The effect of green tea consumption on cholesterol reduction: a study among social service employees in East Nusa Tenggara

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ABSTRACT

Background: Hypercholesterolemia is a major risk factor for cardiovascular diseases, with elevated cholesterol levels prevalent in Indonesia. While pharmaceutical treatments are effective, they can be costly and cause side effects, prompting interest in natural remedies. Green tea, rich in bioactive compounds such as catechins, has shown potential in reducing cholesterol levels through its lipid-lowering and antioxidant properties.

Objective: This study aimed to evaluate the effect of green tea consumption on total cholesterol levels in employees of the Social Service Office, East Nusa Tenggara Province, Indonesia.

Method: An experimental study was conducted involving 38 participants aged 25–55 years, divided into a treatment group (n = 19) and a control group (n = 19). The treatment group consumed 240 ml of green tea twice daily for one week, while the control group received no intervention. Total cholesterol levels were measured using capillary blood and cholesterol test strips pre- and post-intervention. Data analysis was performed using the paired t-test.

Results: The treatment group exhibited a significant reduction in total cholesterol levels (mean pre-treatment: 210.95 mg/dL; post-treatment: 188.26 mg/dL; p = 0.003). The control group showed no significant change (pre-treatment: 208.11 mg/dL; post-treatment: 214.37 mg/dL; p = 0.42).

Conclusion: Green tea consumption for one week significantly reduced total cholesterol levels, demonstrating its potential as a natural remedy for managing hypercholesterolemia.

Keywords: catechins, cholesterol reduction, green tea, hypercholesterolemia, natural remedies

Introduction

Hypercholesterolemia, characterized by elevated cholesterol levels, is a significant risk factor for cardiovascular diseases. According to the American Heart Association (AHA), between 2015 and 2018, 38.1% of adults in the United States had total cholesterol levels ≥ 200 mg/dL, 27.8% had low-density lipoprotein (LDL) levels ≥ 130 mg/dL, 21.1% had triglycerides ≥ 150 mg/dL, and 17.2% had high-density lipoprotein (HDL) levels < 40 mg/dL [1]. In Indonesia, the 2018 Basic Health Research (Riskesdas) reported a 7.6% prevalence of high total cholesterol levels, with a higher prevalence in women (9.9%) than in men (5.4%). Furthermore, the 2016 Non-Communicable Disease Profile (PTM) revealed that East Nusa Tenggara ranked 16th among provinces, with a cholesterol prevalence of 43.8% [2,3].

To mitigate high cholesterol levels and reduce the risk of cardiovascular diseases, modern pharmaceutical interventions are commonly used. However, these treatments may have adverse

side effects and are often expensive, prompting interest in alternative remedies, particularly those utilizing herbal plants [4,5]. Green tea is one such natural remedy, known for its cholesterol-lowering properties. Rich in tannins, saponins, alkaloids, and polyphenols, green tea contains catechins—specifically epigallocatechin gallate (EGCG)—which act as potent antioxidants and inhibit free radical damage [6–8].

Evidence suggests that green tea consumption can effectively reduce cholesterol levels, particularly in individuals aged 46–55 [8]. Studies on male Wistar rats have also shown that extracts from green tea leaves and bitter melon leaves significantly lower cholesterol levels [9,10]. Despite these findings, limited information exists regarding the efficacy of commercially available green tea, such as Tong Tji's green tea, in reducing blood cholesterol levels among specific populations, such as employees at the Social Service NTT.

This study aims to evaluate the impact of Tong Tji's green tea consumption on lowering total cholesterol levels, providing insight into its potential as an alternative, accessible, and natural intervention for managing hypercholesterolemia.

Method
Study samples

This study received ethical approval from the Health Research Ethics Committee of the Faculty of Medicine and Veterinary Medicine, Nusa Cendana University (Reference Number: 36/UN15.16/KEPK/2023). Employees of the NTT Provincial Social Service were randomly selected as participants. The study was conducted at the Social Service Office of NTT Province.

The sample size was calculated using the Isaac and Michael formula, resulting in a total of 38 participants, divided into two groups of 19 each. Participants were selected based on the following inclusion criteria: active employees aged 25–55 years, who fasted for 12 hours before cholesterol testing, engaged in light exercise, had a normal body mass index (BMI), were willing to consume green tea, and were generally healthy. Individuals

taking medications or undergoing treatment for heart and vascular diseases, diabetes mellitus, or kidney failure were excluded. All participants provided informed consent prior to the study.

Treatment

The study consisted of two groups: a treatment group receiving the green tea intervention and a control group. The intervention involved daily consumption of Tong Tji green tea for one week. Green tea was prepared by steeping in 240 ml of water at 70°C for 10 minutes and consumed unsweetened twice daily, in the morning and evening.

