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Is Green Tea an Effective Aid in Weight Reduction?

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A SELECTIVE EVIDENCE BASED MEDICINE REVIEW

In Partial Fulfillment of the Requirements For

The Degree of Master of Science

In

Health Sciences – Physician Assistant

Department of Physician Assistant Studies
Philadelphia College of Osteopathic Medicine
Philadelphia, Pennsylvania

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ABSTRACT

OBJECTIVE: The objective of this systematic review is to determine whether or not green tea extract is effective in aiding in weight reduction.

STUDY DESIGN: Review of three English language primary studies published in 2005, 2007, and 2008.

DATA SOURCES: Randomized, double blind, placebo-controlled trials comparing green tea extract to placebo were found using Ovid MEDLINE, PubMed, and Cochrane databases.

OUTCOMES MEASURED: Each of the three studies measured change from baseline weight parameters including weight, body mass index, waist circumference, and hip circumference. Study participants were measured at baseline, fourth week, eighth week, and twelfth week.

RESULTS: All three RCT's included in the review found that the green tea extract group experienced slight improvement in energy expenditure, but did not benefit in weight reduction. Participants in each of the three studies reported some minor adverse effects, but no major adverse effects were reported.

CONCLUSIONS: The results of the RCT's reviewed demonstrate that green tea extract is not effective in aiding in weight loss.

KEY WORDS: Green tea extract, Weight Loss, Weight Reduction, Overweight, Obese

INTRODUCTION

Obesity is a term that describes body weight that is much greater than what is considered to be healthy. Globally, there are more than 1 billion overweight adults, at least 300 million of them obese.⁴ Obesity has become the second leading cause of preventable deaths in the United States and it accounts for a numerous amount of doctor office visits annually. In 2006, it was reported that obesity alone accounted for over 7.6% of office visits.⁶ The costs of caring for those who are overweight or obese has also taken its toll on society. Researchers have suggested that these individual's medical expenses may have reached as high as \$78.5 billion dollars in 1998.⁵

In terms of body mass index, overweight is defined as greater than 25 kg/m^2 and obesity is defined as greater than 30 kg/m^2 . Obesity can lead to many complications and can impact those affected for the rest of their lives. Conditions such as osteoarthritis, hypertension, diabetes mellitus, heart disease, and stroke can be directly correlated with obesity. Economic growth, modernization, urbanization, and globalization of food markets are just some of the forces thought to underlie the obesity epidemic.⁴

Definitive treatment for those individuals who are either overweight or obese is rooted in proper dieting, portion control, and physical exercise. Although these do provide the majority of the population with a solution, many persons wish to add or supplement their weight loss program with medications or herbal remedies.

Patients seeking treatment consult physician assistants in this country and health care providers worldwide daily for advice on how to lose weight. There are few medications that can be prescribed for those individuals that fit within the criteria needed and these medications also come with warnings of multiple adverse effects. Also, there is a huge market for non-FDA approved weight loss supplements that can put patients at risk. While there are multiple options

for weight reduction, patients often want to have accessible, affordable, and convenient methods to aid in their weight reduction. Green tea is a natural supplement that can be found in many forms. It contains two ingredients that many feel can stimulate metabolic processes that can aid in weight reduction and satiety. Green tea is possibly a safe alternative to these options to aid in weight reduction and may be an alternative that physician assistants can add to their arsenal to combat obesity.

OBJECTIVE

The objective of this systematic review is to determine whether or not green tea is effective in aiding in weight reduction.

METHODS

All three studies selected for this review met the following criteria. The population included primarily overweight to obese female patients ranging in age from 18-60 years old. The interventions used in the studies were Green Tea extract in capsule form. The treatment groups were compared to control groups given visually matched placebo. The main outcomes measured were reduction in weight parameters including body weight, body mass index, waist circumference, and hip circumference. The studies were double blind, randomized, and placebo-controlled.

The study performed by Auvichayapt et al took place at Khon Kaen University in Thailand. Participants were recruited from the officers of the Faculty of Medicine. After selection, participants were divided into groups, given instructions and capsules, and gave written informed consent.

The study performed by Diepvens et al was located in Maastricht, The Netherlands at Maastricht University. The subjects were recruited via local newspaper advertisement.

Preliminary volunteers participated in initial screening that measured weight parameters and other inclusion and exclusion criteria. Participants were to follow strict dietary instructions during study period.

