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Effect of Garcinia cambogia supplement on obesity indices: A systematic review and dose-response meta-analysis

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ABSTRACT

Objective: Several trials have examined the effect of Garcinia cambogia supplement on the weight and body composition, but their results are conflicting. This systematic review and dose-response meta-analysis was designed to determine the effect of Garcinia cambogia supplement on the obesity indices in human randomized controlled trials (RCTs).

Methods: PubMed/Medline, Scopus, Cochrane library, and Web of Science databases were searched up to 1th January, 2020, to screen relevant trials. The mean changes in the weight, body mass index (BMI), percentage of fat mass (PFM), and waist circumference (WC) from the baseline were used to conduct the present dose response meta-analysis.

Results: In the current study, eight trials (including 530 subjects) were included. Garcinia cambogia supplement significantly reduced the weight by -1.34 kg (95% CI: -2.62 to -0.07, P = 0.03), BMI by -0.99 kg/m^2 (95% CI: -1.48 to -0.49, P < 0.001), PFM by -0.42% (95% CI: -0.77 to -0.06, P = 0.02), and WC by -4.16 cm (95% CI: -7.83 to -0.49, P = 0.02) compared with the placebo group. Dose-response analysis revealed that there is a nonlinear association between Garcinia cambogia dosage and changes in the body weight ($P_{nonlinearity}$ = 0.04) and BMI ($P_{nonlinearity}$ < 0.001) not PFM ($P_{nonlinearity}$ = 0.68). There was no publication bias among the studies.

Conclusion: Our results suggested that Garcinia cambogia supplement had a significant effect on the body weight, BMI, PFA, and WC as compared with the placebo.

1. Introduction

Overweight and obesity are major public concerns which contribute to development of type II diabetes, cardiovascular disease (CVD), some cancers, and mortality. Evidence from 2416 population-based surveys has indicated that the prevalence of obesity has grown rapidly from 1980 where 671 million adults (281 million men and 390 million women) suffered from obesity in 2016 worldwide.[1] The conventional approach to treating obesity involves diet therapy, physical activity, and lifestyle modifications. However, use of anti-obesity agents as an adjuvant therapy can promote weight loss among patients with overweight and obesity. In according to Endocrine Society Clinical Practice (ESCP) guideline, weight-reducing agents are recommended for body mass index (BMI) > 30 kg/m^2 or ≥27 kg/m^2 with an obesity-related co-morbidity.[2]

Besides the weight loss drugs, herbal weight-reducing agents have been traditionally used worldwide.[3] One of the natural products is Garcinia cambogia that sold as an anti-obesity agent in many countries.[4] It is a member of Clusiaceae family and is known as brindleberry, Malabar tamarind and kudam puli.[5] Garcinia cambogia is an edible fruit which grows in some parts of South Asia and Africa.[4,6] It was traditionally used to preserve and taste foods and to cure intestinal discomfort and parasites. Garcinia cambogia contains some organic acid, benzophenones and xanthones and poses anti-inflammatory and anti-lipidemic properties. Experimental studies have indicated beneficial effects of Garcinia cambogia extract on weight.[5] Hydroxycitric acid (HCA) is the main functional component of Garcinia cambogia possessing weight-reducing properties.[4] Several randomized controlled trials (RCTs) have studied the effect of Garcinia cambogia supplement on weight and body composition, but their results are conflicting. Hence, conducting a meta-analysis to pooled data is essential.[3,7] In the past, a meta-analysis in 2010 showed that Garcinia cambogia supplement had a marginal effect on body weight with no effect on BMI.[8] However, they did not assess the effect of Garcinia cambogia

