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Enjoyment of high-intensity interval training in an overweight/obese cohort: a short report

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Summary

Exercise enjoyment has been shown to be important for adherence. Minimal data exist on enjoyment of intense exercise, especially in clinical populations. The purpose of this study was to evaluate enjoyment levels of overweight and obese subjects undergoing 3 weeks of high-intensity interval training. Forty-two generally healthy overweight and obese men and women (body mass index = 30·8 ± 4·8 kg × m^{-2}) volunteered for this study. Exercise enjoyment was quantified using the Exercise Enjoyment Scale before and after each of nine total interval training sessions, over a three-week period. Heart rate and ratings of perceived exertion (RPE) were measured at the end of each interval and training session. There were no significant differences in enjoyment between training groups ($P > 0·05$). Exercise enjoyment improved significantly over the three-week training phase ($P < 0·05$). Enjoyment levels were relatively high to begin training: mean ± SD: 4·2 ± 1·0 out of a 7 point scale. Heart rate and RPE were significantly reduced ($P < 0·05$) from pre- (day 1) to post-training (day 9). High-intensity interval training may be an enjoyable form of exercise for overweight and obese men and women. Enjoyment levels may continue to increase following initial introduction to this type of training. Due to the small time demand and high enjoyment, interval training may be an effective exercise approach in a sedentary population.

Keywords

aerobic; clinical; exercise; heart rate; rating of perceived exertion

Introduction

Exercise as medicine is growing as a therapeutic approach to disease prevention (Garber *et al.*, 2011). While the importance of physical activity is widespread, with positive effects on reducing cardiometabolic disease, lack of motivation and time are the most commonly cited barriers (Gibala & Little, 2010). Due to the short-time demands, high-intensity interval training (HIIT) has become a popular exercise approach. HIIT has been shown to be an effective alternative to traditional endurance training, resulting in superior physiological changes and health-related metabolic improvements (Wisloff *et al.*, 2007; Tjonna *et al.*,

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Conflict of interest

The author declares no conflicts of interest.

2008; Nybo *et al.*, 2010) in a shorter period of time. There is evidence to suggest the potential clinical benefit of implementing HIIT (Gibala *et al.*, 2012). Specifically, this type of training has been shown to be effective for weight loss and insulin sensitivity in overweight and obese (OW/OB) individuals (Trapp *et al.*, 2008; Joseph *et al.*, 2011; Skleryk *et al.*, 2013). Despite the physiological benefit, to our knowledge, there are no data that have evaluated the enjoyment level of OW/OB individuals when undergoing HIIT. For this type of training to be feasible and sustainable, enjoyment is a key component that has been overlooked. The purpose of this study was to evaluate enjoyment levels of overweight and obese subjects undergoing interval training, as well as to identify whether varying interval work duration has a positive or negative affect on enjoyment levels. A secondary purpose was to assess the effects of sex, body fat and baseline fitness on enjoyment levels and perceived exertion.

Methods

Overweight and obese men and women were recruited using emails and flyers in a south-eastern urban community, identifying individuals with a body mass index (BMI) of > 25 kg × m^{-2}. Initial email and telephone screenings were conducted to further identify whether inclusion criteria were met. Sixty-eight individuals were screened in person for eligibility, which included completion of height, weight, health history questionnaire, normal 12 lead electrocardiogram and physician clearance. Individuals were excluded if (i) their recorded BMI was < 25 kg × m^{-2}; (ii) reported history of metabolic, renal, hepatic, autoimmune or neurological disease; (iii) resting blood pressure was above 140/90 mmHg; (iv) could not or did not want to ride a stationary bike; (v) their personal physician did not approve participation or did not respond; and (vi) they were currently participating in high-intensity exercise. Fifty-six participants remained eligible and chose to participate. Participants were randomly assigned, according to a random allocation sequence of 2:2:1, to one of two training groups ($n = 42$) or a control group ($n = 15$) (Table 1A). The controls did not undergo training or enjoyment assessments and therefore are not included in this study. Forty-two generally healthy overweight/obese men and women were cleared for participation in this study (mean ± SD, age: 35·9 ± 12·1 years, height: 173·8 ± 9·7 cm, weight: 93·1 ± 14·5 kg, body mass index: 30·8 ± 4·8 kg × m^{-2} and peak oxygen consumption: 28·3 ± 7·6 ml × kg^{-1} × min^{-1}). Of this sample, there were 20 men and 22 women (Table 1B), with 31 Caucasian and 11 African American participants. All procedures were approved by the Institutional Review Board, and an approved consent form was signed prior to study participation. All participants completed interval exercise training three times per week for 3 weeks.

