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Avocado Juice and Changes in Total Cholesterol and Triglyceride Levels among Depot Medroxyprogesterone Acetate Contraceptive Acceptors: A Quasi-Experimental Study

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ABSTRACT

Introduction: Depot medroxyprogesterone acetate (DMPA) is a widely used progestin–only injectable contraceptive that has been associated with changes in lipid profiles and a potential increase in cardiovascular risk among women of reproductive age. Avocado is a nutrient dense fruit rich in monounsaturated fatty acids, fibre, and phytosterols, which may improve blood lipids and support cardiovascular health. This study aimed to explore the short term association between avocado juice consumption and changes in total cholesterol and triglyceride levels among women using progestin based injectable contraceptives.

Methods: A quasi–experimental pretest–posttest control group design was used. DMPA users were allocated to an intervention group that received avocado juice plus a high-cholesterol diet, or to a control group that received only the high-cholesterol diet, for 14 consecutive days. Total cholesterol and triglyceride levels were measured before and after the intervention. Data were analysed using normality tests, followed by paired t-tests and independent t-tests, and between-group comparisons were based on changes from baseline.

Results: After 14 days, the intervention group showed a greater reduction in mean total cholesterol than the control group, indicating a possible association between avocado juice consumption and lower total cholesterol among DMPA users. In contrast, triglyceride levels decreased in both groups but did not differ significantly between them, and most triglyceride values remained within the normal range. The observed between–group differences were modest and should be interpreted cautiously in light of the quasi–experimental, non–randomized, short–term, and unblinded design.

Conclusion: In this exploratory study, avocado juice consumption was associated with a short–term reduction in total cholesterol levels among DMPA injectable contraceptives acceptors, whereas triglyceride levels did not change significantly between–groups. These preliminary findings require confirmation in larger randomized controlled studies with longer follow up, stricter dietary control, and baseline–adjusted analyses before firm conclusions can be drawn.

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INTRODUCTION

The majority of the participants were depot medroxyprogesterone acetate (DMPA) injectable contraceptives acceptors with 49.93% of the participants being new users and 47.78% being ongoing users. The hormone progesterone is included in the DMPA contraceptive (1). Total cholesterol and triglyceride levels are much greater in women using DMPA than in women not using DMPA. The risk of atherosclerosis can be increased if DMPA is used for at least two years because it raises levels of blood total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C), while decreasing levels of high-density lipoprotein cholesterol (HDL-C) (2). The risk of cardiovascular disease is greatly increased in women using DMPA due to changes in blood lipid levels, including increased total cholesterol triglycerides, and low-density lipoprotein cholesterol (LDL-C), and decreased high-density lipoprotein cholesterol (HDL-C). This includes conditions such as heart disease, myocardial infarction, and stroke (3).

Fat metabolism disorders in women using DMPA contraceptives can be managed through pharmacological and non-pharmacological treatments. One non- pharmacological therapy believed to reduce cholesterol levels is consuming avocados. Avocado (*Persea americana Mill.*) is a nutrient-dense fruit containing vitamins, minerals, fibre, phytosterols, and polyphenols (4). Avocados are rich in monounsaturated fatty acids (MUFAs), particularly oleic acid, which improve lipid profiles by reducing lipoprotein cholesterol (LDL-C) and triglyceride (TG) levels while maintaining or increasing high-density lipoprotein cholesterol (HDL-C) levels (5). Avocados also contain beta-sitosterol, a phytosterol that inhibits cholesterol absorption in the intestine and reduces hepatic cholesterol synthesis, thereby contributing to a reduction in plasma cholesterol levels (6).

Incorporating avocados into the diet has been shown to help lower cholesterol levels in several studies. This includes both total cholesterol and LDL-C. A meta-analysis of randomized clinical trials reported that fruit consumption was associated with a decrease of 18.80 mg/dL in total cholesterol (TC) and 16.50 mg/dL in low-density lipoprotein (LDL-C. In a separate animal study, the hypolipidemic impact of avocado was demonstrated by a 16.39% reduction in total cholesterol (TC) and a 76.47% reduction in triglyceride (TG) levels in hamsters (7). A study also reported that consuming one avocado per day can successfully reduce cholesterol levels in overweight or obese people, indicating that the avocado-based diet considerably reduced total cholesterol and LDL-C levels more than the low-fat and low-carbohydrate diets (4).

