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Physiological Effects of Adding a Percentage of Body Weight During a 7 Week Stair Climbing Sprint Interval Training Program

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During a 7 Week Stair Climbing Sprint Interval Training Program

by

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During a 7 Week Stair Climbing Sprint Interval Training Program

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ABSTRACT

The purpose of this study was to determine the effect of adding a percentage of bodyweight (BW) during a 7 week stair climbing (SC) sprint interval training (SIT) program on maximal oxygen consumption, body composition, and lower body peak power. Twenty-seven recreationally active males (22±2 yrs) were divided into 1 of 2 groups (non-weighted or weighted) and performed 4, 15 sec bouts of 'all-out' SC sprints separated by 90 secs of rest, 3x/week, for 7 weeks. Non-weighted stair climbers performed SC sprints without any additional load throughout the entire duration of the study, and weighted stair climbers performed SC sprints with a progressive load of 10% and 20% bodyweight (BW). After the first week of SC SIT, the weighted SC group increased to 10% BW for weeks 2-4, and 20% BW for weeks 5-7. Lower body peak power improvements were found after 4 and 7 weeks of SC SIT training, as well as maximal oxygen consumption improvements after 7 weeks of SC SIT for both non-weighted and weighted stair climbers with no significant differences between groups. These improvements in lower body peak power and maximal oxygen consumption are similar to previous SIT studies involving treadmills, cycle ergometers, and stair climbing. Also, the results indicate that the addition of a progressive load (10-20% BW) as in a weighted vest to SC SIT did not improve maximal oxygen consumption and lower body peak power when compared to non-weighted SC SIT since no additional physiological challenge (HR) was added with BW (10-20% BW) during SC SIT. Lastly, strength and conditioning coaches or personal trainers need to be cautious about adding a weighted vest to SC SIT since there is no added benefit in improving aerobic fitness or lower body peak power and may only increase the incidence of injury.

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LIST OF ABBREVIATIONS/SYMBOLS

BLa = Blood Lactate

BPM = Beats Per Minute

BW = Bodyweight

HR = Heart Rate

Kcal/Min = Caloric Expenditure

Kg = Kilograms

M = Mass

Max HR = Maximum Heart Rate

Min – Minute

Mins - Minutes

mmol/L = millimoles per litre

Mph = Miles per Hour

MVO_2 = Maximal Oxygen Consumption

PAR-Q+ = Physical Activity Readiness Questionnaire Plus

RHR = Recovery Heart Rate

RPE = Rating of Perceived Exertion

SC = Stair Climbing

SCAS = Stair Climbing Ascending Stairs

SCADS = Stair Climbing Ascending and Descending Stairs

SC SIT = Stair Climbing Sprint Interval Training

Sec – Second

Secs - Seconds

SD = Standard Deviations

SIT = Sprint Interval Training

TM = Treadmill

Wk = Week

Wks = Weeks

Yrs = Years

VO_2 = Oxygen Consumption

% = Percentage

INTRODUCTION

Aerobic exercise is typically performed at a continuous, moderate heart rate intensity for 30-45 minutes (mins) per session, 1-7x per week (wk), for 4-15 weeks (wks) on a cycle ergometer or treadmill (Ghasemi et al., 2013; Patel et al., 2017; Schnohr, O'Keefe, Marott, Lange & Jensen, 2015; Scribbans, Vecsey, Hankinson, Foster, & Gurd, 2016). Both cycle ergometer and treadmill aerobic exercise training studies have been shown to significantly improve oxygen consumption (VO_2) in all age ranges and genders (Egana & Donne, 2004; Gillen et al., 2016; Loy et al., 1993; Tabata et al., 1996).

Similarly, stair climbing on a motorized stair climber or in a stairway is an effective form of cardiovascular exercise. Stair climbing (SC) studies have been performed at varying intensities for 2–45 mins for 6–12 wks or longer with 3-5 workouts per wk and have resulted in improvements in maximal oxygen consumption (MVO_2) and lower body strength (Boreham et al., 2005; Loy et al., 1993; 1994).

In one of the first acute SC studies, Oldenburg, McCormack, Morse, & Jones (1979) compared 6 participants (average 34 years(yrs)) using a self-paced SC protocol of eight flights of stairs (79 steps, 14.8 metres) versus cycling at a resistance that was comparable in workload to the SC protocol. They reported that SC and cycling had similar acute heart rate (HR) and VO_2 responses, but that cycling blood lactate levels were significantly higher suggesting that lower body cycling ergometry stimulated more skeletal muscle anaerobic glycolysis (Oldenburg, McCormack, Morse, & Jones, 1979).

In a 50 wk SC study, Cress et al. (1991) followed elderly females (72±6 yrs) who performed non-weighted SC (ascending and descending) for 8 sets of 24 stairs (15-cm high) per workout session. After 2 months of non-weighted SC, participants were then fitted with progressively increasing sand-weighted backpacks to a maximum of 10% of their body weight to improve leg strength over the next 4 months. Participants were instructed to maintain a SC speed that evoked HR responses equal to 75% of HR reserve. After 50 wks of SC, participants saw a 16% improvement in treadmill maximal oxygen consumption (MVO_2), a 9% increase in quadriceps strength, and muscle biopsies revealed a 29% increase in type IIb muscle fiber size in the vastus lateralis muscle.

Loy et al. (1993) compared 9 wks of SC and treadmill running in 25 active college women (average 21.8 yrs) training 4 times per wk for 30 mins at an intensity of 70-80% of maximum HR (max HR) progressing to 4 times per wk for 45 mins at 80-90% of max HR. SC training resulted in a significant 12% increase in MVO_2 and treadmill running a 16% increase, with no statistically significant differences between groups, indicating that SC was as effective as treadmill running for improving aerobic fitness.

In a follow-up study, Loy et al. (1994) conducted a 12 wk SC study in females (average 55 yrs) training for 35 mins on a motorized SC (Stairmaster Gauntlet) with or without a weighted vest for 12 wks. The non-weighted vest group performed 12 wks of SC, versus a progressively increasing weighted vest group (no added weight for 5 wks, +4% body weight (BW) at wk 6, +8% BW for wks 7-12). The added weight was designed to improve lower body strength. Weighted SC HR was maintained at 80-85% of age predicted max HR by reducing step count to ensure exercise intensity was the same between the non-weighted and weighted SC groups. After 12 wks of SC, the non-weighted group exhibited a significant 11.1% increase in treadmill MVO_2 and a 9.6% increase in the weighted vest group with no statistical difference between the two groups.

The authors also reported a significant improvement in quadriceps strength at 60 degrees of knee angular velocity in the weighted-vest group. Loy et al. (1994) concluded that if weighted SC exercise intensity (HR) is maintained, the addition of an external load (% BW) has no effect on improving MVO_2 or that the addition of 4-8% BW was an insufficient stimulus to elicit any potential additional changes in MVO_2.

In a 7 wk SC study, Boreham, Wallace & Nevill (2000) examined the VO_2 changes with a SC protocol starting with 1 stair climb per session and progressing to 6 climbs, 5 days a wk, in sedentary females aged 18-22 yrs. The participants stair climbed at a pace averaging 88 steps/min for a total of 199 steps (vertical displacement of 32.8 meters) per climb and then descended at their own pace. The researchers assessed VO_2 changes using a standardized SC field test at 88 steps/min before and after the 7 wk training protocol, monitoring both HR and VO_2 during the test. They reported that when performing the standardized SC test, the 7 wk SC group exhibited a significant reduction in both VO_2 (pre 27.1 ± 0.2 vs. post 24.8 ± 0.2) and lactate accumulation (pre 7.4 ± 0.87 vs. post 5.6 ± 0.57) representing an improvement in aerobic performance.

In 2004, Egana & Donne (2004) compared the MVO_2 responses of 3 separate 12 wk training groups that involved SC, treadmill (TM) or elliptical exercise modalities in 24 moderately active females (average 29.6 yrs). Participants trained 3 times per wk for 30 mins at a HR of 70-75% HR max and progressively increased to 40 mins after wk 4 starting at a HR of 75-80% HR max and progressively increasing to 80-90% HR max for the final 4 wks. They reported a significant increase in MVO_2 following SC (4.4%), treadmill (5.7%), and elliptical protocols (6.8%) with no statistically significant differences between the training protocols (Egana & Donne, 2004) supporting the idea that SC was comparable to TM or elliptical aerobic training.

Boreham et al., (2005) performed a follow-up study to their 2000 SC study (Boreham et al. 2000), in which they attempted to replicate their previous VO_2 findings but utilized a MVO_2 test versus a standardized SC field test VO_2 determination. They trained sedentary females (average 18.8 yrs) for 8 wks SC at 90 steps/min for a total of 199 steps (vertical displacement 32.8 meters) and allowed them to descend at their own pace. Participants performed 2 climbs, 5 times per wk for the first 2 wks, and then progressively increased one climb every 2 wks till participants were performing 5 stair climbs, 5 days/wk. They reported that the progressively increasing SC routine elicited a significant 17.2% improvement in cycle ergometer MVO_2.

In summary, treadmill, cycle ergometer, elliptical, and SC training are comparably effective at improving MVO_2. However, all traditionally require 30-45 mins of continuous training and may not be practical for an individual with a limited amount of time to exercise. In contrast to endurance training, sprint interval training (SIT) involves performing exercise at an 'all-out' or supramaximal intensity for 10-30 seconds (secs) on a cycle ergometer or treadmill (Hazell, Macpherson, Gravelle & Lemon, 2010; Hazell, Hamilton, Olver & Lemon 2014; MacInnis & Gibala, 2016; Whyte, Gill, Cathcart, 2010). Each SIT exercise (work) session is separated by a period of active or inactive recovery (rest), with work to rest ratios ranging from 1:1 to 1:24, (Allison et al., 2017; Burgomaster, Heigenhauser, Gibala, 2006; Hazell, Macpherson, Gravelle & Lemon, 2010), repeated 2-7 times per session, with 2-3 workouts per wk for 2 to 16 wks (Allison et al., 2017; Burgomaster, Heigenhauser, & Gibala, 2006; Hazell, Macpherson, Gravelle

& Lemon, 2010; Metcalfe, Babraj Fawkner & Vollaard, 2012; Whyte, Gill, Cathcart, 2010). SIT produces the same MVO_2 improvements as traditional endurance training protocols, but the participants total exercising time (work + recovery) can be 90% less than traditional endurance training. As little as 2 wks of SIT has been shown to produce significant increases in MVO_2, muscle oxidative capacity, muscle buffering capacity, and anaerobic and aerobic enzyme activity (Allison et al., 2017; Burgomaster, Hughes, Heigenhauser, Bradwell & Gibala, 2005; Burgomaster et al., 2008; Gibala et al., 2006; Hazell, Macpherson, Gravelle & Lemon, 2010; MacInnis & Gibala, 2016; Metcalfe, Babraj Fawkner & Vollaard, 2012; Whyte, Gill, Cathcart, 2010).

Given the success of aerobic-based SC and TM or cycle ergometer SIT, Allison et al. (2017) recently examined the effectiveness of SC SIT. They determined MVO_2 and HR adaptations following 6 wks of SC SIT in 31 sedentary females (average 24 yrs) using either a SC ascending stairs (SCAS) protocol or a SC ascending and descending stairs protocol (SCADS). Participants were instructed to stair climb as fast and as safely as possible using handrails if necessary. The SCAS (99 stairs; stair height = 0.195 meters) training study consisted of 3 sets, 3x/wk, at a 1:6 work to rest ratio (20 sec: 120 sec) and the SCADS (61 stairs; stair height = 0.205 meters) study consisted of 3 sets, 3x/wk, at a 1:1 work to rest ratio (60 sec: 60 sec). The SCAS SIT protocol elicited HR responses that were 81% of age-predicted HR max and observed a significant 12% increase in MVO_2 during an incremental cycle ergometer test (pre 28.9 ± 3.4 ml kg^{-1} min^{-1} vs. post 32.4 ± 3.6 ml kg^{-1} min^{-1}). Additionally, the SCADS SIT protocol observed HR responses that were 80% of age-predicted HR max and a significant 8% increase in MVO_2 (pre 31.2 ± 4.6 ml kg^{-1} min^{-1} vs. post 33.3 ± 5.3 ml kg^{-1} min^{-1}). Allison et al.,

(2017) also compared blood lactate values following 3 separate sprint intervals involving a work:rest ratio of 20 sec:120sec for SCAS (120 stairs; stair height = 0.135 meters) versus cycle ergometer SIT set at .05% BW resistance. Both SCAS and cycle ergometry SIT showed progressive increases in blood lactate concentrations and peak HR for each subsequent bout, and there were no significant differences between the protocols indicating a comparable exercise intensity. These results were the first to report that SC SIT MVO_2 improvements are comparable to TM and cycle ergometry SIT, but unlike treadmill or cycle ergometer SIT sessions, SC SIT could be performed indoors or outdoors with no associated equipment costs (Allison et al., 2017)

Typically, an increase in exercise intensity is used to further enhance MVO_2 adaptations or performance and is accomplished by increasing treadmill speed/grade or cycle ergometer workload resistance. However, for SC on a motorized stair climber, Loy et al. (1994) added 4-8% bodyweight (BW) in their 12 wk SC study, but interestingly chose to maintain exercise intensity (HR) similar to that seen in the control or no-load group (0% BW), by reducing the number of stairs climbed (Loy et al., 1994). The added 4-8% BW had minimal effects on lower body muscular strength and had no effect on MVO_2 which they attributed to the maintenance of exercise intensity (HR) (Loy et al., 1994).

Puthoff, Darter, Nielsen & Yack, 2006, examined the metabolic costs in male and female participants (average 23.4 ± 1.7 yrs) walking at treadmill speeds varying from 2-4 miles per hour (mph) without (0%) and with a weighted vest of 10%, 15% and/or 20% of an individual's BW. They reported that in the majority of participants the addition of 10%, 15% and/or 20% of BW led to progressive and significant increases in VO_2 at all speeds when compared to walking without a weighted vest (0%). Furthermore, Puthoff et al., (2006) reported no significant increases in HR for 10% BW, but 15% BW at speeds of 2.5, 3, 3.5 and 4mph, and 20% BW at speeds 3, 3.5 and 4mph, showed significant increases in HR when compared to 0% BW. Their data suggested that the addition of 10%, 15% and 20% BW while walking on a treadmill was required to significantly increase VO_2 and that the addition of 15% or 20% BW was required in order to significantly increase exercise intensity (HR) without increasing TM speed.

