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Beneficial effects of Apple Cider Vinegar on weight management, Visceral Adiposity Index and lipid profile in overweight or obese subjects receiving restricted calorie diet: A randomized clinical trial

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ABSTRACT

A randomized, clinical trial was performed to examine whether Apple cider vinegar (ACV) can result in dietary modifications that provides beneficial effects on the management of body weight and serum metabolic profiles in overweight or obese individuals. The participants (n = 39) were randomly allocated into the ACV (subjected to a restricted calorie diet (RCD) with 250 kcal/day energy deficit and 30 mL/d of ACV)) or the control group (RCD only) for 12 weeks. The ACV significantly reduced body weight, BMI, Hip circumference, visceral adiposity index (VAI) and appetite score ($P \leq 0.00$). Furthermore, Plasma triglyceride (TG) and total cholesterol (TC) levels significantly decreased and high density lipoprotein cholesterol (HDL-C) concentration significantly increased in the ACV group in comparison to the control group ($P \leq 0.05$). Thus, ACV along with RCD can be considered as an effective strategy for reducing anthropometric parameters, TG and TC level, VAI, appetite and increasing HDL-C concentration in overweight or obese individuals.

1. Introduction

Obesity has become a critical challenge worldwide in the recent decades and is associated with many public health problems such as dyslipidemia, cardiovascular disease, and type 2 diabetes (Al-Kuraishy & Al-Gareeb, 2016; Health, 2000). The most effective strategies for the management of obesity are energy intake restriction, increased physical activity, behavioral modifications, pharmacotherapy, and bariatric surgery (Health, 2000). Unfortunately, these treatments have had a maximum success rate of only 21% (Wing & Hill, 2001).

Traditional and complementary medicine is becoming more popular worldwide generally due to fewer side effects (Ajaykumar, Anandarajagopal, Jainaf, Venkateshan, & Ananth, 2012). Apple cider vinegar (ACV) is widely used as a flavoring (or dressing) and preservative in foods. In addition, ACV is a traditional natural treatment that has two main active constituents including acetic acid (Kondo, Kishi, Fushimi, Ugajin, & Kaga, 2009) and polyphenolic compounds (Denis et al., 2013). Recently ACV has attracted a lot of interest for its beneficial effects on controlling body weight and visceral fat accumulation (Kondo et al., 2009). So far, a few animal studies and clinical trials have been performed investigating the effects of ACV on anthropometric measurements, body composition and plasma lipids. Some of these studies show that vinegar administration has favorable effects on anthropometric parameters especially body weight regulation (Kondo et al., 2009; Lim et al., 2009; Ok et al., 2013; Seo et al., 2014), whereas others did not find these effects (Lee et al., 2013; Park et al., 2014). In addition, the effects of vinegar on lipid parameters were contradictory in the previous studies (Kondo et al., 2009; Ok et al., 2013; Park et al., 2014; Seo et al., 2014). Furthermore, based on the current evidence, there is a general lack of research investigating the effects of ACV on plasma concentrations of neuropeptide-Y (NPY) which is the most potent orexigenic peptide, regulating food intake (Tatemoto, 2004). Moreover, it seems that evaluating the visceral adiposity index (VAI) is a beneficial marker determining adipose tissue dysfunction, in regards to subcutaneous and visceral adipose tissue in the abdominal region (Al-Kuraishy & Al-Gareeb, 2016). Therefore, the present study aimed to evaluate the impact of ACV along with restricted calorie diet (RCD) on the anthropometric measurements, body

