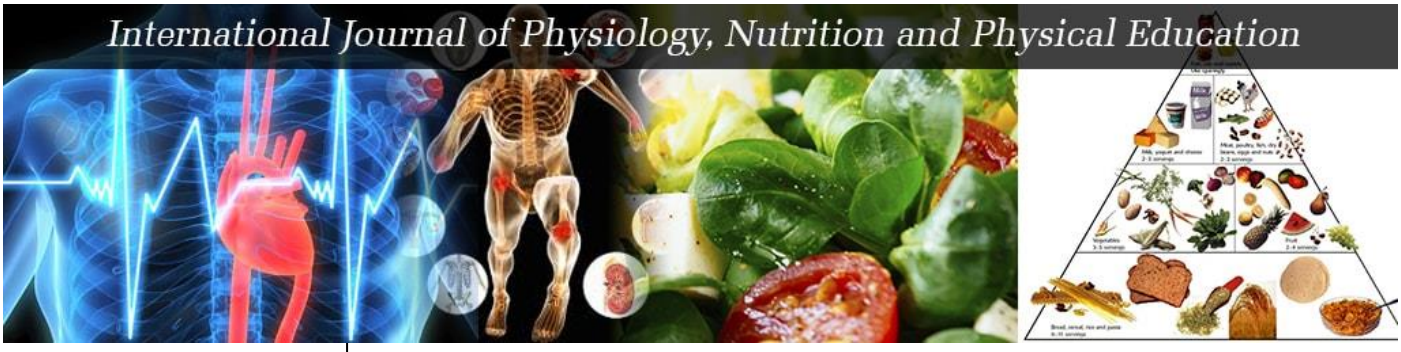

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Effects of kettlebells and battle rope training on grip strength and body composition in youngsters

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Abstract
The aim of this current study is to evaluate the changes in body composition and hand grip strength following high intensity interval training (HIIT) utilizing kettlebells and battle ropes. The hypothesize results will show that our HIIT protocol will improve grip strength and body composition. Subjects in the experimental and control group consist of 13 college-aged students (9 females and 4 males). Subjects in both groups complete a pre-test and post-test consisting of height, weight, grip strength via handgrip dynamometers and body composition via skinfold calipers. The experimental group completes a 5-week training session while the control continues their normal workout routines. Experimental group will undergo 5 weeks of HIIT for 3 sessions per week, consisting of a 20-minute protocol with an exercise work-to-rest ratio of 1:1 (15sec exercise; 15sec rest) alternating 2 minutes of kettlebell exercises with 2 minutes of battle rope exercises totaling four sets of each of the five exercises. To examine the group and time effects on grip strength and body comp results, a two-way repeated measured ANOVA and paired sample t-test was used. The only significant finding was in right handgrip strength (RHGS) which improved from 39.5kg±10.63kg to 42.08kg±11.45kg. There were no significant differences in body composition or left handgrip strength (LHGS). The results suggest that HIIT using kettlebells and battle ropes does not elicit significant changes in body composition or LHGS over a 5-week period, although there were minor improvements in these measurements for the experimental group.

Keywords: Low volume, exercise, resistance training

Introduction
High-intensity interval training (HIIT), also called high-intensity circuit training (HICT), has recently become a very popular tool in the fitness and rehabilitation setting to elicit many improvements such as changes in body fat, muscle strength and cardiovascular fitness in a short period of time. HIIT is a form of exercise utilizing alternating bouts of high-intensity exercise followed by a bout of low-intensity exercise or rest. It can be performed by using a wide variety of resistance or aerobic training equipment or by simply using one's own body weight. A major benefit to HIIT is the ability to maximize caloric expenditure in a minimalistic time period. Only within the past decade has research been conducted more extensively to determine the benefits of this type of work-to-rest interval training. To obtain the positive effects of HIIT, rest time is an important factor to control for. During HIIT, heart rate stays elevated for the Duration of the workout leading to a higher level of oxygen consumption compared to traditional exercise. The shorter the rest period while completing HIIT, the higher the heart rate and oxygen consumption tends to be. A high level of oxygen consumption elicits greater physiological changes such as changes in body fat due to exercise post-oxygen consumption (EPOC) which is the body's way of restoring oxygen deficits from working out. It is imperative that rest periods are 30 seconds or less between exercises to result in the greatest metabolic impact, such that a greater caloric expenditure occurs leading to a greater rate of fat loss. Many studies use a 1:1 exercise-to-rest ratio typically resulting in 30 seconds of exercise and 30 seconds rest, but not many studies if any use 15:15 as will be done in this study to try to elicit positive effects on body composition and handgrip strength.
Another reason why HIIT is becoming a growing topic of interest is because of claims stating that it can reduce body fat in less time than the conventional steady-state exercise. Using similar volumes and frequency for low-intensity and high-intensity circuit groups, it has been found that using a higher intensity elicits a greater decrease in body fat.

