STUDY PROTOCOL

To: Ethics Committee of the Department of Physical Education and Sports Science (DPESS) of the University of Thessaly (UTh).

Title: The effects of a circuit-type integrated neuromuscular training on body composition, body weight and energy balance in sedentary overweight/obese women.

Advisory Committee:
Athanasios Jamurtas, Associate Professor, University of Thessaly
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Relationship with the study programs of the DPESS at UTh:
Master's Thesis of Alexios Batrakoulis as a part of the requirements for the degree of Master Science (MSc) in Exercise and Health Graduate Program of DPESS at UTh.

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Purpose of the study

The purpose of this investigation will be the determination of the effects of a functional circuit training protocol with whole-body exercises using alternative modalities on body mass, body composition and energy balance of previously inactive, overweight/obese women. The initial hypothesis will be that this type of training and its subsequent detraining would not alter body mass, body fat and energy balance of overweight women.

Importance of the study

Body weight training, high-intensity interval training (HIIT), exercise for weight loss, personal and group personal raining, functional fitness, and circuit training are currently considered some of the top worldwide trends in the commercial, corporate, clinical, and community landscapes within the health and fitness industry (Thompson, 2016). In addition, the most recent epidemiology findings and future predictions by the World Health Organization (WHO) regarding the prevalence of overweight and obesity adult population indicate that more than one out of two in Europe and two out of three worldwide are and will be maintaining overweight (WHO, 2014). On the other side, physical inactivity rates have grown immensely worldwide (Hallal et al., 2012) although regular exercise induces many positive changes in health by lowering the risk factors for several chronic diseases. (Blair et al., 1996).

Introduction and literature review

High-intensity interval training (HIIT), circuit weight training (CWT) and functional fitness training (FFT) are considered some of the top fitness trends worldwide, time-effective, safe and efficient exercise modalities for general population (Thompson, 2014). According to the ACSM's position statement, HIIT, CWT, and FFT induce the improvement of cardiovascular endurance, musculoskeletal health, and functional capacity in healthy adults (Garber et al., 2011). Additionally, fitness professionals who are interested in providing clients with the optimal results in less possible time, they always seek some innovative training methods and protocols

(Paton & Hopkins, 2005) that are able to be more efficient and time-effective than some similar traditional options (Jones, Parker, & Cortes, 2011).

HIIT consists of alternatively repeated work intervals of high-intensity exercise with rest intervals of low-intensity exercise or complete rest and has become an increasingly popular exercise modality due to its potentially large effects on aerobic and anaerobic capacity, and short time requirement (Cress, Porcari, & Foster, 2015; Foster et al., 2015; Kilpatrick, Jung, & Little, 2014). HIIT is not only considered a time-efficient approach compared to traditional CET (Foster et al., 2015) but it has also been shown to improve physical fitness components within a short time period compared to the traditional CET (Hazell, MacPherson, Gravelle, & Lemon, 2010; Ziemann et al., 2011) and induces physiological adaptations that improve both health (Gibala, Little, Macdonald, & Hawley, 2012; Gremeaux et al., 2012) and performance (Gillen & Gibala, 2014) of healthy adults. Many researchers have already studied the effects of HIIT in healthy, sedentary overweight or obese adults finding improvements in aerobic capacity (Lunt et al., 2014; Trilk, Singhal, Bigelman, & Cureton, 2011), body composition (Gremeaux et al., 2012; Hazell, Hamilton, Olver, & Lemon, 2014; Trapp, Chisholm, Freund, & Boutcher, 2008), insulin resistance (Whyte, Gill, & Cathcart, 2010), RMR (Kelly, King, Goerlach, & Nimmo, 2013), hormones that increase metabolism (Racil et al., 2013), lipid profile (Miller et al., 2014), and skeletal muscle metabolism (Schjerve, 2008).

Recent evidence suggests that high-intensity intermittent circuit-style resistance training protocols may be considered more efficient than traditional steady state sustained-effort aerobic work or traditional resistance training programs (Klika & Jordan, 2013). Furthermore, this training method induces decrease of body fat in physically inactive middle-aged women with a normal BMI (Ferreira et al., 2010) and improves muscular strength, body composition, waist-to-hip ratio (WHR), waist circumference (WC), and blood lactate (BLA) production in overweight middle-aged untrained (Paoli et al., 2010). Applying the CWT in overweight middle-aged it has been observed a significant decrease on health markers, such as hypertension and blood lipids in comparison with the traditional endurance training and low-intensity circuit training (Paoli et al., 2013). Additionally, CWT may slightly increase resting energy expenditure (REE) and decrease respiratory rate (RR) 22 hours post-workout (Paoli et al., 2012).

The combination of cardiorespiratory training and resistance training is a basic methodology in exercise programming for physical performance and health of middle-aged and older adults with no risk factors for chronic diseases (Kraemer, Ratamess, & French, 2002; Takeshima et al., 2004; Wood et al., 2001). Moreover, CWT contributes to the decrease in risk factors for metabolic diseases and coronary artery disease (CAD) and improves significantly lipid profile (Fett, Fett, & Marchini, 2009). Furthermore, three different CWT protocols that included resistance training exercises and steady state aerobic or/and HIIT induce significant acute effects on BLA, heart rate (HR), and rating of perceived exertion (RPE) in recreationally active women (Skidmore, Jones, Blegen, & Matthews, 2012).

