

# Effect of Green Tea on Body Composition in Healthy Adults: A Randomised Controlled Trial

SIDDHARTH PRAVEEN CHOUDHARY<sup>1</sup>, RAJESHREE MESHAM<sup>2</sup>, TEJASWINI SONWANE<sup>3</sup>

## ABSTRACT

**Introduction:** Green tea has gained attention for its potential benefits in weight loss and improving metabolic health, particularly concerning obesity and Metabolic Syndrome. Green tea and its extracts have shown positive results in weight reduction by causing energy expenditure, and fat oxidation, and also by preservation of fat-free body mass.

**Aim:** To compare the effect of green tea on weight, Body Mass Index (BMI), body fat percentage, blood pressure and basal metabolic rate in study and control groups at the start of study and at the end of eight weeks.

**Materials and Methods:** The present randomised controlled trial was conducted in Indira Gandhi Government College and Hospital, Nagpur, Maharashtra, India, from April to May 2021, involving healthy MBBS students aged 18-25 years. The present study was completed with 32 participants in each group: Group I consumed green tea daily for eight weeks, while Group II was control group. The study assessed anthropometric measures, such as weight, BMI, body fat percentage, blood pressure and Basal Metabolic Rate (BMR) before and after the

intervention using body composition analyser QUADSCAN-4000. Parameters between same group at time duration 0 and 8 weeks were compared by paired t-test. Comparison between control and experimental groups were done by unpaired t-test.

**Results:** The mean age of subjects (16 males, 16 females) was 20.09±0.09 years and of control group (16 males, 16 females) was 19.38±1.10 years at the start of study. The green tea drinking group experienced significant reductions in weight (mean -2.20 kg, p-value <0.001), BMI (mean -0.80 kg/m<sup>2</sup>, p-value <0.001), waist circumference (mean -2.69 cm, p-value <0.001), hip circumference (mean -2.19 cm, p-value <0.001) and body fat percentage (mean -1.80%, p-value <0.001) at the end of eight weeks. BMR in the subject group showed a significant decrease (mean -24.9 kCal/day, p-value <0.001).

**Conclusion:** Based on the present study findings it was concluded that regular consumption of Green tea for eight weeks could cause a reduction in body weight and BMR. Green tea has improved body composition by reducing fat percentage which is associated with decreased risk of cardiovascular disease.

## INTRODUCTION

The use of green tea has been highly devised for weight loss, weight maintenance after weight loss, for its positive changes in body's metabolism leading to a better body composition, reduction in body fat and reduction of obesity. The reduction of body fat has also helped in tackling metabolic syndrome diseases. These include treatment of Type-2 Diabetes Mellitus (T2DM) having increased arterial stiffness [1].

Results of green tea on T2DM are argumentative due to the type of administration, time duration, presence of caffeine and previous caffeine sensitisation. Green tea and its extracts have shown positive results in weight reduction by causing energy expenditure, and fat oxidation, and also by preservation of fat free body-mass [2]. Weight reduction was also seen accompanied by improved high density lipoprotein cholesterol and better Systolic Blood Pressure (SBP) and glucose homeostasis [3,4]. Green tea is able to achieve this fat metabolism by reducing food intake by inhibiting appetite, disturbing lipid emulsification and absorption, subduing adipogenesis and lipid synthesis and boosting energy expenditure through thermogenesis, fat oxidation and faecal lipid excretion [5].

Research shows green tea to be a good supplement to enhance effects of exercise as it is anti-inflammatory and findings have also shown decrease in plasma creatine kinase concentration at rest. Green tea's consumption has shown to reduce body fat and this can lead to decreased cardiovascular diseases' risk factors [6]. The main components in caffeine responsible for this reduction in body fat are its polyphenols-catechin (especially epigallocatechin-3-gallate (EGCG)) and the involvement of caffeine has produced contrasting results [7,8]. Following the consumption of high dose of

**Keywords:** Body weight, Caffeine, Catechin, Obesity, Weight loss

Green Tea Extract (GTE), several disadvantages and adverse effects can be seen like: Gastrointestinal disturbance like heartburn and liver hepatotoxicity by mitochondrial cell damage, nervous system stimulation, cardiovascular problems, disrupts renal function, interferences with some medications by inhibiting the metabolism of these drugs, impair thyroid function, induce iron deficiency anaemia by blocking iron absorption, lowering potassium levels in blood, birth defects by its anti-folate effects, and infertility [9].

