



## Effects of mild calorie restriction and high-intensity interval walking in middle-aged and older overweight Japanese

Jinko Sawashita<sup>a,\*</sup>, Sayaka Onitsuka<sup>b,c</sup>, Hirokazu Gen-no<sup>b,c</sup>, Shinobu Ishikawa<sup>d</sup>, Fumie Iino<sup>e</sup>, Norihiko Tateishi<sup>e</sup>, Takeo Murakami<sup>e</sup>, Yoichi Seki<sup>e</sup>, Toshiyuki Nagaiwa<sup>d</sup>, Masaaki Hanaoka<sup>d</sup>, Sumio Hama<sup>f</sup>, Hiroshi Nose<sup>b,c</sup>, Keiichi Higuchi<sup>a</sup>

<sup>a</sup> Departments of Aging Biology, Institute on Aging and Adaptation, Shinshu University Graduate School of Medicine, 3-1-1 Asahi, Matsumoto 390-8621, Japan

<sup>b</sup> Departments of Sports Medical Science, Institute on Aging and Adaptation, Shinshu University Graduate School of Medicine, 3-1-1 Asahi, Matsumoto 390-8621, Japan

<sup>c</sup> Jukunen Taiiku Daigaku Research Center, 3-1-1 Asahi, Matsumoto 390-8621, Japan

<sup>d</sup> Softmedia Technology Laboratory, Kissei Comtec Co., Ltd., 4010-10 Wada, Matsumoto 390-1293, Japan

<sup>e</sup> Medical Group, Sunny Health Co., Ltd., 1-6-6 Yaesu, Chuo-ku, Tokyo 103-0028, Japan

<sup>f</sup> Compass Co., Inc., 3-3-11 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

### ARTICLE INFO

#### Article history:

Received 12 March 2009

Received in revised form 31 May 2009

Accepted 22 July 2009

Available online 26 July 2009

#### Keywords:

BMI

High-intensity interval walking

Hypertension

Medical expenditures

Mild calorie restriction

### ABSTRACT

We investigated whether a combination of mild calorie restriction (MCR) and high-intensity interval walking (HIW) improved physical fitness more than HIW alone in middle-aged and older overweight Japanese (40–69 years old, BMI  $\geq 23.6$  kg/m<sup>2</sup>). Forty-seven women and 16 men were divided into MCR + HIW and HIW groups. All subjects performed HIW:  $\geq 5$  sets of 3-min low-intensity walking (40% peak aerobic capacity for walking, VO<sub>2peak</sub>) and 3-min high-intensity walking ( $\geq 70\%$  VO<sub>2peak</sub>) per day,  $\geq 4$  days per week, for 16 weeks while energy expenditure was monitored with a tri-axial accelerometer. The MCR + HIW group consumed meal replacement formula (240 kcal): a mixture of low-carbohydrates and -fat and high-protein, for either lunch or dinner everyday and therefore, had  $\sim 87\%$  of the energy intake of the HIW group during the intervention period. Although the HIW group showed improvements in BMI, blood pressure, and several blood chemicals, the MCR + HIW group had greater improvement. Moreover, the medical expenditure for the 6 months including the intervention period was 59% lower in the MCR + HIW group than in the HIW group. Our strategy of a short-term combination of MCR and HIW may thus prevent lifestyle-associated diseases and improve health in middle-aged and older overweight Japanese.

© 2009 Elsevier Inc. All rights reserved.

### 1. Introduction

In Japan, the number of overweight and obese middle-aged and older people has been increasing yearly (Kubo et al., 2003; Kuriyama et al., 2004), accompanied by an increased incidence of metabolic syndromes such as hypertension, type II diabetes, hyperlipemia, and atherosclerosis (Ishikawa-Takata et al., 2002; Hasegawa et al., 2005; Zhang et al., 2005; Shiraishi et al., 2006; Arai et al., 2006). Indeed, it has been suggested that the risk for incidence of metabolic syndrome is increased in Japanese people with a BMI above 25.0 kg/m<sup>2</sup> (Matsuzawa et al., 2000; Japan Society for

*Abbreviations:* CR, calorie restriction; fGlc, fasting plasma glucose; HDL-C, HDL-cholesterol; HIW, high-intensity interval walking; HR<sub>max</sub>, maximal heart rate; MCR, mild calorie restriction; LDL-C, LDL-cholesterol; TC, total cholesterol; TG, triglycerides; VO<sub>2peak</sub>, peak aerobic capacity for walking.