There is also a handful of research done on the aerobic effects of HIIT that suggests HIIT is effective at inducing improvements in aerobic fitness, and also increasing muscular endurance in a wide variety of muscle groups in as little as four weeks. This style of training has also been found to provide many of the same affects as doing longer aerobic based workouts, even with resistance training as the modality. Evidence illustrates the effectiveness of high-intensity circuit training (HICT) in reducing fat mass, diastolic blood pressure, total cholesterol, LDL cholesterol, triglycerides, as well as an increase in HDL cholesterol in men ages 61±3.3 years with a BMI of 29.8±0.9. HICT has resulted in a positive effect on resting energy expenditure (REE); resting energy expenditure has shown to be higher in individuals that perform HICT compared to their resistance training counterparts. REE is the largest component of daily energy expenditure; therefore, positive effects of HICT on REE could potentially help researchers and practitioners in prescribing exercise regiments aimed to promote overall health, which may lead to effective weight management strategies. Overtime, HIIT has been performed with a wide variety of workout equipment. However, there is little to no research done on the effects of using battle ropes or kettle bells. Battle ropes seem to be a promising new exercise tool, and in the near future will be getting more attention to their place in workout regimens. Another resistance tool, the kettle bell, has been utilized among practitioners, and kettle bell workouts have shown to improve strength, endurance, agility, and balance of both the muscular and cardiovascular systems with dynamic, total body movements. If kettle bell workouts can provide the benefits mentioned above, further research could provide data on their ability to help improve body composition as well.

Handgrip strength combined with cardiorespiratory fitness and nutrition are important determinants of motor fitness and skill-related fitness for musculature of the upper extremities Handgrip strength is also an important necessity for everyone, regardless of occupation since it is needed in everyday life without any conscious thought. Handgrip strength has been studied extensively in the past and has been found that poor handgrip strength is shown to increase the chances of the development of disability later in life, a decrease in functional ability, premature mortality, and an increased risk of complications as well as prolonging the length of stay after hospitalization or surgery. By performing HIIT with kettle bells and battle ropes, handgrip strength may show improvement which would aid in preventing future health problems. Therefore, it is of interest to examine the effectiveness of HIIT training utilizing kettle bells and battle ropes on body composition and handgrip strength in college-aged adults. The focus of the present study is to examine the effects that kettle bell and battle ropes-based high intensity interval training has on body composition and handgrip strength in young adults. Since kettle bells and battle ropes are exercise equipment that have not been frequently studied, this study could develop new information for the health fitness community. Based on previously read literature and experience using kettle bells and battle ropes, it is hypothesized that performing a 20-minute HIIT protocol consisting of kettle bells and battle ropes, three days per week over a five-week period will elicit positive changes in handgrip strength and body composition.

Objective of study

To find the effect of kettle bells and battle rope training on grip strength and body composition in youngsters.

Methods

Twenty-six physically active individuals were recruited by means of promotional flyers and word of mouth from the Eau Claire, Wisconsin area to participate in a HIIT study involving kettle bells and battle ropes. Only test volunteers that fulfilled the inclusion criteria and did not meet the exclusion criteria were included in the study. Inclusion Criteria: College-aged males and females 18-25 years old, history of regular exercise (self-reported exercise of at least 30 minutes of moderate-to-vigorous intensity exercise per day, 3-5 days per week for a total of 75-150 minutes per week). Exclusion Criteria: Individuals that have reported using kettle bells and battle ropes regularly in their workouts, recent injuries or persisting pains that would result in subject from doing certain exercises in the HIIT protocol, major competitive or life events that would prevent individuals from fully participating in workout routine, individuals below the age of 18 or over the age of 25.Upon screening individuals based on the inclusion and exclusion criteria, approximately one dozen individuals were excluded from participating in the study due to age (3 individuals), injuries or limitations (2 individuals), not meeting activity guidelines (5 individuals) and reporting regular use of kettle bells and battle ropes (1 individual). Participants that met all requirements were selected to be in the HIIT study and were randomly assigned to a control group or an experimental group that would participate in the kettle bell and battle ropes workout.

Participant characteristics of the control group included n=13 (4 males and 9 females), age 20.9 ± 1.0 years,

Height 168.1 ± 9.2 cm, Weight 157.1 ± 50.3 lbs, Body mass index (BMI) 24.9 ± 6.1 kg/m2, Body Fat percentage 20.8 ± 5.2%, right handgrip strength 38.6 ± 14.5 kg, Left hand grip strength 37.8 ± 14.9 kg. Participant characteristics of the experimental/test group included n=13 (4 males and 9 females), age 20.2 ± 1.3 years, height 170.7 ± 13.5 cm, weight 158.8 ± 29.6 lbs, body mass index (BMI) 24.8 ± 4.3 kg/m2, body fat percentage 22.5 ± 7.8%, right handgrip strength 39.5 ± 10.6 kg, left handgrip strength 36.8 ± 12.1 kg.

