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The effect of oral supplementation of cinnamon on weight loss and blood pressure in patients with type 2 diabetes: a randomized clinical trial

Tayebe Zamani, Fatemeh Esmaeli Shahmerzadi, Rasole Zarrin

Department of Nutrition, School of Medical Science, Urmia University of Medical Sciences, Urmia, Iran

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Objectives: Cinnamon, as a flavoring additive and a drug in traditional medicine, has a long history. Today, several studies have been carried out on the effects of cinnamon on blood glucose, obesity, and hypertension in type 2 diabetic patients. The aim of this study was to determine the effect of cinnamon powder on weight loss and blood pressure in patients with type 2 diabetes.

Materials and Methods: This study was a randomized double-blind clinical trial conducted for 3 months on 81 patients with type 2 diabetes from the city of Maku, Iran. Patients were randomly divided into 3 groups receiving (a) two 500-mg cinnamon capsules (n = 27), (b) four 500-mg capsules (n = 28), and (c) placebo (n = 26). The biochemical parameters, systolic and diastolic blood pressure, height, weight, waist circumference (WC), body mass index (BMI), and body fat and lean mass were measured at the beginning and end of the study. Data analysis was performed using SPSS 16 software.

Results: The mean age of participants was 51.73 ± 6.40 years. Weight, BMI, and WC decreased significantly following the intervention in the group receiving the higher dose of cinnamon supplementation (p = 0.009). Statistically significant differences were also observable among the 3 groups in weight (p = 0.03), BMI (p = 0.02), WC (p = 0.02), fat mass (p = 0.03), and lean mass (p = 0.04) after the intervention. There was no significant difference in systolic and diastolic blood pressure between preintervention and postintervention values.

Conclusion: This study showed that supplementation with dietary cinnamon powder in type 2 diabetic patients significantly decreases weight, BMI, WC, and body fat and increases lean mass.

Introduction

Type 2 diabetes is a progressive metabolic disorder which is known as the most common metabolic dysfunction. According to 2014 estimates, the number of people with diabetes was 387 million, with 4.9 deaths attributable to diabetes, worldwide. By 2035, that number is projected to skyrocket to 592 million [2]. The prevalence of diabetes in Iran was 7.9% in 2010, which increased to 11.4 % in 2014. The main characteristic of this disease is high blood glucose due to insufficient insulin secretion, decreased sensitivity of peripheral cells to insulin, or a combination of them. Type 2 diabetes is a complex situation that increases the risk of cardiovascular disease, retinopathy, chronic liver and kidney diseases, cancer, and many chronic diseases [1].

Owing to the chronic and progressive nature of

Corresponding author:
Rasole Zarrin, Associate Professor of Nutrition, Urmia University of Medical Sciences, Urmia, Iran
Tel: +98 44 3223 4897 Fax: +98 44 322 290 59
Email: wwzarrin@yahoo.com
Address: Orjhans Street, Resalat Blvd, Urmia, Iran (Postal Code: 571478334)
University Campus: Pardis Nazlou, 11 km of Nazlou Road, Urmia, Iran

diabetes and its association with many chronic diseases, a substantial economic burden is placed on diabetic patients, their families, and health care system, imposed by the direct and indirect costs of diabetes [3]. A study of Iranian diabetic patients found that the direct medical costs of diabetes for 2.5 million patients exceeded $4.05 billion per year [4]. Therefore, the early detection and control of diabetes through lifestyle modifications including diet, exercise, and proper medication not only can control blood glucose but also contributes to longevity and quality of life of diabetic patients by delaying the progress of diabetes complications.

Cinnamon, a word of Greek origin meaning sweet wood, is extracted from the stem of an Asian tree species called *Cinnamomum zeylanicum* in the family Lauraceae. There are generally two types of cinnamon tree: true Ceylon cinnamon (*Cinnamon zeylanicum* Blume) that grows in Sri Lanka and southern India, and cassia (*Cinnamomum aromaticum* Ness) which is native to China, Indonesia, and Vietnam [8]. Cinnamon has a long history of use as a flavoring for food and also as a medicine in traditional medicine among the Egyptians and Chinese. Cinnamon has been found to have antioxidant, antibacterial, anti-inflammatory, and fever-reduction properties and is also effective in tissue regeneration and treatment of colds, cardiovascular diseases, chronic gastrointestinal diseases, sore throat, abdominal cramps, intestinal spasms, nausea, bloating and diarrhea [9, 10].

Clinical trials showed that short-term use of cinnamon was effective in reducing blood pressure in diabetic patients, and it also decreased appetite and serum levels of ghrelin through affecting transient receptor potential ankyrin 1 (TRPA1) in mice [11, 12].