Dekant W and Fujii K also said that safe level of green tea should be below 300 mg EGCG/day. The study was carried out keeping safety level in mind [10]. Hence, present study was conducted to compare the effect of green tea on weight, BMI, body fat percentage, blood pressure and basal metabolic rate in study and control groups at the start of study and at the end of eight weeks.

**Null hypothesis:** The use of green tea is associated with weight loss, weight maintenance after weight loss, leading to a better body composition, reduction in body fat and obesity.

**Alternate hypothesis:** Green tea consumption alone, without physical activity, is not effective to improve body composition in a short span of consumption.

## MATERIALS AND METHODS

The present randomised controlled trial was conducted in Department of Physiology in Indira Gandhi Government College and Hospital, Nagpur, Maharashtra, India, between April and May 2021 for two months. Approval was taken from Institutional Ethical Committee. IEC approval number- IGGMC/Pharmacology/IEC/598-99/2021. Informed written consent was obtained from participants. General and Physical examination of participants was done.

**Inclusion criteria:** Healthy subjects aged between 18-25 years, from MBBS students who were previously not drinking green tea regularly were included.

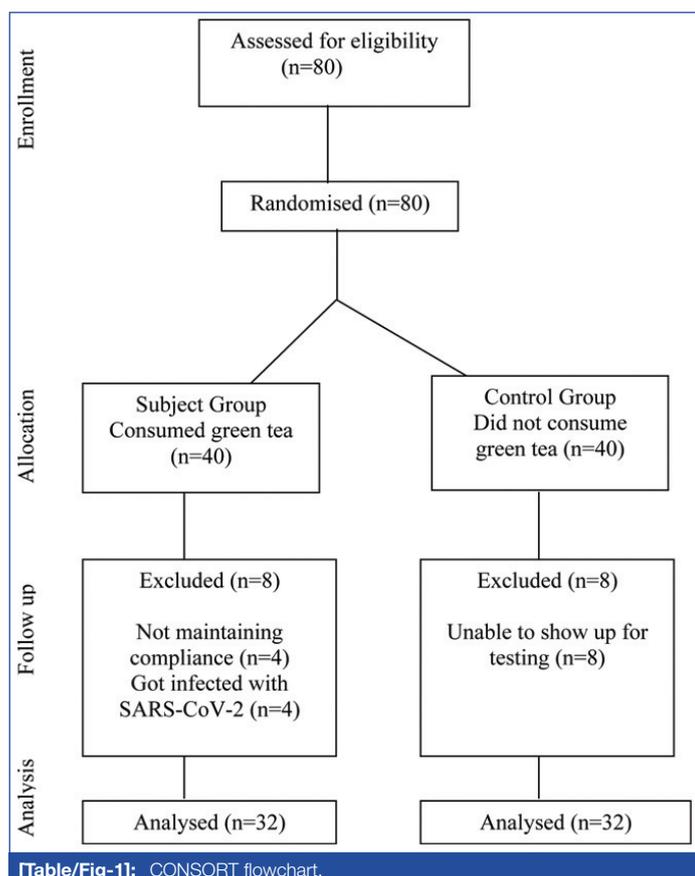
**Exclusion criteria:** Subjects having any cardiovascular, respiratory disease, anaemia, history of smoking or alcohol intake were excluded from study.

Subjects were divided in two groups- Group I (study group) and Group II (control group) by computerised randomisation.

**Sample size calculation:** Sample size was determined by taking values from research of Kajimoto O et al., where the values for body weight of the control was  $69.2 \pm 1.1$  and values for green tea containing low catechin level was  $68.1 \pm 1.1$  at the end of eight weeks by the following formula [11]:

$$n \geq \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 (\sigma_1^2 + \sigma_2^2/r)}{(\mu_1 - \mu_2)^2}$$

Each group initially had 40 participants. Of this, four volunteers dropped out because of their failure to comply with regular green tea intake. Four more volunteers dropped out due to getting infected with Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), and eight participants were unable to timely report to the department for their testing. So the study was completed with 32 participants in each group [Table/Fig-1].