\* Corresponding author. Tel.: +81 263 37 3392; fax: +81 263 37 3428.

E-mail address: [jinkos@shinshu-u.ac.jp](mailto:jinkos@shinshu-u.ac.jp) (J. Sawashita).

The Study of Obesity (JASSO), 2002), and, in fact, the annual medical expenditure among Japanese with BMI  $\geq 25.0$  kg/m<sup>2</sup> was reported to be higher than that of Japanese with BMI  $< 24.9$  kg/m<sup>2</sup> (Kuriyama et al., 2002). This may be a result of recent increased in westernized dietary habits and a sedentary lifestyle (Hawks et al., 2003; Watanabe et al., 2004; Arai et al., 2006; Maskarinec et al., 2006; Otsuka et al., 2006).

Calorie restriction (CR) and exercise training have been recommended as countermeasures against the development of overweight and obesity. CR has been suggested to have multiple beneficial effects, including increased physical fitness, vitality, and resistance to oxidative stress (Bluher et al., 2003; Cohen et al., 2004; Cox et al., 2004; Rodgers et al., 2005). Exercise has been suggested to significantly contribute to body weight control (Schoeller, 1998; Bhattacharya et al., 2005; Kretschmer et al., 2005; Kondo et al., 2006; Redman et al., 2007) as well as to increase physical fitness in obese animals and humans (Novelli et al., 2004; Rector et al., 2004; Albeck et al., 2006; Coutinho

et al., 2006; Huang et al., 2006), and moreover, combined treatment with CR and exercise has been suggested to be more effective in maintaining a low body weight with low fat deposition than CR alone (Couturier et al., 2004; Kretschmer et al., 2005).

However, several studies have not provided support for the merits of combined treatment, suggesting that the effects of combined exercise training and CR are not greater than the effects of either alone (Bryner et al., 1999; Cox et al., 2003; Colak and Ozcelik, 2004; Hioki et al., 2004; Nicklas et al., 2004; Giannopoulou et al., 2005). However, in nearly all of these studies were conducted using severely obese people with BMI  $\geq 30$  kg/m<sup>2</sup> who underwent high-intensity exercise training involving weight training, cycling, and running and severe CR with energy intake  $\leq 75\%$  of a standard diet (Colak and Ozcelik, 2004; Hioki et al., 2004; Nicklas et al., 2004; Giannopoulou et al., 2005), and lasting more than 6 months in western countries.

In Japan, it may be difficult for middle-aged or older overweight people to perform such high-intensity exercise combined with severe CR in their daily activity since this population requires medical supervision to avoid injuries during exercise and nutritional disorders during CR. Moreover, the population of highly obese people is only 2.0–3.0% of the total population in Japan (Yoshiike et al., 1998; Anuurad et al., 2003). Thus, it remains unknown whether mild exercise training combined with mild CR (MCR) is more effective in the prevention of lifestyle-associated diseases and deterioration of physical fitness than mild exercise training alone in middle-aged and older overweight people.

To examine this, we subjected subjects to MCR by replacing either regular lunch or dinner with a meal replacement formula with very low carbohydrate and fat content, and high-protein, and sufficient minerals and vitamins (Stordy, 1989; Bryner et al., 1999; Raghuvanshi et al., 2001; Miyashita et al., 2004), everyday, which has been suggested to improve physical fitness in middle-aged obese women (Okura et al., 2007). Also, we used high-intensity interval walking (HIW) as mild exercise training, which has been suggested to increase thigh muscle strength and peak aerobic capacity ( $VO_{2peak}$ ) by 10–20% with  $\sim 10$  and 5 mm Hg reductions in systolic and diastolic blood pressure, respectively, after 5-months of training whereas these changes were minimal after moderate-intensity continuous walking exercise training (Nemoto et al., 2007). Therefore, in the present study, we hypothesized that a combination of MCR and HIW training might be effective for improving physical fitness in overweight middle-aged and older people.

