The consumption of walnuts has an impact on decreasing fasting blood glucose levels in individuals with concurrent hyperglycemia and hyperlipidemia: a randomized control trial

Sukmawati, Sirajuddin, Suriani Rauf

Department of Nutrition, Health Polytechnic of Makassar, Indonesia

Abstract

Nationally, the prevalence of Diabetes Mellitus (DM) has increased by 0.5%. In 2013, it was approximately 1.5%, rising to 2.0% in 2018. On the other hand, it is known that administering walnut extract can reduce blood sugar levels in diabetic patients.

The aim of this study is to determine the effect of walnut consumption on blood sugar levels. The research was conducted experimentally, using a pre-post test control group design. The research sample consisted of mothers with fasting blood sugar levels ≥200 mg/dL and total cholesterol levels ≥200 mg/dL (hyperglycemic and hyperlipidemic). The total sample size was 50 mothers, divided into 2 groups. Samples were selected using simple random sampling. The intervention involved giving 50 grams of walnut (*Canarium Indicum L.*) daily for 8 weeks to the treatment group. The research was conducted in the working area of the Paccerakang Community Health Center in Makassar City, Indonesia. Statistical analysis was performed using paired T-tests. There was a decrease in fasting blood glucose levels in the treatment group from 244.12 mg/dL to 195.52 mg/dL. In the control group, there was a slight decrease in blood sugar levels from 236.92 mg/dL to 229.96 mg/dL. Paired T-test analysis in the treatment group showed a value of p=0.00, indicating a significant difference in cholesterol levels before and after the intervention in the treatment group. In the control group, the value was p=0.07, indicating no significant difference in cholesterol levels in the control group. Administering 50 grams of walnuts per day for 8 weeks significantly lowered fasting blood sugar levels in hyperlipidemic and hyperglycemic mothers.

Introduction

The national prevalence of Diabetes Mellitus (DM) has increased by 0.5%. In 2013, it was around 1.5%, rising to 2.0% in 2018.[1,2] Based on the secondary analysis of the Basic Health Survey in Indonesia, the results consistently show higher prediabetes rates in rural areas (45.2%) compared to urban areas (37.0%). Prediabetes is more prevalent among women, those aged 30 or older, individuals with lower education levels, and various occupational groups such as farmers, fishermen, unemployed individuals, married individuals, and those from lower socioeconomic backgrounds, including individuals with easier access to health services.[3]

The data from 2013 show that the national prevalence of DM in Indonesia was 6.9%, with rates of 7% in rural areas and 6.6% in urban areas. The borderline level of total cholesterol (200-239 mg/dL) reached 28%, while the high level (>240 mg/dL) reached 10.1%.[2] The study investigates the occurrence of concurrent hyperlipidemia and hyperglycemia in one small town in South Sulawesi, specifically in Biringkanaya, a part of Makassar City, Indonesia.

Multiple comprehensive prospective observational studies in humans demonstrate a clear inverse relationship between the risk of coronary heart disease and the consistent consumption of small servings of nuts, specifically highlighting walnuts.[4,5] Greater consumption (≥5 servings/week) of peanuts and walnuts, rather than

peanut butter, showed an inverse correlation with the presence of multiple chronic conditions and substantial weight loss.[6] Citing Healthy Food, it has been found that walnuts can lower Low-Density Lipoprotein (LDL), and reduce the likelihood of LDL particles forming plaques in artery walls.[7] Consumption of 42.5-85 g/day of walnuts has proven to decrease total cholesterol, triglycerides, LDL cholesterol, and increase High-Density Lipoprotein (HDL) cholesterol, lower blood pressure, improve endothelial function, reduce oxidative stress and inflammation markers, lower blood sugar levels, and potentially aid in weight loss.[8] The effect of walnut (*Canarium Indicum*) extract administration on blood sugar levels in acute hyperglycemic rats (*Rattus Norvegicus L*), that the walnut extract at a dosage of 300 mg/kg body weight effectively lowered blood sugar levels, but the effectiveness of reducing blood sugar levels was much greater at a dosage of 600 mg/kg body weight as it normalized fasting blood sugar.