Cholesterol levels were measured in both groups using capillary blood and cholesterol test strips before and after the intervention. Blood samples were collected for baseline cholesterol measurements (pre-test). The treatment group consumed green tea for the duration of the study, while the control group received no intervention. After one week, post-intervention cholesterol levels were measured again in both groups.

Data analysis

Data distribution was assessed using the Shapiro-Wilk test, appropriate for sample sizes smaller than 50. A p-value < 0.05 indicated non-normal distribution, while a p-value > 0.05 indicated normal distribution. For normally distributed data, a paired t-test was used to compare pre- and post-test cholesterol levels. For non-normally distributed data, the Mann-Whitney test was employed to analyze the results.

Results
Participant characteristics

The study included a treatment group of 11 males and 8 females and a control group of 10 males and 9 females. Participant ages ranged from 25 to 59 years, with the treatment group predominantly composed of individuals aged 35–39 years (6 participants), while the control group had the highest representation in the 45–49 age range.
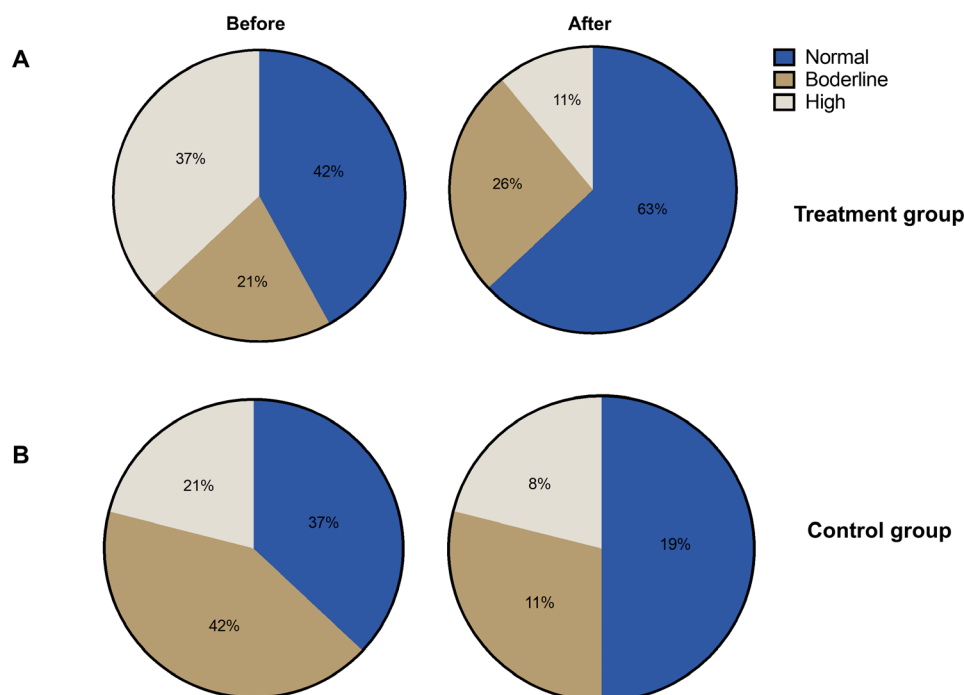
Figure 1. Classification of cholesterol levels within the treatment and control groups

Cholesterol levels pre- and post-treatment

The cholesterol cutoff value for this study was 200 mg/dL. In the treatment group, the mean cholesterol level before treatment was 210.95 mg/dL, which decreased to 188.26 mg/dL post-treatment. The minimum cholesterol level in this group declined from 130 mg/dL to 125 mg/dL, and the maximum level decreased from 312 mg/dL to 279 mg/dL.

In contrast, the control group exhibited a mean cholesterol level of 208.11 mg/dL before treatment, which increased to 214.37 mg/dL post-treatment. The minimum cholesterol level in the control group rose from 144 mg/dL to 160 mg/dL, while the maximum cholesterol level decreased from 301 mg/dL to 263 mg/dL. A Shapiro-Wilk test confirmed that the data were normally distributed.

Cholesterol level classification

Total cholesterol levels were classified into three categories: normal (<200 mg/dL), borderline (200–239 mg/dL), and high (≥240 mg/dL). In the treatment group, 42% of participants had normal cholesterol levels, 21% had borderline levels, and 37% exhibited high cholesterol levels before treatment. Post-treatment, the proportion of participants with normal cholesterol levels increased to 63%, reflecting a 21% improvement. In the control group, only 19% of participants achieved normal cholesterol levels post-treatment, compared to 63% in the treatment group.

