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The Effectiveness of Green Tea Administration in Reducing Blood Glucose Levels in Patients with Diabetes Mellitus

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Abstract

Background: Diabetes Mellitus (DM) is a global health problem with an increasing prevalence and the potential to cause chronic complications. Blood glucose control does not solely rely on pharmacological therapy but can also be supported by complementary therapies such as the consumption of green tea (Camellia sinensis), which is rich in polyphenols that act as antioxidants and have the potential to reduce blood glucose levels.

Objective: To analyze the effectiveness of green tea consumption on blood glucose levels in patients with type 2 DM.

Methods: This study used a quasi-experimental design with a pre-posttest control group. A total of 60 respondents were divided into an intervention group (n=30) who consumed two cups of green tea daily for 8 weeks, and a control group (n=30) without intervention. Blood glucose levels were measured using the GOD-PAP method. Data were analyzed using paired t-test and independent t-test.

Results: The intervention group experienced an average reduction in blood glucose levels of 20–25 mg/dL, while the control group showed a decrease of only about 5 mg/dL. Statistical tests indicated a significant difference between the two groups ($p<0.05$).

Conclusion: Green tea consumption was proven effective in lowering blood glucose levels in patients with type 2 DM and can be recommended as a safe, inexpensive, and easily accessible complementary therapy.

Keywords: Type 2 Diabetes Mellitus, green tea, polyphenols, blood glucose, complementary therapy, antioxidants

Introduction

Diabetes Mellitus (DM) is a major global health problem with an increasing prevalence and is recognized as one of the leading causes of morbidity and mortality worldwide. DM is defined as a chronic metabolic disorder characterized by persistent hyperglycemia, which results from defects in insulin secretion, impaired insulin action, or a combination of both [1]. This chronic hyperglycemia, if left uncontrolled, contributes to long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels. According to the International Diabetes Federation (IDF), the number of adults living with DM reached 537 million in 2021, and this figure is projected to rise alarmingly to 643 million by 2030 and 783 million by 2045 [2]. Such an upward trajectory underscores the growing burden on healthcare systems globally, not only in terms of direct clinical management but also regarding indirect economic costs, such as loss of productivity and reduced quality of life.

In Indonesia, the increasing prevalence of DM mirrors the global trend. Data from the Basic Health Research Survey (Riskesdas) show that prevalence rose from 6.8% in 2013 to 8.5% in 2018, reflecting the rapid growth of non-communicable diseases in the country [3]. DM has become the fourth leading cause of death in Indonesia, with chronic complications including diabetic nephropathy, retinopathy, neuropathy, and cardiovascular disease—conditions that significantly impair patients' functional

capacity and quality of life [4]. In South Sulawesi, particularly Pinrang District, health authorities have reported a consistent annual increase in DM cases. This rise has been strongly linked to lifestyle changes, such as reduced physical activity, increased consumption of processed foods, and poor dietary habits, all of which accelerate the risk of metabolic disorders [5]. The growing number of DM cases in this region highlights the urgent need for innovative, affordable, and community-based interventions to improve disease management.

The management of DM traditionally relies on pharmacological therapies, such as oral hypoglycemic agents and insulin. However, it is increasingly recognized that effective diabetes management should not rely solely on pharmacological approaches. Complementary and lifestyle-based interventions are now considered crucial in achieving optimal glycemic control, reducing the risk of complications, and improving overall patient well-being. Among various complementary approaches, green tea (Camellia sinensis) consumption has emerged as one of the most widely studied due to its bioactive compounds and long history of use in traditional medicine. Green tea contains polyphenolic compounds, particularly epigallocatechin gallate (EGCG), which have been reported to exert antioxidant, anti-inflammatory, and antidiabetic properties [6,7]. These bioactive substances play a multifaceted role by enhancing insulin sensitivity, inhibiting intestinal glucose absorption, and protecting pancreatic β-cells from oxidative stress and apoptosis, thereby improving endogenous insulin secretion [8].

Evidence from both experimental and epidemiological studies supports the beneficial effects of green tea in the context of diabetes management. Regular consumption of green tea has been shown to lower fasting blood glucose levels, reduce glycated hemoglobin (HbA1c), and improve lipid profiles in patients with type 2 DM, suggesting its potential role as an adjunct to standard therapy [9–11]. Nevertheless, the scientific evidence remains somewhat heterogeneous, with variations in study outcomes attributed to differences in green tea dosage, duration of intervention, study design, and population characteristics. Importantly, the majority of existing studies have been conducted in East Asian and Western populations, while community-level studies in Indonesian settings, particularly in South Sulawesi, remain scarce. This gap in knowledge makes it essential to investigate whether green tea consumption can provide comparable benefits for patients with DM in this cultural and dietary context.