Hsu et al conducted the trial at Taipei Hospital, Taiwan for one full year. One hundred subjects were chosen from selection process and were randomly divided into groups. Participants received capsules and had to return to the hospital every four weeks for blood work and assessment of compliance in consuming amount prescribed.

All three studies had initial screening with inclusion and exclusion criteria. Auvichayapat et al chose to include males between 40 to 60 years of age, females that were at least 1 year postmenopausal, and body mass index of 25 kg/m^2 or greater. Those with metabolic disease, systemic disease, prescribed medications, energy expenditure of greater than 8373.6 kJ/day , or history of tea or caffeine hypersensitivity were excluded.¹ Dievpens et al included females 19 to 57 years of age with a body mass index of 25 kg/m^2 to 31 kg/m^2 . Completion of initial screening required that participants be moderate caffeine users (200-400 mg/d) in good health, non-smokers, normotensive, not using medications, and at most moderate alcohol users.² Inclusion criteria for Hsu et al included females ages 16-60 years of age with a body mass index of 27 kg/m^2 or greater. Exclusion criteria included endocrine disease, heart disease, allergy or immunology diseases, high liver or renal enzymes, pregnant or lactating females, childbirth within six months, stroke history, unable to exercise, management for weight control within 3 months, or other conditions that deem participant unsuitable.³

Key words used in literature searched were green tea, weight loss, weight reduction, overweight, and obese. All articles searched were published in peer-reviewed journals in the English language. All literature searches were performed using Ovid MEDLINE, PubMed, and

Cochrane Databases. Inclusion criteria for the review were POEM, randomized controlled trials, and studies published in 2005 or later. An exclusion criterion for the review was combination of green tea with other substances. The statistics utilized in the studies were *p*-value, relative risk increase (RRRI), absolute risk increase (ARI), and numbers needed to harm (NNH).

Table 1- Demographics of included studies

Study	Type	# Pts	Age (yrs)	Inclusion Criteria	Exclusion Criteria	W/D	Interventions
Auvichayapat, 2007 (1)	RCT	73	Males 40-60 Females Post-menopausal >1 yr	-Males between 40-60 years old -Females post-menopausal > 1 yr -BMI > 25 kg/m ²	-History of metabolic disease -Systemic disease -Prescribed medications -Regular exercise or an average of total energy expenditure > 8373.6 kJ/day -History of tea or caffeine hypersensitivity	13	250 mg green tea capsule TID after breakfast, lunch, and dinner
Diepvens, 2006 (2)	RCT (Double-blind, placebo controlled)	46	19-57	-Overweight females 19-57 years old -BMI between 25 and 31 kg/m ² -Initial Screening	-Poor health -Current smoker -Hypertensive -Current medication usage -Greater than moderate alcohol usage - Intake of > 200-400 mg caffeine/day	0	Green tea extract capsules
Hsu, 2008 (3)	RCT (Double-blind, placebo controlled)	100	16-60	-Females -16-60 years old -BMI of >27 kg/m ²	-Endocrine Disease, Heart Disease, Allergy and Immunology Disease, High aminotransferases or high serum creatinine, Pregnant or lactating, Childbirth within 6 months, Stroke or otherwise unable to exercise, Management for weight control within 3 months, Other conditions deemed un-suitable for trial as evaluated by the physician-in-charge	0	Green tea extract (in capsule form)

OUTCOMES MEASURED

The primary outcomes measured in all three studies were changes from baseline weight parameters. Weight parameters here are defined as body weight, body mass index, waist circumference, and hip circumference. Quantitative measurements were evaluated in percent reduction in all parameters at different time intervals throughout the intervention. All three studies conducted measurements at fasted state using standardized methods.

Each of the three studies also measured differing secondary outcomes. Auvichayapat et al measured hunger and fullness on visual analogue scales, resting energy expenditure and substrate oxidation, blood pressure and heart rate, urine vanillylmandelic acid levels, and leptin levels.¹ Diepvens et al measured systolic and diastolic blood pressure changes and also changes in blood parameters such as TG, LDL, HDL, leptin, and glucose levels.² Hsu et al measure hormone peptide levels throughout intervention including insulin, adiponectin, leptin, and ghrelin.³

RESULTS

The results pertaining to the primary outcome were presented as continuous data. The continuous data in the Hsu et al study can be converted to dichotomous form. The data from the studies was presented as an intention to treat analysis with the exception of participants who withdrew or were lost to follow-up.

Auvichayapat et al reported weight loss of 2.7 kg and 2.0 kg in the green tea extract and control groups, respectively. The *p*-value over time was statistically significant between groups ($p < 0.05$). During this study, neither the control group nor the experimental group experienced adverse affects. Therefore, number needed to harm could not be calculated (Table 2).