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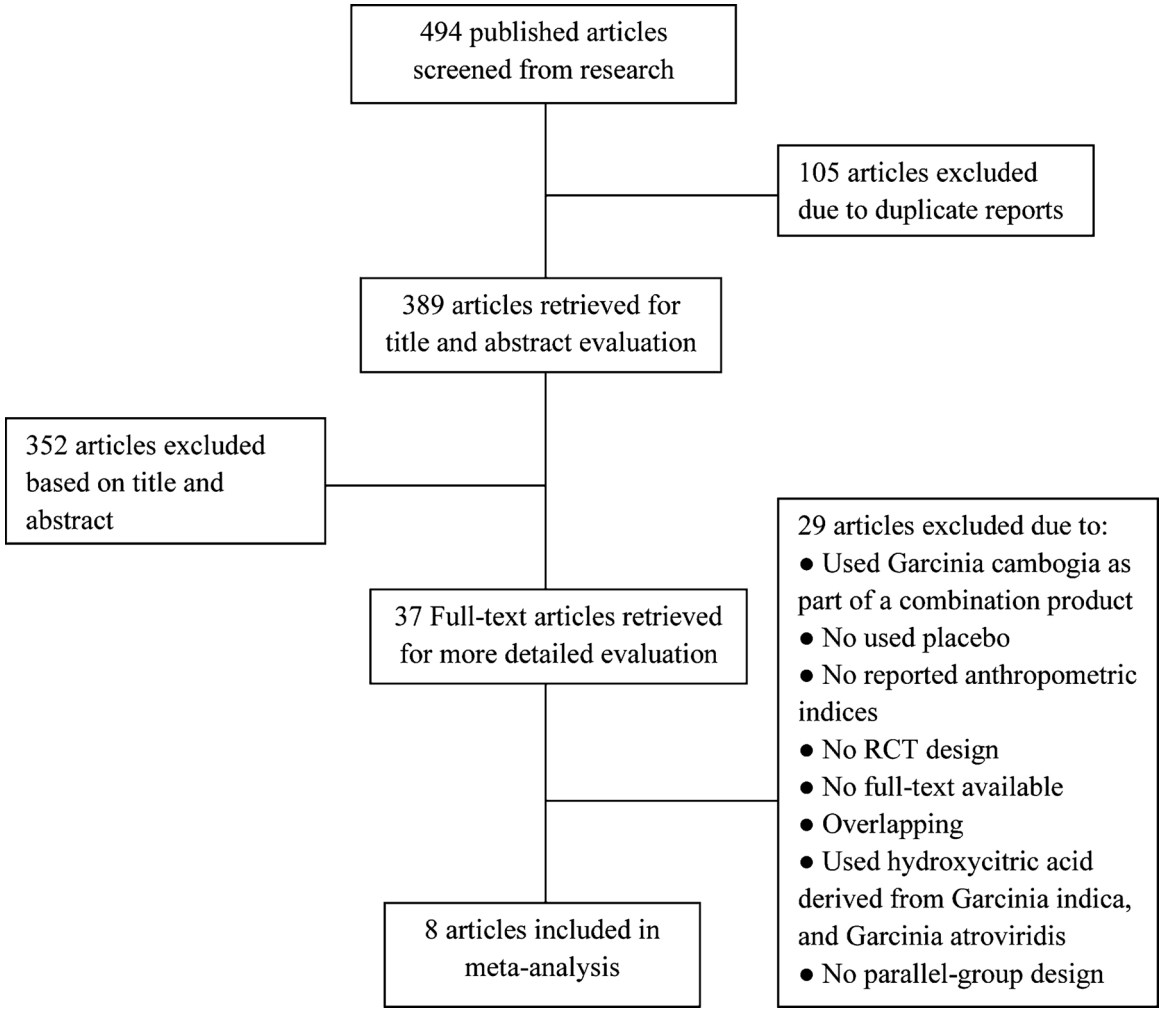

Fig. 1. Flow chart of studies reviewed.

supplement on the other obesity indices i.e. percentage of fat mass (PFM) and waist circumference (WC). In addition, there is no dose-response meta-analysis evaluating the effect of Garcinia cambogia supplement on obesity indices. Therefore, this systematic review and dose-response meta-analysis was designed to determine the effect of Garcinia cambogia supplement on the obesity indices in human RCTs.

2. Materials and Methods

2.1. Data source and search

The current systematic review and meta-analysis was reported in accordance with PRISMA guideline.[9] For literature search, PubMed/Medline, Scopus, Web of Science, and Cochrane library databases were reviewed for all clinical trials examining the effect of Garcinia cambogia supplement on the obesity indices from the beginning up to 1th January, 2020. The search terms included:"Obesity", "weight", "weight loss", "weight gain", "body composition", "fat mass", "fat free mass", "body mass index", "BMI", "adiposity", "overweight", "weight change", "waist circumference", "Garcinia cambogia", "brindleberry", "Malabar tamarind", and "kudampuli". The reference list of previous systematic review studies[3,7,8] was checked to find additional relevant studies.

2.2. Study selection

To define the research question, the PICOS criteria (population, intervention, comparison, outcome, and setting) were used. Two independent investigators (M.G and K.T) screened the retrieved articles based on inclusion and exclusion criteria to find relevant studies. Inclusion criteria were as follows: a) parallel clinical trial, b) human studies, c) oral Garcinia cambogia supplementation as intervention vs. placebo, d) reported weight, BMI, PFM and WC as outcome and e) adult participants (aged > 18 years). We removed animal, observational, review, and editorial articles. Cross-over studies without parallel design, trials which did not use placebo, studies employing Garcinia cambogia as part of a combination product and those which used Garcinia indica and Garcinia atroviridis supplement were excluded. In addition, trials conducted in children, adolescents, pregnant and lactationg women were removed. In order to avoid overlapping, recent studies and studies with a longer follow-up period were included.

2.3. Data extraction

Study name, sample size, age, gender, publication date, as well as mean and standard deviation (SD) of outcomes i.e. weight, BMI, PFM, and WC at baseline, end of study, and their changes from baseline, dosage of intervention, duration of follow-up were extracted. The quality of studies was determined based on Cochrane Collaboration Risk of Bias tool.[10]

2.4. Statistical analysis

Stata software version 12 (StataCrop, College Station, Texas, USA) was applied to analyze the data. The mean and SD of changes in weight,

BMI, PFM, and WC from the baseline were used to conduct meta-analysis. A random-effect model was used to pool the effect size unless the heterogeneity was < 50%. Heterogeneity of studies was assessed using *I*-squared (I^2) statistics. Random-effect meta-regression analysis was performed to evaluate the effect of source of heterogeneity on the effect size. To assess nonlinear dose-response association between Garcinia cambogia dosage and changes in the obesity indices, fractional polynomial analysis was conducted. Eggers' regression symmetry test was utilized to evaluate publication bias. Due to the few number of included studies (< 10), we could not perform funnel plot test to assess the publication bias. $P < 0.05$ was considered as significant.