Baseline cardiorespiratory fitness (VO_2 peak) was assessed using indirect calorimetry (True One 2400®, Parvo-Medics, Inc., Provo, UT, USA), while cycling on an electronically braked bike. The highest 15-s oxygen consumption, minute ventilation, heart rate and power output (PO) were recorded as VO_2 peak. Body composition was measured using dual-energy X-ray absorptiometry (Hologic Discovery W, Bedford, MA, USA) to determine per cent body fat, fat mass and lean mass. Results from this data are beyond the scope of the current paper, but have been previously published (Trexler *et al.*, 2014; Smith-Ryan *et al.*, 2015).

Interval training was performed on a cycle ergometer under the supervision of trained research staff. Participants were randomly assigned to either a series of 1-min bouts with 1-min passive rest periods at 90% PO for 10 bouts (1MIN), or a series of 5 sets of 2-min cycling bouts with 1-min passive rest at a daily undulating intensity (80–100% PO, adapted from Smith *et al.* (2009) (2MIN). The 2MIN group alternated intensity as follows: 80% (D1), 85% (D2), 80% (D3), 90% (D4), 80% (D5), 95% (D6), 80% (D7), 100% (D8) and 80% (D9). The 1MIN group completed 90% for all days. Exercise volume was the same for both groups. Exercise enjoyment was quantified objectively using the Exercise Enjoyment Scale (Stanley & Cumming, 2010), which has previously been shown to be a valid single-item measure of feeling and felt arousal (Stanley *et al.*, 2009). The 7-point rating scale was implemented before each training session to assess how much the participant would enjoy the session. Enjoyment was also assessed after each exercise training session to determine how much the participant enjoyed the exercise. The scale ranged from 1 (not at all) to 7 (extremely), with all other integers 2–6 assigned an affect. Ratings of perceived exertion and heart rate were recorded during each exercise bout to capture the relationship between exertion and enjoyment.

Statistical Analysis

Two-way repeated-measures ANOVA on collapsed pre-/ post-training enjoyment scores were evaluated for each training day [group (1MIN versus 2MIN) × time (D1-D9)]. Subsequent mixed factorial ANOVAs were completed to evaluate the influence of sex on enjoyment scores. Repeated-measures ANOVAs were used to analyse HR and RPE scores over each workout (acute) and each day (chronic): [acute (5 bouts) × chronic (D1-D9) × group (1MIN versus 2MIN)]. Bonferroni *post hoc* comparisons were completed when necessary. Pearson product moment correlations were run to evaluate the relationship between enjoyment and baseline fitness (VO_2peak), %fat, lean mass, sex, age and race. All statistical procedures were performed using SPSS (version 20·0, IBM SPSS Statistics for Windows, Armonk, NY, USA: IBM Corp). Significance for all statistical analyses was determined using a two-sided alpha of 0·05. Sample size calculations were completed using nQuery + nTerim 2·0 (Statistical Solutions, Boston, MA, USA) based on an expected VO_2 peak increase of 2·0 ml × kg^{-1} × min^{-1}, with a standard deviation of 2·5 ml kg^{-1} min^{-1}. A total sample size of 40, not including the control group, with two equal groups yielded 80% power.