## Study Procedure

The study participants were divided into respective groups of study and control using computer generated random number sequence.

**Group I:** This group consumed green tea once every day for eight weeks.

**Group II:** This group was age-and-sex matched control subjects who did not drink green tea.

To ensure compliance, subjects consuming green tea were asked to report their status of green tea consumption daily. They were instructed to consume green tea daily before breakfast. Energy and fat intake was limited throughout the trial period. There was no restriction on tea and coffee intake throughout the

entire trial period for both groups. Subjects were instructed to have their usual diet and maintain their routine physical activity. Participants were advised to have light physical activity, and were not having any heavy activity. Subjects visited the medical institution before start of study and at the end of eight weeks. Anthropometries, measurement of blood pressure, body fat and lean body mass percentage were measured at week 0 and at the end of week 8.

**Test drink:** With references from Shah T et al., the beverage was prepared by adding 250 mL of hot water to the green tea bag (1.5 g tea bag, Lipton). An average cup of green tea from commercial products when prepared according to instructions given on their packaging contains on average 83 mg of catechins and 30 mg of caffeine [12].

**Anthropometric measurement:** Circumferences in waist and hip were obtained using a retractable measuring tape to the nearest 0.1 cm while maintaining close contact with skin and without compressing underlying tissues. BMI calculation formula is: weight in kg/ height<sup>2</sup> in m<sup>2</sup> (kg/m<sup>2</sup>).

**Blood pressure measurement:** After five minutes rest, Systolic Blood Pressure (SBP) and Diastolic blood pressure (DBP) was measured by auscultatory method in a supine position by mercury manometer.

**Body composition analysis:** Body fat percentage and lean body mass were recorded by Bodystat composition analyser QUADSCAN -4000 for measuring Bioelectric Impedance Analysis (BIA). The basic principle of method- Lean tissue consists essentially of electrolyte containing water which conducts the electrical current, whereas fat acts as an insulator. The impedance of the body is therefore determined majorly by low-impedance lean tissues.

## STATISTICAL ANALYSIS

Statistical analysis was done on Statistical Package for Social Sciences (SPSS) software version 22. Parameters between same group at time duration zero and eight weeks were compared by paired t-test. Comparison between control and experimental groups were done by unpaired t-test. Parameters were considered statistically significant if their p-value were less than 0.05.

## RESULTS

The mean age of subjects was  $20.09 \pm 0.9$  years and  $19.38 \pm 1.10$  years of controls at the start of study. The mean height of subjects was  $168.28 \pm 9.37$  cm and mean height of controls was  $166.12 \pm 7.42$  [Table/Fig-2]. The mean weight and BMI among subjects who drank green tea ( $n=32$ , 16 male and 16 female) revealed significant losses after eight weeks ( $p$ -value  $< 0.05$ ). There were significant reductions in the waist circumference, hip circumference and mean waist-hip ratio in subjects at the end of eight weeks ( $p$ -value  $< 0.05$ ). Changes in mean SBP and DBP were not significant. The mean fat percentage exhibited a significant decrease, whereas the mean lean percentage weight increased significantly ( $p$ -value  $< 0.05$ ) in the green tea drinkers. The BMR/BW increased significantly in subjects at the end of eight weeks ( $p$ -value  $< 0.05$ ) [Table/Fig-3].

Parameters	Week 0 subject	Week 0 control	p-value
Age (years)	20.09±0.9	19.38±1.10	0.0912
Height (cm)	168.28±9.37	166.12±7.42	0.1657
Weight (kg)	66.06±10.22	57.56±11.82	0.0701
BMI (kg/m <sup>2</sup> )	23.39±3.69	20.82±3.73	0.0624

**[Table/Fig-2]:** Showing the mean parameters in subjects and control group at week 0.

The mean weight and BMI of the control group ( $n=32$ , 16 male and 16 female) showed no significant loss in weight after eight weeks. The mean waist circumference, hip circumference and waist-hip

ratio did not show any significant change in the control group. There were no significant changes in the SBP and DBP in the control in the course of eight weeks. The mean fat% increased which was not significant while mean lean weight% showed a non-significant decrease. The mean BMR and BMR/BW of the control group indicated no significant decrease [Table/Fig-4].

