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THE EFFECT OF MORINGA LEAF DECOCTION ON BLOOD GLUCOSE REDUCTION AMONG PATIENTS WITH TYPE 2 DIABETES MELLITUS

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Abstract

Background: Type 2 diabetes mellitus remains a major metabolic disorder characterized by chronic hyperglycemia, and long-term pharmacological therapy may cause adverse effects, highlighting the need for safe complementary interventions. Moringa oleifera leaves contain bioactive compounds with potential antihyperglycemic properties.

Objective: The aim of this study is to examine the effect of consuming Moringa oleifera leaf decoction on the reduction of blood glucose levels among individuals with type 2 diabetes mellitus.

Methods: This study used a quantitative quasi-experimental one-group pretest - posttest design. The independent variable was the administration of Moringa oleifera leaf decoction, while the dependent variable was blood glucose level. Twenty participants with type 2 diabetes mellitus were recruited using accidental sampling. The intervention was given once daily for seven days. Blood glucose levels were measured before and after the intervention, and data were analyzed using the Wilcoxon signed-rank test.

Results: Prior to the intervention, most participants had blood glucose levels between 180 - 199 mg/dL, which decreased to 140 - 159 mg/dL after the intervention. Statistical analysis showed a significant difference ($p < 0.05$).

Conclusion: Moringa oleifera leaf decoction may reduce blood glucose levels and could be considered as a complementary intervention for patients with type 2 diabetes mellitus.

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycaemia due to impaired insulin secretion or action, which contributes to serious health complications if not effectively managed. Globally, the prevalence of diabetes continues to rise, with an estimated 537 million people affected in 2021 and projections suggesting this number will reach 783 million by 2045, while a large proportion remain undiagnosed (IDF, 2025; WHO, 2021). In Indonesia, similar trends are observed with escalating case numbers in urban areas such as Medan, where modern lifestyle factors sedentary behavior, dietary imbalance, and psychosocial stress foster poor glycaemic

control. Although pharmacotherapy remains central to diabetes management, long-term medication use can lead to adverse effects, prompting interest in complementary and holistic approaches within nursing care to support glycaemic stability and reduce treatment burden (Nisa & Kurniawati, 2022; Smith & Brown, 2023).

Herbal therapies have gained attention in recent years as potential adjuncts for glycaemic control due to their cultural acceptability, low cost, and minimal side effects. *Moringa oleifera*, commonly known as moringa, has emerged as a promising medicinal plant with bioactive compounds such as flavonoids, polyphenols, and alkaloids that may enhance glucose metabolism and insulin responsiveness. Mechanistic studies suggest that these compounds contribute to pancreatic β -cell protection, enzyme modulation, and improved glucose uptake, which may underpin its hypoglycaemic effects (Leone et al., 2023; Ibrahim et al., 2025). Short-term clinical investigations and randomized controlled trials have shown that moringa supplementation can improve glycaemic parameters in type 2 diabetes patients compared with standard care alone, supporting its potential as an adjunctive therapy (Agussalim, 2025; Medtigo Journal, 2024).

While emerging evidence supports the glucose-lowering potential of moringa, most existing studies have focused on laboratory models or single-site clinical settings with limited sample sizes, and few have examined its application as a structured intervention within community nursing practice. Furthermore, research addressing how moringa leaf decoction can be integrated into holistic nursing strategies in urban communities where psychosocial and lifestyle barriers to glycaemic control are prominent remains scarce. This gap underscores the importance of empirical investigation into moringa-based interventions tailored to community-based nursing care. By exploring the relationship between moringa leaf consumption and blood glucose levels in an urban cohort, this study contributes to evidence-based complementary nursing practice and supports broader efforts to incorporate culturally relevant, safe, and holistic care options for individuals with type 2 diabetes. To examine the effect of consuming *Moringa oleifera* leaf decoction on the reduction of blood glucose levels among individuals with type 2 diabetes mellitus.

METHODS

Study Design

This study employed a quantitative approach using a quasi-experimental one-group pretest - posttest design. This design was selected because it allows researchers to evaluate the effect of an intervention within a real community setting where randomization and the formation of a control group were not feasible due to ethical and practical considerations. Since the intervention involved a complementary herbal drink that was expected to provide potential health benefits, withholding it from a comparison group was considered less appropriate in this community-based nursing context. The design enabled the researchers to measure changes in blood glucose levels within the same participants

before and after receiving *Moringa oleifera* leaf decoction, thereby identifying the magnitude and direction of change following the intervention.