Because of the potential effects of cinnamon on weight loss, improved glucose tolerance, and increased insulin level in mice [12], and the limited studies on the effects of cinnamon on diabetic patients parameters, this study aimed to investigate the effect of oral supplementation of cinnamon on weight loss and blood pressure in patients with type 2 diabetes.

Methods and Materials:

In a randomized double-blind clinical trial, 315 patients with type 2 diabetes who had medical records in public and private outpatient clinics of the city of Maku, Iran, were assessed for eligibility for inclusion in the study. Patients aged 30 to 65 years with a type 2 diabetes history of at least 2 years who were treated either with diet or metformin and glibenclamide were enrolled in this study. Exclusion criteria were (a) receiving insulin therapy; (b) having obstructive coronary artery diseases, kidney disease, or thyroid dysfunction; (c) being allergic to cinnamon; (d) being pregnant or lactating; (e) smoking or using alcohol or drugs; (f) taking cholesterol- or blood pressure–lowering medications; or (g) irresponsibly changing the type or dose of medications. After providing the patients with information about the study and its implementation, the consent form was obtained from the patients.

Ninety of the 315 patients were selected according to inclusion and exclusion criteria and randomized into 3 groups including a group receiving a high dose of cinnamon (HDC), a group receiving a low dose of cinnamon (LDC), and a placebo group. The HDC group received four cinnamon capsules, and the LDC took two cinnamon capsules per day. (Each capsule contained 500 mg of cinnamon.) The placebo group received capsules containing wheat flour, which were quite similar to cinnamon capsules in size and appearance.

Cinnamon supplements were supplied by Mahdaru pharmaceutical company with health certificate No. 93-262. All participants were asked to avoid any variation in their lifestyle including diet and medication during the study. The study duration was 3 months. The participants were instructed how to complete the dietary recall questionnaire at the baseline of the study. At the beginning and end of the study, daily dietary intakes data and daily physical activity were assessed using a 24-hour dietary recall for 3 days (two normal days and a holiday) and the International Physical Activity Questionnaires-short form, respectively.

The capsules containing the cinnamon powder and placebo were placed in identical packages labeled as A, B, or C so that neither patients nor researchers were aware of which medication was being administered. During the study, 3 patients in the LDC group, 2 patients in the HDC group, and 4 patients in the placebo group were excluded due to gastrointestinal side effects, unwillingness to continue the study, and traveling. The flowchart of sample selection and assignment of the three groups is shown in Figure 1. Anthropometric data and blood pressure were measured in all the 3 groups at baseline and the end of the study.

Body weight was measured before breaking an overnight fast and after emptying the bladder, with participants wearing light clothing and no shoes, using a digital scale (Seca 725; seca, GmbH & Co. KG., Germany) to the nearest 0.5 kg. Measuring height was done using a wall-mounted stadiometer (seca, GmbH & Co. KG., Germany) with participants wearing no shoes and standing erect on the horizontal platform with their head, shoulders, hips, and heels against the wall. Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2).