Parameters	Week 0 subject	Week 8 subject	p-value
Height (cm)	168.28±9.37	168.28±9.37	
Age (years)	20.09±0.9	20.10±0.78	
Gender	16 male, 16 female		
Weight (kg)	66.06±10.22	63.86±10.82	<0.001
Waist circumference (cm)	77.75±8.04	75.06±8.44	<0.001
Hip circumference (cm)	96.44±7.94	94.25±8.26	<0.001
SBP (mmHg)	117.06±4.36	118.06±4.23	0.0611
DBP (mmHg)	76.81±5.18	76.43±3.95	0.3047
Fat (%)	25.92±9.04	24.11±8.42	<0.001
Lean Weight (%)	74.08±9.19	75.89±8.42	<0.001
BMR (kCal)	1610.84±199.94	1585.91±202.88	<0.001
BMR/BW (kCal/kg)	24.59±2.11	25.1±2.32	<0.001
BMI (kg/m <sup>2</sup> )	23.39±3.69	22.55±3.73	<0.001
Waist-Hip ratio	0.80±0.05	0.80±0.05	0.0009

**[Table/Fig-3]:** Showing the mean parameters in subjects at week 0 and at the end of 8th week along with p-values from t-test.

Parameters	Week 0 control	Week 8 control	p-value
Height (cm)	166.12±7.42	166.12±7.42	
Age (years)	19.38±1.10	19.38±1.10	
Gender	16 male, 16 female		
Weight (kg)	57.56±11.82	57.69±11.98	0.3067
Waist circumference (cm)	73.97±8.37	74.1±8.65	0.3348
Hip circumference (cm)	92.84±8.81	93.21±8.87	0.1055
SBP (mmHg)	116.81±8.45	117.37±7.5	0.2461
DBP (mmHg)	75.88±6.52	75.75±6.15	0.3756
Fat (%)	22.85±5.72	22.91±5.55	0.3843
Lean weight (%)	77.12±5.81	77.08±5.55	0.3956
BMR (kCal)	1501.56±202.78	1502.53±206.42	0.3622
BMR/BW (kCal/kg)	26.64±3.41	26.06±2.40	0.3006
BMI (kg/m <sup>2</sup> )	20.82±3.73	20.64±3.71	0.4234
Waist-Hip ratio	0.79±0.05	0.79±0.04	0.1214

**[Table/Fig-4]:** Showing mean parameters in the control group at week 0 and at the end of 8 weeks along with p-values from t-test.

The mean differences in weight and BMI of subjects in eight weeks denoted a significant loss (p-value <0.05) as compared to the control group. Significant reductions were demonstrated in mean waist circumference, hip circumference and waist-hip ratio value in subjects who consumed green tea as compared to the group who did not consume green tea. No significant changes were noted in SBP and DBP in subjects as compared to control. The mean fat percentage dropped significantly, whereas mean lean weight percentage increased significantly in subjects compared to control (p-value <0.05) [Table/Fig-5].

## DISCUSSION

Green tea has been used as a functional drink in many countries. Recent evidences support that green tea is very effective in losing weight and improving body composition. In the present study, it was found that the body weight has decreased significantly in subjects who consumed green tea for eight weeks. Body weight has decreased from 66.06±10.22 kg to 63.86±10.82 kg (p<0.001). Waist circumference has decreased from 77.75±8.04 cm to 75.06±8.44 cm (p<0.001). Hip circumference also has decreased

