Available online at www.sciencedirect.com
ScienceDirect
Metabolism Clinical and Experimental 56 (2007) 1149 – 1158
Metabolism
Clinical and Experimental
www.elsevier.com/locate/metabol

Effect of adding exercise to a diet containing glucomannan

William J. Kraemer[a,b,*], Jakob L. Vingren[a], Ricardo Silvestre[a], Barry A. Spiering[a], Disa L. Hatfield[a], Jen Y. Ho[a], Maren S. Fragala[a], Carl M. Maresh[a,b], Jeff S. Volek[a]

[a]*Department of Kinesiology, Human Performance Laboratory, University of Connecticut, Storrs, CT 06269, USA*
[b]*Department of Physiology and Neurobiology, University of Connecticut, Storrs, CT 06269, USA*

Received 25 September 2006; accepted 30 April 2007

Abstract

The aim of this study was to examine the effect of adding a total-body exercise program to an 8-week diet supplemented with glucomannan on weight loss, body composition, blood parameters, and physical performance in overweight men and women. Sedentary men and women who were overweight (body mass index >25 kg m^{-2}) (men: 18-57 years, 27.0 ± 11.2 years, 177.5 ± 7.6 cm, 102.4 ± 14.9 kg; women: 18-52 years, 33.4 ± 12.1 years, 160.6 ± 4.6 cm, 79.9 ± 9.3 kg) completed an 8-week diet with 3000 mg glucomannan combined with either no exercise (No-Ex) (10 men, 10 women) or a resistance and endurance exercise training program (Ex) (12 men, 10 women). The diet emphasized healthy food choices and portion size control. The exercise training consisted of 3 weekly sessions of approximately 1 hour of a nonlinear periodized total-body resistance exercise program followed by 30 minutes of endurance exercise. After the intervention, there were reductions ($P < .05$) in body mass (men, −2.7 ± 1.4 and −3.0 ± 4.0 kg; women, −2.2 ± 1.5 and −3.3 ± 1.5 kg; No-Ex and Ex, respectively), fat mass (men, −2.3 ± 1.6 and −3.9 ± 2.5 kg; women, −2.6 ± 1.4 and −3.6 ± 1.1 kg; No-Ex and Ex, respectively), total cholesterol (TC) (men, −17.9 ± 21.5 and −18.8 ± 19.4 mg dL^{-1}; women, −9.3 ± 20.0 and −10.1 ± 19.5 mg dL^{-1}; No-Ex and Ex, respectively), and low-density lipoprotein cholesterol. Exercise significantly improved high-density lipoprotein cholesterol (HDL-C) (No-Ex, −2.0 ± 4.7 and −2.3 ± 4.5 mg dL^{-1} vs Ex, 4.4 ± 10.8 and 1.6 ± 3.6 mg dL^{-1}; men and women, respectively), TC/HDL-C ratio, squat and bench press 1-repetition maximum, and distance covered during a shuttle-run test. In addition, exercise appeared to augment the reduction in fat mass (by 63% and 50%; men and women, respectively) and waist circumference, but did not affect total weight loss. Addition of a resistance and endurance exercise training program to a glucomannan diet regimen significantly improved measures of body composition, HDL-C, and TC/HDL-C ratio.

1. Introduction

A growing body of research supports beneficial health effects of dietary fiber, particularly soluble fibers, on weight loss [1,2], diabetes mellitus [3,4], and risk factors for cardiovascular disease [3,5-9]. The soluble fiber shown to have the greatest gel volume and viscosity properties is glucomannan [10], a viscous, water-soluble polysaccharide that is a natural constituent of *Amorphophallus konjac* (konjac root). A number of placebo-controlled studies have shown that relatively small amounts of glucomannan (1 to 4 g d^{-1}) enhance weight loss when part of a calorically restricted diet [1,11-14], even when no dietary guidance to restrict calories is provided [14-16]. Glucomannan appears to reduce appetite because of its powerful bulk-forming properties in the stomach. When taken with meals, glucomannan decreases the rate by which food exits the stomach and enters into the intestines for absorption. This reduces the rate of absorption of nutrients, decreases the glucose and insulin response to meals by as much as one half [17,18], and promotes satiety [13].

Glucomannan also has cholesterol-lowering effects [3,5,7-9,14,15,19-21]. The hypocholesterolemic effects of glucomannan are evident with small doses (<4 g d^{-1}) and have been observed in a variety of healthy and clinical populations. In a recent randomized, placebo-controlled, double-blind, crossover clinical trial in diabetic subjects, glucomannan (3.6 g d^{-1}) decreased low-density lipoprotein cholesterol (LDL-C) by 21% and improved the total cholesterol (TC) to high-density lipoprotein cholesterol

* Corresponding author. Tel.: +1 860 486 6892; fax: +1 860 486 6898.
E-mail address: william.kraemer@uconn.edu (W.J. Kraemer).