McCormick, Kravitz, Mermier & Gibson (2011), examined the metabolic changes in untrained females (average 37 yrs) wearing 0%, 10% or 15% of their BW walking at 2.5 mph with incremental gradient increases (0%, 5%, 10%, and 15%) every 4 mins (16 mins total walking time). They reported significant increases in VO_2, caloric expenditure (kcal/min), and exercise intensity (HR) for the 10% BW group at 5%, 10%, and 15% gradient, and the 15% BW group at 0%, 5%, 10% and 15% gradient when compared to walking without a load (0%). Additionally, they reported significant increases in VO_2, caloric expenditure (kcal/min), and exercise intensity (HR) from 10% to 15% of BW for treadmill gradients of 0%, 5%, and 10%. These results indicate that the addition of 10% and/or 15% BW was required to increase $VO_{2,}$ caloric energy expenditure (kcal/min), and exercise intensity (HR) without increasing speed.

In summary, typically an increase in exercise intensity (HR) is used to enhance VO_2 gains and is accomplished by increasing cycle ergometer resistance or treadmill speed/grade (McCormick et al., 2011; Puthoff et al., 2006). With stair climbing, Loy added 4-8% BW but maintained exercise intensity (HR) similar to that seen with no load SC and reported an increase in leg strength but the additional BW had no effect on improving MVO_2 as exercise intensity (HR) was not elevated. While the addition of 10-20% BW to TM walkers increases exercise intensity (HR), caloric expenditure, and VO_2 when compared to walking without load (McCormick et al., 2011; Puthoff et al., 2006). Combining the addition of 10-15% BW to TM walking with increasing TM grades (5%, 10% & 15%) also resulted in further significant increases in exercise intensity (HR), caloric expenditure, and VO_2 when compared to walking without a load (McCormick et al., 2011). Collectively, given the reported effects of adding a % BW on improving SC skeletal muscle strength, increasing TM exercise intensity (HR), caloric expenditure and VO_2 walking at increasing TM inclines and the recent report by Allison et al. (2017) on SC SIT to improve MVO_2, the question arises is what effect would adding a % BW do to SC SIT exercise intensity, MVO_2 and leg power. Therefore, the purpose of this investigation was to determine the effect of adding weight during SC SIT on heart rate, rating of perceived exertion, $MVO_{2,}$ and skeletal muscle power following a 7 wk SC SIT protocol. The study consisted of 2 experimental groups:

1. Control Group - 7 wk non-weighted
2. 10/20% Group - 1 wk non-weighted + 3 wk with 10% BW + 3 wk with 20% BW

The specific objectives were to determine the changes from baseline to 4 wks and following 7 wks of non-weighted and weighted SC SIT on:

- treadmill MVO_2
- lower body skeletal muscle power
- body composition

- heart rate, and blood lactate accumulation during and following the SC SIT programs
- rating of perceived exertion during and following the SC SIT programs

METHODS

Session 1: Documentation and Familiarization

This study was approved by the University of Windsor Research Ethics Board (REB#17-155). Twenty-seven male participants were recruited between the ages of 18-30 years who had been exercising at least 2 times per wk for the past 3 months and were not following a stair climbing training program, strenuous aerobic-based training program, high intensity interval training program or sprint interval training program or were university or community elite athletes. This population was chosen due to their familiarity with regular exercise (i.e., fatigue, muscle soreness, and exercising heart rates). Only males were recruited as there were no SC SIT studies on males to date.

Participants were recruited from the University campus and the local community via posters, e-mail, social media, and word of mouth (Appendices A and B). When an interested participant responded, they were sent a letter of information (Appendix C) via email.

Individuals who were still interested in participating were asked to visit the Multipurpose Research Lab (room 202) for a documentation and familiarization session in the Human Kinetics building, at the University of Windsor. Upon arrival, participants were further informed about the purpose of the study both verbally and in writing and were also asked to sign a written form of consent (Appendix D). Participants were then asked to complete the Physical Activity Readiness Questionnaire Plus (PAR-Q+, see Appendix E) that sought to identify whether participants were free of any known risks that would have indicated possible issues in participating in the physical exercise prescribed. If they passed the PAR-Q+, they were asked to fill out the participant information questionnaire (Appendix F), in order to collect normative data including age, month/year of birth, height, and weight. Participants were then asked to fill out the Godin Leisure-Time Exercise Questionnaire (Appendix G), in order determine their exercise status (i.e., strenuous, moderate, mild), weekly ability to work up a sweat (i.e., often, sometimes, never) and to confirm inclusion/exclusion exercise criteria stated during the recruitment process.

Participants were then asked to schedule a date for their baseline testing session following a 24 hour period free of caffeine, alcohol, and exercise. Participants were required to fast for at least 4 hours prior to testing. Alcohol is known to slow down the central nervous system and may significantly reduce performance, whereas caffeine is a stimulant that may provide an ergogenic benefit and may alter resting and exercise heart rates.

Participants were shown and explained the SC SIT groups and experimental design (Table 1):

1. Control Group - 7 wk non-weighted
2. 10/20% Group - 1 wk non-weighted + 3 wk with 10% BW + 3 wk with 20% BW

Table 1: *The order of testing and data collection: "x" represented data collection points. Baseline testing, during training wks 1-4, mid-way (testing after 4 wks of SC SIT), during the training wks 5-7, and post SC SIT. The first wk of SC SIT had all SC SIT groups using no load. During wks 2-4 SC weight for the Control group was 0%, and the 10/20% group added 10% of their bodyweight. The last 3 wks the Control group continued to use 0%, and the 10/20% Group added 20% of their body weight during SC SIT.*

Variables Measured	Baseline Testing	Wk1 SIT	Wk2 SIT	Wk3 SIT	Wk4 SIT	Mid Way	Wk5 SIT	Wk6 SIT	Wk7 SIT	Post SIT
Body Composition (Fat-Free Mass, Fat Mass, Body Mass) (kg)	X									X
Blood Lactate (Resting) (mmol/L)	X					X				X
Margaria stair climb Power (Watts)	X					X				X
Treadmill MVO_2 (ml/min/kg)	X					X				X
Stairs Climbed		X	X	X	X		X	X	X	
Heart Rate (bpm)	X	X	X	X	X	X	X	X	X	X
Rating of Perceived Exertion (RPE)	X	X	X	X	X	X	X	X	X	X
Blood Lactate (Immediately Post Exercise) (mmol/L)	X					X				X

The first "baseline testing" session was conducted prior to the start of SC SIT training. Following baseline testing, the participants were randomly divided into one of 2 experimental groups: 1. Control Group - 7 wk non-weighted, and 2. 10/20% Group – (1 wk non-weighted + 3 wk with 10% BW + 3 wk with 20% BW). The first wk of non-weighted SC was designed for the purpose of familiarizing all participants with SC SIT protocol before adding additional BW. The second testing session was conducted after 4 wks (after 12 training sessions) of SC SIT for both experimental groups. The last testing session was conducted after wk 7 (another 9 training sessions) of SC SIT for both experimental groups. Testing consisted of body composition, Margaria stair climb power, and treadmill MVO_2 protocol. Heart rate (HR)(Figure 1), rating of perceived exertion (RPE) and pre and post ear-lobe blood lactates were also collected prior to and immediately after the TM MVO_2 test.

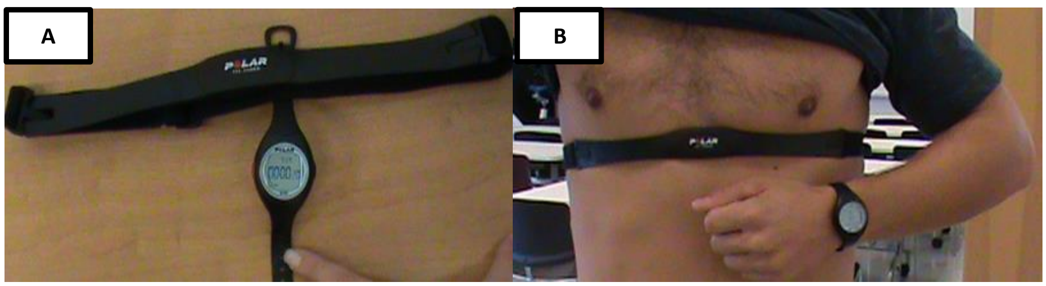

Figure 1: *A represents the Polar Heart Rate Monitor (Model E40) watch and the corresponding chest strap. B represents the proper placement of the Polar Heart Rate Monitor chest strap. The chest strap rested below the nipples and was centered just below the sternum.*

During the familiarization session, participants were also introduced to the RPE Borg scale 6-20 (Appendix H) and fitted with a Polar HR monitor (Model E40; Figure 1). The investigator then explained the SC SIT training protocol, which involved participants performing 4 SC SIT sets, climbing stairs as fast and as safe as possible using the handrail if needed, for 15 secs separated by 90 secs of rest. This 1:6 work to rest ratio was selected as it had been shown to elicit improvements in MVO_2 for sedentary females performing SC SIT (Allison et al., 2017) and cycle ergometer SIT MVO_2 (Gillen et al., 2014, 2016). Fifteen-second (sec) work intervals were selected due to the availability of staircases in the Department of Kinesiology that offered enough steps to perform SC SIT and since as little as 10-sec intervals had been shown to elicit improvements in SIT MVO_2 (Hazell et al., 2010). The Kinesiology stairway corridor was signed “testing in progress “and cordoned off during SC SIT to ensure participant and tester safety. An emergency action plan for medical emergencies during exercise testing and/or training had been established as a precautionary measure (Appendix I).

After the SC SIT protocol was explained, participants were given 4 opportunities to practice the SC SIT sessions. Participants started without any additional body weight, then with 10% BW, then 20% BW and finally without weight again in order to ensure they were familiar and comfortable with the different SC SIT training groups. Prior to the SC SIT weighted practice trials, the investigator familiarized participants with the weighted vest by inserting or removing the weighted packets (approximately 3 pounds) from the vest in order to match the 10% or 20% BW (Figure 2A). The weight that each participant was fitted with was based on their bodyweight, and it was recorded during the familiarization session in order to ensure standardization throughout the study. After the proper external weight was matched to the participant, the investigator demonstrated to the participant how to put the weighted vest on (Figure 2B).

Figure 2: *A represented how the weighted vest was adjusted for each participant. Packets that weigh approximately 3 pounds were inserted or removed depending on the individual's body weight and which weight group they were in (10% or 10-20%). B represented how the weighted vest was worn by each participant. Participants placed their arms through the side of the vest and secured the front velcro strap in order to minimize vest movement during the SC SIT interval.*

The investigator timed each work and rest interval using the Gymboss interval timer, and tracked the intervals using the Gymboss 'beep' to begin and stop the SC SIT work (15 sec) and rest periods (90 sec) (Figure 3).

Figure 3: *Gymboss Interval Timer was pre-set to indicate the start and end of every work and rest period with a "beep*

Participants were instructed to inform the investigator of the step number reached (top foot was taken) with the completion of each 15 sec SC SIT session (Figure 4). Each step was numbered to make it easy to determine how many steps the participant had completed during their SC SIT session.

Figure 4: *Typical numbered staircase that the SC SIT sessions were performed on. The participant ran up the stairs as fast and as safe as possible using the handrail if necessary for a total of 15 secs, which represented the completion of one work interval. The average step height and step width were 18.4cm and 28cm respectively as indicated by the arrows. Each step was numbered to give an indication to the participant and investigator the step reached upon completion of each 15-sec interval.*

During the SC SIT, the investigator gave feedback and encouragement to the participant so that for the first training session, participants already had a complete understanding of how the training exercise would be performed (Appendix J). The SC SIT practice sessions were performed at the end of the documentation and familiarization session.

Session 2: Baseline Testing Session

The baseline testing session took place in the Multipurpose Research Lab (room 209) at the University of Windsor's Human Kinetics building. Each testing session required approximately 80 mins of participation time including warm up, rest intervals, testing exercises, and post-exercise cooldown. Participants were reminded via email to fast for 4 hours and to be alcohol, caffeine and exercise free for 24 hours before all testing sessions. All participants were asked to maintain their regular nutritional and exercise habits outside of testing dates. All testing and training sessions were separated by a minimum of 24 hours, to provide adequate time for muscle recovery.

The first test that was conducted was a body composition analysis using the BodPod (Figure 5).

Figure 5: *The BOD POD analysis was used to assess for changes in body composition at the start (0 wks) and end (7 wks) of SC SIT.*

BOD POD Testing Procedure Guidelines: (Heyward, 2010)

1) The participant was dressed in the appropriate attire (form-fitting speedo or single layer compression shorts) and had fasted for two hours, refrained from exercise for two-six hours and had used the restroom.
2) Participant identification number was entered into the computer.
3) The BOD POD was calibrated.
4) The participant's mass was measured using a digital scale, height recorded, and the measures were used to calculate body surface area.
5) The participant's body volume was measured while sitting inside the BOD POD.
6) The participant's Thoracic Gas Volume (TGV) was determined using a prediction equation
7) Test results were recorded.

Before all testing sessions and all training sessions, participants were fitted with a Polar HR monitor (Model E40) (Figure 1) that recorded their HR. On testing days only, once the HR monitor had been fitted, participants were seated for 10 mins of rest prior to the collection and determination of baseline ear-lobe blood lactate concentration. Increases in baseline blood lactate concentrations following exercise testing (treadmill) represented the contribution of anaerobic metabolism to energy demand and was an indicator of exercise intensity (Goodwin, Harris, Hernandez & Gladden, 2007). For blood lactate determination, the standard earlobe technique (Figure 6A-F) was used. (REB #09-197; 16-031; 30-45).