3. Results

The flow chart of studies is presented in Fig. 1. At the initial search, a total of 494 papers from PubMed/Medline (n = 28), Scopus (n = 262), Web of Science (n = 173), and Cochrane library (n = 31) databases were included. After excluding duplicate studies (n = 105), 389 papers were screened based on title and abstract. Of those, 352 papers were removed and 37 papers were considered for further inspection. Finally, eight papers[11–18] (including 530 patients with overweight and obesity) that met inclusion and exclusion criteria were included in the meta-analysis.

The general characteristics of the included trials are presented in Table 1. These studies were published between 1998 and 2016. Five studies were from Asian countries including Iraq,[11] Taiwan,[13] India,[15] Korea[14] and Japan,[16] two from USA[17,18] and one from Brazil.[12] The mean age of participants was 36.0 ± 4.3 yr in Garcinia cambogia and 38.9 ± 3.9 yr in placebo. The mean weight was 82.5 ± 11.0 and 81.7 ± 11.3 kg, BMI was 31.1 ± 4.6 and 30.9 ± 4.7 kg/m^2, PBF was 35.7 ± 6.5 and 35.3 ± 6.1%, and WC was 98.4 ± 6.5 and 96.5 ± 6.4 cm in Garcinia cambogia and placebo, respectively. The duration of follow-up was 8 to 12 wk and dosage of Garcinia cambogia was 166 to 4667 mg per day. All trials had the same treatment regimen (i.e. daily type).

3.1. Effect of Garcinia cambogia supplement on weight

Seven trials had assessed the effect of Garcinia cambogia supplement on the body weight.[11,13–18] Forest plot for the effects of Garcinia cambogia on the weight is shown in Fig. 2. Garcinia cambogia supplement significantly reduced weight by -1.34 kg (95% CI: -2.62 to -0.07, P = 0.03). There was a high heterogeneity among included studies (I^2 = 93.8%, $P < 0.001$). The results of meta-regression analysis revealed that the baseline weight (slope = -0.57, P = 0.006) but not age (slope = 1.52, P = 0.17), Garcinia cambogia dosage (slope = 0.002, P = 0.25), and follow-up period (slope = -2.13, P = 0.18) is source of heterogenity. Dose-response analysis suggested that there is a nonlinear association between Garcinia cambogia dosage and changes in the body weight ($P_{nonlinearity}$ = 0.04) (Fig. 6A).

3.2. Effect of Garcinia cambogia supplement on BMI

Effect of Garcinia cambogia supplement on BMI was investigated in six studies.[11–16] BMI significantly decreased in Garcinia cambogia group compared with the placebo group (-0.99 kg/m^2, 95% CI: -1.48 to -0.49, $P < 0.001$) (Fig. 3). A significant heterogeneity was observed between studies (I^2 = 97.7%, $P < 0.001$). Meta-regression analysis showed that age (slope = 0.96, P = 0.30), Garcinia cambogia dosage (slope = 0.0008, P = 0.36), and follow-up period (slope = -1.24, P = 0.08) but not baseline weight (slope = -0.18, P = 0.03) are not source of heterogenity. The results of Dose-response analysis showed that Garcinia cambogia dosage was associated with changes in BMI in a nonlinear fashion ($P_{nonlinearity} < 0.001$) (Fig. 6B).

3.3. Effect of Garcinia cambogia supplement on PFM

Six trials had examined the influence of Garcinia cambogia supplement on PFM[12–14,16–18] whose forest plot is presented in Fig. 4. Garcinia cambogia supplement significantly changed PFM from the baseline (-0.42%, 95% CI: -0.77 to -0.06, P = 0.02) compared with placebo. The heterogeneity of studies which assessed PFM was 71.7% (P = 0.003). Meta-regression analysis revealed that age (slope = -0.41, P = 0.88), Garcinia cambogia dosage (slope = -0.0002, P = 0.78), follow-up period (slope = 0.37, P = 0.18), and baseline weight (slope = -0.15, P = 0.13) are not source of heterogenity. Garcinia cambogia dosage indicated an insignificant nonlinear association with changes in PFM ($P_{nonlinearity}$ = 0.68) (Fig. 6C).

3.4. Effect of Garcinia cambogia supplement on WC

The forest plot of the effect of Garcinia cambogia supplement on WC is presented in Fig. 5. Overall, three studies had assessed the effect of Garcinia cambogia supplement on WC.[11,13,17] There was a significant reduction in WC in Garcinia cambogia group (-4.16 cm, 95% CI: -7.83 to -0.49, P = 0.02) compared with placebo group. The heterogeneity between studies was 99.1% ($P < 0.001$). Due to the few number of studies that had assessed the effect of Garcinia cambogia on WC, we could not perform meta-regression and nonlinear dose-response analyses.

3.5. Publication bias

No publication bias was found among the included studies for weight (Egger's regression symmetry test = 0.51), BMI (Egger's regression symmetry test = 0.09), PFM (Egger's regression symmetry test = 0.39), and WC (Egger's regression symmetry test = 0.16).