Results

Enjoyment

The evaluation of enjoyment demonstrated a significant group × time interaction (P = 0·001). *Post hoc* comparisons yielded no significant between group differences (P = 0·369); there were significant differences over training days (P = 0·001). Enjoyment on the last day of training (D9) was significantly higher than all other days (P < 0·005). Enjoyment on D1 was significantly lower than compared to D7 (P = 0·006). Enjoyment on D2 was significantly lower than on D7 (P = 0·011); D3 was significantly higher than on D4 (P = 0·007); D4 enjoyment was lower than D5 (P = 0·018) and D7 (P = 0·001); D6 was lower than D7 (P = 0·001); and D7 was lower than D8 (P = 0·001).

There was no significant interaction for sex × time ($P = 0{\cdot}773$). There was a main effect for enjoyment ($P = 0{\cdot}001$), with similar significance as noted above. There was no main effect for sex ($P = 0{\cdot}272$), with average enjoyment scores of 4·6 ± 0·4 for men and 4·3 ± 0.·4 for women.

The relationship between status and body composition with enjoyment demonstrated a significant positive relationship for D4 ($R = 0{\cdot}371$; $P = 0{\cdot}016$) and D8 ($R = 0{\cdot}339$; $P = 0{\cdot}028$) with DXA FFM. Enjoyment on D4 was also significantly inversely related to %BF ($R = -0{\cdot}487$; $P = 0{\cdot}001$) and significantly positively correlated with VO_2peak ($R = 0{\cdot}324$; $P = 0{\cdot}036$). There was no significant relationship between enjoyment, sex, age or race ($P > 0{\cdot}05$).

Heart rate

For HR, there was no acute × chronic × group ($P = 0{\cdot}857$), no two-way interactions ($P > 0{\cdot}05$) and no main effect for chronic ($P = 0{\cdot}465$) or group ($P = 0{\cdot}690$). There was a main effect for acute ($P = 0{\cdot}001$). Post hoc comparisons demonstrated a significant increase in HR over each bout of interval training (Figure 2A), ranging from 135·0 (± 12·8) to 164·8 (± 12·6) bpm. Paired samples t-tests for HR during the last interval demonstrated a significant decrease from pre-training to post-training for 2MIN group (Δ9·7 ± 6·3 bpm; $P = 0{\cdot}001$) and for 1MIN (Δ6·8 ± 6·7 bpm; $P = 0{\cdot}001$).

Ratings of perceived exertion

For RPE, there was a significant acute × chronic × group ($P = 0{\cdot}001$) interaction ($P > 0{\cdot}05$). When decomposing the model, RPE was greater for the 2MIN (14·7 ± 0·6) compared to the 1MIN group (12·3 ± 0·7; $P = 0{\cdot}001$). RPE significantly increased over each bout ($P = 0{\cdot}001$), ranging from 10·2 to 17·9 (Figure 2B). Over each of the training days RPE was significantly higher on D1, D2, D4, compared to D3, D5, D7 and D9. RPE on D3 was significantly higher than compared to D7 and D9. RPE on D6 was significantly higher than D5, D7 and D9. RPE on D7 and D8 was significantly higher than D3, D5 and D9. RPE on D9 was significantly lower than D1, D2, D3, D4, D6 and D8. Paired samples t-tests for RPE during the last interval demonstrated a significant decrease from pre-training to post-training for 2MIN (Δ2·9 ± 3·0; $P = 0{\cdot}001$) and for 1MIN (Δ2·2 ± 2·2; $P = 0{\cdot}001$).

Discussion

Short-term high-intensity training has growing support as an effective strategy to improve a number of disease risk factors (Gibala *et al.*, 2012). This style of training is not only effective in a variety of populations but also addresses complaints of not having enough time to exercise. Despite the benefits and minimal time demand, 'lack of enjoyment' is another major contributor to lack of physical activity in the United States (Stutts, 2002; Bartlett *et al.*, 2011). Specifically, there are thoughts that overweight and obese individuals may not enjoy this type of strenuous activity. The current study is the first study to demonstrate relatively high enjoyment levels over 3 weeks of very high-intensity training, with an average 4·5 rating, out of a seven point scale. It also appeared that enjoyment went up over the training series, suggesting that an OW/OB population can become accustomed to higher intensity training. There were no significant differences in enjoyment levels between the two training groups or between men and women, but the 1MIN group reported more consistent levels of enjoyment (Fig. 1). In addition to high enjoyment, heart rate values averaged around 86% of estimated maximal heart rate and were not different between groups.