Although several studies have investigated the effects of contraception on lipid metabolism, few have directly assessed the impact of avocado intake among depot medroxyprogesterone acetate (DMPA) contraceptive acceptors. Therefore, this study is important for filling the gap in the literature by providing further evidence regarding dietary interventions in managing increased lipid levels among using hormonal contraceptive acceptors. This study aims to determine the effect of avocado consumption on total cholesterol and triglyceride levels among acceptor of progestin injectable contraceptives. This study is expected to provide useful information in efforts to prevent lipid metabolism disorders among progestin injectable contraceptive acceptors, as well as provide a safe and natural alternative for maintaining the balance of blood lipid levels.

Avocado consumption has been associated with modest reductions in total cholesterol and low-density lipoprotein cholesterol (LDL-C) in adults with dyslipidemia, although findings for HDL-cholesterol and triglycerides remain inconsistent and most trials have been conducted in general overweight or hyper hypercholesterolaemic populations (8,9). In parallel, recent studies have confirmed that use of depot medroxyprogesterone acetate (DMPA) is associated with adverse lipid changes, including increased total cholesterol, LDL-C, and triglycerides, and reduced HDL-C, thereby elevating cardiometabolic risk. However, to our knowledge, no clinical study has specifically evaluated avocado as a targeted dietary strategy to counteract DMPA-related dyslipidemia in contraceptive acceptors (10). The present quasi-experimental study addresses this gap by examining the short-term effects of a standardized daily dose of avocado juice on total cholesterol and triglyceride levels among long-term DMPA contraceptive acceptors, thereby providing novel evidence at the intersection of contraceptive-related metabolic risk and functional food–based lipid modulation. This study fills a specific gap by examining avocado juice among DMPA contraceptive acceptors, a population that has received little direct attention in prior avocado and lipid studies. To our knowledge, this is one of the first quasi-experimental studies to examine avocado juice as a short-term dietary intervention specifically in DMPA contraceptive acceptors, a population at risk of adverse lipid changes. Unlike previous avocado studies conducted in general dyslipidaemic or overweight populations, this study focuses on a contraceptive-related metabolic context and therefore provides preliminary evidence for a targeted nutritional approach among DMPA contraceptive acceptors.

METHOD

Research Type

This study used a quasi-experimental pretest-posttest control group design. Fasting lipid measurements were obtained before and after the 14-day intervention in both groups.

Operational definitions

The operational definitions of total cholesterol and triglyceride were based on measurements obtained by collecting 3–5 mL of venous blood from the antecubital vein and placing it into a vacuum venoject tube. Total cholesterol levels were categorized as normal (<200 mg/dL), borderline high (200-239 mg/dL), and high (>240 mg/dL) (11). Triglyceride classification was defined as normal (<150 mg/dL), borderline high (150-199 mg/dL), high (200-499 mg/dL), and very high (≥500 mg/dL) (12).

Population and Sample

The inclusion criteria were DMPA contraceptive acceptors who had used DMPA injectable contraceptives for more than one year, were willing to participate, and provided written informed consent. Exclusion criteria included a history of hypercholesterolemia (total cholesterol >200 mg/dL) before initiating injectable contraception, current use of lipid-lowering medication, or a documented allergy to avocado. A total of 120 DMPA acceptors were enrolled in the study, with 60 participants allocated to the intervention group and 60 to the control group. Participants who met the eligibility criteria were recruited consecutively during routine clinic visits and assigned according to the clinic visit schedule and service flow, with no individual randomization or quasi-randomized sequence used. This non-random, clinic-schedule-based allocation was chosen for feasibility in the clinic setting but may introduce selection bias and confounding by baseline. To reduce this risk, eligibility criteria were applied consistently to both groups, and baseline characteristics, including age, education, parity, and lipid category, were compared between groups and were broadly similar, as shown in Table 1. All 120 participants completed both baseline and post-intervention assessments; thus, no attrition occurred, and all participants were included in the final analysis.

Control of Confounders

Several strategies were implemented to minimize potential confounding. First, inclusion and exclusion criteria were used to reduce baseline variability: women with pre-existing hypercholesterolemia (>200 mg/dL before starting DMPA), those taking lipid-lowering medications, and those with a history of avocado allergy were excluded. Second, both groups received similar high-cholesterol dietary advice, with the only systematic difference being the addition of avocado juice in the intervention group, thereby controlling for the effect of a cholesterol-raising diet. Third, key sociodemographic and reproductive variables (age, education, and parity) were comparable between groups at baseline, as shown in Table 1, thereby reducing the likelihood that these factors explain the observed differences in lipid changes.