4. Discussion

The results of the present study revealed that Garcinia cambogia supplement significantly decreases weight, BMI, PBF, and WC compared with the placebo. However, the results should be interpreted with caution due to observed substantial heterogeneity between studies. In

Table 1
General characteristics of included studies.

Author, year	Country	Intervention	Subjects	No. In/Pl	Dosage	Follow-up	Outcome
Al-Kuraishy, 2016	Iraq	Garcinia combogia	Obese	29/30	166 mg/d	12 wk	Weight, BMI, WC
Vasques, 2014	Brazil	Garcinia combogia	Overweight	30/13	2400 mg/d	8 wk	BMI, PBF
Lu, 2012	Taiwan	Garcinia combogia	Overweight and obese	35/36	2800 mg/d	8 wk	Weight, BMI, WC, PBF
Kim, 2011	Korea	Garcinia combogia	Overweight	29/29	2000 mg/d	10 wk	Weight, BMI, PBF
Preuss, 2004	India	Garcinia combogia	Overweight and obese	19/16	4667 mg/d	8 wk	Weight, BMI
Hayamizu, 2001	Japan	Garcinia combogia	Overweight	20/20	1000 mg/d	8 wk	Weight, BMI, PBF
Mattes, 2000	USA	Garcinia combogia	Overweight	42/47	2400 mg/d	12 wk	Weight, WC, PBF
Heymsfield, 1998	USA	Garcinia combogia	Overweight	66/69	3000 mg/d	12 wk	Weight, PBF

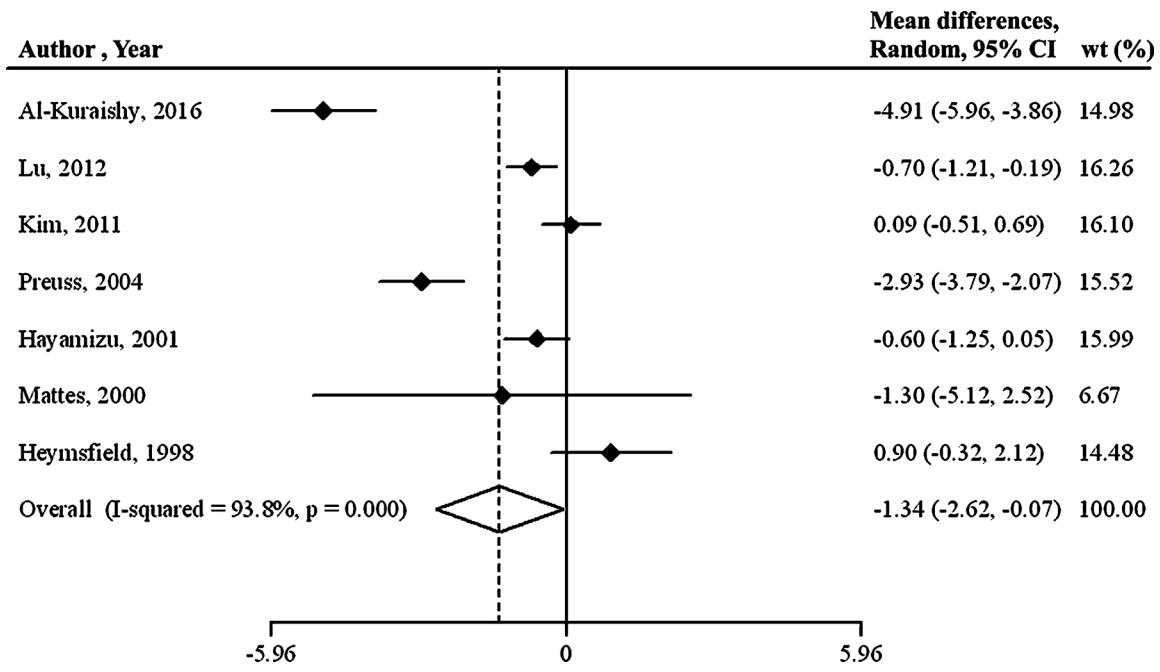

Fig. 2. Forest plot of studies that assessed effect of Garcinia cambogia on body weight.