Previous data suggest that high-intensity interval training may result in greater enjoyment compared to moderate intensity continuous exercise, in healthy men (Bartlett *et al.*, 2011). To date, no previous data have evaluated enjoyment of interval training over time, nor have it been evaluated in an OW/OB population. In the current study, enjoyment was quantified both before and after each exercise session using the Exercise Enjoyment scale (Stanley & Cumming, 2010). While enjoyment was lowest on the first day of exercise (4·2 ± 1·0), ratings were still in an enjoyable range. A secondary aim of the current study was to evaluate enjoyment of two separate protocols. Previous data have suggested that the effects and practicality of HIIT would be compromised if intensity reduced and duration of the interval is lengthened, beyond the traditional 30-s ‘all-out’ bouts (Boyd *et al.*, 2013), yet it is difficult for a clinical population to get motivated to sprint all-out a number of times. Therefore, in the current study, more practical protocols were evaluated. It appeared that the 1MIN protocol provided more consistent enjoyment levels and may be more feasible for a variety of populations. Due to the undulating nature of the 2MIN protocol and longer work bouts, a few of the higher intensity days (>90%W) were not as enjoyable to the participants. Thus, the current study demonstrated high enjoyment for variations of interval style training. It was hypothesized that those individuals with more lean body mass and a higher baseline fitness status might enjoy the training more. However, this was only found to be true part way through the training (D4) and may be more important for the longer work bouts (i.e. >2 min), which would require greater stamina and strength. Overall, higher baseline fitness status or greater lean mass had no influence on enjoyment. Additionally, it is clear there were differences between baseline fitness status and body composition between men and women, with the women in the current group having lower cardiorespiratory fitness and higher body fat. Despite this, men and women reported similar enjoyment levels over the 3 weeks.

In summary, due to the small time demand and high enjoyment, interval training may be an effective exercise approach in a sedentary population. Enjoyment levels may continue to increase following initial introduction to this type of training and are independent of baseline fitness status, body composition or sex.