Information on body composition including fat

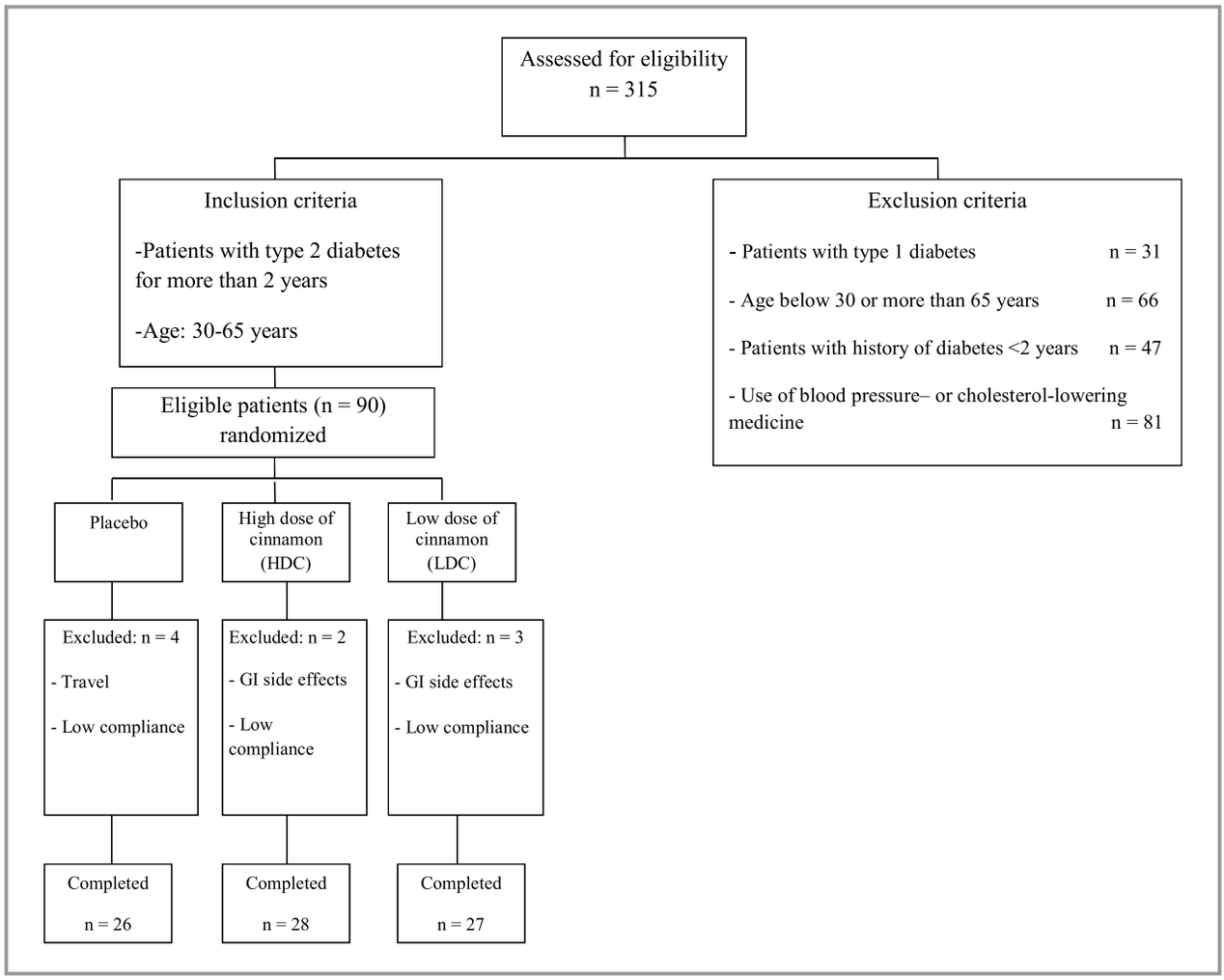

Figure 1. Flow diagram of the study design

mass and lean body mass were provided by bioelectric impedance analysis using an In Body R20 unit (Made in Korea). Patients were required to avoid intense physical activity, heavy meals, coffee, alcohol, drug, drinks, and smoking for at least half an hour before measurement of blood pressure. Also, the patients should not be fasting for a long time (over 14 hours).

Blood pressure for each person was measured by a physician using a standard, calibrated, mercury manometer (Iran Easy Life International Trading Co. Ltd.). The first and fifth sounds of Korotkoff were considered as the systolic and diastolic blood pressure, respectively. Two blood pressure measurements were obtained for each participant at intervals of at least 30 seconds. Blood pressure for each patient was measured in a sitting or lying position on an angiography bed provided that the patient had rested for 15 minutes.

Blood samples (10 mL) were obtained after 12 hours of fasting, while the patient was sitting on the seat, by a qualified nurse. To prepare serum, the blood samples were placed for 10 temperature, then centrifuged at 3000 rpm for 10 minutes at room minutes and then the serum was separated from the plane tube without anticoagulant. Fasting blood glucose was measured with glucose oxidase enzyme (GOx) method using a Hitachi 911 Automatic Analyzer (Boehringer Mannheim, Indianapolis, IN, US), and hemoglobin A1c was measured using ion exchange chromatography (Biosystem S.A, Barcelona, Spain).

Dietary data and the average dietary intakes were extracted and analyzed using Nutritionist IV software. All statistical tests were performed using SPSS version 16. Quantitative variables were reported as the means and standard deviations (SD) and qualitative variables were expressed as numbers and percentages. The pair-samples t test was used to compare the measurements from before and after the intervention. Also, one-way ANOVA was used to compare the mean changes among the three groups. P values less than 0.05 were considered statistically significant. The present study was approved by the Ethics Committee of Urmia University of Medical Sciences and registered with Iranian Registry of Clinical Trials (registration number IRCT2013061613678N1).

Results

Data from 81 patients were used in the final analysis. Table 1 presents the demographic characteristics of the participants in the study. Of 81 patients, 18 (22.2 %) and 63 (77.8 %) were men and women, respectively. Twenty-seven patients received low-dose cinnamon, 28 high dose, and 26 patients were in the placebo group. Table 2 shows the average systolic and diastolic blood pressure and anthropometric data including weight, height, BMI, and waist circumference (WC) before and after supplementation with cinnamon powder. Table 3 demonstrates the dietary energy and macronutrients intake of participants in the treatment and control groups at the baseline and after 3 months of supplementation with cinnamon.

As shown in Table 2, weight, BMI, and WC in both LDC and HDC groups decreased after the intervention compared with preintervention values ($p < 0.05$). Reduction in BMI was in the threshold of significance level in the LDC group ($p = 0.05$) and significant in the HDC group ($p = 0.009$).