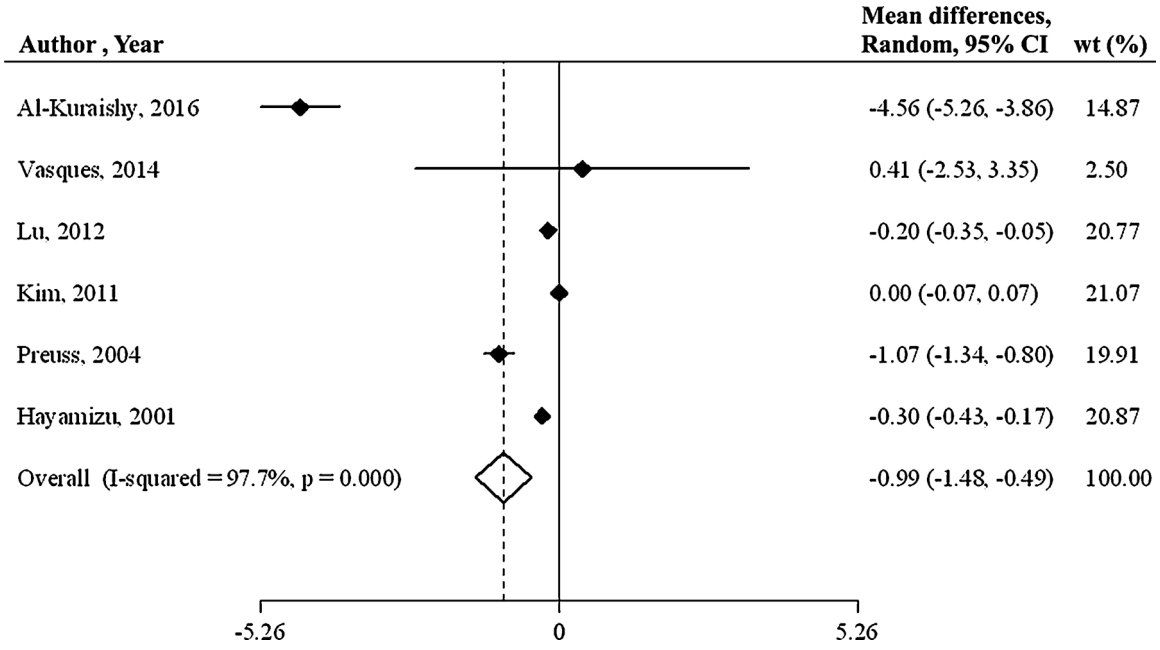

Fig. 3. Forest plot of studies that assessed effect of Garcinia cambogia on BMI.

the present study, we found a significant nonlinear dose-response association between Garcinia cambogia dosage and changes in weight and BMI.

Previously, Onakpoya et al[8] in a meta-analysis on 12 RCTs assessed effect of Garcinia extract (HCA) on weight and BMI in 2010. They indicated that HCA supplement results in significant weight loss among patients with overweight and obesity (-0.88 kg, 95% CI: -1.75 to 0.00), but not BMI (-0.34 kg/m^2, 95% CI: -0.88 to 0.20). However, the authors used P = 0.05 as the significant level; while in the most studies P < 0.05 was consider to establish significant differences. Our results were inconsistent with the latter meta-analysis which showed lack of beneficial effects of HCA on weight and BMI compared with placebo. In addition, we evaluated the effect of Garcinia cambogia supplement on PFM and WC and performed a dose-response meta-analysis to assess the association between this supplement and outcomes. Furthermore, they included HCA supplement derived from both Garcinia cambogia and Garcinia atroviridis; thus, their findings do not provide an accurate estimate of the effect of Garcinia cambogia on weight. They also included cross-over studies without parallel design which may affect final pooled effect size. Nevertheless, after excluding cross-over studies, there was no significant difference in the results of present meta-analysis (-1.34 kg, 95% CI: -2.62 to -0.07) and aboved meta-analysis (-1.22 kg, 95% CI: -2.29 to -0.14). Also, their literature search was up to 2010 while afterwards some clinical trials had been published which were included in the present study.[11–14]

Garcinia cambogia is known as an anti-obesity supplement and commonly used worldwide. In the previous systematic reviews and meta-analyses, the effect of some conventional weight-reducing agents

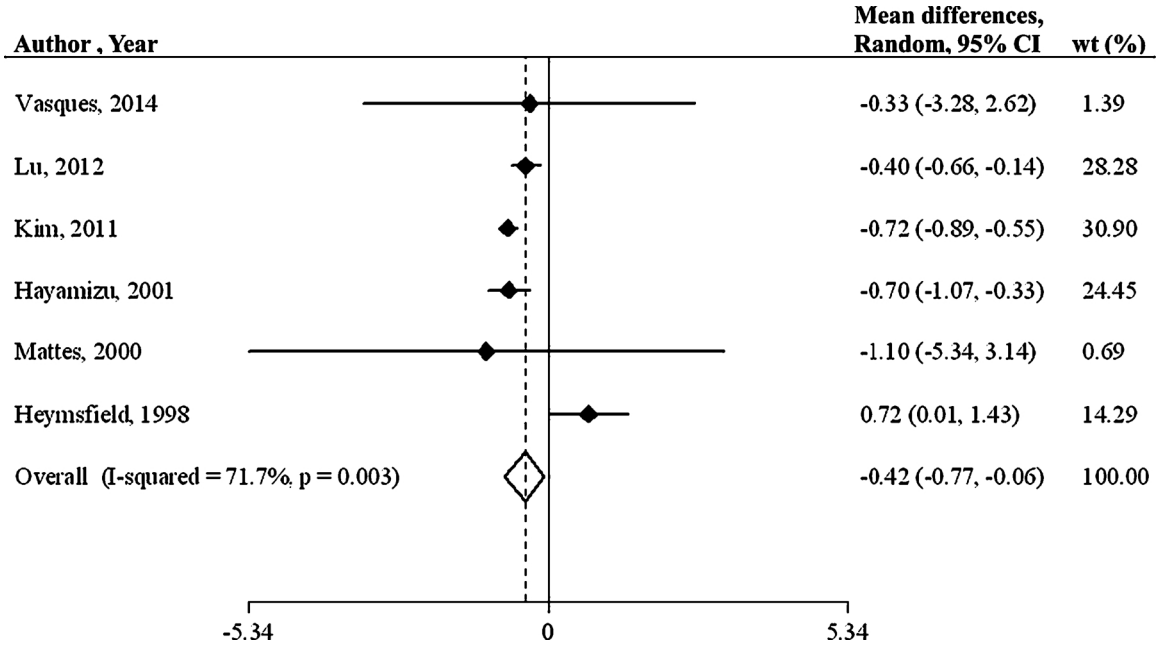

Fig. 4. Forest plot of studies that assessed effect of Garcinia cambogia on PFM.