Intervention Rationale and Dose Selection

The avocado intervention was selected for its high content of monounsaturated fatty acids (MUFA), particularly oleic acid, which has been shown to improve lipid profiles and reduce low-density lipoprotein cholesterol (LDL-C) levels. Previous studies have demonstrated that avocado consumption (approximately 136-200 g/day) significantly improves cardiovascular risk markers, including total cholesterol and triglycerides, particularly in populations with metabolic dysregulation (4,13).The dose of one medium avocado, 300 grams (136-200 g edible portion) per day, was chosen to provide approximately 20-30 g of MUFA, an amount consistent with dietary recommendations for lipid management and previous intervention studies (14,15). This dosage was also deemed practical and palatable for daily consumption by participants, thereby enhancing adherence to the intervention. Given that DMPA use is associated with adverse lipid profile changes, including increased total cholesterol and triglycerides, the intervention aimed to mitigate these metabolic side effects through dietary modification. Each participant in the intervention group consumed the avocado in the form of juice (one medium avocado blended with 100 cc of water) to standardize intake and facilitate consumption (4,13-15).

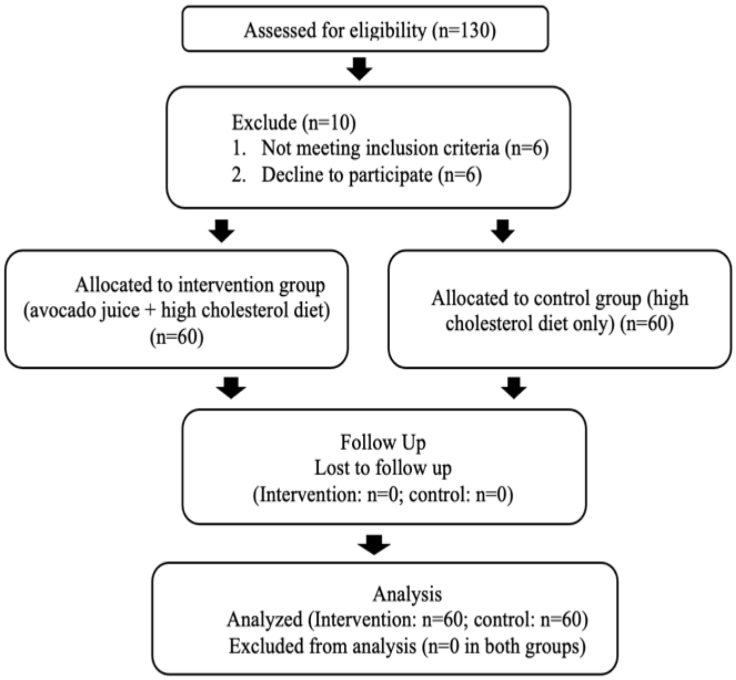

Figure 1. Participant flow diagram. The diagram shows the number of women assessed for eligibility, excluded (with reasons), enrolled, allocated to the avocado juice plus high-cholesterol diet group or high-cholesterol diet–only control group, followed up, and included in the final analysis.

Research Location

The research was conducted at the Tesalonika Restuaji Clinic

Data Collection Procedures and Instrumentation

The treatment and control groups were pretested to measure total cholesterol and triglyceride levels at baseline (Day 0). The intervention was administered for 14 consecutive days, during which the treatment group consumed one medium avocado (300 g; approximately 136–200 g edible portion) daily in the form of juice, while the control group received only dietary counseling regarding high-cholesterol foods to avoid.

To optimize dietary adherence, the avocado juice for the intervention group was prepared and distributed directly daily by the researchers, and consumption was directly observed or confirmed at the clinic. Participants also completed a daily food record documenting avocado intake and other high-cholesterol foods, which the researchers checked at each visit. Any missed avocado doses or major deviations from the prescribed diet were recorded and taken into account when interpreting the findings. Fasting venous blood samples (3-5 mL) were collected again on Day 15 (post-intervention) to measure total cholesterol and triglyceride levels using photometric and colourimetric methods. All blood samples were collected after an overnight fast of at least 10 hours.