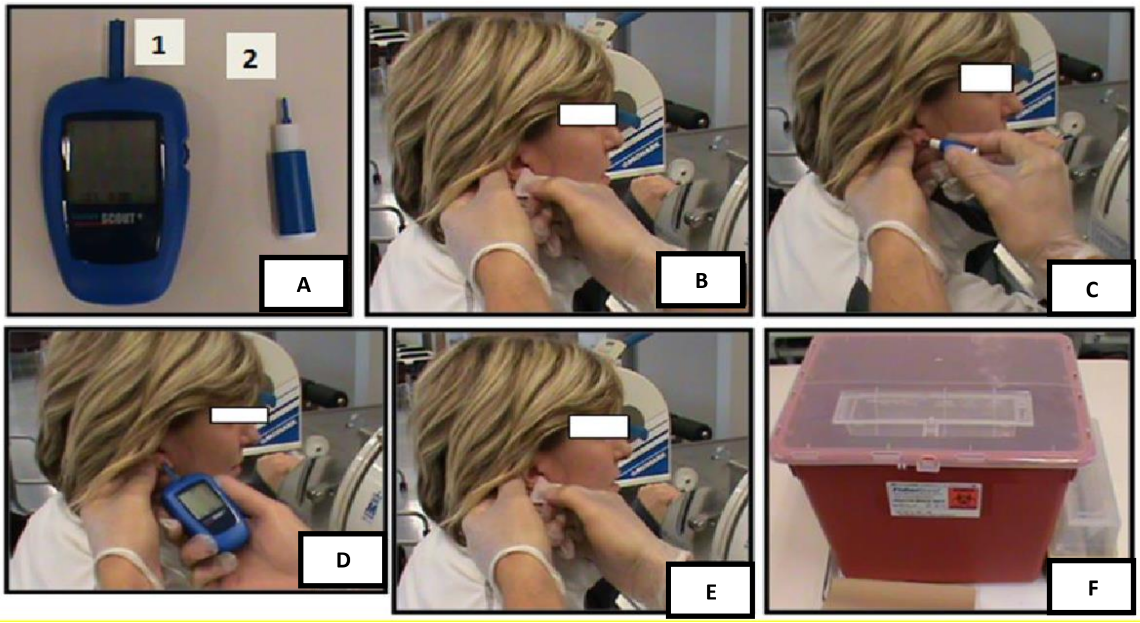

Figure 6: *A was the Lactate Scout Analyzer (1) and Medlance 1.8 mm, 21G Autolancet (2) which was used for attaining a single blood droplet and analyzing it for lactic acid concentrations. B was the participant's ear being cleaned with an alcohol swab while the investigator was wearing protective gloves before attaining a blood droplet. C was the use of the Medlance Autolancet which was held against the earlobe and pushed until it clicked. D was the Lactate Scout testing strip touched to the droplet of blood on the earlobe. Once the droplet touched the strip sufficiently, and reading was obtained by the Lactate Scout, the testing strip was disposed of into the sharps container. E was the earlobe being cleaned with a new alcohol whip post blood sample. The Medlance Autolancet lactate testing strip and alcohol wipe were disposed of into the sharps container seen in F. All areas used were disinfected post-test, with the liquid disinfectant found in the lab.*

Participants with long hair were asked to pull or tie their hair to expose their ears. The investigator wore disposable latex gloves, and then wiped the earlobe of the participants with an alcohol swab and dried the area (Figure 6B). The earlobe was pricked using a single-use Medlance 1.8mm, 21G auto-lancet to collect a single drop of venous blood (Figure 6C) onto a Lactate Scout Analyzer disposable lactate test strip (Figure 6D). Directly following the collection of venous blood, the investigator wiped the earlobe with a new alcohol wipe (Figure 6E), recorded the lactate value from the Lactate Scout, and immediately disposed of the lactate testing strip into the sharps container (Figure 6F). Also, ear blood lactate measurements were taken immediately post-treadmill testing, and 5 mins post-testing, to facilitate the determination of peak lactate due to diffusion of intramuscular lactate into the bloodstream (Cheetham et al., 1986; MacRae et al., 1992; Plowman & Smith, 2014). The lactate measurements were taken from alternate earlobes in order to improve participant comfort.

Following blood lactate collection, a standardized dynamic warm-up took place to prepare participants for movements associated with baseline testing and consisted of 10 forward/backward leg swings, 10 horizontal side to side leg swings, 10 knee to butt kicks and 10 side twists. Following the warm-up, a 3-min rest break was taken prior to the initiation of the muscular strength, speed and power tests to allow adequate recovery.

The first skeletal muscle performance test was the 'Margaria stair climb Power test' (Figure 7) used to assess muscular power changes due to SC SIT.

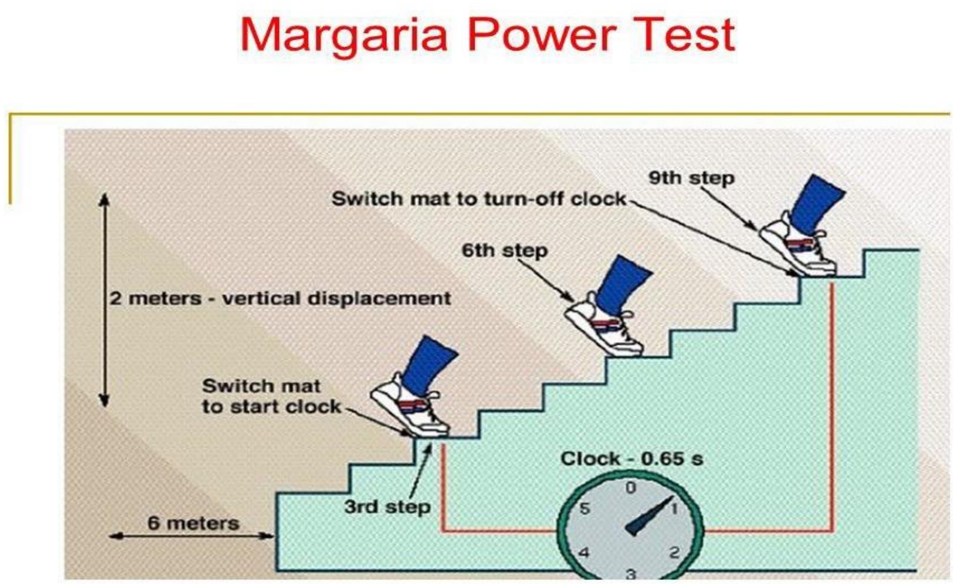

Figure 7: *Represented the Margaria stair climb power test, which involved an individual starting 6 meters from the initial step and then running up as quick as possible by hitting every third step with their foot, until they got to the ninth step. At the third and ninth step, a pressurized mat was placed down in order to record the interval time between the third and ninth step, which was recorded and placed into a calculation formula to determine lower body power (*Baechle & Earle, 2008).

Prior to the beginning of the Margaria stair climb test, the investigator demonstrated the Margaria stair climb to the participants (Margaria, Aghemo & Rovelli; 1966). The participants started 6 meters from the bottom of the steps and then ran up the steps three at a time, stepping on the third, sixth and ninth steps. The interval between the participant placing a foot on the third and ninth step was timed using pressurized time mats to accurately determine the interval time between the 3^{rd} and 9^{th} stair. The participant was allowed to practice the stair climb 2 times prior to testing. Participants performed 3 Margaria stair climb tests, separated by 2 mins of active recovery (walking down the stairs and standing) and their fastest time was recorded for data purposes. After the participants' fastest time was recorded, it was inserted into a calculation formula to determine lower body muscular power.

Formula

$$\text{Power (Watts)} = \frac{\text{G (Acceleration due to Gravity) x M (Mass) x H (vertical height between 3}^{rd}\text{ and 9}^{th}\text{ step)}}{\text{T (time between 3}^{rd}\text{ and 9}^{th}\text{ step)}}$$

After the Margaria stair climb, participants were given 5 mins of rest to recover prior to doing the treadmill (MVO_2 test. The treadmill MVO_2test determined the participant's ability to take in and utilize oxygen, which is a standard measure of aerobic capacity.

To determine the MVO_2, participants completed a graded exercise test to exhaustion, which was performed on a motorized treadmill (Figure 8).

Before the treadmill test, the investigator began recording data with the previously fitted Polar HR monitor. Each participant was shown a Borg RPE 6-20 point scale which measured the degree of difficulty experienced by each participant throughout different stages of testing and training sessions (Appendix H, Appendix K). During the treadmill test, the investigator held up an RPE chart at the end of each 2-minute (min) session, and signal indicated by nodding to the effort they perceived. The participant was also fitted with a Hans Rudolph facemask (Model V2) which was attached to the VO_2 testing apparatus (Cosmed Quark CPET) for a breathe by breathe gas collection and analysis.

Figure 8: *Illustrates the MVO_2 Treadmill Protocol being performed with Hans Rudolph Mask attached to the participants head.*

Following a 5-min treadmill warm-up, each participant ran at a self-selected pace (5–7 miles per hour) with incremental increases in grade (2%) applied every 2 min until volitional fatigue (Miller, Dougherty, Green, Crouse, 2007; Schealder & Devor, 2015). HR was recorded every 2 mins throughout the test using the Polar HR monitor. MVO_2 was taken when 1 of the following criteria were met: (i) greatest 30-s average in the presence of a plateau in VO_2 values (<1.35 mL.kg−1.min−1 increase) despite increasing workload, (ii) achievement of a HR max (<10 beats.min−1 of age-predicted maximum (220 − age), and/or (iii) voluntary exhaustion (Miller, Dougherty, Green, Crouse, 2007; Schealder & Devor, 2015). Upon completion of the treadmill protocol and a reduction in treadmill speed, participants sat down on a chair, and an earlobe blood lactate measurement was obtained. Water was readily available in the lab for the participant to replenish hydration levels.

Stair Climbing SIT Sessions

When participants arrived for the first SC SIT session, they were fitted once again with the Polar HR monitor, were shown a copy of the Borg RPE 6-20 scale (Appendix H), aand were given an explanation of the SC SIT protocol. The participant was reminded to note the stair number reached during the completion of each 15 sec SC SIT interval in order to keep track of potential differences from interval to interval as fatigue set in. The Gymboss Interval Timer (Figure 3) was used to track time of the intervals using a "beep" to notify the participant to begin and stop the SC SIT work and the rest periods.

A standardized dynamic warm-up took place consisting of 10 jumping jacks, 10 forward/backward leg swings, 10 horizontal side to side leg swings, and ascending/descending 2 flights of stairs that got participants accustomed to moving up the stairs prior to SC SIT.. Following the warm-up, participants were seated for 2 mins prior to the initiation of the SC SIT training to allow adequate recovery from the warm-up. Participants were told that they would perform four SC SIT sets climbing stairs as fast and as safe as possible using the handrail if necessary. Participants were reminded that they would perform 4, 15 sec bouts of SC SIT separated by 90 secs of rest, a 1:6 work to rest ratio. This work to rest ratio was chosen because it has been previously reported in a SC SIT study (Allison et al., 2017) and two separate cycle ergometer SIT studies (Gillen et al., 2014 2016) to elicit significant MVO_2 responses. Total training session time was approximately 20 mins including warm up, SC SIT, and cool down.

The participants climbed as many stairs as possible in a 15-sec bout without weight. For both groups (Table 2), no-weight was used during the first wk of SC SIT to ensure all participants became familiarized with SC SIT. Upon completion of the first wk, participants continued with SC SIT in their respective training groups: Control Group - 7 wk non-weighted, and 10/20% BW Group – (1 wk non-weighted + 3 wk with 10% BW + 3wk with 20% BW). The purpose of increasing the weight was to provide a progressive overload and determine if further improvements in MVO_2 and skeletal muscle performance could be elicited during weighted SC. The addition of 10% and 20% BW had been previously used in treadmill and stair climbing exercise training studies (Cress et al., 1991; Puthoff et al., 2006; McCormick et al., 2011). Additionally, as fatigue began to set in during SC SIT, it was the job of the investigator to constantly monitor participant technique and provide encouragement (Appendix J).

Table 2: *The exercise protocol for wk 1 involved all three groups utilizing no weight to ensure that all groups became accustomed to SC SIT. The first wk of SC SIT involved all SC SIT groups using no load. During wks 2-4 SC SIT weight for the Control group was 0%BW, and the 10/20% group added 10% of their bodyweight. The last 3 wks the Control group continued to use 0%BW, and the 10/20% Group added 20% of their body weight during SC SIT.*

SIT SC Workout Set Week 1	**1. Control Group**	**2. 10-20% BW Group**
1	0%	0%
2	0%	0%
3	0%	0%
4	0%	0%
Workout Set Weeks 2-4		
1	0%	10%
2	0%	10%
3	0%	10%
4	0%	10%
Workout Set Weeks 5-7		
1	0%	20%
2	0%	20%
3	0%	20%
4	0%	20%

Work: Rest 15:90secs

At the end of each SC SIT work interval, participants reported their HR, RPE, and step number attained to the investigator which were then recorded during all 21 SC SIT sessions (Table 3). After the SC work interval was finished, participants were given a rest time of 90 secs, during which time they walked down to the bottom at their own pace to prepare for the next interval. When participants reached the bottom of the stairs, they were allowed to stand or walk around for the remaining rest interval. Ten secs before the end of the rest interval, participants were instructed to move to the start of the stairs in preparation for the next SC interval.

Table 3: *The investigator recorded each participant's SC SIT HR, RPE, stair number climbed and recovery HR during each session (1-21) in order to track physiological responses throughout the SC SIT study.*

Stair Climbing Round (15 secs) **Sessions # ______**	**Rest Break (secs)**	**Stairs Climbed**	**Heart Rate (BPM)**	**RPE (6-20)**	**Recovery Heart Rate (BPM)**
1. 15secs	**90**				
2. 15secs	**90**				
3. 15secs	**90**				
4. 15secs	**90**				

At the end of each testing and SC SIT session participants completed a cool down routine, where each participant walked at a self-selected pace for 2-5 mins or until they achieved a pre-exercise resting heart rate value. A foam roller was provided as well to aid in participant recovery post-exercise. After each training session, the Polar HR monitor was sterilized with disposable alcohol wipes.

Participant Confidentiality

Participant's personal information and testing results were stored confidentially. All digital data was on a password protected computer with hard copies locked in the investigator's office away. All VO_2 data was stored on a password-protected computer in the Undergraduate Laboratory. All personal data was stored as a unique identification number, instead of a participant's name to further keep the data anonymous. Participants were notified that if they felt uncomfortable, or would like to no longer participate in this research study, they could withdraw from the investigation at any point in time.

Sample Size

The purpose of this study was to examine if there were any physiological adaptations in lower body power, lower body strength, treadmill MVO_2, heart rate, and metabolic adaptations in exercising lactate concentration. With an alpha level of 0.05, an effect size of 0.25, and a power of 0.8, the sample size necessary to detect significant changes was 24 participants, with 12 required for each of the two training groups. For the purpose of this study, the aim was to recruit 30 participants to account for potential dropouts.

Statistics

Statistical analyses were performed using SPSS 21. All data including descriptive statistics were presented as means and standard deviations (SD). Discriminative analyses using factorial ANOVA between within interaction was conducted on Body Composition, Margaria stair climb power, treadmill MVO_2, resting blood lactate, blood lactate post MVO_2, peak HR, peak RHR and RPE that investigated and identified relationships throughout the training protocol. All ANOVA's required repeated measures on the factor of time (baseline, mid-way, and post SIT). For the analysis of lactate values, a 2 (resting and immediately after) x 3 (baseline, mid-way, and post SIT) factorial ANOVA between within interaction was used. Mean differences were considered statistically significant when $p < 0.05$.

RESULTS

Participant characteristics in the two experimental groups are outlined in Table 4.