on body weight was studied. The results of the present study indicated that Garcinia cambogia supplement is more effective than green tea/green tea extract (-0.65 kg, 95% CI: -1.10 to -0.20),[19] conjugated linoleic acid (CLA) (-0.52 kg, 95% CI: -0.83 to -0.21)[20] and capsaicin supplements (-0.50 kg, 95% CI: -0.90 to -0.11).[19] However, its effect on body weight was similar to that of L-carnitine supplement (-1.33 kg, 95% CI: -2.09 to -0.57)[21] and liraglutide (-1.22 kg, 95% CI: -1.51 to -0.93)[22] and less than orlistat (-2.12 kg, 95% CI: -2.51 to -1.74).[23]

It has been proposed that Garcinia cambogia plays a role in weight reduction through several mechanisms. HCA is a major active component of Garcinia cambogia which results in weight loss.[24] First, HCA is an inhibitor of adenosine triphosphate citrate lyase enzyme which converts citrate to acetyl coenzyme A and oxaoacetate, which contributes to lipogenesis. So, by suppressing this enzyme, HCA prevents *de novo* fatty acid and cholesterol biosynthesis, thereby alleviating subcutaneous and visceral fat deposition and causing weight loss.[25,26] Second, HCA raises the level of serotonin in the brain and suppresses appetite and food intake.[27] Finally, it improves fat and carbohydrate metabolism by suppressing the intestinal absorption of fat and α-amylase as well as α-glycisidase activity, respectively.[8,28]

However, there are some concerns about the safety of Garcinia cambogia supplement.[29,30] Some studies have reported that Garcinia cambogia is toxic for liver limiting its usage as an adjuvant agent for weight management. Nevertheless, it has been suggested that liver damage will resolve after withdrawal of Garcinia cambogia supplement.[31] It seems that control of liver function through laboratory evaluation including alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total bilirubin, and direct bilirubin can be useful to prevent hepatotoxicity during Garcinia cambogia utilization.

The main strength of the current study was performing a dose-response meta-analysis to assess the effect of Garcinia cambogia on obesity indices. However, there were some limitations. The main limitation of the present study was the few numbers of included studies. In addition, a high rate of heterogeneity among studies made interpretation of the results difficult.

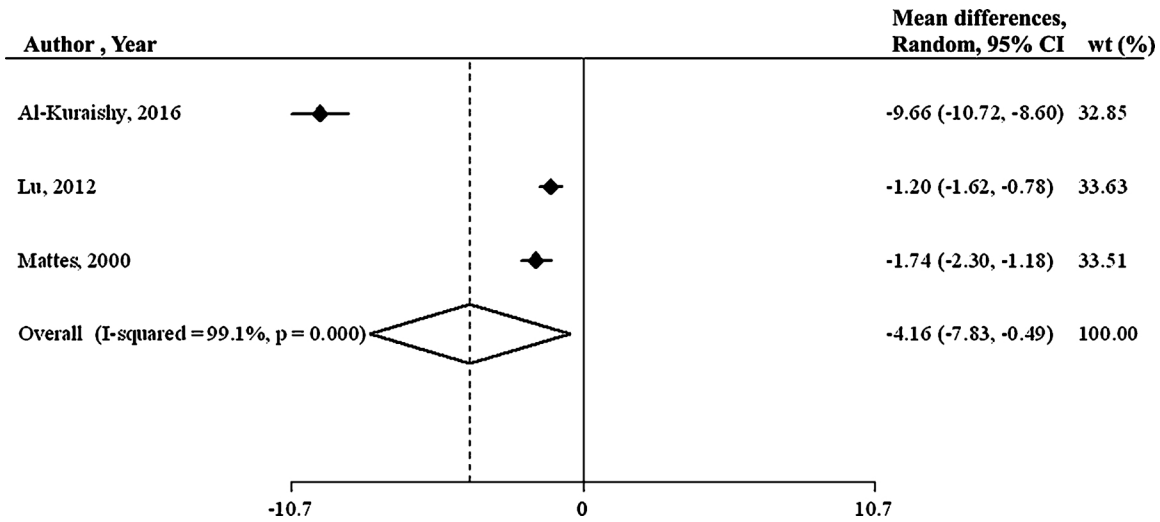

Fig. 5. Forest plot of studies that assessed effect of Garcinia cambogia on WC.