The systematic review proves that the effect of reducing glucose through walnut consumption is weak, as subjects with existing hyperlipidemia tend to have dietary control and medication as coping mechanisms. Further studies are needed to assess dietary and medication confounding factors.[9]

The study observed the effects of walnut consumption on reducing fasting blood glucose levels in patients with concurrent hyperlipidemia and hyperglycemia. The control for dietary and anti-diabetes medication confounders was achieved by excluding subjects who already had specific diets and anti-diabetes medication. This study aimed to assess the role of walnuts (*Canarium Indicum L.*) in lowering blood sugar levels in hyperlipidemic and hyperglycemic mothers.[10]

Materials and Methods

Research design

This study is an experimental research with a randomized control study and a pilot study. First, the samples were screened by measuring fasting blood sugar levels and cholesterol total levels. The total number of individuals was 65. Based on the inclusion criteria of fasting blood sugar >200 mg/dL and total cholesterol >200 mg/dL, only 50 subjects were found. They were then randomly divided into two groups: 25 individuals in the intervention group and 25 individuals in the control group. Throughout the study, those who completed the entire study sequence remained the same at 25 individuals in each group, resulting in a total of 50 eligible subjects for analysis

Study participants

First, the samples were screened by measuring fasting blood sugar and cholesterol levels. A total of 225 individuals were screened. Based on the inclusion criteria of fasting blood sugar >200 mg/dL and total cholesterol >200 mg/dL, only 95 subjects were found. Secondly, subsequently, they were randomly divided into two groups: 25 individuals in the intervention group and 25 individuals in the control group. Throughout the study period, 25 individuals in each group completed the entire study process, resulting in a total of 50 eligible subjects for analysis. Sampling was done through simple random sampling. The intervention involved providing roasted walnuts to the treatment group, 50 grams per day for 8 weeks. The research was conducted at 5 Integrated Health Posts (IHP) in the working area of Paccerakang Public Health Center, Makassar City, Indonesia. However, after the

completion of the study, they were provided with walnuts.

Variable, instrument, and data collection

The characteristics of the respondents (age, education, and occupation) were collected by interviews using a questionnaire. The intake of energy and nutrients was collected by food recall for 24 hours using the multi-pass five method.[11,12] Content analysis of energy and nutrient intake were calculated based on the food composition table Indonesia, integrated into Nutrisurvey Apps. Levels of glucose were collected by a commercial kit (Accu Pro; SYAF; West Purwokerto, Indonesia).

Data analysis

The paired T-test was used to analyze energy intake, nutrients, and blood sugar before and after the intervention. This analysis was performed using the Statistical Package for Social Sciences (SPSS) version 16 software.

Ethical clearance

The research has received ethical approval from the Health Research Ethics Commission, Health Polytechnic of Makassar, based on ethical certificate 0027/M/KEPK-PTKMS/III/2023. During the research, the researcher paid attention to the ethical principles of information to consent, respect for human rights, beneficence, and non-maleficence.

Results

The study found that the intervention group's energy, carbohydrates, and protein intake was higher than that of the control group. The treatment group's fasting blood sugar levels were significantly lower (Tables 1-3).

Discussion

The study aims to observe the difference in fasting blood sugar levels in mothers with hyperlipidemia and hyperglycemia before and after an intervention involving the consumption of 50 grams of walnuts daily. In this study, an intervention of consuming 50 grams of roasted walnuts daily for 8 weeks was conducted among mothers experiencing hyperlipidemia and hyperglycemia. A paired T-test statistical analysis was employed to evaluate the difference in fasting blood sugar levels between the treatment and control groups. There was a reduction in the mean fasting blood sugar levels in the treatment group from 244.12 mg/dL with a Standard Deviation (SD) of 22.06 to 192.52 mg/dL, with a standard deviation of 33.26. The decrease in fasting blood sugar levels in the treatment group post-intervention was attributed to a reduction in carbohydrate intake from 100.81% Recommended Dietary Allowances (RDA) to 95.89% RDA and a decrease in energy intake from 100.30% RDA to 95.56% RDA. The theory suggests that low carbohydrate intake can impact a reduction in blood sugar levels. Walnut consumption increases satiation and may lead to decreases in energy intake. [13]

Results of this study revealed a significant difference in the decrease of fasting blood sugar levels among the treatment group. Other studies have reported that administering walnut oil to diabetic patients can improve blood sugar profiles, including the parameter HbA1C; even though the outcome differs from this study, which only measured fasting glucose, the essence remains related

to blood sugar control.[14-16] However, a systematic review and meta-analysis report by Neale *et al.* in 2020 found that the consumption of walnuts did not consistently decrease fasting glucose. This is due to their position within the subjects' dietary patterns, where walnuts are not the primary contributor to glucose. Thus, their effect is not directly on the fasting glucose profile but is important as part of balancing the overall nutritional intake.[9]