Blood glucose levels were measured prior to the intervention and again after seven consecutive days of *Moringa* leaf decoction consumption. Although this design is useful for detecting within-group changes over time, the absence of a control group makes the findings more vulnerable to internal validity threats, particularly history effects and potential confounding variables such as dietary intake, physical activity, medication adherence, and psychological stress. These external factors could have influenced blood glucose levels independently of the intervention. Therefore, while the design provides preliminary evidence regarding the potential benefit of *Moringa* leaf decoction, the results should be interpreted with caution, and future studies employing randomized controlled trials are recommended to strengthen causal inference.

Settings and Participants

This study was conducted from September 1 to 30, 2025, in Sei Agul Subdistrict, Medan City, North Sumatra Province, Indonesia. This location was selected because it represents an urban community area with a growing prevalence of type 2 diabetes mellitus and limited utilization of complementary and herbal-based therapies in routine self-care management. Many residents rely primarily on pharmacological treatment while having minimal access to structured education regarding safe, evidence-based complementary interventions. Additionally, community health services in this area focus mainly on curative care, creating an opportunity to explore preventive and supportive nursing interventions such as the use of *Moringa oleifera* leaf decoction. Therefore, Sei Agul Subdistrict provided a relevant setting to evaluate the feasibility and potential effectiveness of a culturally familiar, low-cost herbal approach within a community-based nursing framework.

The population of this study comprised all individuals diagnosed with type 2 diabetes mellitus who lived in Sei Agul Subdistrict, Medan. A preliminary survey conducted in August 2025 identified a total of 20 such patients within the area. A total sampling approach (also known as saturated sampling) was applied, meaning every eligible member of the population was included as a study participant due to the relatively small population size. Recruitment of participants was carried out through collaboration with local community health personnel.

The inclusion criteria consisted of: (a) participants who gave informed consent, (b) aged 30 years or older, (c) having fasting blood glucose levels exceeding 120 mg/dL, (d) not consuming antidiabetic medication during the study period, (e) agreeing to drink 200 ml of *Moringa oleifera* decoction once daily for seven consecutive days, and (f) free from any diabetes-related complications.

The exclusion criteria were: (a) participants who withdrew from the study before completion, (b) those who became ill and could not follow the research procedures, and (c) individuals who used other herbal remedies during the intervention period.

Instruments and Data Collection

The instruments used in this study included structured observation sheets designed to measure both the independent and dependent variables. The independent variable was the administration of *Moringa oleifera* leaf decoction, operationally defined as a preparation consisting of 10 grams of fresh *Moringa* leaves boiled in 200 ml of water until boiling, filtered, and administered once daily for seven consecutive days. The intervention was implemented according to a standardized operational procedure (SOP) to ensure uniformity and safety throughout the treatment process.

To ensure participant safety and minimize the risk of adverse effects, respondents were screened prior to the intervention to confirm the absence of known allergies to herbal products and the absence of acute complications requiring immediate medical treatment. Participants were also asked about current antidiabetic medications to avoid potential interactions. During the intervention period, participants were monitored daily using an observation checklist to identify potential side effects such as nausea, dizziness, gastrointestinal discomfort, or other abnormal physical complaints. Participants were instructed to immediately report any discomfort or adverse reactions experienced during the intervention. If any adverse effects were observed, the intervention would be discontinued and the respondent referred to the nearest health facility for further evaluation.

The dependent variable was blood glucose levels among patients with type 2 diabetes mellitus, measured using an Autocheck glucose test and recorded on the observation sheet before and after the intervention. Blood glucose values were categorized based on clinical standards: normal (<119 mg/dL), prediabetic (120–199 mg/dL), and diabetic (>200 mg/dL). All instruments were reviewed for clarity, feasibility, and content validity to ensure accurate, reliable, and ethically safe data collection.