Based on this background, the present study was conducted to analyze the effectiveness of green tea consumption in reducing blood glucose levels among patients with type 2 DM in Pinrang District, South Sulawesi. By focusing on a community setting, this research aims not only to contribute to the growing body of literature on complementary therapies for DM but also to provide locally relevant evidence that may inform public health strategies and patient-centered interventions in Indonesia.

Methods

This study employed a quasi-experimental design with a pre-posttest control group. This design was chosen as it is considered appropriate for evaluating the effectiveness of health interventions at the community level, particularly when full randomization is difficult to implement in the field [12]. The study was conducted over 8 weeks in Wattang Sawitto Subdistrict, Pinrang District, South Sulawesi, one of the regions with a relatively high prevalence of type 2 Diabetes Mellitus (DM) according to reports from the local Health Office.

The study population consisted of all patients with type 2 DM aged 30–60 years who were registered at the Wattang Sawitto Community Health Center (*Puskesmas*). This age group was selected based on the fact that patients in this range generally exhibit significant metabolic disorders while still being stable enough to participate in the intervention [13].

The research sample was determined using purposive sampling based on inclusion criteria:

a) diagnosed with type 2 DM for at least 1 year

b) not undergoing insulin therapy

c) no history of severe complications such as renal failure or coronary heart disease

d) not consuming other herbal supplements and

e) willing to participate by signing informed consent.

A total of 60 respondents were recruited and proportionally divided into two groups: an intervention group (n=30), who received green tea twice daily, and a control group (n=30), who did not receive the intervention. Group allocation was conducted using non-randomized assignment but with consideration of baseline homogeneity such as age and sex [14,15].

The intervention consisted of green tea (*Camellia sinensis*) prepared by brewing 2 grams per cup, consumed twice daily (morning and afternoon) after meals. This dosage was selected based on previous studies that demonstrated the effectiveness of consuming 3–5 grams of green tea per day in improving glucose profiles without causing significant gastrointestinal side effects [16,17].

Blood glucose levels were measured using the GOD-PAP (Glucose Oxidase-Phenol Aminophenazone) method, which is known for its high sensitivity and specificity and is widely used in clinical trials and laboratory research [18]. Measurements were carried out twice: before the intervention (pre-test) and after 8 weeks of intervention (post-test). Data analysis was conducted in two stages. First, descriptive analysis was performed to describe respondents' characteristics. Second, inferential analysis was conducted using paired sample t-tests to assess differences in blood glucose levels before and after the intervention within each group, and independent t-tests to compare differences between the intervention and control groups [19].

Ethical considerations were strictly observed. All respondents were informed about the study objectives, procedures, benefits, and potential risks prior to signing the informed consent form. This study obtained ethical approval from the Health Research Ethics Committee of Poltekkes Kemenkes Makassar with an official registration number in accordance with the study protocol. The procedures adhered to the principles of the Declaration of Helsinki regarding medical research involving human subjects [20].

Results

This study employed an experimental design with a control group to analyze the effectiveness of green tea consumption in reducing blood glucose levels among patients with type 2 Diabetes Mellitus (DM). The research was conducted in Pinrang District, South Sulawesi, during the period of January–June 2024. Respondents were selected using purposive sampling with the following inclusion criteria: patients with type 2 DM diagnosed for at least 1 year, aged 30–65 years, not pregnant or breastfeeding, and willing to participate in the study. Exclusion criteria included patients with severe complications such as end-stage renal failure, stroke, and advanced cardiovascular disease.

The sample size was calculated using the formula for comparing two means with a 95% confidence level and 80% power, resulting in a total of 60 respondents, divided into two groups (intervention = 30 participants, control = 30 participants). The intervention group was given brewed green tea (*Camellia sinensis*), two cups per day (200 ml each) for 8 weeks, while the control group did not receive any additional intervention besides their standard DM therapy. The administration of green tea was based on safe dosage recommendations widely applied in clinical studies [21,22].

Blood glucose levels were measured using an enzymatic glucose oxidase-based glucometer under fasting conditions (FBG), both before the intervention and after 8 weeks of intervention. The glucometer instrument used was calibrated according to international standards [23]. Demographic data such as age, sex, and duration of diabetes were also collected through structured questionnaires.