Parameters	Subject difference	Control difference	p-value
Weight (kg)	-2.20±2.32	-0.23±1.66	<0.001
Waist circumference (cm)	-2.69±2.79	-0.38±2.02	<0.001
Hip circumference (cm)	-2.19±2.26	-0.03±1.96	<0.001
SBP (mm Hg)	1.31±4.67	1.75±6.96	0.2595
DBP (mm Hg)	-0.375±4.10	-0.125±3.76	0.3814
Fat (%)	-1.80±1.51	1.41±5.75	<0.001
Lean Weight (%)	1.80±1.51	-1.41±5.80	<0.001
BMR (kCal)	-24.9±30.5	-95.72±92.74	<0.001
BMR/BW (kCal/kg)	0.5±0.6	-1.38±1.43	0.0339
BMI (kg/m <sup>2</sup> )	-0.80±0.81	-0.12±0.61	<0.001
Waist- Hip ratio	-0.01±0.02	-0.00±0.01	0.0148

**[Table/Fig-5]:** Showing differences in the mean parameters in subjects and the control at the end of eight weeks from week 0 and along with p-values from t-test.

from 96.44±7.94 cm to 94.25±8.26 cm (p<0.001) in subjects who consumed green tea.

As body weight decreased Body Mass Index (BMI) also decreased. The decrease in waist and hip circumference has caused a decrease in Waist-Hip Ratio (WHR). Body fat percentage also decreased significantly from 25.92±9.04% to 24.11±8.42% (p<0.001) after eight weeks of green tea consumption. Lean body mass has increased from 74.08±9.19% to 75.89±8.42% (p<0.001).

In a trial conducted by Abdul GD et al., who studied the efficacy of GTE in increasing 24 hour Energy Expenditure (24-h EE) as compared to caffeine, and placebo showed that there was no correlation observed between the magnitude of thermogenic response and the degree of fatness (BMI or percentage of body fat) of the subjects [13]. This means that GTE can be used as an intervention for increasing metabolism even in lean and healthy patients, along with obese patients; and can be used as a preventive as well as curative measure for tackling obesity. Hence, the authors did not keep any specific inclusion criteria of BMI grading in selecting the participants, and hope to see the effect of green tea in an unbiased collective group comprising of participants with low, normal and high BMI.

Nagao T et al., in the year 2007 studied effects of green tea beverage in subjects with visceral fat-type obesity, and their body compositions were noted at every four weeks interval, till week 12 [14]. Similar to the present study, significant improvement in body composition was first seen in 8<sup>th</sup> week of testing.

Similar results were observed in the moderately overweight Chinese population where regular consumption of a very high catechin green tea with caffeine (886 mg catechins+198 mg caffeine/day) over 90 days led to a significant reduction in measures such as body weight, waist circumference and IAF [15].

Catechin-rich green tea beverage plus inulin (534 mg catechin and 11.7g inulin) consumption for six weeks has decreased body weight, BMI, fat mass and blood pressure significantly; and also after refraining from consumption for two weeks, sustained effects on body weight and fat mass were observed [16].

Michelle CV et al., found that even after acute ingestion of green tea, average fat oxidation rates were 17% higher after ingestion of GTE than after ingestion of placebo (0.41±0.03 and 0.35±0.03 g/min, in GTE and placebo consumers respectively; p<0.05) [17]. In contrast to our study, some studies found no effect of green tea consumption on body weight and body composition. Kristel D et al., carried out a study in which subjects were fed with low energy diet along with Green tea (1125 mg tea catechins+25 mg caffeine/day) or placebo. Reductions in weight, BMI, waist-hip ratio, fat mass and fat-free mass were not statistically different between the treatment and placebo. This could be due to increased hunger with green tea treatment and the lack of a robust effect on the prevention of decrease in resting energy expenditure [18].

The effect of GTE to influence the body weight and body composition could be due to increasing 24 hour energy expenditure causing thermogenesis and stimulation of fat oxidation as suggested by Abdul GD et al., [13]. In the year 2014, Huang J and Wang Y have suggested that caffeine and green tea polyphenols, especially EGCG are major components responsible for fat reduction and weight loss. Caffeine acts as a metabolic stimulant and increases fat oxidation and energy expenditure. EGCG acts as an uncoupler in thermogenesis, as well as inhibits adipocyte production and induces its apoptosis [5].

