiled water is easy to make, and the raw materials are easy to find in the surrounding environment at relatively low prices. The study results are expected to be the basis for community nurses to apply non-pharmacological techniques for treating dyslipidemia in people with excess nutritional status. As is known, lifestyle modifications such as dietary adjustments are the first steps taken for the management of dyslipidemia before actually deciding on pharmacotherapy. Healthcare staff provide education about the benefits of corn-boiled water and perform simulations on how to make it to the community.

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