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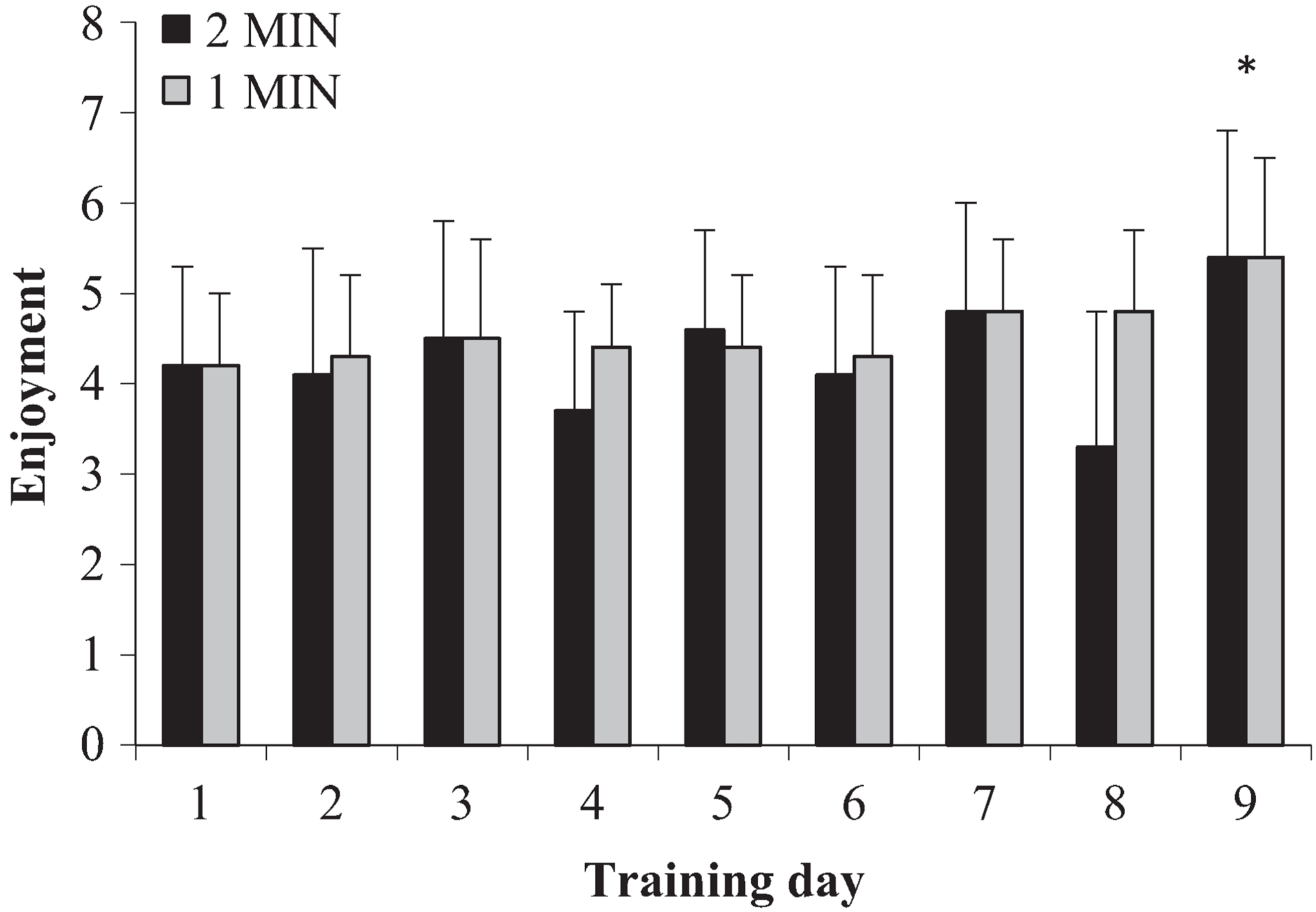

Figure 1.

Enjoyment levels, averaged from pre- to post-training, for the high-intensity training (2MIN) group and short-intensity training (1MIN) group on all training days. *indicates significantly higher values compared to all other days ($P < 0{\cdot}05$).

