

Short-Term Sprint Interval Training Improves Systolic and Diastolic Blood Pressure in Sedentary Overweight Women

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Abstract: *Sprint Interval Training (SIT) has become one of the time-efficient training protocol which capable to improve fitness and health-related measures in healthy as well in overweight individual. The aim of this study was to determine the effects of short term SIT on body mass index (BMI), total body fat percentage, resting heart rate and blood pressure in overweight sedentary women. Eleven women (aged 20.64 ±0.81 years; body mass index, 30.17 (±3.97) kg/m²) participated in this study. After baseline measurement of BMI, total body fat percentage, resting heart rate and blood pressure, participants completed a 2-week SIT intervention, comprising 6 session of 4 to 6 repeats of 30-second Wingate anaerobic sprints protocol on an electromagnetically braked cycle ergometer, with 4-minute recovery time between each repetition. The BMI, total body fat percentage, resting heart rate and blood pressure assessment were repeated as post-intervention. Significant decrease in systolic pressure (108 ± 9.1 vs 112.36 ± 12.5 mm Hg, P .04) and diastolic pressure (74.45 ± 6.4 vs 79.73 ± 10.5 mm Hg, P .03) were observed after the 2-week SIT intervention. No significant changes were found in BMI, total body fat percentage and resting heart rate. Thus, the 2-week of SIT improves both systolic and diastolic blood pressure in sedentary overweight women, highlighting the potential for this short-term intervention as an alternative exercise programme for the improvement the cardio metabolic health in overweight individual.*

Keywords: *short-term, sprint interval training, blood pressure, overweight*

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1. INTRODUCTION

The prevalence of overweight and obesity has become increasing year by year which contribute to a global health challenge [1]. There are various forms of exercise training have been reported which highlighting the potential to provide an alternative exercise model for the improvement of health related disorder in this population. The types of exercise protocol are ranging from prolonged aerobic exercise to short duration of high intensity of anaerobic training. Sprint interval training (SIT) is a form of low-volume, high-intensity progressive

exercise training that consists of four to eight all-out 30-s sprints with periods of active recovery between intervals and has been proposed as a time-efficient approach to induce physiological adaptations similar to more prolonged, moderate-intensity aerobic exercise [2-3]. Recent finding shows that by comparing with moderate-intensity continuous training (MICT), short-term-high intensity training intervention with 8 s of high-intensity interval cycling interspersed with 12 s of rest is a more time-efficient approach and is perceived as being easier for improving aerobic fitness and blood glucose in sedentary overweight and obese young women [4]. In addition, SIT also been thought to be more beneficial than MICT in improving insulin sensitivity in overweight [5] and become one of a time-metabolic efficient strategy in improving physical fitness of obese women [6]. To date, it has been demonstrated that short-term SIT has improves several cardiopulmonary and metabolic parameters in overweight and obese group, which includes improved insulin sensitivity, increased resting fat oxidation, reduced systolic blood pressure [7] and improved blood glucose [8].

Collectively, the purpose of this study was mainly to compare the effects of short-term (2 weeks) of SIT intervention on BMI, total body fat percentage, resting heart rate and the systolic and diastolic blood pressure in sedentary overweight women. We hypothesized that this short term-SIT intervention would be resulted in the improvements of body composition (eg. BMI and total body fat percentage) as well as the heart rate and blood pressure.

2. EXPERIMENTAL, MATERIALS AND METHODS

The inclusion criteria includes, being sedentary or inactivity (defined as participating in <1 hour/week of structured exercise) and having BMI over 23 kg/m². Volunteers who are interested in the study and met the inclusion criteria were required to fill up the consent form and a brief medical history questionnaire for further eligibility screening. The final subjects included 11 participants (n=11 female), aged 20.64 ±0.81 years; height, 154.74±3.75 cm, weight, 72.27±10.01 kg and BMI 30.17 (±3.97) kg/m² (Table 1).

