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Original Research Article

The Acute Cardiovascular and Metabolic Responses to Gliding™ Sliding Disc Exercise in Women

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Abstract

Aim: The purpose of this study was (a) to assess the acute cardiovascular and metabolic responses to Gliding™ Sliding Disc exercise and (b) to determine if Gliding™ Sliding Disc exercise meets guidelines for improving and maintaining cardiorespiratory fitness and elicits a significant energy expenditure.

Methods: Twelve women (mean \pm SD: age, weight, percentage body fat, and $VO_2\max = 37.2 \pm 7.0$ years, 69.2 ± 8.4 kg, 29.4 ± 4.1 %, and 35.4 ± 4.5 mL/kg/min, respectively) completed a 35min Gliding™ Sliding Disc exercise session. Cardiovascular and metabolic data were collected via a portable calorimetric measurement system. **Results:** Mean relative exercise intensity was $57.9 \pm 8.0\%$ of heart rate reserve and $50.2 \pm 9.3\%$ of oxygen uptake reserve. Absolute exercise intensity in metabolic equivalents (METs) was 5.2 ± 0.4 . Total energy expenditure for the Gliding™ Sliding Disc exercise session was 234.7 ± 44.8 kcal/session. **Conclusions:** Results indicate that Gliding™ Sliding Disc exercise is a feasible alternative to more traditional aerobic exercise modalities for young and middle-aged women that fulfills guidelines for improving and maintaining cardiorespiratory fitness.

Key Words: Group Exercise, Energy Expenditure, Exercise Intensity

Introduction

Regular physical activity confers various health benefits including the prevention and management of hypertension, obesity, Type 2 diabetes, dyslipidemia, and cardiovascular disease (CVD). Physical activity may also contribute to improved cardiorespiratory fitness provided that

exercise intensity is sufficient. Cardiorespiratory fitness, typically determined by maximal oxygen uptake ($VO_2\max$), refers to the highest rate at which oxygen can be taken up and consumed by the body during incremental exercise¹. Studies have consistently demonstrated an inverse relationship between $VO_2\max$ values and risk of CVD

and all-cause mortality²⁻³. Given its relationship to positive health, the parameters of an exercise program needed to improve cardiorespiratory fitness have been studied extensively, and subsequently well-defined guidelines have been published⁴⁻⁵ by numerous organizations, including the American Council on Exercise (ACE) and the American College of Sports Medicine (ACSM). Current recommendations⁶ to improve cardiorespiratory fitness are 20-60 minutes of aerobic exercise 3-5 days/week at an intensity of 64/70-94% of heart rate maximum (HRmax), 40/50-85% of heart rate reserve (HRR) or oxygen uptake reserve (VO₂R), and 12-16 rating of perceived exertion (RPE). Additionally, the ACSM has recommended a target energy expenditure of 150 to 400 kilocalories per day (kcal/day). Traditional forms of aerobic exercise include walking, jogging, and cycling. Despite the myriad of health benefits associated with regular physical activity, the majority of North American adults do not fulfill the minimal requirements of physical activity wherein the benefits are proposed to accrue⁷.

Gliding™ was invented by fitness professional Mindy Mylrea. Gliding™ consists of the Gliding™ system and the Gliding™ discs. The gliding discs are patented high-tech polymer discs, and reported to gracefully move with an individual's body so the individual is able to obtain the workout without the work. On the Gliding™ Sliding Disc website a number

of health claims are made, including the following: Gliding™ exercises allow you to do smooth, graceful movements that firm, tone and sculpt long, lean beautiful muscles; the revolutionary sliding motion engages your muscles through a full range to strengthen and lengthen the major muscle groups of your entire body. Furthermore, it is purposed that you can sculpt shapely legs, tone your inner and outer thighs, trim your hips and firm and lift your buns, and typical results are 1 jean size and 5.3 pounds in first 10 days⁸.

Nevertheless, to our knowledge, there is currently no scientific research examining the physiological responses to exercise with the Gliding™ Sliding Disc. Understanding the cardiovascular and metabolic responses to exercise is essential for designing safe and effective physical activity and rehabilitation programs. For example, it would be beneficial to understand the metabolic equivalent (MET) value associated with exercise with the Gliding™ Sliding Disc. A MET value would allow the quantification of Gliding™ Sliding Disc exercise intensity as low, moderate, or vigorous in nature, and hence, aid in establishing a safe and effective target workload. The lack of research concerning the physiological responses to Gliding™ Sliding Disc exercise prompted the present study.