High cholesterol diet rationale

A short-term high-cholesterol diet was applied in both groups to standardize background dietary exposure during the intervention period. This strategy was chosen to reduce heterogeneity in usual food intake across participants during the intervention period. However, because this dietary manipulation does not fully reflect the habitual diet of most DMPA contraceptive acceptors, the findings may have limited generalizability beyond the study setting. Dietary adherence was monitored through direct daily provision of avocado juice in the intervention group, direct observation or confirmation of intake at the clinic, and review of daily food records by the research team.

Data Analysis

Data were analysed using IBM SPSS Statistics version 26.0. Normality was assessed using the Kolmogorov-Smirnov test. Within-group changes were initially explored using paired t-tests, and between-group differences in change scores were examined using independent t-tests; primary between-group comparisons were therefore based on differences in change scores rather than post-test values alone. Effect sizes were calculated using Cohen's d for between-group differences in change scores, with 95% confidence intervals (CI) reported for mean differences, and Cohen's d values of 0.2, 0.5, and 0.8 were interpreted as small, medium, and large effect sizes, respectively. Statistical significance was set at $p < 0.05$. Because this was a pretest-posttest quasi-experimental study and advanced baseline-adjusted models, such as analysis of covariance (ANCOVA) or linear mixed-effects regression models, were not applied, the results should be interpreted with caution as exploratory findings and potentially affected by residual confounding; future reanalysis should adjust for baseline lipid values and clinically relevant covariates such as age, parity, and duration of DMPA use

Ethical Approval

The researchers obtained ethical clearance from the Research Ethics Commission of Universitas Jenderal Achmad Yani, Yogyakarta, on May 30, 2024, with reference number SKep/177/KEP/V/2024

RESULTS

This study showed that the majority of DMPA contraceptive acceptors were classified as being at higher age-related risk (>35 years), with 55.0% in the intervention group and 46.7% in the control group. Most participants in both groups had a high school level of education. Furthermore, the majority of DMPA contraceptive acceptors in both groups had two children or fewer (≤2 children). Total cholesterol levels in the treatment group were predominantly borderline high (40%), while in the control group, they were predominantly normal (43.3%).

Table 1. Characteristics of the Participants of the Treatment and Control Groups

Characteristics	Description	Intervention group		Control group	
		Frequency	%	Frequency	%
Age	<20 years	0	0	0	0
	20-35 years	27	45.0	32	53.3
	>35 years	33	55.0	28	46.7
Education	Elementary School	4	6.7	2	3.3
	Junior High School	13	21.6	16	26.7
	Senior High School	31	51.7	33	55.0
	Higher Education	12	20.0	9	15.0
Parity	≤2 children	39	65.0	38	63.3
	>2 children	21	35.0	22	36.7
Total Cholesterol	Normal	21	35.0	26	43.3
	Borderline high	24	40.0	22	36.7
	High	15	25.0	12	20.0
Triglyceride	Normal	28	46.7	26	43.3
	Borderline high	23	38.3	28	46.7
	High	9	15.0	6	10.0
	Very High	0	0.0	0	0.0

Table 2. Change in Total Cholesterol and Triglyceride Levels Before and After the Intervention

Variable	Group	Pre-test mean ± SD (mg/dL)	Post-test mean ± SD (mg/dL)	Mean change (post–pre) (mg/dL)	95% CI for the between-group mean difference in change	Cohen's d	Within-group p-value (paired t-test)	Between-group p-value (independent t-test)
Total cholesterol	Intervention	198.07 ± 39.57	173.80 ± 34.20	−24.27	−27.79 to −7.27	0.62	0.000	0.028
	Control	194.22 ± 38.57	187.48 ± 30.55	−6.74			0.110	
Triglycerides	Intervention	127.07 ± 52.80	116.27 ± 61.02	−10.80	−2.36 to 31.66	0.31	0.060	0.273
	Control	129.67 ± 69.00	104.22 ± 47.83	−25.45			0.352	

Note: SD = Standard Deviation; CI = Confidence Interval. Values are expressed as mean ± standard deviation (SD). 95% CI refers to the between-group difference in mean change. Paired t-test was used for within-group comparisons, and an independent t-test was used for between-group comparisons.