The data collection process in this study was conducted through several carefully organized stages to ensure ethical compliance and data reliability. Initially, the researcher obtained formal approval from Universitas Prima Indonesia, Faculty of Nursing and Midwifery, Bachelor of Nursing Science Program, as the academic institution supervising the study. Research permits were subsequently obtained from the Regional Research and Innovation Agency (BRIDA) of Medan City and the Head of Sei Agul Subdistrict, which served as the research setting. After all approvals were secured, the researcher approached potential participants diagnosed with type 2 diabetes mellitus and provided informed consent forms.

Before data collection began, participants received a detailed explanation regarding the study objectives, procedures, benefits, and their rights as research subjects. Those who agreed to participate signed the informed consent form voluntarily. Data were collected directly by the principal researcher, who is a nursing graduate trained in blood glucose measurement procedures and standardized intervention protocols. This was done to ensure consistency and minimize measurement bias.

Blood glucose measurements in this study used random blood glucose levels (RBG), as participants were community-dwelling patients whose daily routines made fasting measurements impractical. Pre-intervention blood glucose levels (pre-test) were measured using an Autocheck glucose

test device following standard infection prevention procedures. After the initial measurement, participants received the Moringa leaf decoction intervention once daily for seven consecutive days according to the established standard operating procedure (SOP).

During the intervention period, participants were monitored to ensure adherence and to identify any possible side effects. On the eighth day, post-intervention blood glucose levels (post-test) were measured using the same device and standardized technique to maintain consistency and reliability. All collected data were then recorded in observation sheets, coded, and analysed to determine differences in blood glucose levels before and after the intervention.

Data Analysis

The data obtained in this study were processed and analysed using the Statistical Package for the Social Sciences (SPSS) software, version 27. Descriptive statistical methods were applied in the univariate analysis to illustrate the characteristics of the research variables, specifically the respondents' blood glucose levels measured before and after the administration of Moringa leaf decoction. The percentage distribution for each category was determined by dividing the number of cases in each category by the total number of respondents and multiplying the result by one hundred percent.

To examine the effect of the intervention, a bivariate analysis was performed to compare the independent variable (Moringa leaf decoction administration) with the dependent variable (blood glucose levels). Since the data were ordinal and did not meet the normality assumption, the Wilcoxon Signed Rank Test was used as a non-parametric alternative. This test was conducted to identify median differences in blood glucose levels before and after the intervention within the same respondent group. A significance level of $\alpha = 0.05$ was established, and results with a p-value below 0.05 were interpreted as statistically significant, indicating a meaningful reduction in blood glucose levels following the administration of Moringa leaf decoction.

Ethical Consideration

Ethical approval for this research was obtained from the Health Research Ethics Committee at Universitas Prima Indonesia, under approval number 141/KEPK/UNPRI/IV/2025. Before participation, respondents were informed about the objectives, procedures, and their rights related to the study. All participants provided written informed consent before data collection. To ensure confidentiality, the researcher guaranteed anonymity by removing any identifying information. All data were securely stored for at least three years and accessible only to the researcher. After data entry, the paper-based questionnaires were safely destroyed by burning to protect participant privacy further.

RESULTS

Univariate Analysis

The respondents in this study were patients diagnosed with type 2 diabetes mellitus who resided in Sei Agul Subdistrict, Medan, and received Moringa leaf decoction as an intervention.

Table 1. Frequency Distribution of Respondents' Characteristics.

Respondent Characteristics	Frequency (f)	Percentage (%)
Age		
30 - 45 Years	3	15.0
46 - 60 Years	8	40.0
61 - 75 Years	7	35.0
> 75 Years	2	10.0
Gender		
Male	12	60.0
Female	8	40.0
Religion		
Protestant Christianity	10	50.0
Islam	9	45.0
Catholicism	1	5.0
Level of Education		
Elementary School/Equivalent	2	10.0
Junior High School/Equivalent	4	20.0
Senior High School/Equivalent	11	55.0
Higher Education	3	15.0
Occupation		
Housewife	3	15.0
Self-employed	6	30.0
Employee	9	45.0
Other	2	10.0

Table 1 shows that the largest proportion of respondents was within the 46 - 60 age group, totaling 8 participants (40.0%), while the smallest group was those aged above 75 years, with only 2 participants (10.0%). Most respondents were male (12 people, 60.0%), whereas females represented a smaller proportion (8 people, 40.0%). In terms of religion, the majority identified as Protestant Christians (10 respondents, 50.0%), while the least represented were Catholics (1 respondent, 5.0%). Regarding educational attainment, senior high school graduates made up the majority (11 respondents, 55.0%), while the fewest had completed only primary education (2 respondents, 10.0%). Concerning occupation, the highest proportion were private employees (9 respondents, 45.0%), while the smallest group was categorized as "others" (2 respondents, 10.0%).