## 2. Subjects and methods

### 2.1. Subjects

We recruited middle-aged and older (40–69 years old), overweight and obese (BMI  $\geq 23.6$  kg/m<sup>2</sup>), female and male Japanese volunteers from the community based health promotion program Jukunen Taiiku Daigaku Program in Matsumoto. This program was organized to promote health and wellness for middle-aged and older people through HIW training since 2003. Although overweight for Japanese is categorized as  $23.0 \leq \text{BMI} < 25.0$  (kg/m<sup>2</sup>) (JASSO, 2002; Anuurad et al., 2003), we excluded subjects with BMI 23.0–23.5 kg/m<sup>2</sup> because we were concerned that we would have to stop CR in some MCR + HIW subjects with BMI 23.0–23.5 kg/m<sup>2</sup> when their BMIs decreased to the normal range of 18.5–22.9 kg/m<sup>2</sup> (JASSO, 2002; Anuurad et al., 2003) before the end point of the intervention.

### 2.2. Design

As shown in Fig. 1, to recruit subjects for the present study, we verbally explained to participants in the Jukunen Taiiku Daigaku

Program the protocol and significance of this study using an explanatory leaflet while hearing their medical history. The exclusion criteria were (1) presence of osteoarthritis, knee pain, or pregnancy; (2) current treatment with a low calorie diet; or (3) contraindications for an exercise program (stroke, serious hypertension, serious infectious disease, serious inflammation, type I diabetes, renal disease, or liver disease). After 2 more weeks, we obtained informed consent from the 80 subjects (60 females and 20 males) in the study in compliance with the Ethical Committee's Review Board on Human Experiments, Shinshu University School of Medicine.

Then, we measured height, body weight, blood pressure, pre-training  $VO_{2peak}$ , maximum heart rate ( $HR_{max}$ ), and isometric knee extension and flexion force, and took blood samples after an overnight fast with free access to water in all subjects within a few weeks after April 1, 2005. For blood biochemical parameters at baseline, we measured serum LDL-cholesterol (LDL-C), HDL-cholesterol (HDL-C), total cholesterol (TC), triglycerides (TG), and plasma glucose (fGlc) concentration.

After confirming that subjects were accustomed to HIW and had mastered the use of a tri-axial accelerometer (Jukudai Mate, Kissei Comtec, Matsumoto, Japan) for 2 weeks as described below, the 80 subjects were divided into smaller groups of 33 (24 females and 9 males) for the HIW group and 47 (36 females and 11 males) for the MCR + HIW group so as not to have any significant differences in the baseline between the groups.

After learning how to perform HIW and also how to record their daily diet and beverage intake in a diary provided by dietitians, all subjects started HIW training shortly after May 9 and continued for the subsequent 16 weeks. Subjects in the MCR + HIW group replaced either their lunch or dinner with a meal replacement formula every day. We received daily records of HIW training and food intake as recorded in the diaries from all subjects every 2 weeks when they visited a local community office to have their body weight and blood pressure measured as detailed below. Subjects were instructed to continue to take all the medications prescribed by their family doctors during the intervention.

Within 2 weeks after the end of the 16-week intervention in September, we measured isometric knee flexion and extension force and took blood samples again in all subjects. We also investigated total medical expenditure for the 6 months from April 1 to September 30, 2005 in 37 subjects (HIW, 17; MCR + HIW, 20) who were enrolled in the national health insurance system.

### 2.3. Measurements

#### 2.3.1. Blood pressure

Blood pressure was measured by nurses using the auscultation method after a 10-min rest in a sitting position at  $\sim 25$  °C room temperature.

#### 2.3.2. Knee force

Isometric knee extension and flexion force was measured on the dominant leg with an isometric force meter (Isoforce GT330, OG Giken, Okayama).

#### 2.3.3. $VO_{2peak}$

Before HIW training, we determined pre-training  $VO_{2peak}$  with a graded walking exercise (Nemoto et al., 2007). Subjects were equipped with the accelerometer on the midclavicular line of their left- or right-side waist. After 3 min of baseline measurements were made at rest, subjects walked for 3 min on a flat floor at 3 graded subjective velocities (slow, moderate, and fast) while 3-dimensional acceleration and heart rate were recorded.  $VO_{2peak}$  and  $HR_{max}$  were adopted as the averages for the last 30 s of 3-min maximal walking velocity. The square root of summed

Download English Version:

<https://daneshyari.com/en/article/1906846>

Download Persian Version:

<https://daneshyari.com/article/1906846>

[Daneshyari.com](https://daneshyari.com)