Table 4: Male Participant Characteristics

Group	Age (yrs)	Weight (kg)	Height (m)
Non-Weighted (n=13)	22.69 ± 2.91	80.43 ± 14.28	1.78 ± 0.04
Weighted (n=14)	22.30 ± 2.26	80.63 ± 9.02	1.79 ± 0.06

Values are mean ± SD

All participants performed the same protocol for the first wk of SC SIT, which involved completing 4, 15 sec bouts of SC SIT separated by 90 secs of rest, a 1:6 work to rest ratio without a weighted vest. Upon the completion of wk 1, participants were randomly assigned into one of the two experimental groups (non-weighted or weighted). The non-weighted stair climbers performed the additional 6 wks of SC SIT without any additional load, whereas the weighted stair climbers added 10% BW through wks 2-4 and then increased to 20% BW for the final 3 wks of the SC SIT protocol. The addition of BW was added to the weighted stair climbers in an attempt to increase exercise intensity and lead to further increases in performance.

Two stair climbers in the non-weighted group had to withdraw from the study: one due to an injury obtained outside of the study, and other due to an inability to adhere to the time commitment of the training protocol. Three stair climbers in the weighted group were unable to complete mid-way (4 wks) MVO_2, blood lactate, and peak average HR post

MVO_2 testing due to complications with the VO_2 system and as a result their data was not included in the mid-way calculations

Stair Climbing SIT Peak Heart Rate and Recovery Heart Rate Responses

Statistical analyses for non-weighted and weighted stair climbers determined there were no significant differences in average peak heart rate responses between the 2 groups for any of the SC SIT bouts over the 7 wks of SC SIT. (Figure 9).

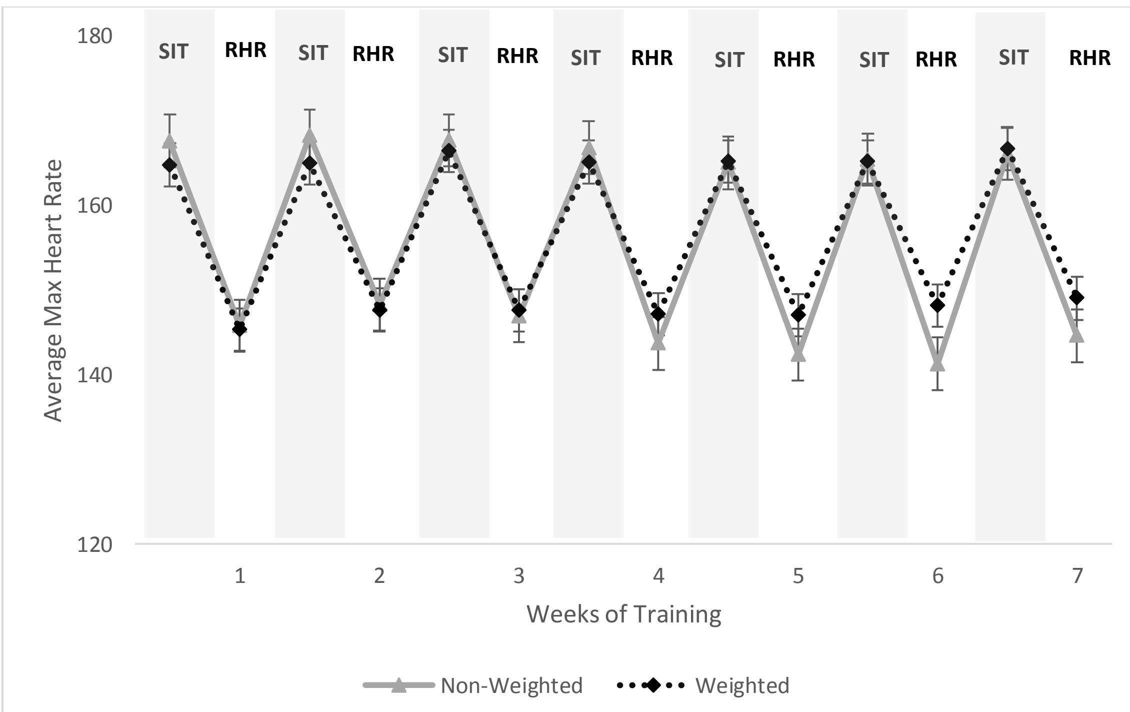

Figure 9: *Average peak heart rate during stair climbing (15 sec) and recovery heart rate (RHR) responses (90 sec) for the non-weighted (n=13) and weighted (n=14) stair climbing (SC) groups over the 7 wks of SC SIT. Percentage of age-predicted maximum heart rate (Max HR) was 84% for both stair climbing (SC) groups. Values are means ± SD.*

Stair climbing recovery HR responses were collected 20 secs before the next SIT interval and were determined once the participants had walked down the stairs to start the next work interval. Statistical analyses for non-weighted and weighted stair climbers determined there were no significant differences in average recovery heart rates for any of the 7 wks of SC SIT recovery periods.

Stair Climbing SIT Rating of Perceived Exertion Responses

Statistical analyses for non-weighted stair climbers determined there were no significant differences in rating of perceived exertion (RPE) throughout the 7 wks of SC SIT. (Figure 10). Statistical analysis for weighted stair climbers found significant differences in rating of perceived exertion (RPE) from wk 1 of SC SIT to wk 2 of SC SIT (10% BW) ($F(1,13) = 4.670$, $p<0.05$), no significant differences from wk 1 of SC SIT to wk 3 of SC SIT (10% BW) ($F(1, 13) = 2.209$, $p=0.161$), significant difference found from wk 1 of SC SIT to wk 4 of SC SIT (10% BW) ($F(1,13) = 4.472$, $p<0.05$). Further, for weighted stair climbers, significant differences were found from wk 1 of SC SIT to wk 5 of SC SIT (20% BW) ($F(1,13) = 20.351$, $p<0.05$), wk 1 of SC SIT to wk 6 of SC SIT (20% BW) ($F(1,13) = 23.248$, $p<0.05$), and wk 1 of SC SIT to wk 7 of SC SIT (20% BW) ($F(1,13) = 13.951$, $p<0.05$).

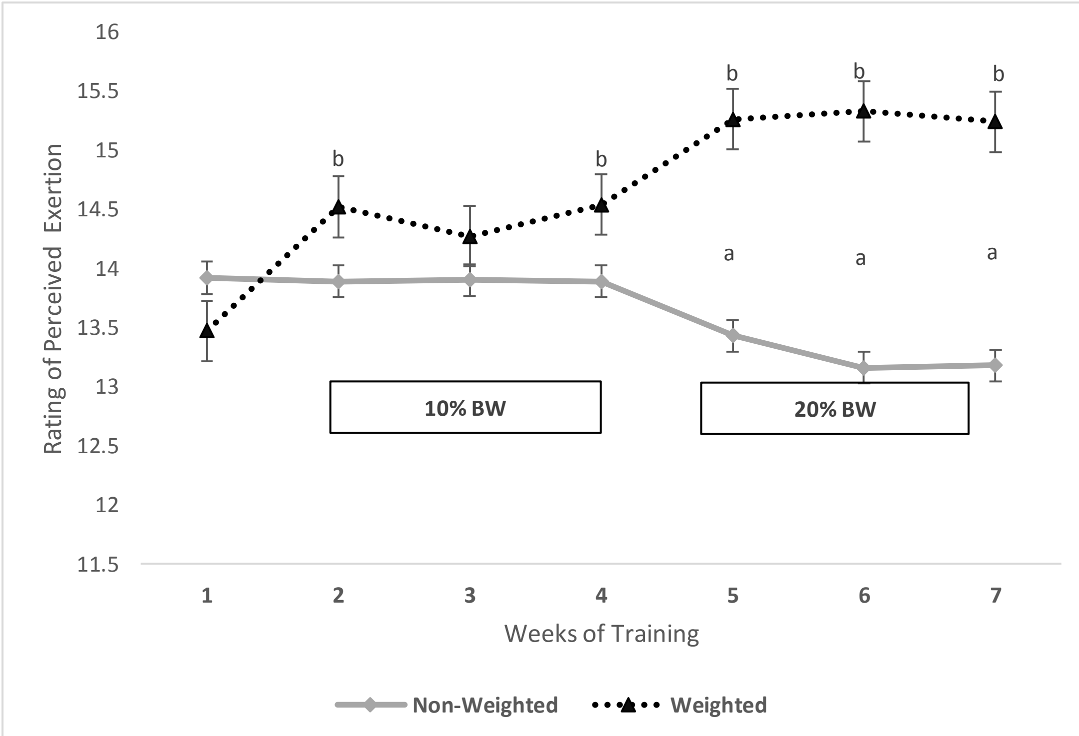

Figure 10: *Average rating of perceived exertion for the non-weighted (n=13) and weighted (n=14) stair climbing (SC) groups during the 7 wks of SC SIT. Values are means ± SD.* [a]*p < .05 between non-weighted SC and weighted SC groups for the corresponding wk.* [b]*p < .05 from wk 1.*

When comparing rating of perceived exertion between non-weighted and weighted stair climbers, there was no significant differences found between groups at wk 1 (F (1,26) = 0.081, p=0.781), and wk 2 (10% BW added to weighted stair climbers) (F (1,26) = .748, p=0.395), wk 3 (10% BW added to weighted stair climbers) (F (1,26) = .796, p=0.381) and wk 4 (10% BW added to weighted stair climbers) (F (1,26) = 0.641, p=0.439) of SC SIT. However there was a significant RPE differences found at wk 5 of SC SIT (20% BW added to weighted stair climbers) (F (1,26) = 13.508, p<0.05), wk 6 of SC SIT (20% BW added to weighted stair climbers) (F (1,26) = 12.983, p<0.05), and wk 7 of SC SIT (20% BW added to weighted stair climbers) (F (1,26) = 8.427, p<0.05).

Stair Climbing SIT Stairs Climbed

Statistical analyses for non-weighted stair climbers determined there were no significant differences in the average number of stairs climbed during the first 3 wks of SC SIT. (Figure 11). However, there was a significant increase found following 4 wks of SC SIT ($F(1,12) = 6.230$, $p<0.05$), 5 wks of SC SIT ($F(1,12) = 9.753$, $p<0.05$), 6 wks of SC SIT ($F(1,12) = 7.647$, $p<0.05$), and 7 wks of SC SIT ($F(1,12) = 14.751$, $p<0.05$). Similarly, when 10% BW was added the weighted stair climbers demonstrated no significant differences in stairs climbed from wk 1 to wk 2 of SC SIT ($F(1,12) = 1.243$, $p<.285$), wk 1 to wk 3 of SC SIT ($F(1,12) = .081$, $p<0.250$) and wk 1 to wk 4 of SC SIT ($F(1,12) = 0.001$, $p<0.280$).

However, with addition of another 10% BW to a total additional 20% BW load at wk 5 there was a significant decrease in the number of stairs climbed at wk 5 of SC SIT ($F(1,12) = 9.837$, $p<0.05$), wk 6 of SC SIT ($F(1,12) = 8.315$, $p<0.05$), and wk 7 of SC SIT ($F(1,12) = 7.923$, $p<0.05$).

Figure 11. *Average stairs climbed for the non-weighted (n=13) and weighted (n=14) stair climbing (SC) groups. Values are means ± SD.* [a]*$p < .05$ between non-weighted SC and weighted SC groups for the corresponding wk.* [b]*$p < .05$ from wk 1.*

Comparing average stairs climbed there were no significant differences found between the non-weighted and weight stair climbers for the first 3 wks of SC SIT. Between non-weighted and weighted stair climbers, a significant difference was only found when 20% BW was added (see Figure 11) at wk 5 of SC SIT ($F(1,26) = 66.753$, $p<0.05$), wk 6 of SC SIT ($F(1,26) = 37.634$, $p<0.05$), and after wk 7 of SC SIT ($F(1,26) = 35.597$, $p<0.005$).

Body Composition

BOD POD Analysis

Body composition changes were only assessed for baseline and post 7 wks as it was believed that 4 wks would not have been a sufficient time stimulus to produce any significant results.

For non-weighted stair climbers, changes in body composition following 7 wks SC SIT observed no significant improvements in Body Mass (kg) Fat-Free Mass (kg) Fat Mass (kg), Fat Mass and Fat-Free Mass Post. Similarly, weighted stair climbers, observed no significant improvements in Body Mass (kg), Fat-Free Mass (kg), Fat Mass (kg), Fat Mass %, and Fat-Free Mass Post % following 7 wks SC SIT.

Table 5: Summary of SC SIT body composition values pre and post SC training for non-weighted and weighted participants.

Group	Wks	Body Mass (kg)	Fat-Free Mass (kg)	Fat Mass (kg)	Fat Mass %	Fat-Free Mass Post %
Non-Weighted	0	81.18 ± 14.10	65.19 ± 6.65	15.44 ± 10.16	18.14 ± 7.61	81.86 ± 7.61
(n=13)	7	80.63 ± 14.28	65.86 ± 7.20	15.31 ± 9.08	18.04 ± 6.73	81.96 ± 6.76
Weighted	0	80.36 ± 12.31	65.52 ± 7.60	14.84 ± 4.71	18.39 ± 5.03	81.65 ± 5.00
(n=14)	7	80.39 ± 9.02	66.02 ± 7.79	14.53 ± 6.35	17.82 ± 6.61	82.17 ± 6.61
Values are mean ± SD						

Comparing differences in body composition values over the baseline testing period between non-weighted and weighted stair climbers observed no significant differences between groups for Body Mass (kg), Fat-Free Mass (kg), Fat Mass (kg), Fat %, Free Mass %. Comparing differences between non-weighted and weighted stair climbers post

7 wks of SC SIT also did not demonstrate significant changes in body composition Body Mass (kg), Fat-Free Mass (kg), Fat Mass (kg), Fat %, and Fat-Free Mass % (Table 5).