Table 1
Demographic Data

Variable	Mean ± SD	Range
Age (y)	20.64 ± 0.81	20 - 22

Weight (kg)	72.27 ± 10.01	61.1 – 92.6
Height (cm)	154.74 ± 3.75	150.6 – 162.6
BMI (kg/m ²)	30.17 ± 3.97	25.4 – 37.3

2.1 Study design

This study was conducted as quasi-experimental which consist of pre- and post-test. The 11 participant were assessed their anthropometric, total fat percentage, resting heart rate blood pressure for baseline (pre-test) and after SIT-intervention (post-test). The first visit to the laboratory involved basic anthropometric measurements and familiarization with the exercise tests (Wingate anaerobic test on a cycle ergometer). Within 1 week of the baseline testing session, the participants commenced the 2-week SIT intervention which consist of 3 times/week session. The post-intervention measurement were taken approximately within 24 hours after final training session. Throughout the 2-week SIT intervention, participants were encouraged to continue their normal diet and maintain their typically sedentary lifestyle.

2.2 Anthropometric assessment

The weight, height, BMI and total body fat percentage were assessed using non-invasive Body Composition Analyser (InBody 370; USA).

2.3 Blood pressure and resting heart rate measurement

Prior to obtaining blood pressure and resting heart rate measurements, all participants were sat quietly for 5 min with both arms in a forward position, on a flat table surface. Systolic and diastolic blood pressure and resting heart rate were measured using a digital automated blood pressure monitor (Omron M10-IT, Japan).

2.4 Sprint Interval Training (SIT) protocol

The SIT protocol was conducted based on Wingate anaerobic test which consist of six sessions (3 times/week; with 1 to 2 days recovery between each session) consisted of repeated 30-second of all-out against a high resistance (0.065kg per kg of FFM) by using cycle ergometer (Lode Corival V3) with a fixed recovery period of 4 minutes between each sprint. Each session was consist of 4 to 6 repetitions of sprints which increasing session by session as shown in Table 2. The cycle ergometer was connected with Lode Ergometry

Manager –LEM 10 software to control the speed and load of the cycling. Verbal encouragement were given to the subjects during each sprint.

Table 2

Number of repeated sprint for each SIT-session

Visit	Session	Repeated sprints
2	1	4
3	2	4
4	3	5
5	4	5
6	5	6
7	6	6

2.5 Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Science (SPSS) version 21. Differences between pre-test and post-test measurement were determined using One-Way Repeated ANOVA. Statistical significance was accepted at $P < .05$ level. Data are presented as mean \pm SD.

3. RESULTS AND DISCUSSION

Collectively, this study showed that 2-weeks of SIT resulted a markedly changes in both systolic and diastolic blood pressure but had no effects in the resting heart rate, BMI and body fat percentage in overweight women (Table 3). The duration of 2-week with 6 session of SIT seemly did not affected the body composition particularly the total body fat and body mass. Different protocols of SIT have been shown to significantly reduce body mass [9-10] and total or regional fat mass [11-12] in overweight and obese women. Previous meta-analysis concludes that SIT improves aerobic capacity in healthy, young people and SIT method presents an equally effective alternative with a reduced volume of activity [13]. On the other hand, low-volume of SIT was found to increase the feelings of vitality and perceptions of having fewer physical limitations among middle-ages women with metabolic syndromes [14].

Based on several recent studies, short-term SIT appears to be a very time-efficient mode of exercise training that shares many same metabolic adaptations or changes associated with traditional endurance exercise training [7, 15]. However, a study on sedentary obese men shows that 2 weeks of reduced-volume SIT did not elicit any metabolic or skeletal muscle adaptations [16].

Table 3

Body composition, resting heart rate and blood pressure measurement for baseline and post 2-week SIT intervention.

