International Journal of Biotechnology and Biomedical Sciences
Volume 1, Number 1; July- December, 2015 pp. 21-24

http://www.krishisanskriti.org

Green Tea and Weight Loss: An update (Meta-Analysis)

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Abstract—*Obesity is the growing health disorder globally and lifestyle changes are at the heart of this problem. It has been found that green tea market is increasing. One of the supposedly many effects of green tea is the weight loss. There is vast literature available related to this subject. The purpose of this study was to elucidate by meta-analysis whether green tea has an effect on body weight. PubMed search was done for the term - Green tea and later limited by English-language, human studies published in last decade and available as full text. Out of the 704 initially retrieved articles 11 were included in the present meta-analysis after considering the exclusion and inclusion criteria of the study. The pooled results of all the studies with the random effect model is -1.26 [-1.87 to -0.65]. It is imperative by this meta-analysis that green tea consumption leads to weight loss. However the substantial heterogeneity (I2 = 81.71%) among the studies warranties larger studies for confirmation and validation of the effect of green tea on weight of an individual.*

Keywords*: Green Tea, Weight Loss, Meta-Analysis*

1. INTRODUCTION

Obesity is a growing health issue worldwide. According to world health organization (WHO) report updated in January 2015 (a) prevalence of obesity has more than doubled since 1980 (b) 600 million adults are obese and 39% are overweight as per the 2014 statistics (c) obesity is also prevalent in children under age 5, according to 2013 statistics it accounts to 42 million [1].

Specifically in India there is a growing prevalence of obesity. India is third most obese country in the world, just behind US and China [2]. India is a developing country with 270 million people under poverty line. In such a scenario the rise in obesity and obesity related disorders focuses on the increasing effect of Lifestyle changes specifically eating habits i.e. more consumption of junk food [3].

The solution to this problem is to have healthy lifestyle speaking of which opens a lot of doors from exercise to food. India is the world's largest Tea-drinking nation and there is an emerging trend of drinking green tea is observed specifically for the reasons of weight loss [4]. There is increase in the demand of green tea in Indian market [5].

Asians have been aware of health benefits of green tea for over a century [6] and for almost 24 years now, it is has been considered as enhancer of energy expenditure and fat oxidation and thereby inducing weight loss (WL) [7,8]. The polyphenols in green tea such as EpiGalloCatechin Gallate (EGCG) stimulates energy expenditure because it has thermogenic effect as proven by a couple of short-term studies showing significant increase in energy expenditure and fat oxidation [9, 10]. Later on the longer term studies were published on the effect from an EGCG–caffeine mixture on WL.

Hence a lot of literature is generated in context to green tea and weight loss. Therefore this study aimed to find out whether green tea has effect on body weight through meta-analysis of the available literature.

2. METHODOLOGY

2.1 Identification of Relevant Studies

PubMed was searched for the term – Green tea.

The search was limited to English language and human studies. All the studies available as free full text articles for the past decade.

2.2 Inclusion and exclusion criteria

A study was included in the review if (a) the study participants were randomly assigned to conditions, (b) the results allowed a direct comparison of the effects of green tea consumption (either dosage versus placebo or high dosage versus low dosage) on either WL or WM, and (c) the study lasted at least for 8 weeks. Green tea is served as either regular tea or as capsules.

An important exclusion criterion was the use of any tea other than an EGCG–caffeine mixture (such as oolong tea).

2.3 Data extraction

We extracted data for various parameters from the original articles using a standardized data extraction form. Wherein the study's author(s), year of publication, the duration of the

treatment phase (weeks), the age range, average body weight and gender of the participants in the study was recorded. We also recorded the number of participants and the dosage of green tea administered (mg/day).

For each condition, we calculated or extracted the mean weight change (kg) between the post-treatment and the baseline assessment. For studies which mentioned WL and/or WM the baseline corresponded to the time immediately before starting of WL phase and /or WM phase respectively. The post-treatment mean was recorded just after the intervention ends. Irrespective of the study design, negative values for the mean change, indicate WL, a value of zero indicates no change, and positive values indicate an increase in the body weight on average. The effect size measure for the Metaanalysis was therefore difference between values of the mean change for the treatment minus the mean change value for the control group.

2.4 Statistical Analysis

The results are represented as weighted mean of the body weights (kg) of the study participants. The Meta-Analysis is performed using Exploratory Software for Confidence Intervals, ESCI software. The effect size estimates were aggregated based on a random effects model to estimate the amount of heterogeneity in the effect sizes. We report the estimated average effect (μ), the estimated amount of heterogeneity (τ), and the estimated percentage of the total amount of variability that can be attributed to heterogeneity (I^2). Corresponding 95% confidence intervals are given for all of these statistics.

3. RESULTS

Initially 48 potentially relevant articles were retrieved.

These articles where then assessed on the basis of titles and abstract thereby excluding in vitro studies, unrelated studies, biochemical and molecular biology based studies..