Skeletal Muscle Power

Margaria Stair Climb

The Margaria Stair Climb was performed to measure changes in lower body leg power, as it involves an individual running up a flight of stairs (landing on the 3rd step and 9th step) and simulates the action associated with SC SIT (Figure 7). The repeated ANOVA analyses, for non-weighted stair climbers, demonstrated a significant improvement in skeletal muscle power production for the Margaria Stair Climb test after the first 4 wks of SC SIT ($F(1,12) = 6.693$, $p<0.05$), as well as significant improvements from 0 wks to 7 wks ($F(1,12) = 8.773$, $p<0.05$). No significant improvements were found in non-weighted stair climbers from wks 4 to 7 of SC SIT ($F(1,12) = 3.547$, $p=0.084$)

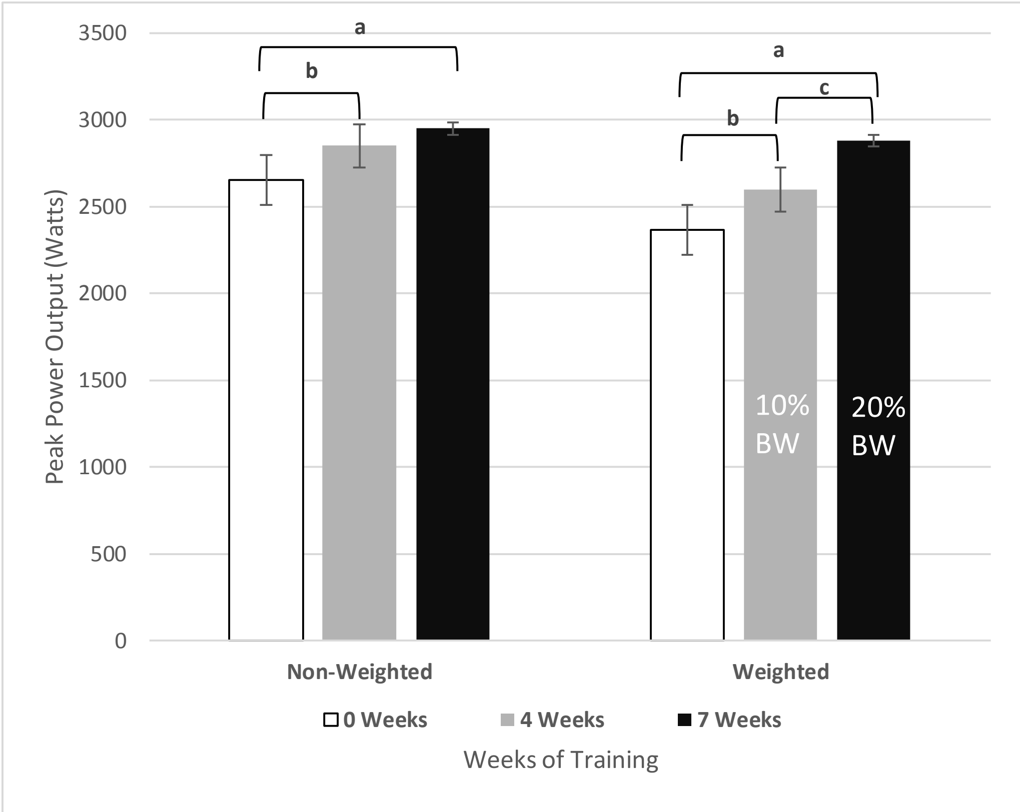

Figure 12: *Non-weighted and weighted peak power output (Watts) during the Margaria Stair Climb at 0 wks, after 4 wks of SC SIT and after 7 wks of SC SIT. Non-weighted SC SIT n=13, weighted SC SIT n=14. Values are means ± SD.* [a]*p<.05, 0 vs. 4 wks* [b]*p<.05 0 vs. 7 wks* [c]*p<.05 4 vs. 7 wks. No significant differences were found between groups.*

Similarly, weighted (10% BW) stair climbers observed similar significant improvements after the first 4 wks of SC SIT (F (1,13) = 11.691, p<0.05), when BW was increased to 20% BW from wks 4 to 7 of SC SIT (20% BW) (F (1,13) = 5.007, p<0.05), and significant improvements from 0 wks to 7 wks (F (1,13) = 34.575, p<0.001).

Comparing differences between non-weighted and weighted stair climbers in skeletal muscle power over the three testing periods 0 wks, 4 wks SC SIT, post 7 wks SC SIT, no significant differences were observed at 0 wks(F (1,26) = 2.473, p=0.142) and after 4 wks of SC SIT (F (1,26) = 2.478, p=0.141), along with no significant differences post 7 wks SC SIT (F (1,26) = 0.769, p=0.398) despite the addition of 10% and 20% BW to weighted stair climbers in attempts to further increase skeletal muscle power.

MVO_2, Blood Lactate and Peak Heart Rate Data Collection

Earlobe blood lactate (BLa) concentrations were taken before and after each MVO_2 test to measure the contribution of anaerobic glycolysis to exercise and peak heart responses were recorded after each MVO_2 to measure exercise intensity.

Blood Lactate and Peak Average Heart Rate Post MVO_2

Blood lactate (BLa) concentrations before and after each MVO_2 test, as well peak average heart rates during the MVO_2 for non-weighted and weighted stair climbers are shown in Table 6.

Table 6: Summary of average treadmill MVO_2, blood lactate concentrations and peak average heart rates values at 0 wks, after 4 wks of SC SIT and 7 wks of SC SIT for non-weighted and weighted (10-20% BW) stair climbers.

Group		**Resting Blood Lactate (mmol/L)**	**Post MVO_2 Blood Lactate (mmol/L)**	**Peak Average Heart Rate Post VO_2 (bpm)**
Non-Weighted	0 Wks	1.82 ± 0.29	9.1 ± 2.01[a]	191.07 ± 9.0
(n=13)	4 Wks	1.81 ± 0.30	9.36 ± 1.97[a]	191.67 ± 9.5
	7 Wks	1.86 ± 0.22	8.9 ± 2.24[a]	188.46 ± 8.8
Weighted	0 Wks	1.92 ± 0.40	10.2 ± 2.07[a]	191.14 ± 10.1
(n=11)	4 Wks	1.87 ± 0.33	10.44 ± 3.4[a]	189.74 ± 9.5
	7 Wks	1.96 ± 0.31	11.8 ± 4.2[a]	189.21 ± 9.8

Values are mean ± SD
[a]Resting vs. Immediately Post at 0, 4 and 7 wks. No significant differences were found between non-weighted and weighted stair climbers (10-20% BW) for any of the testing periods.

In non-weighted and weighted stair climbers, there were no significant differences were in resting BLa at any of the testing wks. For non-weighted stair climbers, as expected the blood lactate concentrations rose significantly immediately after the treadmill MVO_2 test for the 0 wks testing session $F(1,12) = 147.200$, $p<0.001$, after 4 wks of SC SIT testing session ($F(1,12) = 173.69$, $p<0.001$), and after 7 wks of SC ($F(1,12) = 108.659$, $p<0.001$). Weighted stair climbers observed similar results demonstrating that resting BLa also rose significantly immediately after the treadmill MVO_2 test in the 0 wks testing session ($F(1,10) = 228.95$, $p<0.001$), after the 4 wks of SC SIT testing session ($F(1,10) = 64.436$, $p<0.001$), and after 7 wks of SC training ($F(1,10) = 88.044$, $p<0.001$) (Table 6). In non-weighted and weighted stair climbers, there were no significant differences were in resting BLa at any of the testing wks.

Comparing differences between BLa values over the three testing periods, between non-weighted and weighted stair climbers, there were no significant differences observed between the two experimental SC groups.

Peak Average Heart Rate Post MVO_2

Comparing differences between peak average heart rate values during the MVO_2 over the three testing periods (0 wks, 4 wks, post 7 wks SC SIT), in both non-weighted and weighted stair climbers, no significant differences were observed.

Comparing differences between peak average heart rate values post MVO_2 over the three testing periods (0 wks, 4 wks, post 7 wks SC SIT), between non-weighted and weighted stair climbers, no significant differences were observed .

Oxygen Consumption

MVO_2

For non-weighted stair climbers, no significant improvements were found after 4 wks of SC SIT training ($F (1,12) = 0.181, p=0.678$). However, there were significant improvements in MVO_2 after 7 wks SC SIT ($F (1,12) = 15.910, p<0.05$), as well as significant improvements in MVO_2 between 4 wks and post 7 wks of non-weighted SC SIT ($F (1,12) = 4.889, p<0.05$).

Weighted stair climbers observed no significant improvements after 4 wks (addition of 10% BW for weighted stair climbers) of SC SIT training ($F (1,10) = 0.125$ $p=.731$). However, there were significant improvements in MVO_2 post 7 wks SC SIT ($F (1,10) = 11.900$ $p<.05$), as well as improvements, reached significant levels between 4 wks (addition of 20% BW for weighted stair climbers) and 7 wks of SC SIT ($F (1,10) = 14.481, p<0.05$).

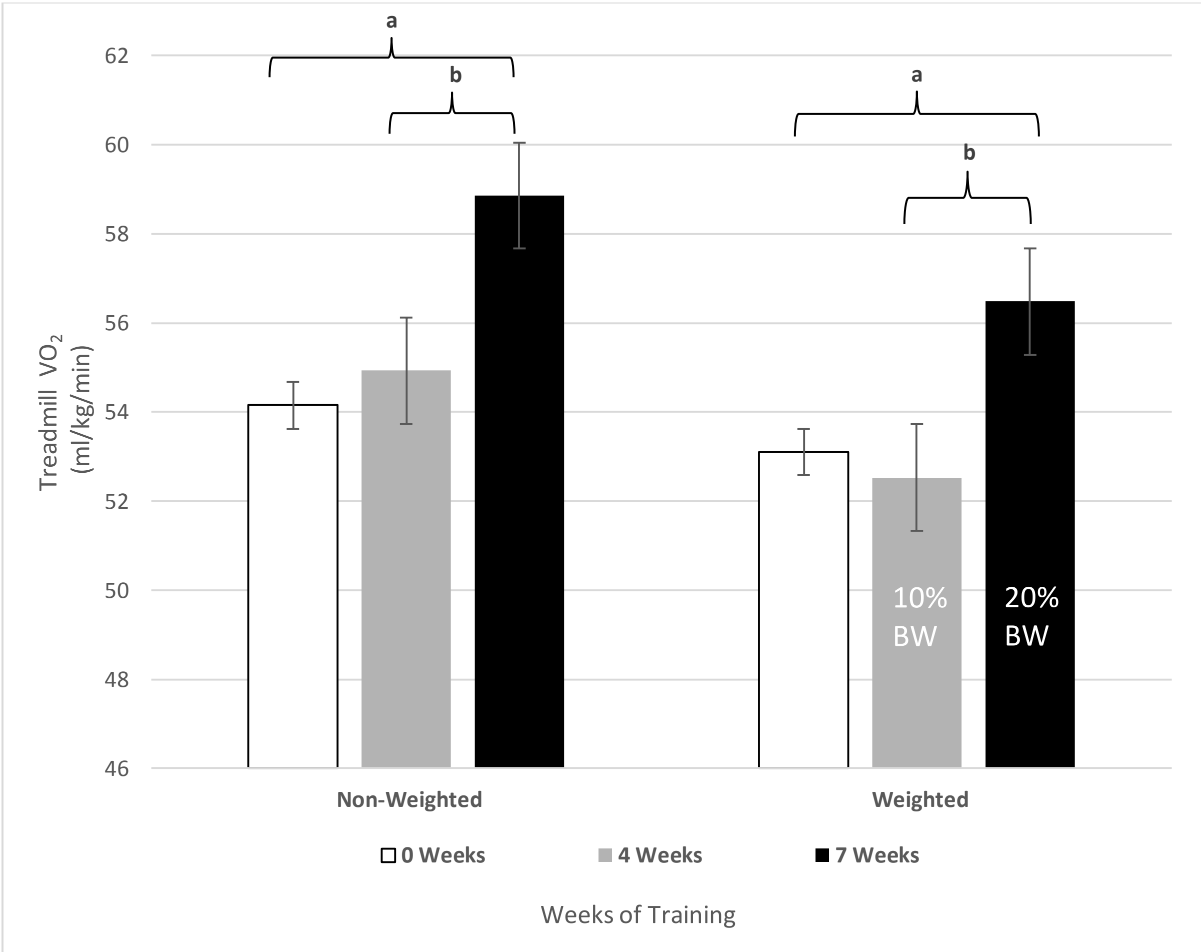

Figure 13*: Treadmill MVO_2 at 0 wks and following 4 and 7 wks of SC SIT for non-weighted (n=13) and weighted (n=11) participants. Values are means ± SD. [a]p<.05 0 vs. 7 wks. [b]p<.05 4 vs. 7 wks.*

Comparing differences between non-weighted and weighted stair climbers in MVO_2 values, there was no significant differences seen at 0 wks of SC SIT (F (1,23) = 0.031, p=0.863), 4 wks of SC SIT (non-weighted versus addition of 10% BW to weighted stair climbers) (F (1,23) = 0.097, p=0.763) and after 7 wks of SC SIT (non-weighted versus addition of 20% BW to weighted to stair climbers) (F (1,23) = 0.431, p=0.524)

DISCUSSION

Traditional stair climbing (SC) studies performed at varying intensities for 2-45 minutes (mins) for 6-12 weeks (wks) or longer with 3-5 workouts per week (wk) have resulted in improvements in maximal oxygen consumption (MVO_2)(4-17%) and skeletal muscle performance (Boreham et al., 2000; 2005; Egana et al., 2004; Loy et al., 1993; 1994). In contrast to traditional aerobic training requiring 30-45 mins, sprint interval training (SIT) involves performing cardiovascular exercise at an 'all out' or supramaximal intensity for 10-30 secs on a cycle ergometer or treadmill separated by a period of active recovery, or inactivity (rest), with work to rest ratios ranging from 1:1 to 1:24 (Burgomaster et al., 2006; Gibala et al., 2006; Hazell et al., 2010). Treadmill and cycle ergometer sprint interval training (SIT) studies have reported significant improvements in anaerobic capacity, body composition, peak power output, skeletal muscle buffering capacity and increases in acute VO_2 and MVO_2, but with up to 90% less training volume (Gibala et al., 2006; Gillen et al., 2016; Hazell et al., 2014; Nalcakan, 2014). In a recent study, Allison et al. (2017) investigated if SC SIT was similar to traditional treadmill and cycle ergometer SIT protocols on improving MVO_2. Allison et al. (2017) conducted 2 separate SC protocols that consisted of stair climbing ascending stairs (SCAS) SIT performed for 3 sets, 3x/wk at a 1:6 work to rest ratio (20 sec: 120 sec) over a 6 wk period, or stair climbing ascending and descending stairs (SCADS) SIT performed for 3 sets, 3x/wk at a 1:1 work to rest ratio (60 sec: 60 sec) over a 6 wk period in university aged females. Allison et al. (2017) reported a significant 12% improvement in MVO_2 scores for the SCAS group and a significant 8% improvement in MVO_2 scores for the SCADS group, indicating that SCAS or SCADS SIT was as effective as traditional treadmill and cycle ergometer SIT.