As shown in Table 2, total cholesterol decreased more in the intervention group than in the control group over the 14-day study period, with levels decreasing substantially in the intervention group from 198.07 ± 39.57 mg/dL at baseline to 173.80 ± 34.20 mg/dL after 14 days of avocado juice consumption ($p < 0.001$), corresponding to a mean reduction of 24.27 mg/dL. In contrast, the control group showed a smaller, non-significant decrease from 194.22 ± 38.57 mg/dL to 187.48 ± 30.55 mg/dL ($p = 0.110$), with a mean reduction of 6.74 mg/dL. The between-group mean difference in change was −17.53 mg/dL (95% CI −27.79 to −7.27; $p = 0.028$), yielding a Cohen's d of 0.62, which indicates a medium effect size. Although the between-group difference in change was statistically significant and suggests a clinically meaningful reduction in total cholesterol among DMPA contraceptive acceptors, the study was non-randomized and did not apply baseline-adjusted models; therefore, the finding should be interpreted as an observed association rather than definitive evidence of a causal intervention effect.

Triglyceride levels decreased numerically in both groups. In the intervention group, mean triglycerides decreased from 127.07 ± 52.80 to 116.27 ± 61.02 mg/dL ($p = 0.060$), representing a mean change of −10.80 mg/dL. In the control group, triglycerides decreased from 129.67 ± 69.00 to 104.22 ± 47.83 mg/dL ($p = 0.352$), with a mean change of −25.45 mg/dL. The between-group mean difference in change was 14.65 mg/dL (95% CI −2.36 to 31.66, $p = 0.273$), with a small effect size (Cohen's d = 0.31). Thus, the short-term avocado intervention did not significantly affect triglyceride levels compared with control among DMPA contraceptive acceptors.

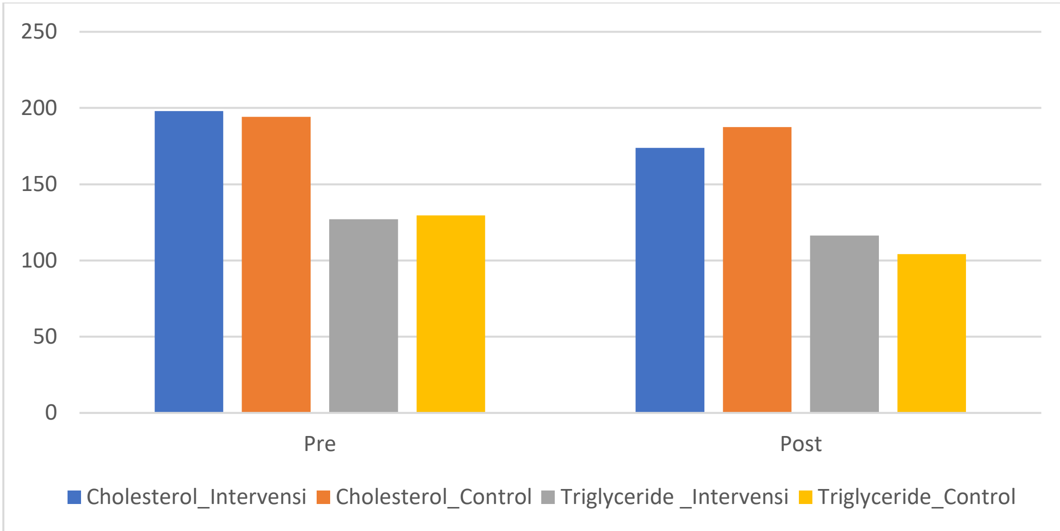

Figure 2. Pre- and post-intervention changes in total cholesterol and triglyceride levels in the intervention and control groups

DISCUSSION

Among DMPA contraceptive acceptors, avocado juice consumption was associated with a greater short-term reduction in total cholesterol than in the comparison regimen. This finding is broadly consistent with previous studies suggesting that avocado intake may improve lipid profiles, particularly cholesterol and low-density lipoprotein cholesterol (LDL-C). However, most prior studies were conducted in general dyslipidaemic or overweight populations rather than in DMPA contraceptive acceptors (5,9,13,18–23). Because the present study used a quasi-experimental, non-randomized, and unblinded design, this result should be interpreted as an observed association rather than definitive evidence of a causal intervention effect

In contrast, triglyceride levels did not differ significantly between-groups, and the numerical change was greater in the control group. One possible explanation is that triglycerides are often more sensitive than total cholesterol to short-term variation in overall energy intake, carbohydrate intake, and day-to-day dietary adherence (24,25) which may have reduced the ability to detect a clear intervention-related pattern during the 14-day study period (19,24,26,27). In addition, baseline triglyceride values in both groups were largely within the normal range, which may have limited the opportunity to observe a measurable short-term reduction