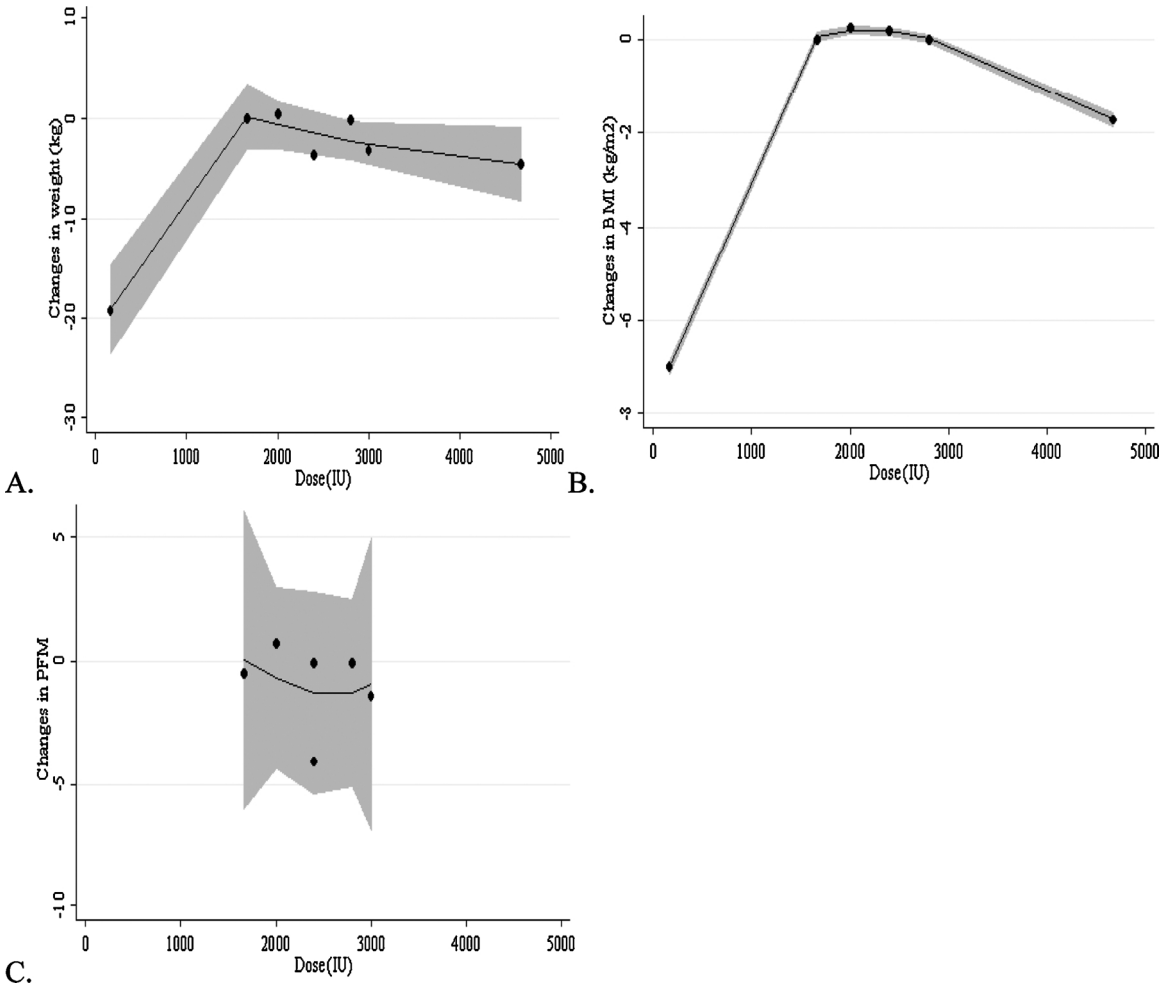

Fig. 6. Non-linear dose-response association between Garcinia cambogia supplement and changes in: A) weight, B) BMI and C) PFM from baseline.

Conflict of interest

The authors report no conflict of interest.