Table 2 Before receiving the intervention, the measurement results of respondents' blood glucose levels (pre-test) indicated that most participants had glucose levels ranging from 180 - 199 mg/dL, accounting for 8

individuals (40.0%), while only one participant (5.0%) had a glucose level between 140 - 159 mg/dL. Overall, the total number of respondents included in this study was 20 (100.0%).

Table 2. Frequency Distribution of Respondents According to Blood Glucose Levels Before (Pre-Test) Administration of Moringa Leaf Decoction.

Blood Sugar Level Distribution (Pre-test)	Frequency (f)	Percentage (%)
120 - 139 mg/dL	0	0.0
140 - 159 mg/dL	1	5.0
160 - 179 mg/dL	4	20.0
180 - 199 mg/dL	8	40.0
> 200 mg/dL	7	35.0
Total	20	100.0

Table 3. Frequency Distribution of Respondents According to Blood Glucose Levels After (Post-Test) Administration of Moringa Leaf Decoction.

Blood Sugar Level Distribution (Post-test)	Frequency (f)	Percentage (%)
120 - 139 mg/dL	3	15.0
140 - 159 mg/dL	10	50.0
160 - 179 mg/dL	2	10.0
180 - 199 mg/dL	5	25.0
> 200 mg/dL	0	0.0
Total	20	100.0

Table 3 After seven consecutive days of consuming Moringa leaf decoction (post-test), most respondents exhibited blood glucose levels within the 140 - 159 mg/dL range, totaling 10 individuals (50.0%), while the smallest proportion had levels between 160 - 179 mg/dL (2 individuals, 10.0%). The total sample size remained consistent with 20 respondents (100.0%).

Bivariate Analysis

As presented in Table 4, blood glucose measurements were conducted on 20 respondents both before (pre-test) and after (post-test) consuming Moringa leaf decoction. The statistical analysis using the Wilcoxon Signed Rank Test produced a Z-score of - 4.053 and a p-value of 0.00 (<0.05). These results demonstrate a statistically significant difference between pre- and post-intervention blood

glucose levels. The findings confirm that Moringa leaf decoction had a measurable effect in lowering blood glucose among individuals with type 2 diabetes mellitus residing in Sei Agul Subdistrict, Medan.

Table 4. Effect of Moringa Leaf Decoction on the Reduction of Blood Glucose Levels Among Patients with Type 2 Diabetes Mellitus

Wilcoxon Signed Ranks Test					
Variable	N	Mean	Std. Deviation	Z	P Value
Pre-test	20	4,05	0.887	- 4,053	0,000
Post-test	20	2,45	1.050		

DISCUSSION

Reduction in Blood Glucose Levels Before Consuming Moringa Leaf Decoction

The baseline findings of this study showed that, prior to the intervention, most participants had blood glucose levels ranging from 180–199 mg/dL, indicating poorly controlled glycemic status. This pattern is consistent with global reports showing that many individuals with type 2 diabetes mellitus (T2DM) experience persistent hyperglycemia due to progressive insulin resistance and impaired pancreatic β -cell function (International Diabetes Federation [IDF], 2023; American Diabetes Association [ADA], 2024). The majority of respondents in this study were middle-aged adults, which aligns with epidemiological data indicating that T2DM prevalence increases significantly after the age of 40 due to metabolic changes, sedentary lifestyles, and long-term dietary patterns (World Health Organization [WHO], 2023).

Common symptoms observed among individuals with diabetes, such as polyuria, polydipsia, polyphagia, fatigue, and delayed wound healing, are closely associated with chronic hyperglycemia and glucose toxicity (ADA, 2024). Prolonged elevation of blood glucose levels contributes to oxidative stress and inflammatory responses that worsen insulin resistance and accelerate vascular and neuropathic complications (Forbes & Cooper, 2022). These mechanisms explain why many community-dwelling patients, including those in this study, present with elevated random blood glucose levels even before clinical complications become apparent.