The apparent discrepancy between the significant total cholesterol finding and the non-significant triglyceride finding may also suggest that any short-term lipid response to avocado juice is easier to detect for cholesterol-related outcomes than for triglycerides under the present study conditions (9,13,19,27). However, mechanistic interpretation should remain cautious because the study was not designed to test biological pathways directly, and residual confounding cannot be excluded

Overall, the study suggests that avocado juice may be a feasible dietary option for supporting total cholesterol management in DMPA contraceptive acceptors, but larger randomized studies with longer follow-up, tighter dietary control, and baseline-adjusted analysis are needed to confirm whether the observed association is reproducible and clinically meaningful (9,28,29).

Strengths of the study

In addition to these limitations, the study also has several strengths. First, it focuses on a clinically relevant yet understudied population, namely DMPA contraceptive acceptors, for whom dietary strategies to mitigate adverse lipid changes are urgently needed (2,3,10,20). Second, the quasi-experimental pretest–posttest control group design with 120 participants and complete follow-up (no attrition) provides a relatively robust sample for detecting short-term changes in lipid profiles. Third, lipid measurements were obtained using standardized laboratory methods at two clearly defined time points, allowing within-subject comparisons. Fourth, the avocado intervention was based on a biologically plausible rationale, used a standardized daily dose that is feasible in routine practice, and was monitored through direct provision and daily food records to support adherence. In addition, the use of change scores, confidence intervals, and standardized effect sizes enhances the transparency and interpretability of the findings and aligns the statistical reporting with current methodological recommendations.

Limitations and Cautions

Several limitations should be considered when interpreting these findings. Group allocation was non-random, follow-up was limited to 14 days, and the lack of blinding among both participants and researchers may have influenced behaviour and outcome assessment. Dietary intake outside the prescribed regimen was not fully controlled, and baseline-adjusted analyses were not applied, so residual confounding cannot be excluded. To improve internal validity in this pretest-posttest design, the primary outcomes should ideally be reanalysed using an ANCOVA or linear mixed-effects model, adjusting for baseline lipid values and clinically relevant covariates such as age, parity, and duration of DMPA use. These issues may affect both internal validity and generalizability, and the results are therefore best viewed as preliminary and hypothesis-generating rather than confirmatory.

Recommendations for Future Research

Despite these limitations, the present study provides initial evidence that avocado juice consumption may be associated with favourable changes in total cholesterol among DMPA contraceptive acceptors. For clinicians and public health practitioners, avocado could represent a culturally acceptable and readily available food that complements existing counselling on healthy lifestyle practices for hormonal contraceptive acceptors. Future research should use randomized controlled designs with longer follow-up, stricter dietary control, and advanced statistical modelling to confirm these associations**,** explore dose-response relationships, and examine broader cardiometabolic outcomes, including LDL and HDL subfractions, markers of oxidative stress, and inflammatory biomarkers.

CONCLUSION

In this exploratory quasi-experimental study, avocado juice consumption was associated with lower total cholesterol levels after 14 days among DMPA contraceptive acceptors, whereas triglyceride levels did not differ significantly between groups. Given the non-random allocation, short duration, and absence of baseline-adjusted modelling, these findings should be interpreted cautiously as preliminary associations rather than confirmatory evidence of a causal effect.

AUTHOR CONTRIBUTION STATEMENT

Liberty Barokah led the study design, conceptualization, and preparation of the proposal and final report. Dewi Zolekhah handled data collection and statistical analysis, while Tyasning Yuni contributed to article preparation and manuscript revision.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to this study.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors declare that ChatGPT was used only to assist with language refinement and grammar correction. The tool had no role in the study's conceptualization, data analysis, interpretation, or conclusions. All content is the authors' original work and has been reviewed and approved before submission.