References

1. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. *Lancet.* 2017;390:2627–2642.
2. Sun NN, Wu TY, Chau CF. Natural Dietary and Herbal Products in Anti-Obesity Treatment. *Molecules.* 2016;21:E1351.
3. Pittler MH, Schmidt K, Ernst E. Adverse events of herbal food supplements for body weight reduction: systematic review. *Obes Rev.* 2005;6:93–111.
4. Chong PW, Beah ZM, Grube B, Riede L. IQP-GC-101 reduces body weight and body fat mass: a randomized, double-blind, placebo-controlled study. *Phytother Res.* 2014;28:1520–1526.
5. Semwal RB, Semwal DK, Vermaak I, Viljoen A. A comprehensive scientific overview of Garcinia cambogia. *Fitoterapia.* 2015;102:134–148.
6. Mullin GE. Supplements for weight loss: Hype or help for obesity? Part iii. *Nutr Clin Pract.* 2015;30:446–449.
7. Pittler MH, Ernst E. Dietary supplements for body-weight reduction: a systematic review. *Am J Clin Nutr.* 2004;79:529–536.
8. Onakpoya I, Hung SK, Perry R, Wider B, Ernst E. The use of Garcinia extract (Hydroxycitric Acid) as a weight loss supplement: a systematic review and meta-analysis of randomised clinical trials. *J Obes.* 2011;2011 509038.
9. Moher D, Liberati A, Tetzlaff J, Altman D, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med.* 2009;6:e1000097.
10. Higgins JPT, Altman DG, Gøtzsche PC, Jüni P, Moher D, Oxman AD, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ.* 2011;343:d5928.
11. Al-Kuraishy HM, Al-Gareeb AI. Effect of orlistat alone or in combination with Garcinia cambogia on visceral adiposity index in obese patients. *J Intercult Ethnopharmacol.* 2016;5:408–414.
12. Vasques CAR, Schneider R, Klein-Júnior LC, Falavigna A, Piazza I, Rossetto S. Hypolipemic effect of garcinia cambogia in obese women. *Phytother Res.* 2014;28:887–891.
13. Lu CH, Yang TH, Wu CC, et al. Clinical evaluation of garcinia cambogia and phaseolus vulgaris extract for obese adults in taiwan. *Nutr Sci J.* 2012;37:75–84.
14. Kim JE, Jeon SM, Park K, et al. Does Glycine max leaves or Garcinia cambogia promote weight-loss or lower plasma cholesterol in overweight individuals: a randomized control trial. *Nutr J.* 2011;10:94.
15. Preuss HG, Bagchi D, Bagchi M, Rao CVS, Dey DK, Satyanarayana S. Effects of a natural extract of (-)-hydroxycitric acid (HCA-SX) and a combination of HCA-SX plus niacin-bound chromium and Gymnema sylvestre extract on weight loss. *Diabetes Obes Metabol.* 2004;6:171–180.
16. Hayamizu K, Ismi Y, Kaneko I, et al. Effects of long-term administration of Garcinia cambogia extract on visceral fat accumulation in humans: a placebo-controlled Double Blind Trial. *J Oleo Sci.* 2001;50:805–812.
17. Mattes RD, Bormann L. Effects of (-)-hydroxycitric acid on appetitive variables. *Physiol Behav.* 2000;71:87–94.
18. Heymsfield SB, Allison DB, Vasselli JR, Pietrobelli A, Greenfield D, Nunez C. Garcinia cambogia (hydroxycitric acid) as a potential antiobesity agent – a randomized controlled trial. *JAMA.* 1998;280:1596–1600.
19. Golzarand M, Toolabi K, Farid R. Effect of green tea, caffeine and capsaicin supplements on the anthropometric indices: a meta-analysis of randomized clinical trial. *J Func Food.* 2018;46:320–328.
20. Namazi N, Irandoost P, Larijani B, Azadbakht L. The effects of supplementation with conjugated linoleic acid on anthropometric indices and body weight in overweight and obese subjects: a systematic review and meta-analysis. *Crit Rev Food Sci Nutr.* 2019;59:2720–2733.
21. Pooyandjoo M, Nouhi M, Shab-Bidar S, Djafarian K, Olyaeemanesh A. The effect of (L-)carnitine on weight loss in adults: a systematic review and meta-analysis of randomized controlled trials. *Obe Rev.* 2016;17:970–976.
22. Robinson LE, Holt TA, Rees K, Randeva HS, O'Hare JP. Effects of etenatide and liraglutide on heart rate, blood pressure and body weight: systematic review and meta-analysis. *BMJ Open.* 2013;3:e001986.
23. Sahebkar A, Simental-Mendia LE, Reiner Z, et al. Effect of orlistat on plasma lipids and body weight: A systematic review and meta-analysis of 33 randomized controlled trials. *Pharmacol Res.* 2017;122:53–65.

24. Kovacs EMR, Westerterp-Plantenga MS, Saris WHM. The effects of 2-week ingestion of (-)-hydroxycitrate and (-)-hydroxycitrate combined with medium-chain triglycerides on satiety, fat oxidation, energy expenditure and body weight. *Int J Obes.* 2001;25:1087–1094.
25. Hayamizu K, Ishii Y, Kaneko I, et al. Effects of Garcinia cambogia (Hydroxycitric Acid) on visceral fat accumulation: a double-blind, randomized, Placebo-controlled Trial. *Curr Ther Res Clin Exp.* 2003;64:551–567.
26. Preuss HG, Bagchi D, Bagchi M, Rao CVS, Satyanarayana S, Dey DK. Efficacy of a novel, natural extract of (-)-hydroxycitric acid (HCA-SX) and a combination of HCA-SX, niacin-bound chromium and Gymnema sylvestre extract in weight management in human volunteers: a pilot study. *Nutr Res.* 2004;24:45–58.
27. Amin KA, Kamel HH, Abd Eltawab MA. Protective effect of Garcinia against renal oxidative stress and biomarkers induced by high fat and sucrose diet. *Lipids Health Dis.* 2011;10:6.
28. Thom E. A randomized, double-blind, placebo-controlled trial of a new weight-reducing agent of natural origin. *J Int Med Res.* 2000;28:229–233.
29. Licata A, Minissale MG. Weight-loss supplementation and acute liver failure: the case of Garcinia cambogia. *Intern Emerg Med.* 2018;13:833–835.
30. Crescioli G, Lombardi N, Bettiol A, et al. Acute liver injury following Garcinia cambogia weight-loss supplementation: case series and literature review. *Intern Emerg Med.* 2018;13:857–872.
31. Sharma A, Akagi E, Njie A, et al. Acute Hepatitis due to Garcinia Cambogia Extract, an Herbal Weight Loss Supplement. *Case Rep Gastrointes Med.* 2018;2018:9606171.