There is a research gap in the literature regarding the FT and its effects to physiological and metabolic adaptations in healthy adults compared to the traditional resistance training. There are only few studies that investigate chronic adaptations to body composition, physical performance, health, and wellness, and especially in sedentary overweight or obese individuals. More specifically, this type of training induces significant improvements in functional capacity (de Vreede, Samson, van Meeteren, Duursma, & Verhaar, 2005; Milton, Porcari, Foster, & Udermann, 2008;

Whitehurst, Johnson, Parker, Brown, & Ford, 2005) and body composition (Wiszomirska, Krynicki, Kaczmarczyk, & Gajewski, 2014) in elderly while improves musculoskeletal fitness health and flexibility in young adults (Kibele & Behm, 2009; Weiss et al., 2010). Moreover, it is suggested that FT increases adherence to regular exercise and engagement in structured training programs (Williams, Hendry, France, Lewis, & Wilkinson, 2007). In addition, high-intensity group fitness programs seem to be more attractive to the overweight and obese participants rather than traditional aerobics classes or traditional resistance training machine-based workouts. According to these research findings, participants who were engaged in this exercise modality improved significantly enjoyment, adherence, and intentions to systematic exercise experience. (Heinrich, Patel, O'Neal, & Heinrich, 2014).

Methods

Ethics statement

Participants signed a consent form after they were informed of all risks, discomforts and benefits involved in the study. Procedures were in agreement with the 1975 Declaration of Helsinki, as revised in 2000, and approval was granted by the institutional ethics committee of the Department of Physical Education and Sports Sciences of the University of Thessaly.

Participants and research design

The main goal of this investigation will be the evaluation of the efficacy of a circuit integrated neuromuscular training protocol with whole-body exercises using alternative modalities on energy balance of obese women and not to compare it with other exercise approaches used for weight management. A controlled, randomized, three-group, repeated-measures design will be employed. A preliminary power analysis will be completed in advance in order to be suggested the required sample size for this study. All participants will be asked to follow an isocaloric diet (based on RMR measurements and habitual physical activity). A Registered Dietitian will provide instructions on how to adapt to a weight maintenance diet (55-60% carbohydrate, 15-20% protein, 20%-25% fat), in the form of nutritional equivalents during an initial adaptation period when body mass will be monitored to verify the accuracy of the assigned energy approach (it will be re-adjusted at 20 weeks). To measure caloric intake, participants will submit 7-day diet recalls that will be analyzed by a Registered Dietitian using a nutritional analysis software. Participants will be instructed to maintain the same feeding pattern during the entire study.

Inclusion criteria

Participants will be recruited using fliers (posted in the local community), social media and by word of mouth. Women will be participating in the study should: (a) be inactive (<7,500 steps·day-1; VO2max <30 ml·kg-1·min-1; accelerometry-based moderate-to-vigorous physical activity <30 min·day-1), b) be healthy, premenopausal and aged 30-45 years, c) be overweight or obese class 1 [Body Mass Index (BMI) 25.1-34.9], d) have medical clearance for strenuous physical training, e) be non-smokers for ≥6 months before the study, f) not follow a diet intervention or use nutritional supplements/medications before (≥6 months) and during the study, g) have no weight loss greater >10% of body mass before (≤6 months) the study and h) have no symptoms of depression.

Exclusion criteria

Participants will be excluded from the study if: a) the adherence rate will be ≤80% of total exercise sessions, and i) they adhered to a nutritional intervention during the study.

Exercise intervention

A supervised small-group (5-10 women/session) circuit integrated neuromuscular training (CINT) protocol will be performed three times/week (with a 48-hour recovery between sessions), with the use of asynchronous music, for 40 weeks. During the first 20 weeks, training will be divided in three phases characterized by a progressive increase in exercise intensity and volume. During the second 20 weeks (phase 4), training will maintain the intensity and volume of phase 3 but the work-to-rest ratio will be varied bi-weekly. Exercises will incorporate fundamental movement patterns using bodyweight as resistance or adjunct portable modalities. Each session will include a 10-min warm-up (low-intensity endurance exercise, stretching exercises and mobility exercises) and a 5-min cool-down period (walking/stretching exercises). Exercises (~8-12/session) will be performed in timed circuit fashion using working or resting intervals of a prescribed time. Participants will perform as many repetitions as possible at each station with proper form at a controlled, moderate speed. Each session will be consisted of alternate stations emphasizing cardiovascular, resistance and neuromotor exercises. For resistance-type exercises, participants will be encouraged to use a comfortable resistance at the beginning of the study while progressing to heavier loads that will allow them to complete the desired exercise duration at each station. Heart rate will be monitored (Polar Team Solution) throughout each session and mean and maximal heart rate will be recorded. Participants will be guided to keep an intensity >75% of maximal heart rate. Rates of perceived exertion will be recorded for each round and mean exertion will be calculated. Exercise intensity will be calculated as mean heart rate (percentage of maximal heart rate obtained during VO_2max testing), percentage (%) of heart rate reserve, RPE, % of VO_2peak, metabolic equivalents of task (METs), and blood lactate accumulation for all participants.

Data collection

Anthropometric measurements will include height, body mass, Body Mass Index (BMI) and waist-to-hip ratio (WHR). Body composition will be measured by a whole-body dual-energy X-ray absorptiometry scanner (DXA). Strength (one repetition maximal, 1RM) will be measured bilaterally on a horizontal leg press machine using standard procedures while VO_2peak will be assessed during a graded maximal exercise testing (GXT) using the modified Balke protocol on a treadmill. Seven-day habitual physical activity level will be determined via accelerometry and the duration of inactivity and light, moderate, vigorous activity, steps/day and energy expenditure will be recorded. Participants will be encouraged to maintain their usual daily physical activity throughout the study. For the resting metabolic rate (RMR) assessment, resting VO_2/CO_2 will be measured in the morning (07.00-09.00) after an overnight fast using an open-circuit indirect calorimeter with a ventilated hood system while the 24-hour RMR will be calculated using the Weir equation.

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