Among the treatment group, 16 participants (84%) reported a reduction in cholesterol levels, while 3 participants (16%) showed no improvement. Conversely, in the control group, 12 participants (63%) did not exhibit a reduction in cholesterol levels, 5 participants (26%) experienced a decrease, and 2 participants (11%) showed no change.

The total cholesterol levels on treatment and control groups

Figure 2 compares the cholesterol levels of the treatment and control groups before and after treatment. In the treatment group, the mean cholesterol level decreased significantly from 210.95 mg/dL to 188.26 mg/dL (p = 0.003). In the control group, the mean cholesterol level increased from 208.11 mg/dL to 214.37 mg/dL, with no statistically significant difference (p = 0.42).

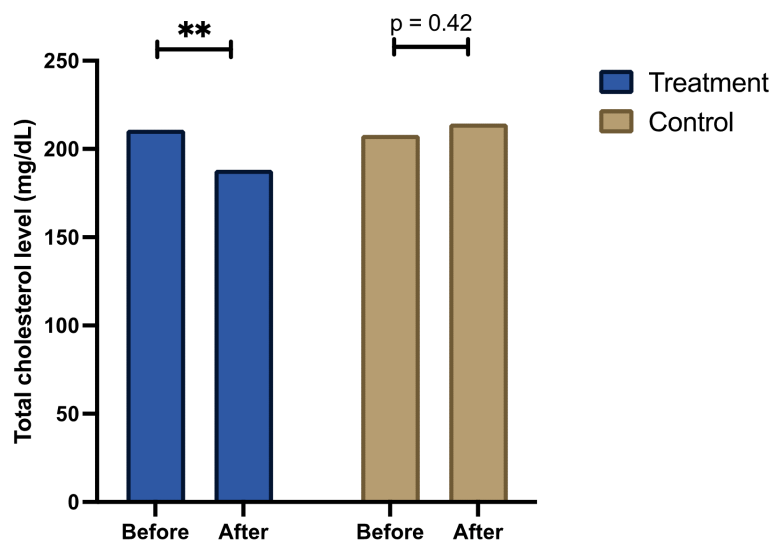**Figure 2.** Total cholesterol levels before and after treatment in the treatment and control groups (*p < 0.05; **p < 0.005; paired t-test).

Discussion

This study demonstrated a reduction in total cholesterol levels following green tea consumption, highlighting its potential as a natural intervention for managing hypercholesterolemia. However, the study did not account for dietary factors, which may have influenced the post-treatment cholesterol outcomes. Green tea's cholesterol-lowering effects are attributed to its bioactive compounds, particularly catechins such as epigallocatechin gallate (EGCG), which play a significant role in lipid metabolism.

Green tea reduces glucose and insulin levels, enhancing leptin expression and activity, which may further promote the efficacy of EGCG in reducing food intake. EGCG regulates carbohydrate and lipid absorption, inhibits emulsion absorption, and limits intestinal lipid uptake by reducing the digestion and dissolution of lipid micelles and starch-mediated amylase activity. These mechanisms collectively restrict intestinal lipid absorption and starch digestion [11,12].

The secondary metabolites in green tea, such as polyphenols, tannins, saponins, and alkaloids, contribute significantly to its cholesterol-lowering properties. Polyphenols and alkaloids inhibit the activity of key enzymes involved in cholesterol metabolism, such as HMG-CoA reductase and acyl-CoA cholesterol acyltransferase (ACAT). Catechins

act as potent antioxidants, enhancing the activity of superoxide dismutase (SOD) and mitigating the formation of free radicals. They also inhibit cholesterol ester transfer protein (CETP), reducing lipid accumulation and increasing β-oxidation of fatty acids [9-14].

Furthermore, catechins modulate gene expression by downregulating lipogenic genes such as sterol regulatory element-binding protein-1c (SREBP-1c) and fatty acid synthase (FAS) while upregulating oxidative genes, including peroxisome proliferator-activated receptor gamma (PPARγ) and carnitine palmitoyltransferase-I (CPT-I). These changes reduce reactive oxygen species (ROS) formation, diminish lipogenesis, and enhance fat oxidation. Saponins inhibit cholesterol synthesis, while tannins bind to proteins and coat the intestinal membrane, limiting fat absorption [9-14].

This study supports the hypothesis that green tea consumption reduces total cholesterol levels through these multifaceted mechanisms, demonstrating its potential as an accessible and cost-effective approach to cholesterol management.

Conclusion

One week of green tea consumption (twice daily) significantly reduced total cholesterol levels among employees of the Social Service in East

Nusa Tenggara Province, Indonesia. These findings suggest that green tea could serve as an effective natural remedy for managing cholesterol levels. Further studies are recommended to explore the long-term effects of green tea on cholesterol and its interaction with dietary and lifestyle factors.

Declaration of interest

The autors declare no conflict of interest.

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