SOURCE OF FUNDING STATEMENTS

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BIBLIOGRAPHY

1. Indonesian Ministry of Health. Indonesian Health Profile [Internet]. Jakarta; 2023 [cited 2025 Nov 25]. Available from: https://kemkes.go.id/id/profil-kesehatan-indonesia-2023
2. Ferdous S, Amir M, Chowdhury SB, Nasrin B, Hamid F, Banu S. Effects of Long-Term Use of Depotmedroxy Progesterone Acetate on Serum Lipids. Bangladesh Journal of Obstetrics & Gynaecology. 2019 Sep 30;34(2):106–11. https://doi.org/10.3329/bjog.v34i2.58277
3. Dilshad H, Yousuf RI, Shoaib MH, Jamil S, Khatoon H. Cardiovascular Disease Risk Associated With the Long-term Use of Depot Medroxyprogesterone Acetate. Am J Med Sci. 2016 Nov;352(5):487–92. https:/doi.org//10.1016/j.amjms.2016.08.007
4. Wang L. The effects of monounsaturated fatty acid-enriched diets with and without avocados on cardio-metabolic risk factors. [Pennsylvania]: The Pennsylvania State University; 2015. https:/doi.org/10.1161/JAHA.114.001355
5. Silva Caldas AP, Chaves LO, Linhares Da Silva L, De Castro Morais D, Gonçalves Alfenas R de C. Mechanisms involved in the cardioprotective effect of avocado consumption: A systematic review. Int J Food Prop. 2017 Jul 20;1–11. https://doi.org/10.1080/10942912.2017.1352601
6. Salgado JM, Bin C, Mansi DN, Souza A. Efeito do abacate (Persea americana Mill) variedade hass na lipidemia de ratos hipercolesterolêmicos. Ciência e Tecnologia de Alimentos. 2008 Dec;28(4):922–8. https://doi.org/10.1590/S0101-20612008000400025
7. Octavio Rodiles-López J, González-Montoya M, Eduardo Martínez-Flores H, Zamora-Vega R. The Effect of Diets Enriched with Avocado (Persea americana cv Hass) on Cholesterol and Triglyceride Decrease Evaluated in Hamsters. Journal of Food and Nutrition Research. 2020 Nov 27;8(11):670–4. https://doi.org/10.12691/jfnr-8-11-7
8. Candeloro BM, Barbalho SM, Laurindo LF, Raimundo RD, Stevanato BL, Assumpção MCB, et al. Is avocado beneficial for lipid profiles? An umbrella review of systematic reviews and meta-analyses. Clin Nutr ESPEN. 2025 Oct 1;69:673–85. https://doi.org/10.1016/j.clnesp.2025.08.019
9. Mostafazadeh P, Etesamnia S, Nasiraei-Moghadam M, Jahan-mihan A, Haghighi A, Zendedel A, et al. Exploring the effect of avocado on lipid profile modulation: a systematic review and dose–response and meta-analysis of clinical trials. Crit Rev Food Sci Nutr. 2025 Aug;1–11. https://doi.org/10.1080/10408398.2025.2531222
10. Odelola O, Akadri A. Depot-medroxyprogesterone acetate: lipid profile changes and associated cardiovascular risks among recipients in Sagamu, South West Nigeria. J Public Health Afr. 2023 Nov 30;14(11):9. https://doi.org/10.4081/jphia.2023.1664
11. Ester AVH, Soralys C, Rosa L, Coromoto ónzalez IL. Efecto del consumo de aguacate (Persea Americana Mill) sobre el perfil lipídico en adultos con dislipidemia. Anales Venezolanos de Nutrición. 2009;22(2):84–9. https://ve.scielo.org/scielo.php?script=sci_arttext&pid=S0798-07522009000200005
12. Brechtel L, Poupore N, Stoikov T, Roley LT, Emerson JF, Nathaniel T. Comorbidities associated with different levels of total cholesterol in male and female acute ischemic stroke patients. Medicine. 2020 Dec 24;99(52):e23870. https://doi.org/10.1097/MD.0000000000023870
13. Mahmassani HA, Avendano EE, Raman G, Johnson EJ. Avocado consumption and risk factors for heart disease: a systematic review and meta-analysis. Am J Clin Nutr. 2018 Apr;107(4):523–36. https://doi.org/10.1093/ajcn/nqx078
14. Peou S, Milliard-Hasting B, Shah SA. Impact of avocado-enriched diets on plasma lipoproteins: A meta-analysis. J Clin Lipidol. 2016 Jan 1;10(1):161–71. https://doi.org/10.1016/j.jacl.2015.10.011