Waist circumference demonstrated a statistically significant decrease in both LDC and HDC groups compared to before the intervention ($p < 0.001$). As shown in Table 2, comparing the mean changes in the variables confirms significant changes in weight, BMI, WC, body fat, and lean body mass. However, the systolic blood pressure in group 2 reduced significantly, whereas the diastolic blood pressure did not change significantly. Table 3 shows that there was no significant change in energy and macronutrients intake among the 3 groups.

Discussion

The findings of this study showed that supplementation with a low (two 500-mg capsules) and a high dose (four capsules) of cinnamon had a significant effect on BMI and WC in patients with type 2 diabetes compared with the placebo group. Although the mean body weight reduced in both the groups receiving cinnamon powder, this reduction was not statistically significant. To the best of our knowledge, this study was the first to be conducted on the effects of oral cinnamon powder on anthropometric measures and blood pressure in patients with type 2 diabetes in Iran. A number of studies have investigated the effects of cinnamon on weight loss. Liu Y et al reported that supplementation with 1.2 g of cinnamon per day for 4 months in 62 patients with fasting plasma glucose between 5.55 and 7.00 mmol/L and a mean BMI of ≥ 25 kg/m^2 had no significant effect on body weight loss but significantly reduced the percentage of lean body mass compared with placebo ($p = 0.02$) [13]. In another study on patients with impaired fasting glucose, 12 weeks of supplementation with cinnamon (500 mg daily) improved body composition and increased lean body mass by 1.4 kg [14]. Another study showed that daily administration of cinnamon (3 grams) for 8 weeks was significantly associated with reduced body fat mass in patients with type 2 diabetes [15]. Couturier et al suggested that, in animals fed a high fat/high fructose diet to induce insulin resistance, cinnamon alters body composition in association with improved insulin sensitivity [15].

Body weight is one of the main risk factors for diabetes, diabetic complications, and insulin resistance, and—as a controllable risk factor—its role in the prevention and control of type 2 diabetes is well known. A slight reduction in body weight, even if it doesn't lead to the desired weight, is associated with a significant decrease in the body's glycemic index. In addition, a small amount of weight loss appears to benefit body fat and lean mass. Some studies have shown that lean body mass contributes to the preservation of basal metabolic rate, body temperature, muscle contraction, muscle strength, body functional capabilities, and the prevention of sarcopenia in the long term [16,17]. Since muscles are the main tissues sensitive to insulin in the body, a large muscle mass can play a significant role in improving insulin resistance in patients with type 2 diabetes or those at risk of diabetes [18].

Our study confirmed the loss of body fat mass and gain of body lean mass in type 2 diabetic patients in the LDC group (1 gram per day), which was statistically significant. Also, a significant reduction in body fat mass was reported in patients in the HDC group (2 grams per day). Previous research has shown that cinnamon extracts can activate glycogen synthase, stimulate glucose uptake, and inhibit glycogen synthase kinase 3β. Collectively, these effects, combined with the slight increase in total energy intake, may have led to the observed increases in lean mass in the cinnamon groups [19].

Another finding of the present study was the effect of supplementation with cinnamon powder on systolic and diastolic blood pressure, which was associated with reduced systolic and diastolic blood pressure. However, such a reduction was only statistically significant for systolic blood pressure in the HDC group. In a study on 59 patients with type 2 diabetes, it was shown that daily intake of 1200 mg of cinnamon for 12 weeks reduced systolic blood pressure by an average of 3.4 mm Hg [20]. In line with the results obtained in this study, a systematic review aimed to assess the impact of short-term use of cinnamon on blood pressure in prediabetic and diabetic patients showed that cinnamon reduced systolic and diastolic blood pressure by 5.39 mm Hg (95% CI, 3.89-6.89) and 2.6 mm Hg (95% CI, 0.66-4.53), respectively. Although it has been strongly suggested that cinnamon intake can lower blood

pressure, more studies are still needed to establish recommended values for lowering blood pressure [11]. Wainstein et al suggested that cinnamon plays a role in lowering blood pressure and glycemic index through activating PPAR receptors and inhibiting the formation of glycation end products [21]. Cinnamon contains compounds such as catechins, epinephrine, procyanidin B2, and phenolic polymers that can be effective in inhibiting the formation of glycation end products [22].

The strengths of our study were its randomized clinical trial design and using two doses of 1000 and 2000 mg cinnamon for diabetic patients. However, sex-based difference in the study was one of the study limitation while judging the BMI in men and women.

Conclusion:

This study showed that supplementation with dietary cinnamon powder in type 2 diabetic patients significantly decreases weight, BMI, WC, and body fat, and increases the lean mass. It is recommended that further studies using different species and doses of cinnamon be conducted to evaluate its prophylactic effects in patients who have recently been diagnosed with diabetes and its controlling role in patients living with diabetes and its complications.

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