Typically, in an attempt to further enhance MVO_2 adaptations or performance, exercise intensity is elevated by increasing treadmill speed/grade or cycle ergometer workload resistance. With stair climbing, Loy et al. (1994) added a weighted vest (4-8% BW) but maintained exercise intensity (HR) similar to the non-weighted SC group by reducing the step rate in the weighted group and reported that only the weighted group showed a significant increase in leg strength at 60 degrees knee angular velocity. They also reported that the additional BW (4-8%) added did not lead to significant improvements in MVO_2 as exercise intensity was maintained by reducing the step rate in the weighted stair climbers. Based off the Loy et al. (1994) study, we wanted to determine if exercise intensity was not maintained when adding a weighted vest to an 'all out' SC SIT protocol would there be improvements in MVO_2, body composition and lower body peak power output. Our SC SIT study compared a non-weighted control group (0% BW) and a weighted experimental group (10%-20% BW) following a SIT protocol that involved performing 4 sets, 3x/wk at a 1:6 work to rest ratio (15 sec work: 90 sec rest) for 7 wks. Our weighted SC SIT group increased weight after wks 1 (10% BW) and 4 (20% BW) with the specific intention of increasing exercise intensity and evoking improvements in MVO_2, body composition, and lower body peak power output. We added 10% and 20% BW to SC SIT based off previous traditional SC (Cress et al., 1991; Loy et al., 1994) and walking studies in an attempt to elicit a higher exercise VO_2 intensity to improve MVO_2 (McCormick et al., 2011; Puthoff et al., 2006) and improve lower body peak power output (Cress et al., 1991; Loy et al., 1994) during SC SIT.

During the SC SIT sessions, there were no significant differences in HR (Figure 9) responses when performing SC SIT with or without load for males throughout all 7 wks of SC SIT. Mean peak exercising HR responses for the non-weighted vest group were 84% ± 6 of age-predicted max HR and for the weighted vest group 84% ± 4 of age-predicted max HR, which is consistent with the mean HR responses of 80-85% of age predicted max HR seen by previous SC researchers (Allison et al., 2017; Loy et al., 1994). We had expected that peak exercising HR would be significantly higher in the weighted vest group (10-20% BW) similar to studies that involved walking on a treadmill with a weighted vest of 10%-20% BW which showed significant increases in HR (McCormick et al., 2011; Puthoff et al., 2006). Our SC SIT peak HR data showed that when performing exercise at an 'all out' intensity in the case of SIT, an additional load (10-20% BW) during a work interval of 15 secs does not lead to further increases in exercise intensity as determined by HR. This is in contrast to performing exercise at a lower intensity as in the case of walking, adding a weighted vest increased exercise intensity HR (McCormick et al., 2011; Puthoff et al., 2006), but during 'all out' efforts it does not. Interestingly, when exercising at an 'all out' intensity for a short 15 sec work interval adding 20% BW for wks 5-7, resulted in a statistically significant drop (3 steps) in average stairs climbed (Figure 11), while the non-weighted SC group had a significant increase (3.5 steps) in stairs climbed for wks 5-7. These opposing changes in steps resulted in a significant difference between non-weighted and weighted SC (6.5 steps) that might be attributed to non-weighted stair climbers improving both speed and leg power while weighted stair climbers slowed down due to the extra 20% BW load.

Similarly, we report no significant differences were seen in peak recovery heart rate (RHR) when comparing the non-weighted and weighted stair climbers, indicating that all participants' heart rates were recovering in a similar manner. Mean RHR responses over the 7 wks of SC SIT for the non-weighted vest group were 73% ± 8 of max HR and for the weighted vest group 75% ± 7 of max HR. No differences in RHR also suggest that walking down the stairs with or without a weight did not influence recovery HR or provide an additional training effect to our participants.

In addition to measuring HR to examine exercise intensity we assessed participants rating of perceived exertion (RPE) (Appendix H) during SC SIT and report that during wks 2-4 of SC SIT when 10% BW was added to weighted stair climbers, no significant differences in RPE responses (Figure 10) was found between training groups. The 10% BW may not have been a sufficient stimulus to alter the RPE similar to our physiological HR data when compared to SC SIT without weight. However, during wks 5-7 when 20% BW was added, RPE rose significantly higher when compared to non-weighted stair climbers but as previously discussed there was no change in heart rate due to the 'all out' nature of SC SIT. The higher RPE responses seen during wks 5-7 for weighted stair climbers may have been attributed merely to the added weight being perceived as being more difficult since the RPE scale is a subjective measurement. While the non-weighted and weighted stair climbers were working at a similar intensity based off physiological data (HR), the perception of 20% BW and the significant drop in their average steps climbed may have all attributed to the elevation in RPE.

To assess the benefits of SC SIT on body composition, we conducted a BOD POD analysis for changes in various parameters of body composition (Table 5). After the 7 wks of SC SIT using 4x15 sec work intervals, there were no significant changes in body composition found within or between the non-weighted and weighted stair climbers. The results were similar to that of Allison et al. (2017), who used a 3x20 sec SCAS SIT work interval for 6 wks and also reported no significant improvements in body composition for sedentary female stair climbers. Interestingly, Islam et al. (2017) compared post-exercise fat oxidation following 3 acute treadmill SIT protocols involving 1:8 work to rest ratios (5 sec: 40 sec, 15 sec: 120 sec, 30 sec: 240 sec) and reported significantly elevated fat oxidation rates with the 15 and 30 sec work intervals. These results from Islam et al., (2017) suggest our work interval of 15 sec: 90 secs and Allison et al. (2017) 20: sec: 120 secs were sufficient to elevate fat oxidation rates post-exercise, but that our study (7 wks) and Allison et al. (2017) (6 wks) SC SIT were not long enough to produce significant changes in body composition. Also, one may suggest that a restriction/reduction in caloric intake during 6 or 7 wks SC SIT might be required to see a change in body composition.

Individual exercises that increase strength, but more importantly translate into muscular power or quickness in sporting events are gaining recognition as a critical component in individual and team strength and conditioning programs (Baker, 2001; Newton et al., 1997). Previously performing cycle ergometer SIT, Nalcakan (2014), had participants perform ‘all-out’ sprints on a cycle ergometer for 4-6 sets, 3x/wk at a 1:9 (30 sec: 270 sec) work to rest ratio over 7 wks and reported a significant 8.9% increase in Wingate lower body peak power output. Given the repetitive movement of climbing stairs during our SC SIT protocols, we decided to assess lower body peak power changes by having our participants perform the Margaria Stair Climb (Figure 7) which assesses leg power by sprinting up a flight of stairs similar to the SC SIT motion. After the first 4 wks of SC SIT non-weighted stair climbers significantly improved their lower body peak power output by 7%, and weighted stair climbers improved by 9%. With an increase in SC weight (20% BW) and an additional 3 wks of SC training, weighted stair climbers significantly increased lower body peak power output an additional 10%, whereas non-weighted stair climbers had an insignificant improvement of 4.5% over the final 3 wks of SC SIT. When analyzing improvements in lower body peak power output from 0 to 7 wks of SC SIT, non-weighted stair climbers had a significant 11% improvement, and weighted stair climbers had a significant 18% improvement, but there were no statistically significant differences in lower body peak power output between the groups. Our increases in lower body peak power data for both non-weighted and weighted SC are similar to the majority of data reported by Loy et al., (1994) following 12 wks of non-weighted and weighted (4-8% BW) SC in middle-aged females. In a recent SIT study by Rey et al. (2017) comparing non-weighted to weighted (18.9% BW) sprinting (20 metre) in male soccer players training 2x/wk over a 6 wk training period, they reported significant improvements in 10 and 30 metre sprinting speeds for both non-weighted and weighted groups, but no differences between groups. Our data, Loy et al. (1994) and Rey et al. (2017) findings suggest that additional BW does not improve lower body power or speed when compared to no BW additions and may only add to higher ground reaction forces (Puthoff et al., 2006) as well as increase the risk of injury. Adding a higher % BW may be needed to elicit additional lower body peak power improvements, but this may come at the cost of increasing the incidence of injury. Additionally, to potentially see benefits with BW additions, longer training intervals (>15 sec) or an extended training duration (wks) may be required for improvements to appear with added BW 10-20%.

Allison et al. (2017) reported that 6 wks of SC SIT led to a significant increase in MVO_2 and we had theorized that if the SC SIT exercise intensity (HR) could be altered by the addition of weights (10 and 20% BW), we might evoke further improvements in MVO_2. Our first 4 wks of SC SIT, 3x/wk using a 1: 6 (15 sec: 90 sec) work to rest ratio resulted in no change in MVO_2 for both non-weighted and weighted stair climbers. This is in contrast to other studies reporting significant MVO_2 improvements in cycle ergometer SIT with as little as 2 wks using a 1:24 (10 sec: 240 sec) work to rest ratio (Hazell et al., 2010) or using a 1:9 (30 sec: 270 sec) work to rest ratio (Whyte, Gill & Cathcart, 2010). Our non-weighted and weighted results as well as Allison et al., (2017) results, indicate that SC SIT for 3X/wk at a work to rest ratio of 1:6 (15 sec:90 sec or 20 sec: 120 sec) for 4 wks is not enough time to produce a significant improvement in MVO_2. Three additional wks of SC SIT did result in a significant 6% and 8% increase in MVO_2 for non-weighted and weighted stair climbers respectively, with no differences between the groups. These improvements following 7 wks of SC SIT MVO_2 scores are similar to those of Allison et al. (2017) SC SIT results of a 12% increase due to SCAS and 8% increase with SCADS, as well as the 5-12% improvements in MVO_2 seen following traditional aerobic SC and SIT treadmill and cycle ergometer studies (Gillen et al., 2016; Hazell et al., 2014; Loy et al., 1993; 1994; Nalcakan, 2014). Allison et al. (2017) and our SC SIT data indicate that work to rest ratios of 1:6 (15 sec: 90 sec or 20 sec: 120 sec) of SC SIT both provide an adequate stimulus to increase MVO_2 changes. Our data also clearly demonstrate that adding 10-20% BW to a 15:90 sec work: rest interval during an ‘all out’ SC SIT does not lead to an increase in exercise intensity or any additional improvements in MVO_2. To potentially elevate exercise intensity (HR) during an ‘all out’ effort between non-weighted and weight groups, increasing the work interval time may be needed to produce a significantly higher exercise intensity (HR) between groups.

In summary, we had theorized that additional BW to SC SIT during an ‘all out’ effort would have increased exercise intensity and subsequently MVO_2. While our decrease in steps climbed and increase in RPE reflect an increase in exercise intensity with additional BW, no change in peak exercising HR or recovery HR suggest no additional physiological challenge with added BW during SC SIT. We report that SC SIT using 4 sets, 3x/wk at a 1:6 work to rest ratio (15 sec work: 90 sec rest) for 7 wks with a weighted vest (10-20%) does not lead to significant additional increases in treadmill MVO_2 scores or lower body peak power output in recreationally active university-aged males.

CONCLUSION

The present study reports that 4 sets of 15 sec: 90 sec (work: rest) SC SIT using a weighted vest (10-20% BW) did not improve aerobic fitness or lower body power. The “all out” nature of the 15 sec SC SIT may not have been long enough to produce differences between the non-weighted and weighted SC groups or the added weight may not have been sufficient enough to increase exercise intensity (HR) to produce additional improvements. Therefore, strength and conditioning coaches or personal trainers need to be cautious about adding a weighted vest to SC SIT since there is no added benefit in improving aerobic fitness or lower body power and may only increase the incidence of injury.

LIMITATIONS

The current study comes with a few limitations:

1. We only examined the addition of 10%-20% BW during SC SIT, and we do not know if a higher % BW would have resulted in greater changes in aerobic fitness or lower body power.
2. A work interval of 15 secs was only used which might not have been long enough to produce any differences between non-weighted and weighted groups in aerobic fitness and lower body power.
3. The 7 wks of training may have been too short to produce any changes between non-weighted and weight stair climbers as well as see improvements in body composition.
4. Our results are also limited to a recreationally active university aged male population, and it is unknown if we would see similar improvements if we had used females, a sedentary male population, an overweight group and/or an elderly population.
5. Our study did not control for diet or record caloric intake, which may have contributed to no significant change in body composition.

FUTURE RESEARCH

Future research should look to determine if:

1. Longer work intervals during SC SIT are required to produce improvements in aerobic fitness and lower body power while using a weighted vest.
2. Adding a weighted vest to Treadmill SIT has any effects on improving aerobic fitness or lower body power.

3. Performing SC SIT in an overweight and/or older population is effective for improving aerobic fitness or lower body power.
4. A longer training period (> 7 wks) produces changes in body composition during SC SIT with added BW.

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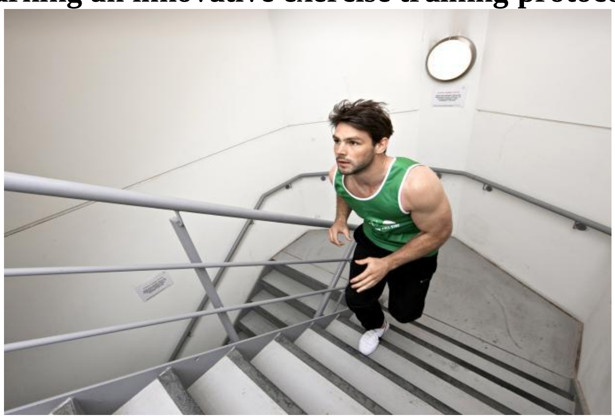
APPENDICES

APPENDIX A

Volunteers Needed

Interested in 7 weeks of stair climbing sprint interval training?

Want to improve your aerobic capacity and skeletal muscle performance while learning an innovative exercise training protocol?



Sign up for a University of Windsor Kinesiology Graduate Thesis Study:

Physiological Effects of Adding a Percentage of Body Weight during a Stair Climbing Sprint Interval Training Program

Male participants are needed (18-30 years of age)

- **With no known cardiovascular disease or major injury (shoulders, low back, hips, knees, ankles)**
- **Recreationally active at least twice per week for the last 3 months and not currently doing stair climbing or sprint interval training**

You will receive a Kinesiology research t-shirt and entered into a draw for 2-$50 Sport Chek gift card for participating!

<u>For more information, please contact:</u>

Remi Sovran: sovranr@uwindsor.ca

APPENDIX B

To: Human Kinetics- Kinesiology University of Windsor Student Body

From: Lead Graduate Researcher- Remi Sovran and Advisor- Kenji Kenno

Subject: Volunteer for a Stair Climbing Sprint Interval Training Study

I am currently recruiting participants for my graduate master's thesis project entitled: "Physiological Effects of Adding a Percentage of Body Weight During a 7 Week Stair Climbing Sprint Interval Training Program". This study will determine if there are significant improvements in muscular power and aerobic capacity (oxygen consumption) after weighted and non-weighted stair climbing sprint interval training.