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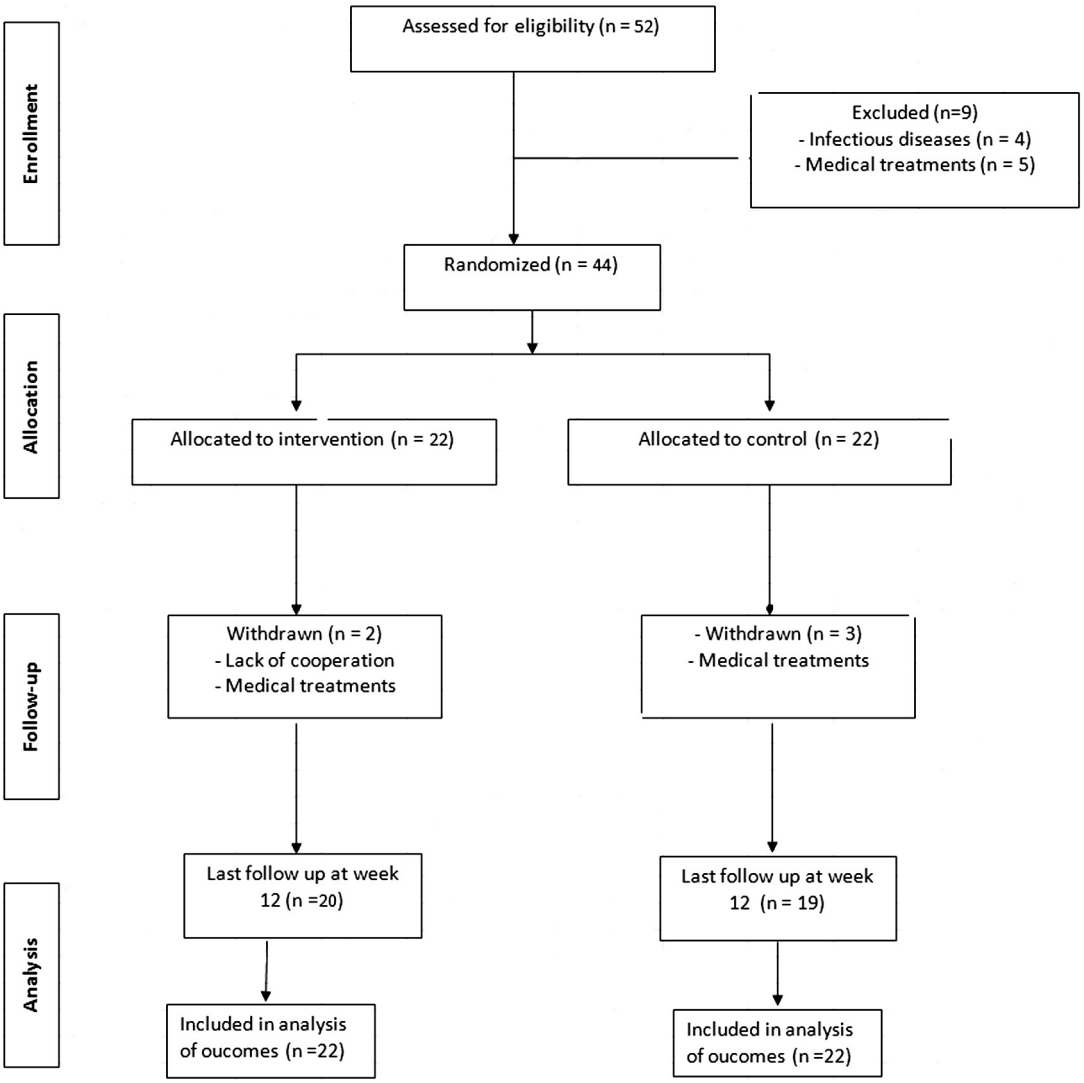

Fig. 1. Summary of the patient flow diagram.

Table 1
Baseline characteristics of subjects in ACV and control groups.

Characteristics	Control	ACV	*P* value**
Age (years)*	45 ± 11	42.5 ± 9	0.69
Sex (n/%)			
Male	3 (16)	4 (20)	0.43
Female	16 (84)	16 (80)	
Past experiences with weight-reducing treatment (n/%)	11 (58)	14 (70)	0.30

* Values are mean ± SD.
** $p < .05$ considered significant.

composition, VAI, plasma lipids, NPY, and appetite in overweight or obese individuals.

2. Methodology

2.1. Subjects and ethical aspects

A randomized, controlled trial conducted from October to December 2014, this study was not blinded as the subjects in the ACV group were aware of the nature of the samples due to the strong odor and taste. No odor masking techniques were used as the control group were only subjected to the RCD. In this two-arm parallel study with 9 kg difference detection and a pooled standard deviation of 9.8 kg (Kondo et al., 2009), the minimum sample size was estimated 19 at a power $(1 - \beta)$ of 80% ($\alpha = 0.05$). Forty-four metabolically healthy overweight or obese adults (men and women) with the body mass index (BMI) of more than 27 kg/m^2 (range 27–40) were selected using convenience sampling from the Specialized Clinic of Nutrition & Diet Therapy located in the Faculty of Nutrition Sciences and Food Technology of Shahid Beheshti University of Medical Sciences in Tehran, Iran.

Subjects enrolled in this study did not have infectious diseases, thyroid disorders, diabetes, or gastrointestinal diseases. In addition, patients who had regularly used ACV within one month prior to the beginning of the study were excluded.

The guidelines of the Helsinki Declaration was applied in this study and the Ethics Committee of the National Nutrition and Food Technology Research Institute of Iran has approved all proceedings. This clinical trial was registered at Iranian Registry of Clinical Trials (IRCT) under IRCT2013122815968N1.

2.2. Protocol

The Research Committee of the National Nutrition and Food Technology Research Institute of Iran has approved this study protocol. Informed consent was signed by all subjects before initiation of the