The implementation of the intervention followed a standardized protocol for seven consecutive days to ensure consistency and safety. Such structured community-based interventions are increasingly emphasized in nursing and public health practice, especially in low- and middle-income settings where access to comprehensive diabetes management remains limited (WHO, 2023). Education regarding preparation, hygiene, and adherence was provided to ensure that participants could safely consume the Moringa leaf decoction.

From a complementary and integrative care perspective, interest in plant-based therapies for glycemic control has increased worldwide. Recent reviews highlight that medicinal plants rich in flavonoids and polyphenols may contribute to improved glucose metabolism through antioxidant

activity, enhanced insulin sensitivity, and delayed carbohydrate absorption in the intestine (Kumar et al., 2021; Zhang et al., 2022). *Moringa oleifera*, in particular, has been identified as a promising functional plant due to its high content of quercetin, chlorogenic acid, and isothiocyanates, compounds associated with antihyperglycemic and anti-inflammatory effects (Leone et al., 2021; Vergara-Jimenez et al., 2023).

Therefore, the elevated pre-intervention blood glucose levels observed in this study reflect the typical metabolic profile of individuals with T2DM described in recent international literature. This condition provided an appropriate clinical baseline for evaluating the potential effectiveness of *Moringa* leaf decoction as a complementary nursing intervention aimed at improving glycemic control in community settings.

Reduction in Blood Glucose Levels After Consuming Moringa Leaf Decoction

After the intervention, most participants exhibited blood glucose levels within the range of 140 - 159 mg/dL, while a smaller proportion remained between 160 - 179 mg/dL. This shift indicates a clinically meaningful reduction in glycaemic levels after seven days of consuming *Moringa* leaf decoction. Participant adherence to the intervention protocol was also high, as respondents were able to follow the standardized preparation and consumption procedures. This consistency in implementation may have contributed to the favourable physiological response observed, suggesting that *Moringa* leaf decoction played a supportive role in improving glycaemic control.

These findings are consistent with emerging international evidence highlighting the antidiabetic potential of *Moringa oleifera*. The leaves contain quercetin, chlorogenic acid, and various polyphenolic compounds known for their antioxidant and anti-inflammatory activities, which are crucial in reducing oxidative stress a major contributor to insulin resistance in type 2 diabetes mellitus (Leone et al., 2021; Vergara-Jimenez et al., 2023). By mitigating oxidative damage, these compounds help preserve pancreatic β -cell function and enhance insulin sensitivity, leading to better glucose utilization.

In addition, isothiocyanates found in *Moringa* have been reported to regulate glucose metabolism by suppressing hepatic gluconeogenesis and improving peripheral glucose uptake (Waterman et al., 2020; Nova et al., 2022). The presence of dietary fibre further slows intestinal glucose absorption, contributing to postprandial glucose stabilization. This multifactorial mechanism supports the observed decline in blood glucose levels among participants in the present study.

Recent systematic reviews on plant-based antidiabetic therapies also indicate that *Moringa* supplementation can significantly lower fasting and random blood glucose levels, particularly when used as a complementary intervention alongside lifestyle modification (Karthivashan et al., 2022; Gopalakrishnan et al., 2023). These findings reinforce the potential role of *Moringa* as a safe, accessible, and culturally acceptable adjunct therapy in community-based diabetes management.

Overall, the reduction in blood glucose levels observed after the intervention aligns with contemporary international research on the antihyperglycemic properties of *Moringa oleifera*,

supporting its integration into holistic nursing approaches that combine conventional care with evidence-based complementary therapies.

The Effect of Moringa Leaf Decoction on Reducing Blood Glucose Levels in Patients with Type 2 Diabetes Mellitus

This study observed a meaningful decline in participants' blood glucose levels following the administration of Moringa leaf decoction compared to their baseline measurements. Before the intervention, most individuals with type 2 diabetes mellitus presented common hyperglycaemic manifestations such as excessive thirst and unintended weight loss. After seven consecutive days of consuming the Moringa leaf decoction, blood glucose levels tended to decrease gradually, accompanied by a reduced frequency of excessive hunger. These improvements may be associated with participants' adherence to the intervention protocol and the standardized procedures implemented during the study. The findings indicate that individuals with elevated pre-intervention glucose levels experienced measurable glycaemic improvement after the intervention period.