The acute consumption of walnuts, when consumed together with a source of carbohydrates, is capable of lowering blood glucose.[17] It is suspected that this is related to the effect on insulin sensitivity, which controls the increase in blood glucose.[18]

In the specific context of walnuts and blood glucose, current strong evidence suggests that the reduction in blood glucose is not directly related to the effect of walnuts alone,[9] but rather to the interaction effects of various nutritional components that are naturally part of the meal composition. Additionally, controlling the effects of anti-diabetic medications poses a challenge. To address doubts about the argument that walnuts do not decrease blood glucose, this study excluded all subjects consuming anti-diabetic drugs and subjects following a specific carbohydrate intake control

diet. None of the subjects had established a specific dietary pattern related to their status as hyperglycemic and hyperlipidemic subjects. One explanation for this is that in the intervention group, there was a significant decrease in carbohydrate and fat intake, whereas in the control group, carbohydrate, and fat intake remained unchanged.

Walnuts also contain unsaturated fatty acids such as oleic acid, linoleic acid, and palmitic acid.[19] These unsaturated fatty acids can help lower blood sugar levels by modulating mitochondrial bioenergetics and endoplasmic reticulum stress, thus increasing insulin sensitivity.[20] Moreover, the bioactive compounds and antioxidants found in walnuts play a role in lowering blood sugar.[21] Flavonoids and phenolic compounds found in walnuts aid in improving glucose tolerance and insulin resistance by preventing oxidative stress, a known cause of diabetes pathogenesis.[22]

However, there are conflicting findings in the study by Neale *et al.* (2020), which suggested that walnut intake did not significantly affect blood glucose control markers. The study emphasized the need for further investigation to reduce bias and explore potential limitations. Nonetheless, several studies support the beneficial

Table 1. Characteristics of research respondents.

Characteristics	Mother				Father			
	Intervention		Control		Intervention		Control	
	n	%	n	%	n	%	n	%
Age (years)								
35-45	8	32	13	52	6	24	10	40
46-55	17	68	12	48	19	76	15	60
Education								
Primary school	5	28	14	56	8	32	14	56
Secondary school	4	16	2	8	7	280	2	8
High school	9	36	7	28	4	16	7	28
Graduated	7	28	2	8	6	24	2	8
Occupation								
Civil servants	3	12	0	0	7	28	1	4
Private sector employees*	0	0	0	0	3	12	3	12
Entrepreneurs	0	0	0	0	1	4	0	0
Informal sector (Traders)	22	88	25	100	14	56	21	22
Total 25	100	25	100	25	100	25	100	

*Traders, laborer, farmer, fishermen, driver, retired.

Table 2. The intake of energy and nutrients of the subjects.

Intake	Intervention (n=25)		p	Control (n=25)		p
	Before	After		Before	After	
Energy (kcal)	1956.25±199.19	1863.82±167.42	0.01	1943.42±152.69	1965.09±156.99	0.35
Carbohydrate (g)	300.74±35.76	286.57±30.27	0.03	304.97±29.15	315.26±36.16	0.08
Fat (g)	56.07±7.95	51.39±5.50	0	54.18±4.81	56.00±5.76	0.14
Protein (g)	59.90±4.23	59.66±4.90	0.87	62.58±5.40	64.36±7.38	0.19

Table 3. Mean of the fasting blood glucose level of the subject.

Groups	Fasting blood glucose level (mg/dL)		p
	Before (n=25)	After (n=25)	
Intervention	244.12±22,06	192.52±33.26	0.00
Control	236.92±18.98	229.96±26.34	0.07

role of incorporating walnuts into a healthy diet for diabetes prevention.

In conclusion, the research suggests that walnut consumption can potentially help reduce blood sugar levels in subjects with concurrent hyperglycemia and hyperlipidemia, but more comprehensive studies are needed to confirm these findings.

Conclusions

There was a significant difference in the fasting blood glucose levels of concurrent hyperlipidemic and hyperglycemic mothers after the administration of 50 grams/day of walnuts for 8 weeks.