Green tea could affect fat metabolism by reducing food intake by inhibiting appetite, disturbing lipid emulsification and absorption, subduing adipogenesis and lipid synthesis and boosting energy expenditure through thermogenesis, fat oxidation and faecal lipid excretion [5]. Catechins in green tea may inhibit the activity of Catechol-o-methyltransferase. This enzyme catalyses the breakdown of Noradrenaline in neural synapses. Inhibition of Catechol-o-methyltransferase could increase the washout time of noradrenaline, causing a more prolonged stimulation of the sympathetic nervous system, thus increasing energy expenditure [19]. In an animal study, Lee MS et al., suggested that green tea EGCG effectively reduces adipose tissue mass and ameliorates plasma lipid profiles in high-fat diet-induced obese mice [20].

In this study, we observed no significant effect of green tea- neither on SBP nor on DBP. In one long-term prospective cohort study, drinking one cup of coffee a day was associated with a small increase in blood pressure however long-term coffee drinking did not substantially increase the risk of developing hypertension in this cohort [21]. The meta-analysis of 13 randomised control trial suggested that green tea consumption had a favourable effect on decrease in BP [22]. Nagao T et al., found a greater decrease in SBP in the catechin group compared with the control group for subjects whose initial SBP was 130 mm Hg or higher. Decrease in BP could be due to decrease in fat content [14]. EGCG from green tea stimulates the production of nitric oxide from endothelium using PI3-kinase-dependent pathways, and is therefore beneficial to improve metabolic and cardiovascular pathophysiology [23]. In the current study, the authors could not find any significant decrease in SBP or DBP. This could be because subjects were young healthy adults and their BP was in a normal range.

In the present study, BMR is decreased significantly in the group drinking green tea which could be due to decrease in body weight. The mean BMR decreased from 1610.84±199.94 kCal/day to 1585.91±202.88 kCal/day ( $p < 0.001$ ). BMR and body weight both decreased, ratio of BMR/BW increased as reduction in body weight was more than in BMR.

Gabrielle AC et al., found that subjects who were supplemented with green tea alone, without physical activity, showed a decrease in RMR by 270.4 kCal/day (1130.44 kJ/day), decreased body mass, which lowers the calorie expenditure necessary for body mass maintenance; but increase in RMR values of 260.8 kCal/day (1091.92 kJ/day) occurred when subjects who consumed green tea were also engaged in the resistance training exercise. This was due to the significant increase in lean body mass, which is more metabolically active, and the body consequently expends more energy to maintain it [24]. In this study, instead of RMR, BMR was calculated.

### Limitation(s)

The limitation of the study was that participants were asked to follow their normal diet and maintain their regular physical activity. Therefore, we don't have a control on both these activities. Also, the study was not a blind trial. A wide age group would have been a confounding factor. The subjects chosen could be closely monitored during the study period of eight weeks. This has

study has limitations in extrapolating the effects of GTE on subjects above 25 years.

### CONCLUSION(S)

From this, we conclude that regular consumption of Green tea for eight weeks could cause a reduction in body weight and BMR. Green tea has improved body composition by reducing fat percentage which is associated with decreased risk of cardiovascular disease. So green tea can be effectively used for weight control and improving body fat mass along with maintenance of lean body mass in normal as well as overweight subjects. For further consolidation of this study, subjects can be blinded to remove any placebo effect. Also, strict diet and physical activity charting can be done to account for daily calories.

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1. Undergraduate Student, Department of Physiology, Indira Gandhi Government Medical College, Nagpur, Maharashtra, India.
2. Associate Professor, Department of Physiology, Government Medical College, Nagpur, Maharashtra, India.
3. Associate Professor, Department of Physiology, Byramjee Jeejeebhoy Government Medical College, Pune, Maharashtra, India.

**NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:**

Dr. Siddharth Praveen Choudhary,  
Flat No. 403, Type 3, New C.P.W.D. Colony, Sahar Village, Andheri East,  
Mumbai-400099, Maharashtra, India.  
Email: chsid04@gmail.com

**PLAGIARISM CHECKING METHODS:** [\[Jain H et al.\]](#)

- Plagiarism X-checker: Jan 12, 2025
- Manual Googling: Jul 05, 2025
- iThenticate Software: Jul 08, 2025 (14%)

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