The measurements showed that the mean baseline blood glucose level in the intervention group was 176.2 mg/dL, which decreased to 151.1 mg/dL after the intervention, with an average reduction of 25.1 mg/dL. Meanwhile, in the control group, the baseline glucose level was 175.3 mg/dL and decreased only to 170.5 mg/dL, with an average reduction of 4.8 mg/dL. This difference in reduction indicates that green tea consumption had a more significant effect compared to the control group. Table 1 presents a comparison of blood glucose levels between the intervention and control groups.

Table 1. Comparison of mean blood glucose levels in intervention and control groups

Group	Baseline (mg/dL)	Final (mg/dL)	Change (mg/dL)
Intervention	176.2	151.1	25.1
Control	175.3	170.5	4.8

Statistical analysis was conducted using paired t-tests to assess differences before and after the intervention within each group, and independent t-tests to compare differences between the groups. The significance level was set at $p < 0.05$. This method was chosen in accordance with experimental research standards for evaluating the effectiveness of non-pharmacological interventions in DM patients [24,25].

Discussion

This study demonstrated that green tea consumption significantly reduced blood glucose levels in patients with type 2 diabetes mellitus (T2DM). The reduction in blood glucose levels was greater in the intervention group compared to the control group. This finding is consistent with previous studies reporting the antidiabetic effects of green tea polyphenols through improved insulin sensitivity and inhibition of glucose absorption in the intestine.

The results of this study support the use of green tea as a complementary therapy that is safe, inexpensive, and easily accessible to the community. Incorporating green tea into healthy lifestyle interventions also aligns with the growing emphasis on non-pharmacological approaches in chronic disease management. Thus, green tea can serve as an adjunct option to standard therapy in controlling blood glucose levels.

Furthermore, epigallocatechin gallate (EGCG), a major compound in green tea, has been reported to reduce oxidative stress, one of the main factors in the progression of T2DM [26]. EGCG works by enhancing the activity of endogenous antioxidant enzymes such as superoxide dismutase (SOD) and glutathione peroxidase [27]. This effect may improve pancreatic beta-cell function, leading to more optimal insulin production [28].

Therefore, green tea not only functions as a direct blood glucose-lowering agent but also provides protective effects against cellular damage caused by oxidative stress commonly found in diabetic patients. Beyond its impact on glucose metabolism, regular green tea consumption has also been associated with additional benefits such as improved lipid profiles [29], weight reduction through enhanced fat oxidation [30], and reduced risk of cardiovascular diseases, which are frequent complications in diabetic patients [31]. These findings suggest that green tea consumption offers multidimensional benefits, encompassing

metabolic, cardiovascular, and overall quality of life aspects. Integrating green tea into a healthy diet may also improve patient adherence to lifestyle management, considering its availability and practicality in daily routines.

However, this study has several limitations, including a relatively small sample size and a short intervention duration. Other limitations that may have influenced the results include variations in the types of green tea used, differences in brewing methods, and the level of participant compliance in consuming the intervention. Additionally, other lifestyle factors such as physical activity, dietary patterns, and adherence to standard medical therapy may have affected the outcomes and should be more tightly controlled in future studies [32].

Therefore, further research using randomized controlled trial designs, larger sample sizes, and longer intervention periods is needed to confirm these findings and evaluate the long-term effects of green tea consumption in patients with T2DM [33]. Future studies are also expected to explore the optimal dosage, method of preparation, and potential interactions with commonly prescribed pharmacological therapies, so that recommendations will be more applicable in clinical practice.

Conclusion

Green tea consumption has been proven effective in reducing blood glucose levels in patients with type 2 diabetes mellitus in Pinrang District. The findings of this study confirm that green tea can be considered a complementary therapy in diabetes management due to its natural properties, easy availability, and relative affordability. In addition to its positive effects on blood glucose regulation, green tea also has the potential to enhance patients' quality of life by reducing the risk of metabolic-related complications.

Thus, green tea may serve as a non-pharmacological intervention option that can be integrated alongside standard therapy in the management of type 2 diabetes. The regular implementation of green tea consumption, when combined with a healthy diet, regular physical activity, and adherence to prescribed treatments, is expected to improve the overall success of disease management.

Conflict of Interest

The authors declare that they have no conflict of interest related to this study.

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