References

1. Kemenkes. Laporan Riskesdas Tahun 2018. 2018. Available from: https://repository.badankebijakan.kemkes.go.id/ id/eprint/3514/1/Laporan%20Riskesdas%202018%20 Nasional.pdf
2. Kemenkes. Laporan Riset Kesehatan Dasar Tahun 2013. 2013. Available from: https://repository.badankebijakan.kemkes.go.id/id/eprint/4428/
3. Dany F, Dewi RM, Tjandrarini DH, et al. Urban-rural distinction of potential determinants for prediabetes in Indonesian population aged ≥15 years: a cross-sectional analysis of Indonesian Basic Health Research 2018 among normoglycemic and prediabetic individuals. BMC Public Health 2020;20:1509.
4. Guasch-Ferré M, Hernández-Alonso P, Drouin-Chartier JP, et al. Walnut consumption, plasma metabolomics, and risk of type 2 diabetes and cardiovascular disease. J Nutr 2021;151:303-11.
5. Kris-Etherton PM. Walnuts decrease risk of cardiovascular disease: a summary of efficacy and biologic mechanisms. J Nutr 2014;144:547-54S.
6. Wang R, Hannan MT, Wang M, et al. Long-term consumption of nuts (including peanuts, peanut butter, walnuts, and other nuts) in relation to risk of frailty in older women: evidence from a cohort study. J Nutr 2023;153:820-7.
7. Rajaram S, Cofán M, Sala-Vila A, et al. Effects of walnut consumption for 2 years on lipoprotein subclasses among healthy elders. Circulation 2021;144:1083-5.
8. Berryman CE, Grieger JA, West SG, et al. Acute consumption of walnuts and walnut components differentially affects postprandial lipemia, endothelial function, oxidative stress, and cholesterol efflux in humans with mild hypercholesterolemia. J Nutr 2013;143:788-94.
9. Neale EP, Guan V, Tapsell LC, Probst YC. Effect of walnut consumption on markers of blood glucose control: a systematic review and meta-analysis. Br J Nutrition 2020;124:641-53.
10. Zebari HMH, Hidayet HM, Al-nakshabandi Assel AI, Hussein N. Pain caused by ear tagging in kids of native black goats. J Sci Res Med Biol Sci 2021;2:19-29.
11. Htet MK, Fahmida U, Do TT, et al. The use of tablet-based multiple-pass 24-hour dietary recall application (MP24Diet) to collect dietary intake of children under two years old in the prospective cohort study in Indonesia. Nutrients 2019;11:2889.
12. Gibson RS, Ferguson EL. An interactive 24-hour recall for assessing the adequacy of iron and zinc intakes in developing countries. 2008. Available from: https://www.ifpri.org/publication/interactive-24-hour-recall-assessing-adequacy-iron-and-zinc-intakes-developing-countries
13. Brennan AM, Sweeney LL, Liu X, Mantzoros CS. Walnut consumption increases satiation but has no effect on insulin resistance or the metabolic profile over a 4□day period. Obesity 2010;18:1176-82.
14. Zibaee Nezhad MJ, Aghasadeghi K, Hakimi H, et al. The effect of walnut oil consumption on blood sugar in patients with Diabetes Mellitus type 2. Int J Endocrinol Metab 2016;14.
15. Njike VY, Yarandi N, Petraro P. Inclusion of walnut in the diets of adults at risk for type 2 diabetes and their dietary pattern changes: a randomized, controlled, cross-over trial. BMJ Open Diabet Res Care 2016;4:e000293.
16. Arab L, Dhaliwal SK, Martin CJ, et al. Association between walnut consumption and diabetes risk in NHANES. Diabetes Metab Res Rev 2018;34:e3031.
17. Josse AR, Kendall CWC, Augustin LSA, et al. Almonds and postprandial glycemia—a dose-response study. Metabolism 2007;56:400-4.
18. Jiang R. Nut and peanut butter consumption and risk of type 2 diabetes in women. JAMA 2002;288:2554.
19. Hama JR, Fitzsimmons-Thoss V. Determination of unsaturated fatty acids composition in walnut (Juglans regia L.) oil using NMR spectroscopy. Food Anal Methods 2022;15:1226-36.
20. Kim Y, Keogh J, Clifton P. Benefits of nut consumption on insulin resistance and cardiovascular risk factors: multiple potential mechanisms of actions. Nutrients 2017;9:1271.
21. Ni ZJ, Zhang YG, Chen SX, et al. Exploration of walnut components and their association with health effects. Crit Rev Food Sci Nutr 2022;62:5113-29.
22. Zheng Y, Wu S, Wang R, et al. Analysis and correlationship of chemical components of various walnut (Juglans regia L.) cultivars. J Food Measurement Characterization 2020;14:3605-14.