0026-0495/$ – see front matter © 2007 Elsevier Inc. All rights reserved.
doi:10.1016/j.metabol.2007.04.010

(HDL-C) ratio by 16% [3]. The mechanism for this potent lipid-lowering effect of glucomannan appears to be via interference with intestinal cholesterol absorption [7] as well as enhanced cholesterol loss caused by increased fecal bile and neutral sterol excretion [3].

Exercise induces favorable alterations in body composition [22], blood lipids [23], and physical performance [22,24]. Exercise also amplifies the positive effects of a dietary weight loss program [25,26]; thus, it is important to consider the impact of adding a total-body exercise program to a glucomannan-supplemented hypocaloric diet. The purpose of this study was to examine the effect of adding a total-body exercise program to an 8-week diet program with glucomannan supplementation on weight loss, body composition, blood lipid parameters, and physical performance in overweight men and women. A secondary purpose was to examine potential sex differences to the 8-week intervention.

2. Methods

2.1. Experimental design

Forty-two men (n = 22) and women (n = 20) who were sedentary and overweight (body mass index [BMI] >25 kg m^{-2}) successfully completed one of two 8-week experimental conditions: (1) a diet with glucomannan with no exercise (No-Ex) or (2) a diet with glucomannan combined with a resistance and endurance exercise training program (Ex). Each participant ingested 1500 mg of glucomannan before each of the 2 largest meals every day for 8 weeks. The diet promoted an emphasis on healthy food choices and portion size control. The exercise training involved 3 weekly sessions consisting of about 1 hour of a nonlinear periodized total-body resistance exercise program followed by 30 minutes of cardiovascular endurance training. The exercise program was a typical total-body conditioning program. Body mass, body composition, maximal strength, cardiovascular endurance, blood lipids, and metabolic markers were measured before and after the 8-week intervention.

2.2. Participants

Participants (men: 18-57 years, 27.0 ± 11.2 years, 177.5 ± 7.6 cm, 102.4 ± 14.9 kg; women: 18-52 years, 33.4 ± 12.1 years, 160.6 ± 4.6 cm, 79.9 ± 9.3 kg) were matched on sex, age, body mass, percent (%) body fat, BMI, and maximal strength and subsequently randomly assigned to either the No-Ex (10 men, 10 women) or Ex (12 men, 10 women) group. To be considered eligible for the study, participants had to be (1) overweight (BMI >25 kg m^{-2}), (2) sedentary, (3) nonsmokers, and (4) not taking any medication or supplements known to influence blood lipid or cholesterol profiles during the 6 months before the study. In addition, participants were medically screened to ensure that they were free from cardiovascular, gastrointestinal, metabolic, endocrine, or orthopedic limitations. Subjects were considered sedentary when they reported via a questionnaire to not engage in any exercise or moderate- to high-intensity physical activity more than 1 hour a week. All participants were asked to maintain their previous physical activity level throughout the duration of the study. The study was approved by the University of Connecticut Institutional Review Board; all participants were informed of potential risks and gave written informed consent to participate before the start of the study.

2.3. Testing

Participants reported to the laboratory in the morning after a 12-hour overnight fast and 36 hours of abstaining from physical activity, alcohol, and caffeine. The posttraining test day was separated from the last training day by at least 72 hours to avoid transient short-term effects from the exercise bout. Upon arrival, anthropometric measurements and a blood sample were collected. The participants then had a small breakfast that was standardized for each participant for the testing day before and after the 8-week intervention. The participants then performed the strength tests followed by the cardiovascular endurance test.

2.4. Anthropometric measurements

Height was measured to the nearest 0.1 cm, waist circumference on the skin at the height of the navel to the nearest 0.5 cm, and total body mass to the nearest 0.1 kg on a digital scale (OHAUS, Florham Park, NJ). Participants were nude or wearing only underwear for measurements of body mass. Whole and abdominal body composition (% body fat, fat mass, lean body mass, and bone mass) were assessed using fan-beam dual-energy x-ray absorptiometry (Prodigy, Lunar, Madison, WI). Total body and regional abdominal tissue were assessed using anatomic landmarks as regional borders (lumbar vertebrae 2 and 4 for abdominal tissue) using computer algorithms (enCORE version 6.00.270). Coefficients of variation for lean body mass, fat mass, and bone mineral content on repeat scans with repositioning on a group of men and women by the technician in our laboratory were 0.4%, 1.4%, and 0.6%, respectively. Each anthropometric measurement was performed by the same technician for all participants before and after the 8-week intervention.

2.5. Blood collection

Participants fasted for 12 hours and abstained from exercise for 36 hours before the blood collection, which was performed in the morning from 6:00 AM to 9:00 AM at the same time of day before and after the 8-week intervention for each participant. Upon arrival to the laboratory, participants rested quietly for 15 minutes in the supine position after which a blood sample (10 mL each for serum and EDTA plasma) was obtained by venipuncture of an antecubital vein. Blood was then centrifuged at 1500*g* for 15 minutes at 4°C and resultant serum or EDTA plasma was divided into several aliquots and stored at −80°C until analysis.