Diepvens et al reported weight loss of 4.5 kg and 4.3 kg in green tea extract and control groups, respectively. The data is statistically significant ($p < 0.001$). During this study, neither

the control group nor the experimental group experienced adverse affects. Therefore, number needed to harm could not be calculated (Table 2).

Hsu et al reported weight loss of 0.2 kg and 0.1 kg in green tea extract and control groups, respectively. The data was not statistically significant ($p = 0.72$). The absolute risk increase (ARI) was calculated to be 0.5% and the relative risk increase (RRI) was calculated to be 0.04%. No participants withdrew from this study because of discomfort or adverse effects associated with treatment; however, some participants did experience adverse effects which contributed to number needed to harm. This study determined that the number needed to harm (NNH) was 25 patients using the dosage of 400 mg TID (Table 2).

Table 2- Efficacy of Green Tea Extract in Weight Reduction

Study	GTE group reduction in parameters [#]	Placebo group reduction in parameters [#]	<i>p</i> -value	RRI	ARI	NNH
Auvichayapat, 2007	2.7	2.0	<0.05	0*	0*	0*
Diepvens, 2005	4.5	4.3	<0.001	0**	0**	0**
Hsu, 2008	0.2	0.1	0.72	0.5	0.04	25

GTE=Green tea extract, RRI= relative risk increase, Absolute risk increase, NNH= number needed to harm

[#]= Reported in kilograms lost from baseline weight

*Reported that there were no adverse effects in this study

**Reported that there were no adverse effects in this study

Only one study reported mild adverse effects; Hsu et al found that 3 patients developed mild constipation and two patients had abdominal discomfort after green tea extract treatment.³ Two patients experienced mild constipation and one patient had abdominal discomfort after placebo treatment.³ These symptoms all were noted during the first week of treatment. No major adverse effects occurred during this study.

During all three studies, patients were only monitored at the respective facilities on scheduled screening days. Auvichayapat et al measured patients weight parameters at weeks 0, 4, 8, and 12.¹ Diepvens et al had patients return on days 0, 4, 32, and 87.² Hsu et al only had patient's weight parameters measured at week 0 and 12.³ Hsu et al was the only study that reported loss of participants to follow-up.

DISCUSSION

Green tea is one of the most popular beverages in the world and is gaining popularity in Western cultures. Green tea originates from the leaves of *Camellia sinensis* that have undergone minimal oxidation during processing. It is an herbal that contains two active ingredients: catechin polyphenol and caffeine.¹ Catechin polyphenol inhibits the action of catechol-o-methyltransferase, resulting in the prolonged action of catecholamines.¹ Caffeine inhibits the phosphodiesterase-induced degradation of intracellular cyclic AMP leading to an increase in norepinephrine release.¹ It is thought that these two combined can stimulate energy expenditure and promote fat oxidation resulting in the reduction of body weight. It had also been suggested that catecholamines might possibly play a role in satiety.

All three studies were conducted using female participants, with Auvichayapat et al being the only study including males. All studies used green tea placed in capsule form with ranging dosages and timing schedules. All placebos were visually matched and formed with cellulose capsules. Diepvens et al was the only study that allowed for other caffeine intake during the intervention period. All studies had sample sizes less than one hundred participants. Each of the three studies lasted approximately twelve weeks. In all three studies, blinding did not seem to be compromised.

CONCLUSIONS

The studies reviewed demonstrate that green tea extract does have association with minimal weight reduction, but does not provide adequate statistical difference between the intervention and placebo. Green tea extract intake was considered safe during each of the studies. Further investigation is needed to determine if green tea extract can increase energy expenditure over time. The studies above were performed over 12 weeks. Lengthening the time of the studies with adequate follow-up may provide better data that would show long-term effects of green tea when added to diet and exercise. Insufficiency in dietary control might have played a role in effectiveness of green tea in these studies as well. More tightly controlled dietary program with weekly or bi-monthly follow up combined with green tea extract intervention should be instituted in further research. Also, these studies did not have large populations of participants. Increasing the amount of participants in future studies may also provide for better data. Performing investigation with relations between required dietary program, green tea extract intake, and anthropometric and metabolic measures would provide for improved research as all studies did report metabolic benefits in secondary outcomes. Long-term, large population research with closer follow up is needed in order to determine if the effects of green tea is statistically significant to aid in weight reduction.

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