This study will involve two randomized training groups:

1. Control Group - 7 wk non-weighted
2. 10/20% Group - (1 wk non-weighted + 3 wk with 10% BW + 3wk with 20% BW)

The training will take place three times per week for seven weeks, with each training session lasting only 20 minutes, and each testing session lasting approximately 80 minutes scheduled around your availability.

This would be a great opportunity for you to learn about some of the applied research that takes place here in Kinesiology and the stair climbing sprint interval training protocol.

We are looking for 30 male participants between the ages of 18-30 years old, who are recreationally active at least twice per week for the last 3 months, currently not following any stair climbing or sprint interval training program.

The study has been approved by the University of Windsor Research Ethics Board (REB#17-155)

If interested, or for more information contact:
Remi Sovran at sovranr@uwindsor.ca

APPENDIX C

LETTER OF INFORMATION FOR CONSENT TO PARTICIPATE IN RESEARCH LETTER

Title of Study: Physiological Effects of Adding a Percentage of Body Weight During a 7 Week Stair Climbing Sprint Interval Training Program

You are asked to participate in a research study conducted by Remi Sovran and Dr. Kenji Kenno from the Department of Kinesiology at the University of Windsor. The results will contribute to a graduate master's thesis study.

If you have any concerns or questions about the research, please feel free to contact Remi Sovran and/or Dr. Kenji Kenno (519 250 3000) at any time.

PURPOSE OF THE STUDY

The primary objective of this investigation will be to determine the effect of adding a percentage of body weight (%BW) during Sprint interval training stair climbing (SC SIT) program on cardiovascular and skeletal muscle performance following a 7 week SC SIT protocol with all participants doing 4 sets of 15 secs work: 90 secs recovery, 3 times per week. The 2 experimental groups will be:

1. Control Group - 7 weeks non-weighted
2. 10/20% Group - (1 week non-weighted + 3 week with 10% BW + 3 week with 20% BW)

In a previous study, 6 weeks of sprint interval training stair climbing with no added weight resulted in a significant improvement in lower body oxygen consumption in female participants. Adding a %BW using a weighted vest is a common method strength and conditioning trainer's use to increase the demands of exercise. The question is does adding 10% BW and then 20% BW during stair climbing sprint interval training lead to further improvements in aerobic fitness (oxygen consumption) and lower body skeletal muscle performance.

PROCEDURES

If you volunteer in this study, you will be asked to:

Come to the Multipurpose Laboratory (Room 202) in the Human Kinetics Building at the University of Windsor where you will be asked to complete the Physical Activity Readiness Questionnaire Plus (PAR-Q+) and participant information questionnaire that determines whether you have any known risks that would prevent you from participating in physical activity. These forms include information such as date of birth, sex, medications you might currently be taking and any known history of cardiovascular disease. Participants will then be asked to schedule a date for their initial testing session 30 following a 24-hour exercise and alcohol hiatus and must fast for 4 hours pre-test to prevent interaction of the thermal effect of food. The first session (80 minutes) will involve:

- Body Composition using the ‘Bod Pod’ to determine changes in lean body mass and fat-free mass following 7 weeks of SC SIT.

- The ‘Margaria stair climbing power test’ - a lower body test that involves an individual running up a flight of 9 stairs to assess lower body power. Participants will perform 3 ‘Margaria stair climbs’ with the fastest time being recorded for lower body power calculation.

- The participant will then be seated for 10 minutes. After which, a single use Medlance blood drop lancet will be used to prick the earlobe and draw a single droplet of blood. This blood will then be analyzed for its lactate concentrations with a Lactate Scout, giving a resting baseline value.

- A graded Treadmill VO_2 max protocol will be completed. This test is designed to measure your aerobic capacity while wearing a Hans Rudolph VO_2 mask and a Polar Heart Rate Monitor. This treadmill protocol is conducted at your selected speed and is completed in two-minute stages until volitional fatigue. At the end of each two-minute stage, you will be asked to rate your exertion using the Borg 6-20 Rating of Perceived Exertion Scale.

- Immediately after the MVO_2 test is completed another earlobe blood lactate concentration measurement will be taken.

- This protocol will also be completed 3 times, prior to stair climbing training, after 4 weeks and after 7 weeks of stair climbing SIT sessions to test training adaptations.

After a minimum of 24 hours, the first SC SIT training session will involve

- Being fitted with a Polar HR monitor and you will be instructed to perform an active warm-up to make sure that your body is prepared for SC SIT

- You will complete 4 SC SIT sessions with 15 seconds of stair climbing, matched by 90 seconds of rest. During each workout set, you will be asked the step number reached, your exercising heart rate and your rating of perceived exertion using the Borg 6-20 point. As well as recovery HR prior to initiating each SC SIT session

- Following the SC SIT, a recovery stretching routine will occur in order to cool down and stretch out the muscle tissue used

POTENTIAL RISKS AND DISCOMFORTS

Delayed onset muscle soreness may occur between 24 to 72 hours after your training session. With proper rest and avoidance of extra training, recovery will occur. Proper stretching protocols will be administered post-training session in order to assist in muscle flexibility post workout. If an unusual or unexpected discomfort is felt throughout the investigation, the protocol can be stopped. Water will be made available to you.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

Participants can expect to gain knowledge of a unique training protocol while improving their fitness. This research can lead to improvements in strength and conditioning programs in the fitness community. Stair climbing is currently being used in this field, and this investigation will provide further information as to their appropriate application, and implementation.

COMPENSATION FOR PARTICIPATION

The participants will not receive any financial compensation, however participants will be entered in a draw to win one of two $50 Sport Chek gift cards, along with receiving a t-shirt for their participation in this study.

CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. The confidentiality of participant information will be ensured as each participant will be given a unique code that can only identify them by name as associated with an initial file. This file will be digitally secured via password on a personal computer, and a hard copy will be kept in an office in a locked cabinet.

PARTICIPATION AND WITHDRAWAL

The investigator may withdraw you from this research if circumstances arise which warrant doing so. Also, the participant may withdraw at any time. If you have a longer than 5-day interval between sessions, you will be asked to withdraw from the study. It is imperative that you are aware of this and can plan accordingly whether you can participate in the study.

FEEDBACK OF THE RESULTS OF THIS STUDY TO THE PARTICIPANTS

The final transcript will be emailed to you upon request, which will contain the research findings.

Your email address: ____

Date when results are available: ______________________________

SUBSEQUENT USE OF DATA

This data may be used in subsequent studies in publications and in presentations.

SIGNATURE OF INVESTIGATOR

These are the terms under which I will conduct research

_____________________________________ _________

Signature of Investigator Date

APPENDIX D

CONSENT TO PARTICIPATE IN RESEARCH

Title of Study: Physiological Effects of Adding a Percentage of Body Weight During a 7 Week Stair Climbing Sprint Interval Training Program

You are asked to participate in a research study conducted by Remi Sovran and Dr. Kenji Kenno from the Department of Kinesiology at the University of Windsor. The results will contribute to a graduate master's thesis study.

If you have any concerns or questions about the research, please feel free to contact Remi Sovran and/or Dr. Kenji Kenno (519 250 3000) at any time.

PURPOSE OF THE STUDY

The primary objective of this investigation will be to determine the effect of adding a % of body weight (%BW) during Sprint interval training stair climbing (SC SIT) program on cardiovascular and skeletal muscle performance following a 7 week SC SIT protocol with all participants doing 4 sets of 15 secs work: 90 secs recovery, 3 times per week. The 2 experimental groups will be:

1. Control Group - 7 weeks non-weighted
2. 10/20% Group - (1 week non-weighted + 3 week with 10% BW + 3 week with 20% BW)

In a previous study, 6 weeks of sprint interval training stair climbing with no added weight resulted in a significant improvement in lower body oxygen consumption in female participants. Adding a %BW using a weighted vest is a common method strength and conditioning trainer's use to increase the demands of exercise. The question is does adding 10% BW and then 20% BW during stair climbing sprint interval training lead to further improvements aerobic fitness (oxygen consumption) and lower body skeletal muscle performance.

PROCEDURES

If you volunteer in this study, you will be asked to:

Come to the Multipurpose Laboratory (Room 202) in the Human Kinetics Building at the University of Windsor where you will be asked to complete the Physical Activity Readiness Questionnaire Plus (PAR-Q+) and participant information questionnaire that determines whether you have any known risks that would prevent you from participating in physical activity. These forms include information such as date of birth, sex, medications you might currently be taking and any known history of cardiovascular disease. Participants will then be asked to schedule a date for their initial testing session 30 following a 24-hour exercise and alcohol hiatus and must fast for 4 hours pre-test to prevent interaction of the thermal effect of food. The first session (80 minutes) will involve:

- Body Composition using the 'Bod Pod' to determine changes in lean body mass and fat-free mass following 7 weeks of SC SIT.
- The 'Margaria stair climbing power test - a lower body test that involves an individual running up a flight of 9 stairs to assess lower body power. Participants will perform 3 'Margaria stair climbs' with the fastest time being recorded for lower body power calculation.
- The participant will then be seated for 10 minutes. After which, a single use Medlance blood drop lancet will be used to prick the earlobe and draw a single droplet of blood. This blood will then be analyzed for its lactate concentrations with a Lactate Scout, giving a resting baseline value.
- A graded Treadmill VO_2 max protocol will be completed. This test is designed to measure your aerobic capacity while wearing a Hans Rudolph VO_2 mask and a Polar Heart Rate Monitor. This treadmill protocol is conducted at your selected speed and is completed in two-minute stages until volitional fatigue. At the end of each two-minute stage, you will be asked to rate your exertion using the Borg 6-20 Rating of Perceived Exertion Scale.
- Immediately after the MVO_2 test is completed another earlobe blood lactate concentration measurement will be taken.
- This protocol will also be completed 3 times, prior to stair climbing training, after 4 weeks and after 7 weeks of stair climbing SIT sessions to test training adaptations.

After a minimum of 24 hours, the first SC SIT training session will involve

- Being fitted with a Polar HR monitor and you will be instructed to perform an active warm-up to make sure that your body is prepared for SC SIT
- You will complete 4 SC SIT sessions with 15 seconds of stair climbing, matched by 90 seconds of rest. During each workout set, you will be asked the step number reached, your exercising heart rate and your rating of perceived exertion using the Borg 6-20 point. As well as recovery HR prior to initiating each SC SIT session

- Following the SC SIT, a recovery stretching routine will occur in order to cool down and stretch out the muscle tissue used

POTENTIAL RISKS AND DISCOMFORTS

Delayed onset muscle soreness may occur between 24 to 72 hours after your training session. With proper rest and avoidance of extra training, recovery will occur. Proper stretching protocols will be administered post-training session in order to assist in muscle flexibility post workout. If an unusual or unexpected discomfort is felt throughout the investigation, the protocol can be stopped. Water will be made available to you.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

Participants can expect to gain knowledge of a unique training protocol while improving their fitness. This research can lead to improvements in strength and conditioning programs in the fitness community. Stair climbing is currently being used in this field, and this investigation will provide further information as to their appropriate application, and implementation.

COMPENSATION FOR PARTICIPATION

The participants will not receive any financial compensation, however participants will be entered in a draw to win one of two $50 Sport Chek gift cards, along with receiving a t-shirt for their participation in this study.

CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. The confidentiality of participant information will be ensured as each participant will be given a unique code that can only identify them by name as associated with an initial file. This file will be digitally secured via password on a personal computer, and a hard copy will be kept in an office in a locked cabinet.

PARTICIPATION AND WITHDRAWAL

The investigator may withdraw you from this research if circumstances arise which warrant doing so. Also, the participant may withdraw at any time. If you have a longer than 5-day interval between sessions, you will be asked to withdraw from the study. It is imperative that you are aware of this and can plan accordingly whether you can participate in the study.

FEEDBACK OF THE RESULTS OF THIS STUDY TO THE PARTICIPANTS

The final transcript will be emailed to you upon request, which will contain the research findings.

Your email address: ____

Date when results are available: ___________________________________

SUBSEQUENT USE OF DATA

This data may be used in subsequent studies in publications and in presentations.

RIGHTS OF RESEARCH PARTICIPANTS

If you have questions regarding your rights as a research participant, contact: Research Ethics Coordinator, University of Windsor, Windsor, Ontario N9B 3P4; Telephone: 519-253-3000, ext. 3948; email: ethics@uwindsor.ca

SIGNATURE OF RESEACH PARTICIPANT/LEGAL REPRESENTATIVE

I understand the information provided for the study "Physiological effects of adding a percentage of body weight during a 7 week Stair Climbing Sprint Interval Training" as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

These are the terms under which I will conduct research.

______________________________________ ___________

Name of Participant Date

______________________________________ ___________

Signature of Participant Date

SIGNATURE OF INVESTIGATOR

These are the terms under which I will conduct research

______________________________________ ___________

Signature of Investigator Date

APPENDIX E

2015 PAR-Q+

The Physical Activity Readiness Questionnaire for Everyone

The health benefits of regular physical activity are clear; more people should engage in physical activity every day of the week. Participating in physical activity is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

GENERAL HEALTH QUESTIONS

Please read the 7 questions below carefully and answer each one honestly: check YES or NO.	YES	NO
1) Has your doctor ever said that you have a heart condition ☐ OR high blood pressure ☐?	☐	☐
2) Do you feel pain in your chest at rest, during your daily activities of living, **OR** when you do physical activity?	☐	☐
3) Do you lose balance because of dizziness **OR** have you lost consciousness in the last 12 months? Please answer **NO** if your dizziness was associated with over-breathing (including during vigorous exercise).	☐	☐
4) Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)? **PLEASE LIST CONDITION(S) HERE:** ____________	☐	☐
5) Are you currently taking prescribed medications for a chronic medical condition? **PLEASE LIST CONDITION(S) AND MEDICATIONS HERE:** ____________	☐	☐
6) Do you currently have (or have had within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active? Please answer **NO** if you had a problem in the past, but it ***does not limit your current ability*** to be physically active. **PLEASE LIST CONDITION(S) HERE:** ____________	☐	☐
7) Has your doctor ever said that you should only do medically supervised physical activity?	☐	☐

If you answered NO to all of the questions above, you are cleared for physical activity.
Go to Page 4 to sign the PARTICIPANT DECLARATION. You do not need to complete Pages 2 and 3.

- Start becoming much more physically active – start slowly and build up gradually.
- Follow International Physical Activity Guidelines for your age (www.who.int/dietphysicalactivity/en/).
- You may take part in a health and fitness appraisal.
- If you are over the age of 45 yr and **NOT** accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.
- If you have any further questions, contact a qualified exercise professional.

If you answered YES to one or more of the questions above, COMPLETE PAGES 2 AND 3.