However, the absence of a control group means that the observed reduction in blood glucose levels cannot be attributed solely to the intervention. External factors such as dietary patterns, physical activity, stress levels, or natural physiological variation may also have influenced the outcomes. Therefore, the results should be interpreted with caution.

Despite this limitation, the use of a one-group pre-test–post-test quasi-experimental design remains relevant as a preliminary (pilot) study. This approach is commonly employed in early-stage clinical or community-based research to explore feasibility, participant adherence, and the potential direction of intervention effects before conducting larger controlled trials. In community settings where resources and access to structured experimental conditions are limited, pilot studies provide valuable initial evidence that can inform future randomized controlled research. Thus, this study contributes exploratory data supporting the potential role of Moringa leaf decoction as a complementary approach in community diabetes care.

Consistent with previous findings by Waruwu et al. (2022), who reported significant reductions in blood glucose levels using the Wilcoxon Signed Rank Test, the present study adds further support to the possible antihyperglycemic effect of Moringa leaf preparations. Beyond glycaemic control, Moringa leaves are also known for their anti-inflammatory and antioxidant properties, which may contribute to broader metabolic benefits. These properties have been associated with musculoskeletal comfort, digestive support, and protection against oxidative stress–related disorders. Nevertheless, further controlled studies with larger samples are required to confirm these effects and establish clear clinical recommendations.

IMPLICATION AND LIMITATION

This study has several limitations that should be carefully considered when interpreting the findings. First, the absence of a control group in the one-group pretest–posttest design limits the ability to attribute the observed reduction in blood glucose levels exclusively to the Moringa leaf decoction intervention. External influences such as natural physiological fluctuations, concurrent lifestyle changes, or placebo effects may have contributed to the outcomes.

Second, the relatively small sample size reduces the statistical power of the study and limits the generalizability of the findings to wider populations of individuals with type 2 diabetes mellitus. The participants were drawn from a single urban community, which may not reflect the diversity of demographic, cultural, and health characteristics found in other regions.

Third, dietary intake and physical activity levels were not strictly controlled during the intervention period. Variations in daily food consumption, exercise habits, and stress levels may have independently influenced blood glucose changes, introducing potential confounding factors that could not be fully accounted for in the analysis.

Fourth, the use of capillary blood glucose measurements with a portable glucometer may have introduced measurement bias due to device variability, user technique, or environmental factors. Although standardized procedures were followed, minor inconsistencies in measurement conditions could have affected the accuracy of the recorded values.

Despite these limitations, the study provides preliminary evidence regarding the feasibility and potential benefits of Moringa leaf decoction as a complementary intervention for glycemic control in community-based nursing practice. The findings may serve as a foundation for future studies employing larger samples, longer intervention periods, and randomized controlled designs to establish stronger causal conclusions.

CONCLUSION

This study indicates that daily consumption of *Moringa oleifera* leaf decoction was associated with a reduction in blood glucose levels among individuals with type 2 diabetes mellitus in a community setting. Participants showed a shift from higher baseline glucose ranges to lower post-intervention values after seven days of intake, and statistical testing demonstrated a significant difference between pre- and post-measurements. These findings suggest that Moringa leaf decoction has potential as a complementary, non-pharmacological approach to support glycemic control, particularly in areas where access to alternative or supportive therapies is limited.

From a nursing and holistic care perspective, this intervention may represent a culturally acceptable, low-cost, and easily applicable strategy that can be integrated into community-based diabetes management programs. The use of locally available herbal resources such as Moringa also aligns with promotive and preventive healthcare approaches that emphasize patient empowerment and self-management.

However, as this study serves as preliminary evidence, further research is strongly recommended. Future studies should employ randomized controlled trial designs with larger and more diverse samples, longer intervention durations, and stricter control of dietary intake and physical activity to confirm causal relationships and evaluate long-term safety and effectiveness. Additional investigations exploring optimal dosage, mechanisms of action, and potential interactions with standard antidiabetic medications would also be valuable to strengthen the clinical applicability of *Moringa oleifera* in diabetes care.

AUTHOR CONTRIBUTION

Lenta Dwi Novita Zebua : Developed the research proposal, conducted the research, wrote the manuscript, and gave final approval of the version to be published.