Therefore, the purpose of this study was (a) to assess the acute cardiovascular and metabolic responses to Gliding™ Sliding

Disc exercise and (b) to determine if Gliding™ Sliding Disc exercise meets guidelines for improving and maintaining cardiorespiratory fitness and elicits a significant energy expenditure. It was hypothesized that Gliding™ Sliding Disc would meet the recommended guidelines for moderate intensity exercise and would elicit an energy expenditure comparable to other common modes of exercise (e.g., walking, cycling, elliptical crosstrainer).

Methods

Participants

12 middle-aged women (19 to 45 years of

age) were recruited from the faculty population of a local university, as well as the surrounding community, via advertisement through the university website, local community newspaper, and word-of-mouth. Participants were eligible for inclusion into the study if they were low-to-moderate risk as defined by the ACSM⁵. Exclusionary criteria included evidence of cardiovascular pulmonary, and/or metabolic disease. This study was approved by the Human Research Committee at Western State Colorado University. Prior to participation each participant provided informed consent.

Table 1. Physical and physiological characteristics of the participants.

Parameter	Mean ± SD
Age (years)	37.2 ± 7.0
Height (cm)	166.6 ± 5.9
Weight (kg)	69.2 ± 8.4
Waist (cm)	77.9 ± 8.1
Body fat (%)	29.4 ± 4.1
Systolic blood pressure (mmHg)	116.0 ± 15.1
Diastolic blood pressure (mmHg)	74.3 ± 7.0
Resting heart rate (beats/min)	69.5 ± 4.5
Maximal heart rate (beats/min)	181.0 ± 7.6
Maximal oxygen uptake (mL/kg/min)	35.4 ± 4.5
Resting oxygen uptake (mL/kg/min)	3.7 ± 0.4

Experimental Design

All measurements were obtained on non-consecutive testing days. Day 1 consisted of the collection of individual physical and physiological measures and measurement of resting metabolic rate and the maximal exercise test. Day 2 consisted of assessment of the cardiovascular and metabolic responses to Gliding™ Sliding Disc exercise.

Testing sessions were separated by 2 days to 2 weeks.

Instrumentation

Metabolic data during resting conditions, Gliding™ Sliding Disc exercise, and the maximal exercise test were obtained using an Oxycon Mobile portable calorimetric measurement system. Continuous HR

measurements during all conditions were obtained using a Polar F1 heart rate monitor interfaced with the Oxycon Mobile system.

Protocols

Physical measurements

All anthropometric measurements were obtained using standardized guidelines⁵. Participants were weighed to the nearest 0.1 kg on a medical grade scale and measured for height to the nearest 0.5 cm using a stadiometer. Percent body fat was determined via skinfolds. Skinfold thickness was measured to the nearest ± 0.5 mm using a Lange caliper (Cambridge Scientific Industries, Columbia, MD). All measurements were taken on the right side of the body using standardized anatomical sites (three-site) for women. These measurements were performed until two were within 10% of each other. Waist circumference measurements were obtained using a cloth tape measure with a spring loaded-handle (Creative Health Products, Ann Arbor, MI). A horizontal measurement was taken at the narrowest point of the torso (below the xiphoid process and above the umbilicus). These measurements were taken until two were within 0.5 mm of each other.

Resting blood pressure measurement

The procedures for assessment of resting blood pressure outlined elsewhere were followed⁵. Briefly, participants were seated quietly for 5 minutes in a chair with a back support with feet on the floor and arm

supported at heart level. The left arm brachial artery blood pressure was measured using a sphygmomanometer in duplicate and separated by 1-minute. The mean of the two measurements was recorded.

Resting metabolic rate and maximal exercise test

After being connected to the Oxycon Mobile system and Polar F1 heart rate monitor, participants rested quietly for 5-min in a seated position. The last minute of breath-by-breath and heart rate (HR) data were averaged and considered to be resting metabolic rate (VO_2) and resting HR. On a power treadmill (Powerjog GX200, Maine), a modified Balke protocol was performed with participants selecting a comfortable walking or running speed that could be maintained for the duration of the test. After a 2min warm up at a self-selected speed, participants were gradually brought to the selected walking or running speed for the first minute of the test, which was then maintained throughout the duration of the test. The first 1 min of the protocol was performed at 0% grade, thereafter, each minute the treadmill grade was increased by 1% until volitional fatigue was attained. The criteria for attainment of maximal oxygen consumption ($\text{VO}_{2\text{max}}$) was two out of three of the following: (1) a plateau ($\Delta\text{VO}_2 \leq 150$ mL/min) in VO_2 with increases in workload, (2) maximal respiratory exchange ratio (RER) ≥ 1.1 , and (3) maximal HR within 15 beats/min of the age-predicted maximum (220 – age).