Delay becoming more active if:

- You have a temporary illness such as a cold or fever; it is best to wait until you feel better.
- You are pregnant - talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-X+ at **www.eparmedx.com** before becoming more physically active.
- Your health changes - answer the questions on Pages 2 and 3 of this document and/or talk to your doctor or a qualified exercise professional before continuing with any physical activity program.

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01-01-2015

2015 PAR-Q+

FOLLOW-UP QUESTIONS ABOUT YOUR MEDICAL CONDITION(S)

1. Do you have Arthritis, Osteoporosis, or Back Problems?

If the above condition(s) is/are present, answer questions 1a-1c — If **NO** ☐ go to question 2

1a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
1b.	Do you have joint problems causing pain, a recent fracture or fracture caused by osteoporosis or cancer, displaced vertebra (e.g., spondylolisthesis), and/or spondylolysis/pars defect (a crack in the bony ring on the back of the spinal column)?	YES ☐ NO ☐
1c.	Have you had steroid injections or taken steroid tablets regularly for more than 3 months?	YES ☐ NO ☐

2. Do you have Cancer of any kind?

If the above condition(s) is/are present, answer questions 2a-2b — If **NO** ☐ go to question 3

2a.	Does your cancer diagnosis include any of the following types: lung/bronchogenic, multiple myeloma (cancer of plasma cells), head, and neck?	YES ☐ NO ☐
2b.	Are you currently receiving cancer therapy (such as chemotheraphy or radiotherapy)?	YES ☐ NO ☐

3. Do you have a Heart or Cardiovascular Condition? *This includes Coronary Artery Disease, Heart Failure, Diagnosed Abnormality of Heart Rhythm*

If the above condition(s) is/are present, answer questions 3a-3d — If **NO** ☐ go to question 4

3a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
3b.	Do you have an irregular heart beat that requires medical management? (e.g., atrial fibrillation, premature ventricular contraction)	YES ☐ NO ☐
3c.	Do you have chronic heart failure?	YES ☐ NO ☐
3d.	Do you have diagnosed coronary artery (cardiovascular) disease and have not participated in regular physical activity in the last 2 months?	YES ☐ NO ☐

4. Do you have High Blood Pressure?

If the above condition(s) is/are present, answer questions 4a-4b — If **NO** ☐ go to question 5

4a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
4b.	Do you have a resting blood pressure equal to or greater than 160/90 mmHg with or without medication? (Answer **YES** if you do not know your resting blood pressure)	YES ☐ NO ☐

5. Do you have any Metabolic Conditions? *This includes Type 1 Diabetes, Type 2 Diabetes, Pre-Diabetes*

If the above condition(s) is/are present, answer questions 5a-5e — If **NO** ☐ go to question 6

5a.	Do you often have difficulty controlling your blood sugar levels with foods, medications, or other physician-prescribed therapies?	YES ☐ NO ☐
5b.	Do you often suffer from signs and symptoms of low blood sugar (hypoglycemia) following exercise and/or during activities of daily living? Signs of hypoglycemia may include shakiness, nervousness, unusual irritability, abnormal sweating, dizziness or light-headedness, mental confusion, difficulty speaking, weakness, or sleepiness.	YES ☐ NO ☐
5c.	Do you have any signs or symptoms of diabetes complications such as heart or vascular disease and/or complications affecting your eyes, kidneys, **OR** the sensation in your toes and feet?	YES ☐ NO ☐
5d.	Do you have other metabolic conditions (such as current pregnancy-related diabetes, chronic kidney disease, or liver problems)?	YES ☐ NO ☐
5e.	Are you planning to engage in what for you is unusually high (or vigorous) intensity exercise in the near future?	YES ☐ NO ☐

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2015 PAR-Q+

6.	**Do you have any Mental Health Problems or Learning Difficulties?** *This includes Alzheimer's, Dementia, Depression, Anxiety Disorder, Eating Disorder, Psychotic Disorder, Intellectual Disability, Down Syndrome* If the above condition(s) is/are present, answer questions 6a-6b — If **NO** ☐ go to question 7	
6a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
6b.	Do you **ALSO** have back problems affecting nerves or muscles?	YES ☐ NO ☐
7.	**Do you have a Respiratory Disease?** *This includes Chronic Obstructive Pulmonary Disease, Asthma, Pulmonary High Blood Pressure* If the above condition(s) is/are present, answer questions 7a-7d — If **NO** ☐ go to question 8	
7a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
7b.	Has your doctor ever said your blood oxygen level is low at rest or during exercise and/or that you require supplemental oxygen therapy?	YES ☐ NO ☐
7c.	If asthmatic, do you currently have symptoms of chest tightness, wheezing, laboured breathing, consistent cough (more than 2 days/week), or have you used your rescue medication more than twice in the last week?	YES ☐ NO ☐
7d.	Has your doctor ever said you have high blood pressure in the blood vessels of your lungs?	YES ☐ NO ☐
8.	**Do you have a Spinal Cord Injury?** *This includes Tetraplegia and Paraplegia* If the above condition(s) is/are present, answer questions 8a-8c — If **NO** ☐ go to question 9	
8a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
8b.	Do you commonly exhibit low resting blood pressure significant enough to cause dizziness, light-headedness, and/or fainting?	YES ☐ NO ☐
8c.	Has your physician indicated that you exhibit sudden bouts of high blood pressure (known as Autonomic Dysreflexia)?	YES ☐ NO ☐
9.	**Have you had a Stroke?** *This includes Transient Ischemic Attack (TIA) or Cerebrovascular Event* If the above condition(s) is/are present, answer questions 9a-9c — If **NO** ☐ go to question 10	
9a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
9b.	Do you have any impairment in walking or mobility?	YES ☐ NO ☐
9c.	Have you experienced a stroke or impairment in nerves or muscles in the past 6 months?	YES ☐ NO ☐
10.	**Do you have any other medical condition not listed above or do you have two or more medical conditions?** If you have other medical conditions, answer questions 10a-10c — If **NO** ☐ read the Page 4 recommendations	
10a.	Have you experienced a blackout, fainted, or lost consciousness as a result of a head injury within the last 12 months **OR** have you had a diagnosed concussion within the last 12 months?	YES ☐ NO ☐
10b.	Do you have a medical condition that is not listed (such as epilepsy, neurological conditions, kidney problems)?	YES ☐ NO ☐
10c.	Do you currently live with two or more medical conditions?	YES ☐ NO ☐

PLEASE LIST YOUR MEDICAL CONDITION(S) AND ANY RELATED MEDICATIONS HERE: ____________________

GO to Page 4 for recommendations about your current medical condition(s) and sign the PARTICIPANT DECLARATION.

2015 PAR-Q+

If you answered NO to all of the follow-up questions about your medical condition, you are ready to become more physically active - sign the PARTICIPANT DECLARATION below:

- It is advised that you consult a qualified exercise professional to help you develop a safe and effective physical activity plan to meet your health needs.
- You are encouraged to start slowly and build up gradually - 20 to 60 minutes of low to moderate intensity exercise, 3-5 days per week including aerobic and muscle strengthening exercises.
- As you progress, you should aim to accumulate 150 minutes or more of moderate intensity physical activity per week.
- If you are over the age of 45 yr and **NOT** accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.

If you answered **YES** to **one or more of the follow-up questions** about your medical condition:

You should seek further information before becoming more physically active or engaging in a fitness appraisal. You should complete the specially designed online screening and exercise recommendations program - the **ePARmed-X+ at www.eparmedx.com** and/or visit a qualified exercise professional to work through the ePARmed-X+ and for further information.

Delay becoming more active if:

- You have a temporary illness such as a cold or fever; it is best to wait until you feel better.
- You are pregnant - talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-X+ **at www.eparmedx.com** before becoming more physically active.
- Your health changes - talk to your doctor or qualified exercise professional before continuing with any physical activity program.

- You are encouraged to photocopy the PAR-Q+. You must use the entire questionnaire and NO changes are permitted.
- The authors, the PAR-Q+ Collaboration, partner organizations, and their agents assume no liability for persons who undertake physical activity and/or make use of the PAR-Q+ or ePARmed-X+. If in doubt after completing the questionnaire, consult your doctor prior to physical activity.

PARTICIPANT DECLARATION

- All persons who have completed the PAR-Q+ please read and sign the declaration below.
- If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that a Trustee (such as my employer, community/fitness centre, health care provider, or other designate) may retain a copy of this form for their records. In these instances, the Trustee will be required to adhere to local, national, and international guidelines regarding the storage of personal health information ensuring that the Trustee maintains the privacy of the information and does not misuse or wrongfully disclose such information.

NAME ______________________________ DATE ______________________________

SIGNATURE ______________________________ WITNESS ______________________________

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER ______________________________

For more information, please contact

www.eparmedx.com

Email: eparmedx@gmail.com

Citation for PAR-Q+

Warburton DER, Jamnik VK, Bredin SSD, and Gledhill N on behalf of the PAR-Q+ Collaboration. The Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) and Electronic Physical Activity Readiness Medical Examination (ePARmed-X+). Health & Fitness Journal of Canada 4(2):3-23, 2011.

The PAR-Q+ was created using the evidence-based AGREE process (1) by the PAR-Q+ Collaboration chaired by Dr. Darren E. R. Warburton with Dr. Norman Gledhill, Dr. Veronica Jamnik, and Dr. Donald C. McKenzie (2). Production of this document has been made possible through financial contributions from the Public Health Agency of Canada and the BC Ministry of Health Services. The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada or the BC Ministry of Health Services.

Key References

1. Jamnik VK, Warburton DER, Makarski J, McKenzie DC, Shephard RJ, Stone J, and Gledhill N. Enhancing the effectiveness of clearance for physical activity participation; background and overall process. APNM 36(S1):S3-S13, 2011.
2. Warburton DER, Gledhill N, Jamnik VK, Bredin SSD, McKenzie DC, Stone J, Charlesworth S, and Shephard RJ. Evidence-based risk assessment and recommendations for physical activity clearance; Consensus Document. APNM 36(S1):S266-s298, 2011.

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01-01-2015

APPENDIX F

Name: ______________________________

ID#:__________________________

D.O.B. (mm/yy): ____/____

Height (meters): ______ Weight (kg): ______

Biological Birth Sex: M or F

Participant I.D. # ______

Contact Information:
Phone (cell) # (_____) _____-________

Phone (home)#: (_____) ______-________

E-mail: ____

Emergency Contact (Optional)
Name: _______________________________________

Phone#: (_____) ______-________

Physical Activity Background:

How many months have you been regularly exercising?

1 2 3+ 6+ 12+

How many times do you exercise per week?

1 2-3 3-4 4+

Are you currently involved in a stairclimbing exercise program (circle) ? Yes No

If yes, please explain ____

Are you currently involved in a sprint/ high-intensity interval training exercise program (circle)? Yes No

If yes, please explain ____

Are you currently involved in an aerobic training program more than 3x per week (circle) ? Yes No

If yes, please explain ____

Are you currently taking any supplements for performance enhancement or medications (circle)? Yes No

If yes, please list ____

APPENDIX G

Godin Leisure-Time Exercise Questionnaire

INSTRUCTIONS

In this excerpt from the Godin Leisure-Time Exercise Questionnaire, the individual is asked to complete a self-explanatory, brief four-item query of usual leisure-time exercise habits.

CALCULATIONS

For the first question, weekly frequencies of strenuous, moderate, and light activities are multiplied by nine, five, and three, respectively. Total weekly leisure activity is calculated in arbitrary units by summing the products of the separate components, as shown in the following formula:

Weekly leisure activity score = (9 × Strenuous) + (5 × Moderate) + (3 × Light)

The second question is used to calculate the frequency of weekly leisure-time activities pursued "long enough to work up a sweat" (see questionnaire).

EXAMPLE

Strenuous = 3 times/wk

Moderate = 6 times/wk

Light = 14 times/wk

Total leisure activity score = (9 × 3) + (5 × 6) + (3 × 14) = 27 + 30 + 42 = 99

Godin Leisure-Time Exercise Questionnaire

1. During a typical **7-Day period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your free time (write on each line the appropriate number).

	Times Per Week
a) **STRENUOUS EXERCISE** **(HEART BEATS RAPIDLY)** (e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)	________
b) **MODERATE EXERCISE** **(NOT EXHAUSTING)** (e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)	________
c) **MILD EXERCISE** **(MINIMAL EFFORT)** (e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking)	________

2. During a typical **7-Day period** (a week), in your leisure time, how often do you engage in any regular activity **long enough to work up a sweat** (heart beats rapidly)?

OFTEN	SOMETIMES	NEVER/RARELY
1. ☐	2. ☐	3. ☐

APPENDIX H

Borg rating of perceived exertion

	6	No exertion at all
	7	Extremely light
	8	
	9	Very light
	10	
	11	Light
	12	
	13	Somewhat hard
	14	
	15	Hard (heavy)
	16	
	17	Very hard
	18	
	19	Extremely hard
	20	Maximal exertion

APPENDIX I

Laboratory Emergency Action Plan (EAP)

for <u>Medical Emergencies</u> during Exercise Testing

STEP 1: **REMAIN CALM.**
CONTROL and ASSESS the situation.
DESIGNATE a person to CALL and meet EMERGENCY PERSONNEL:

911 OR Campus Police EXT. 4444
(they will dispatch required authorities)

<u>OUR ADDRESS/DIRECTIONS:</u>

The University of Windsor
Human Kinetics Building
2555 College Ave.
Main Entrance off College Ave.
Room# 202 (uppermost floor)

<u>Directions:</u> Enter the HK building at the North entrance and head up the staircase on the left. Take your first right, and Room 202 is on your right.

<u>OUR PHONE#:</u>

519-253-3000

STEP 2: **PERFORM all measures (CPR/First Aid) to ensure the safety of the subject.**

ATTEND to subject until replaced by emergency personnel.

STEP 3: **CREATE a Department of Kinesiology Incident Report**.

APPENDIX J

Example of Phrases and Words of Encouragement:

1. **You got this!**
2. **Push!**
3. **Run! Run! Run!**
4. **You're almost there!**

APPENDIX K

Treadmill MVO_2 Test

Testing Protocol

-Warm up 5 minutes prior to beginning the protocol

-Running at a self-selected pace between 5-7mph

-Monitor HR using the Polar HR monitor

-Incremental grade increases by 2% every 2 minutes until volitional fatigue

-Data Collection Format:

Time	**Workload (Speed/Grade)**	**HR**	**RPE**	**Time**	**Workload (Speed/Grade)**	**HR**	**RPE**
0-2				14-16			
2-4				16-18			
4-6				18-20			
6-8				20-22			
8-10				22-24			
10-12				24-26			
12-14				26-28			

VITA AUCTORIS

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