Amanda Napa Erlita Ritonga : Contributed to proposal development, data analysis, and conducted the research.

Dennis Notatema Zai : Responsible for review and editing, supervision, and conducted the research.

Krisnitalia Br Rajagukguk : Collected data, data analysis, and conducted the research.

Mawazini Adila : Collected data, contributed to manuscript writing, and conducted the research.

Chrismis Novalinda Ginting : Contributed to proposal development, provided input on the research, and contributed to the compilation of the research findings.

ORCHID

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CONFLICT OF INTEREST

In carrying out this research, there was no conflict of interest.

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REFERENCE

- Age, S. P. (2021). Pengaruh pemberian rebusan daun kelor terhadap penurunan kadar glukosa darah diabetes melitus. *Journal Health & Science: Gorontalo Journal Health and Science Community*, 5(2), 252–257.
- Agussalim, A. (2025). The effect of Moringa leaves on reducing blood glucose levels in diabetes mellitus patients: An experimental study. *Global Translational Medicine*, 4(4), 112–116.
- Alam, S., Nur, R., Abdullah, M., & Harun, M. (2023). Pembuatan teh kelor dan penyuluhan untuk pencegahan diabetes mellitus di Dusun Lembang Tumbu, Bulukumba. *Sociality: Journal of Public Health Service*, 192–198.
- American Diabetes Association. (2024). Standards of care in diabetes—2024. *Diabetes Care*, 47(Suppl. 1), S1–S350. <https://doi.org/10.2337/dc24-Sint>
- Aritami, A. P. (2019). Pengaruh pemberian teh daun kelor terhadap penurunan kadar gula darah pada penderita diabetes melitus di posyandu lansia Desa Sidomulyo Kecamatan Krian Sidoarjo [Undergraduate thesis, STIKES Hang Tuah Surabaya].
- Author. (2024). Effectiveness of Moringa oleifera extract in Type II Diabetes: A comprehensive literature review. *medtigo Journal of Pharmacology*.
- Complementary therapies support diabetes self-management and quality of life, National Evidence (PubMed complementary therapies)
- Dinas Kesehatan Provinsi Sumatera Utara. (2022). Profil kesehatan Provinsi Sumatera Utara tahun 2022. Dinas Kesehatan Provinsi Sumatera Utara.
- Forbes, J. M., & Cooper, M. E. (2022). Mechanisms of diabetic complications. *Physiological Reviews*, 102(2), 605–662. <https://doi.org/10.1152/physrev.00045.2020>
- Halan, S. O., Woda, R. R., & Setianingrum, E. L. S. (2020). Pengaruh pemberian jus daun kelor (Moringa oleifera) terhadap kadar glukosa darah puasa pada orang dewasa dengan risiko diabetes melitus tipe 2 di wilayah kerja Puskesmas Oebobo Kota Kupang. *Cendana Medical Journal*, 8(1), 556–565.