Variable	Baseline	Post-Intervention	<i>P</i> value
BMI (kg/m ²)	30.173	30.018	0.09
Body fat percentage (%)	44.873	45.491	0.135
Heart rate (bpm)	83.55	78.04	0.07
Systolic pressure (mmHg)	112.36	108.00	0.04
Diastolic pressure (mmHg)	79.73	74.45	0.03

3.1 BMI and total body fat percentage measurement

The 2-week SIT intervention did not change the BMI ($P=0.09$) and body fat percentage ($P=0.135$) (Table 3) in sedentary overweight women. This result may be explained by the facts of short duration of sprint interval training did not affected the body mass and total fat metabolism. This finding are consistent with the recent work by Rahim, Hamzah and Shalan (2018) [17], which demonstrated that 2-week SIT did not change the BMI, body fat percentage and waist-hip ratio in overweight men. Previous research also found that 5-week of HIIT-involve cycling resulted in an improvement in aerobic capacity but had no influence on fat mass or lean mass in the trunk or abdomen [4]. This view also been supported by a previous study which are using a reduced-volume and short term, 2-week SIT does not demonstrate any significant changes in BMI, body composition, fasting blood glucose and insulin in sedentary overweight men [16].

Data from recent studies suggested that although high-intensity training has been presented as a promising strategy relating to lipid metabolism [18-19] to our knowledge, a very limited study reported on the training effects of different protocols of high-intensity training on fat oxidation and energy contribution in obese women. Although recent work has examined metabolic adaptations in human subcutaneous adipose tissue following exercise

training [20-23], it remains unclear how intracellular pathways that modulate substrate storage and mobilization are altered in this tissue following an acute bout of high-intensity interval training.

A recent study on gene expression by Soltani et al. (2020) [24], shows that the 2-week combine HIIT decreased meta-inflammation genes level and improved insulin resistance independent of body composition changes, which may indicate a positive correlation between the changes on total body fat and body composition. On the other hand, finding by Hausswirth et al. (2019) [25], found that the 2-week SIT intervention in combination with a low-frequency ultrasound (LOFU), a non-invasive body-contouring technique that able to reduce fat mass through disruption of the cellular membrane of adipose tissue [26], provides an improvement in lipid profile, improves body composition and reduces body fat percentage in sedentary overweight women. Thus, we can assume that SIT can be further decreased the body total fat through the mobilization of free fatty acids from adipose tissue leading to greater losses in fat mass. Overall, based on the current findings, it appears that positive adjustment of the techniques, frequency or duration of SIT may be able to improve the BMI and total body fat in overweight population.

3.2 Blood Pressure and Resting Heart Rate

As shown in Table 3, the 2-week SIT intervention significantly decreases both systolic pressure (by 3.88%, $P=0.04$) and diastolic pressure (by 6.62%, $P=0.03$) in sedentary overweight women. This result was similar to the previous finding [7], which reported that 6 sessions of 2-week SIT was improved insulin sensitivity, increased resting fat oxidation, and reduced systolic blood pressure in overweight or obese men. In addition, in normotensive young men and women, longer duration intervals performed on 3 days per week have been shown to reduce systolic and diastolic blood pressure by 2–7% and mean arterial pressure by 6% [27-28].

As basis, it has been known that a single bout of exercise can transiently lower blood pressure [29], with this effect persisting for up to about 24 hours post-exercise [30-31]. The exact mechanisms responsible have not been fully elucidated, but it is likely to be a combination of reduced sympathetic nervous activity [32] and increased nitric oxide-mediated vasodilatation [33]. Despite, extremely short duration SIT was found to improve vascular health in older adults [34].

Surprisingly, finding of the present study shows there was no significant improvement in resting heart rate after 2-week of SIT even though there were a markedly decreased in systolic and diastolic blood pressure ($P=0.07$; as shown in Table 3). The pre-test measurement of resting heart rate was 83.55 ± 14.9 bpm and post-intervention was 78.09 ± 10 bpm. Our result differ with the previous literature showing improvement in heart rate variability indices after the application of supramaximal bouts during 2 weeks [35-36], which have been associated with the changes in the aerobic capacity [37].

As conclusion, our findings suggest that 2-week SIT does significantly improves the blood pressure by lowering the systolic and diastolic pressure in sedentary overweight women. However, no significant changes were observed on BMI, total body fat percentage and resting heart rate after SIT-intervention. Even though the 2-week SIT does not alter the body composition and resting heart rate, but these finding might be taken to indicate a potential altered responsiveness of blood pressure which may be related to cardiopulmonary adaptation. This phenomenon should be explored further in future work to provide a better insight into the effect of short term-SIT in overweight or obese population.

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