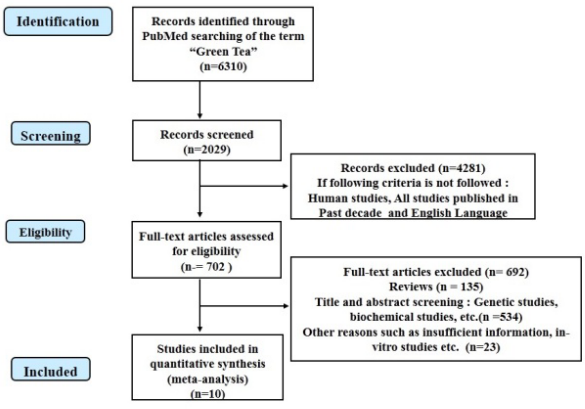

Figure 1: Selection procedure of the articles included in the systematic review (Meta-Analysis).

Further review articles which didn't contribute any additional data were excluded. Also articles having any of the following insufficiencies: 1) animal studies 2) full text in language other than English 3) insufficient data; were excluded. The relevant data from two studies was requested from the corresponding authors through e-mail but could not be procured. Hence these two studies could not be included in this review. None of these studies were excluded due to lack of blinding. After this rigorous screening, 10 articles are included in this review [13-22]. Fig. 1 summarizes the selection procedure of these articles.

More than one effect size could be calculate from two studies. Hursel et al. [14] provided two effect sizes corresponding to two sub-groups viz. adequate protein (AP) diet and high-protein (HP) diet under green tea-caffeine mixture consumption and placebo groups in WL and later WM. Also Wang et al. [15] study group provided three effect size estimates as a result of three treatment groups wherein participants received increasing order of dosage as a result of different number of servings. Therefore a total of 13 effect size estimates could be extracted from the 9 studies. Fig. 2 shows a forest plot of the individual effect size estimates with corresponding study weightings and 95% confidence intervals.

The random-effects model indicated a modest, but significant positive effect of catechins on WL (μ = -1.26, 95% CI: -1.87 to -0.65; p = 0.01). Therefore, it is estimated that subjects in the treatment groups lost on average 1.26 kg more weight (or gained on average 1.26 kg less weight) than people in the control groups [Fig. 2].

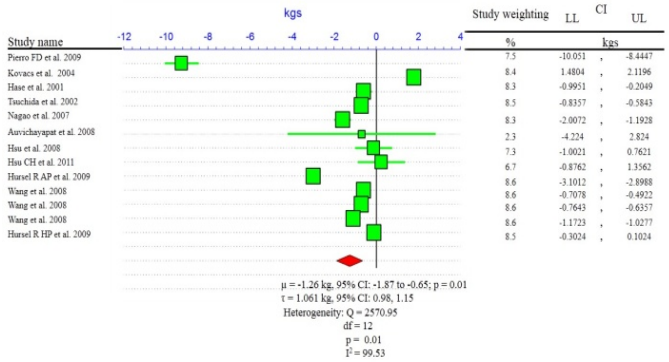

Figure 2: Forest Plot of the Meta-Analysis

Removal of any individual study from the meta-analysis did not alter this conclusion. However, the results were clearly heterogeneous (I^2 = 99.53%, p= 0.01; τ = 1.061 kg, 95% CI: 0.98, 1.15).

4. DISCUSSION

This meta-analysis shows green tea consumption has a negative impact of body weight of an individual even when consumed as an EGCG-caffeine mixture. Also the results show that difference in dosage of catechins in the EGCG–caffeine mixture among treatment and control groups had no effect on overall effect size estimates of this meta-analysis.

This result is in line with study by Berube-Parent et al. [10] wherein different mixtures of EGCG and caffeine with a different dosage of catechins were examined. The results from that study showed that all mixtures increased 24-h energy expenditure and that the increase was similar for all doses of EGCG in the mixtures, which was also found in the study from Wang et al. [15].

It is important to note all the studies included in this particular meta-analysis had comparable designs: in the WL studies [13–22] participants immediately started to consume an EGCG–caffeine mixture for 8-12 weeks following randomization. All studies had test period for at least 12-13 weeks except for Tsuchida T et al. [21] that had a test period of 8 weeks. Two WM studies [14, 20] had participants with first weight loss phase for 4 weeks using a very low energy diet, followed by randomization and then an EGCG–caffeine mixture supplementation phase for either 12 or 13 weeks. One study [16] randomly assigned subjects to three different dosage conditions as compared to controls. All the studies had true placebo group except one [22] made the comparison between two groups of low and high dosage of catechins.

However there was significant heterogeneity observed in this meta-analysis. Therefore there was a need to look up for factors influencing meta-analytical heterogeneity. Two factors were highlighted from the data provided in the research articles included in this review which are ethnicity and habitual caffeine intake. It is noted that Asian studies had a low caffeine intake and while almost all Caucasian studies had a high caffeine intake. Although caffeine intake was not a significant moderator alone but when examined together in a model including ethnicity it was found have an impact. If more studies with both ethnicities with different amounts of caffeine intake are conducted and then a similar meta-analysis would provide a clearer picture of the effectiveness of these moderators.

5. CONCLUSION

Taken together, this meta-analysis has shown that EGCG–caffeine mixtures have a positive effect on WL and on WM. Moreover, it also shows that habitual caffeine intake and ethnicity may be moderators, whereas different doses of catechins do not have a significantly different effect.

6. ACKNOWLEDGEMENTS

Medical Research Society of Sir H N Reliance Foundation Hospital and Research Centre for providing necessary infrastructure for this review writing.

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