Exercise session to determine acute responses to Gliding™ Sliding Disc exercise

Participants performed a single exercise session that followed the *Fat Burning Cardio* video from Gliding™ Sliding Discs. Participants were instructed to arrive 30 min prior to the start of the testing session to be attached with a heart rate monitor and portable metabolic analyzer. Additionally, participants were familiarized with the breathing apparatus and provided an explanation of testing instructions and precautions. Each exercise session commenced with a 5min warm-up consisting of light dynamic stretching. The *Fat Burning Cardio* video consists of a ~35min aerobic interval exercise session that alternates 4-6min aerobic intervals with 3min toning segments using the Gliding™ Sliding Discs. The exercise session concluded with a 5min cool-down consisting of upper- and lower-extremity static stretching.

Exercise intensity & metabolic calculations

Individual heart rate reserve (HRR) was determined as the difference between resting and HRmax values. Percent HRR was calculated by subtracting resting HR from the Gliding™ Sliding Disc exercise HR response, dividing by HRR, and then multiplying the quotient by 100. Likewise, individual oxygen uptake reserve (VO₂R) was determined by the difference between resting and maximum VO₂ values. Percent VO₂R was calculated by subtracting resting VO₂ from the Gliding™ Sliding Disc exercise VO₂ response, dividing by VO₂R, and then

multiplying the quotient by 100. The metabolic equivalent (MET) for Gliding™ Sliding Disc exercise was determined by dividing the exercise VO₂ by resting VO₂ for Gliding™ Sliding Disc exercise. Net energy expenditure (kcal/session) for the Gliding™ Sliding Disc exercise session was calculated by first subtracting the resting metabolic rate (1 MET) from the above-calculated MET equivalent of Gliding™ Sliding Disc exercise. This term was multiplied by individual resting VO₂, individual body mass, divided by 1000, multiplied by 5 (the assumption was made for an energy cost of 5 kcal/L of oxygen), and last multiplied by the length of the *Fat Burning Cardio* video (i.e., 35min).

Statistical analyses

All analyses were performed using SPSS Version 24.0 (Chicago, IL) and GraphPad Prism 6.0. (San Diego, CA). Primary outcome measures included relative exercise intensity [% heart rate reserve (HRR) and % oxygen uptake reserve (VO₂R)], metabolic equivalents (METs), and energy expenditure (kcal/min and kcal/session). Measures of centrality and spread are presented as mean ± SD. The probability of making a Type I error was set at $p \leq .05$ for all statistical analyses.

Results

Cardiovascular and metabolic responses (mean ± SD) to the Gliding™ Sliding Disc exercise session for the 12 women who completed the study are presented in Table 2. Overall heart rate for the 35min Gliding™

Sliding Disc exercise session was 134.0 ± 7.7 beats/min, which corresponded to $57.9 \pm 8.0\%$ HRR and $50.2 \pm 9.3\%$ VO_2R . Absolute exercise intensity in METs was 5.2 ± 0.4 .

Total energy expenditure for the Gliding™ Sliding Disc exercise session was 234.7 ± 44.8 kcal/session.

Table 2. Acute cardiovascular and metabolic responses to Gliding™ Sliding Disc exercise.

Parameter	Mean \pm SD
HR (beats/min)	134.0 ± 7.7
% HRR	57.9 ± 8.0
% VO_2R	50.2 ± 9.3
Metabolic equivalents (METs)	5.2 ± 0.4
kcal/min	6.7 ± 1.3
kcal/session	234.7 ± 44.8

HR, heart rate; %HRR, percentage heart rate reserve; kcal, kilocalories; METs, metabolic equivalents; % VO_2R , percentage oxygen uptake reserve.

Discussion

Physical inactivity is an important risk factor for the development and progression of cardiovascular disease (CVD)⁹. Increased aerobic fitness as indicated by VO_2max or peak METs is associated with favourable effects on measures of cardiovascular health³, while of significant clinical importance is the robust inverse relationship between VO_2max and all-cause and CVD-related mortality¹⁰⁻¹¹. Nevertheless, according to 2013 data in adults ≥ 18 years the age-adjusted proportion who reported engaging in moderate or vigorous physical activity that met current physical activity guidelines for Americans was 50.0%⁹. This is perhaps due in part to a lack of enjoyment experienced from participation in traditional forms of physical activity (such as walking, running, swimming, and cycling). One possible way in which to increase the number of

individuals involved in regular physical activity is to emphasize that the health benefits of traditional exercise can often be found in alternative forms of exercise.