15. Wien M, Haddad E, Oda K, Sabaté J. A randomized 3×3 crossover study to evaluate the effect of Hass avocado intake on post-ingestive satiety, glucose and insulin levels, and subsequent energy intake in overweight adults. Nutr J. 2013 Nov 27;12(1). https://doi.org/10.1186/1475-2891-12-155
16. Padmanabhan M, Arumugam G. Effect of Persea americana (avocado) fruit extract on the level of expression of adiponectin and PPAR-γ in rats subjected to experimental hyperlipidemia and obesity. J Complement Integr Med. 2014 Jun 1;11(2):107–19. https://doi.org/10.1515/jcim-2013-0053
17. Candeloro BM, Barbalho SM, Laurindo LF, Raimundo RD, Stevanato BL, Assumpção MCB, et al. Is avocado beneficial for lipid profiles? An umbrella review of systematic reviews and meta-analyses. Clin Nutr ESPEN. 2025 Oct; 69:673–85. https://doi.org/10.1016/j.clnesp.2025.08.019
18. Peou S, Milliard-Hasting B, Shah SA. Impact of avocado-enriched diets on plasma lipoproteins: A meta-analysis. J Clin Lipidol. 2016 Jan;10(1):161–71. https://doi.org/10.1016/j.jacl.2015.10.011
19. Wang L, Tao L, Hao L, Stanley TH, Huang KH, Lambert JD, et al. A Moderate-Fat Diet with One Avocado per Day Increases Plasma Antioxidants and Decreases the Oxidation of Small, Dense LDL in Adults with Overweight and Obesity: A Randomized Controlled Trial. J Nutr. 2020 Feb;150(2):276–84. https://doi.org/10.1093/jn/nxz231
20. Díaz-Perilla M, Andrea Toro C. Efecto de la adición de aguacate a la alimentación habitual sobre los niveles de lípidos en personas con dislipidemia. Univ Sci (Bogota). 2004;9(2):49–58. https://revistas.javeriana.edu.co/index.php/scientarium/article/view/4930
21. Pieterse, Zelda, Jerling, Johann, Oosthuizen, Welma. Avocados (monounsaturated fatty acids), weight loss and serum lipids. 2003. https://doi.org/10.1016/j.nut.2004.09.010
22. Dreher ML, Davenport AJ. Hass Avocado Composition and Potential Health Effects. Crit Rev Food Sci Nutr. 2013 Jan;53(7):738–50. https://doi.org/10.1080/10408398.2011.556759
23. Li H, Zuo Y, Qian F, Chen S, Tian X, Wang P, et al. Triglyceride-glucose index variability and incident cardiovascular disease: a prospective cohort study. Cardiovasc Diabetol. 2022 Dec 10;21(1):105. https://doi.org/10.1186/s12933-022-01541-5
24. Balaban Yucesan F, Demir EN, Ozer Yaman S, Orem A, Dokuz Murat B, Bilgin B. Short-Term Standard Diet Consumption Prior to the Oral Fat Tolerance Test Modulates the Postprandial Triglyceride Response. Metabolites. 2023 Sep 17;13(9):1019. https://doi.org/10.3390/metabo13091019
25. S. Alagu Thangam, S. Vilma Veronica, G. Suresh, S. Hemalatha. Prognosis of Hyper Triglycerides Using Data Science and Machine Learning. Int J Sci Res Sci Eng Technol. 2023 Oct 11;229–39.
26. Hamednia S, Shouhani Z, Tavakol S, Montazeri N, Amirkhan-Dehkordi M, Karimi MA, et al. Effects of Avocado Products on Cardiovascular Risk Factors in Adults: A GRADE-Assessed Systematic Review and Meta-Analysis. Food Sci Nutr. 2025 Jul 2;13(7). https://doi.org/10.1002/fsn3.70547
27. Tarigan TJE, Khumaedi AI, Wafa S, Johan M, Abdullah M, Surono IS, et al. Determinant of postprandial triglyceride levels in healthy young adults. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2019 May;13(3):1917–21. https://doi.org/10.1016/j.dsx.2019.04.027
28. Mikkelsen M, Wilsgaard T, Grimsgaard S, Hopstock LA, Hansson P. Associations between postprandial triglyceride concentrations and sex, age, and body mass index: cross-sectional analyses from the Tromsø study 2015–2016. Front Nutr. 2023 Jun 15;10. https://doi.org/10.3389/fnut.2023.1158383
29. Yadav BK, Gupta RK, Gyawali P, Shrestha R, Poudel B, Sigdel M, et al. Effects of Long-term Use of Depo-medroxyprogesterone Acetate on Lipid Metabolism in Nepalese Women. Ann Lab Med. 2011 Apr 1;31(2):95–7. https://doi.org/10.3343/kjlm.2011.31.2.95