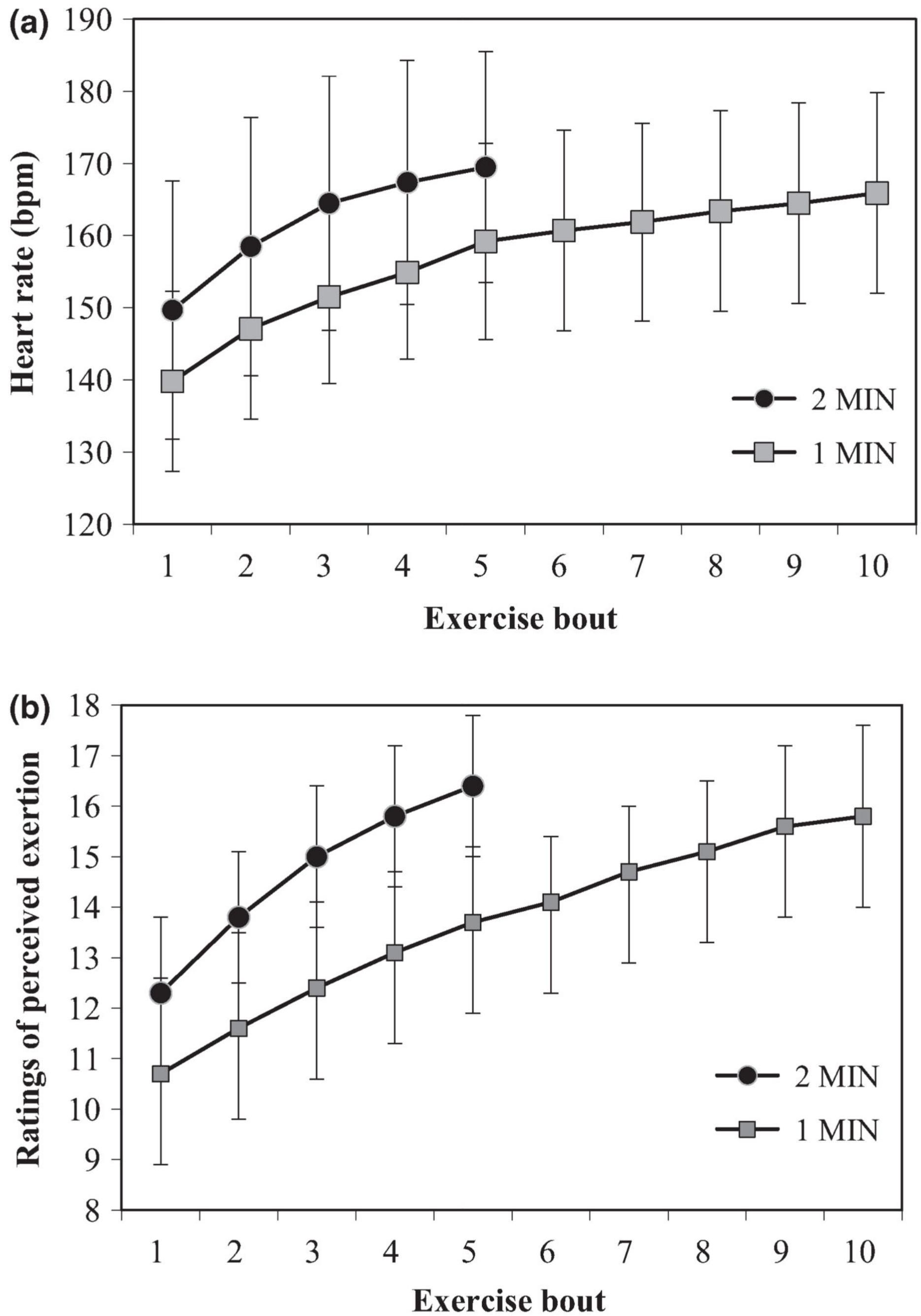

Figure 2.
(a) Heart rate data during each bout of exercise, averaged across workouts and (b) average ratings of perceived exertion for both training groups. Values are mean ± SD.

Table 1

Baseline demographic characteristics for participants by (A) training group and (B) sex. Presented as mean ± standard deviation (SD).

A	Age (years)	Height (cm)	Weight (kg)	Body fat (%)	Overweight (BMI 25–30)	Obese (BMI > 30)	VO_2peak ($ml \times kg^{-1} \cdot min^{-1}$)
2MIN (*n* = 21)	37·0 ± 12·1	175·6 ± 9·3	88·2 ± 12·7	32·8 ± 6·6	*n* = 13	*n* = 8	29·5 ± 7·9
1MIN (*n* = 21)	34·8 ± 12·4	172·1 ± 9·9	98·0 ± 14·8	34·5 ± 7·1	*n* = 8	*n* = 13	27·1 ± 7·2

B	Age (years)	Height (cm)	Weight (kg)	Body Fat (%)	VO_2peak ($ml\ kg^{-1} \cdot min^{-1}$)
Men (*n* = 20)	38·6 ± 12·1	181·1 ± 7·8*	99·6 ± 12·6*	28·1 ± 4·7*	31·9 ± 7·4*
Women (*n* = 22)	33·4 ± 11·9	167·2 ± 5·5	87·2 ± 13·8	38·7 ± 3·7	24·9 ± 6·1

*Indicates significant difference ($P < 0.05$).