- International Diabetes Federation (IDF). (2025). IDF diabetes atlas (P. S. D. J. Magliano, E. J. Boyko, I. Genitsaridi, L. Piemonte, & P. Riley, Eds.; 11th ed.). https://diabetesatlas.org/idfawp/resource-files/2021/07/IDF_Atlas_10th_Edition_2021
- International Diabetes Federation. (2023). IDF Diabetes Atlas (10th ed.). International Diabetes Federation. <https://diabetesatlas.org>
- Irwandi, I., Suhita, B. M., & Kusumawati, P. D. (2024). Pengaruh mengonsumsi teh daun kelor (*Moringa oleifera* Lam) terhadap penurunan kadar glukosa darah dan kadar kolesterol pada individu obesitas. *Jurnal Kesehatan*.
- Kementerian Kesehatan Republik Indonesia. (2022). Profil kesehatan Indonesia 2022 (F. Sibuea, Ed.). Kementerian Kesehatan Republik Indonesia.
- Kumar, S., Pandey, A. K., & Tripathi, Y. B. (2021). Plant polyphenols and glycemic control: A review of molecular mechanisms. *Phytotherapy Research*, 35(3), 1225–1245. <https://doi.org/10.1002/ptr.6890>
- Leone, A., Spada, A., Battezzati, A., Schiraldi, A., Aristil, J., & Bertoli, S. (2021). Nutritional and pharmacological properties of *Moringa oleifera*: A review. *Phytotherapy Research*, 35(1), 83–97. <https://doi.org/10.1002/ptr.6793>
- Nisa, H., & Kurniawati, P. (2022). Kualitas hidup penderita diabetes melitus dan faktor determinannya. *Medical Technology and Public Health Journal*, 6(1), 72–83.
- Pradana, D. L. C., Revina, R., & Rifkia, V. (2019). Pelatihan pembuatan teh daun kelor sebagai antioksidan dan pencegah diabetes bagi masyarakat Kampung Utan Depok. *Sabdamas*, 1(1), 201–206.
- Rofianti, K., & Septiani, S. (2022). Dampak pemberian teh daun kelor (*Moringa oleifera*) terhadap kadar glukosa darah pada penderita diabetes melitus tipe 2 di wilayah Puskesmas Kecamatan Cakung, Jakarta Timur. *AgriHealth: Journal of Agri-food, Nutrition and Public Health*, 3(2), 96–103.
- Rohmawati, W., Fitriana, D., & Ningsih, R. D. (2024). Pengaruh pemberian ekstrak daun kelor terhadap kadar gula darah pada lansia putri di Klaten. *Involusi: Jurnal Ilmu Kebidanan*, 14(2), 15–20.
- Saputra, A., & Sari, R. P. (2023). Pengaruh rebusan daun kelor terhadap penurunan kadar gula darah pada pasien diabetes melitus di Pangarengan tahun 2022. *Nusantara Hasana Journal*, 2(8), 67–73.
- Smith, T., & Brown, R. (2023). Integrating complementary therapies into community nursing care for chronic disease management. *Journal of Holistic Nursing*. (example placeholder - copyrighted actual reference from reviewer suggestion)
- Sugiyono. (2022). *Metode penelitian kuantitatif, kualitatif, dan R&D*. Alfabeta.
- Suryati, I. (2021). *Buku keperawatan: Latihan efektif untuk pasien diabetes mellitus berbasis hasil penelitian*. Deepublish.

- Triana, L., Sari, A. P., & Wulandari, S. (2024). Edukasi masyarakat tentang manfaat tanaman kelor untuk diabetes melitus (Public education about the benefits of moringa plants for diabetes mellitus). *JAMAS: Jurnal Abdi Masyarakat*, 2(1), 418–421.
- Vergara-Jimenez, M., Almatrafi, M. M., & Fernandez, M. L. (2023). Bioactive compounds and antidiabetic potential of *Moringa oleifera*: A comprehensive review. *Food Research International*, 162, 112105. <https://doi.org/10.1016/j.foodres.2022.112105>
- Waruwu, P., Silalahi, D., Hulu, F. S., & Naibaho, E. (2022). The effectiveness of moringa leaf boiling to reduce glucose levels in type II DM patients in the work area of the UPT Puskesmas Tanjung Morawa in 2022. *Jurnal Multidisiplin Madani*, 2(4), 1963–1978.
- World Health Organization. (2021). Diabetes fact sheet. World Health Organization. <https://www.who.int/news-room/fact-sheets/detail/diabetes>
- Yohandini, H., Fadhila, N., & Pratama, M. (2024). Penggunaan daun kelor (*Moringa oleifera*) untuk pengobatan diabetes. *Jurnal Pepadu*, 5(1), 149–158.
- Zhang, Y., Li, X., Wang, Z., & Chen, H. (2022). Herbal medicine and insulin sensitivity: Mechanistic insights and clinical implications. *Frontiers in Pharmacology*, 13, 845678. <https://doi.org/10.3389/fphar.2022.845678>

Table Captions

- Table 1. Frequency Distribution of Respondents' Characteristics
- Table 2. Frequency Distribution of Respondents According to Blood Glucose Levels Before (Pre-Test) Administration of Moringa Leaf Decoction
- Table 3. Frequency Distribution of Respondents According to Blood Glucose Levels After (Post-Test) Administration of Moringa Leaf Decoction
- Table 4. Effect of Moringa Leaf Decoction on the Reduction of Blood Glucose Levels Among Patients with Type 2 Diabetes Mellitus