Gliding™ consists of the Gliding™ system and the Gliding™ discs. The gliding discs are patented high-tech polymer discs. Results from the present study provide preliminary lines of evidence supporting Gliding™ Sliding Disc as an ideal alternative exercise modality. Indeed, participation in a Gliding™ Sliding Disc exercise session elicited cardiovascular and metabolic responses that fulfill exercise intensity guidelines for improving and maintaining cardiorespiratory fitness⁴⁻⁵. Mean exercise intensity was 57.9% of HRR, 50.2% of VO_2R , and 5.2 METs, respectively. Overall energy expenditure for a Gliding™ Sliding Disc exercise session was ~ 235 kcal/session.

Acute cardiovascular and metabolic responses – comparison between Gliding™ Sliding Disc exercise and other activities

Exercise intensity is arguably the most critical component of the exercise prescription model. Failure to meet minimal threshold values may result in lack of a training effect, while too high of an intensity could lead to over-training and negatively impact adherence to an exercise program¹². Results from the present study indicate participation in Gliding™ Sliding Disc exercise can be classified as “moderate” according to various organizations definition of physical activity intensity⁴⁻⁵. For example, moderate exercise intensity in relative terms has been defined as 40-59% of HRR/ VO_2R ⁵. Participants in the present study exercised at workloads during the Gliding™ Sliding Disc exercise session that elicited HRR (57.9%) and VO_2R (50.2%) values that fall within the moderate relative intensity category.

In the 2008 US physical activity guidelines report¹³ and elsewhere¹⁴, moderate-intensity physical activity in absolute metabolic terms has been classified as 3 to 6 METs. In the present study, the MET response to Gliding™ Sliding Disc exercise averaged 5.2. Thus, participants in the present investigation exercised at workloads during the Gliding™ Sliding Disc exercise session that elicited metabolic responses within the accepted moderate-intensity range. This is an important finding given the fact that moderate-intensity exercise has been widely recommended for

health benefits^{4-5,14-15}. Additionally, MET values described in the present study compare favorably to more traditional land-based aerobic exercise values and non-traditional exercise values. For instance, treadmill and over ground walking at 3.0 miles per hour is an equivalent moderate-intensity physical activity at 3.3 METs. Likewise, an 80kg individual cycling between 50 and 100 Watts will elicit a MET value ranging from 4.0 to 6.0 METs⁵. More recently, Dalleck and colleagues¹⁶ reported that participation in an Aerial Yoga exercise class also elicited an absolute moderate-intensity metabolic response at 4.8 METs.

For the improvement and maintenance of cardiorespiratory fitness, the ACSM has recommended a target energy expenditure of 150 to 400 kilocalories per day (kcal/day). From a practical perspective, results from the present study highlight that participation in a 35min Gliding™ Sliding Disc exercise session yields a mean energy expenditure of 235 kcal that satisfies the ACSM recommendations for daily energy expenditure. This volume of energy expenditure is comparable to other non-traditional alternative activities. For instance, Bausch et al. (2008) reported that participation in 1hr session of Nintendo Wii Sports elicited a mean energy expenditure of ~250 kcal/session¹⁷. More recently, Dalleck and colleagues (2016) reported that participation in a 50min Aerial Yoga class elicited a total energy expenditure of ~320 kcal/class¹⁸.

Methodological Considerations

Possible limitations to the present study merit discussion. The present study investigated the acute cardiovascular and metabolic responses to a representative sample of young to middle-aged women that exercised to the *Fat Burning Cardio* video from Gliding™ Sliding Discs. There are many other exercise program options with the Gliding™ Sliding Discs and undoubtedly the cardiovascular and metabolic responses would vary across different Gliding™ Sliding Discs routines. Another possible limitation is the relatively short resting period used for collecting resting HR and VO₂. However, unpublished pilot testing data from our laboratory found no significant differences ($p > 0.05$) between resting HR and VO₂ values obtained following 5 and 30min of rest. Furthermore, resting values obtained in the present study are comparable to those reported elsewhere¹⁶.

CONCLUSION

To our knowledge, this is the first study to investigate the acute cardiovascular and metabolic responses to exercise with the Gliding™ Sliding Discs. Findings from the present study support Gliding™ Sliding Disc exercise as a feasible alternative to traditional exercise modalities for young to middle-aged women that elicits metabolic responses within the accepted moderate-intensity range. Overall, these findings are important for exercise physiologists, fitness professionals, and others who design

exercise programs and promote physical activity in the adult population.

Competing interests

This investigation was supported financially by the American Council on Exercise (ACE). The American Council on Exercise (ACE) was not involved in development of the study design, data collection and analysis, or preparation of the manuscript. There are no other potential conflicts of interest related to this article.

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