The study met all requirements of the institution's Institutional Review Board (IRB). Each participant was given a cover letter explaining what the study consisted of and was also explained verbally to them. Each participant also received an informed consent form that was approved by the IRB which was also verbally described to them in which they were also instructed to read over and sign if they still chose to participate in the study.

Body composition was measured using Lange skinfold calipers (Lange skinfold caliper, Beta Technology Inc., Cambridge, Maryland). Body composition was measured at three sites which included subscapula, chest and triceps for male participants and triceps, suprailiac, and abdomen for female participants. Measurements were made according ACSM guidelines and procedures. Skinfold measurements were recorded to the nearest millimeter by a single skilled technician to avoid variability between testers. Three measurements were performed at each site and the median number was selected. Body fat percentage was calculated based on the Jackson-Pollock 1985 skinfold equation which is the reason why different sites were measured in females and males. Body composition was assessed using skinfold measurements because they are highly correlated with percent body fat in physically active and healthy individuals.

Handgrip strength was measured using Takei Kiki Kogyo handgrip dynamometers (Takei Kiki Kogyo handgrip dynamometer, Takei Scientific Instruments Co., Niigata,

Japan). Grip strength was measured similar to what was done in a study by Bandyopadhyay with the exception of not using a three minute rest brake between trials. Subjects performed the grip test with arms down next to their side and would rotate testing between hands. Three measurements were taken on each side with the highest value being recorded to the nearest half kilogram.

Height was taken using a standard wall-mounted stadiometer. There was no brand name or company name on the device. Subjects were measured with backs against the wall and without shoes. A measuring platform was raised over subjects head and they were instructed to take a deep breath and step forward away from the stadiometer. Height was then recorded to the nearest tenth of a centimeter. Weight was measured using a digital scale. Participants were instructed to stand on the scale without shoes on and with shorts and t-shirt as attire. Weight was recorded to the nearest tenth of a pound. From height and weight information obtained during baseline assessments, BMI was then calculated.

All eligible participants were notified to report to the exercise physiology lab at the institution during one of three time slots for paper work processing and baseline assessments. They received a cover letter of the study ahead of time and were instructed to show up with shorts and a t-shirt. Subjects also were instructed not to exercise beforehand or put lotion on due to possible errors in skinfold measurements. During these initial baseline meetings, each subject was read to and explained the cover letter and informed consent form that was approved by the University of Wisconsin-Eau Claire's Institutional Review Board. After any possible questions and signing of the consent form, participants were notified of their randomly selected group (either experimental/test group or control group) which was altered for gender to make sure an equal number of females were in each group and an equal number of males in each group. They then were given an identification number, which would be used for all data collection and for confidentiality purposes. During this first visit, height, weight, handgrip strength and body composition was measured (details described above under Instrumentation) for both the experimental group and control group. Both groups were also given a nutritional data sheet to log their dietary intake. They were instructed to log everything containing calories three days per week which consisted of a random weekday, a workout day and a weekend day. A three day dietary recall of this nature is similar to what was done in a study by Porrata-Maury et al. After all of this was completed, the control group was free to leave while the experimental group stuck around to run through a trial run of the HIIT protocol they would be performing the upcoming five weeks and sign up for a time slot to complete the workout.

The next participant-researcher meetings (weeks 2-6) consisted of performing the HIIT workout, which was done by the experimental group only and performed entirely within the campus fitness center. The workout consisted of a five minute warm-up, 20 minute HIIT workout, and five minute cool-down. Subjects participated in the workout three days per week (Monday, Wednesday and Thursday) for five weeks. The kettle bell and battle ropes HIIT protocol consisted of five kettle bell exercises using a kettle bell that was approximately 25% of the subject's body weight, and five battle ropes exercises for a total of ten different exercises. Weight of the kettle bell was set as25% of the subject's body to ensure proper technique for each of the exercises without compensatory movement, while also eliciting a desirable intensity. The kettle bell and battle ropes exercises are presented in

Table 1: Kettle bell and battle rope exercises.

Kettle bell Exercises	Battle Ropes Exercises
Regular Swing	Alternating Waves
Swing with Goblet Squat	Jumping Jacks
Shovel	Parallel Waves
1-Armed Alternating	
Swing	Rotational Slam
Kettle bell Burpees	Jump Slam

Each exercise was performed for two minutes and consisted of four sets lasting 15 seconds each. For this study a 1:1 work to rest ratio was used in order to keep each session at a high intensity during the entire workout (7). So in this study's case, 15 seconds of HIIT was performed followed by 15 seconds of rest. After the four sets were completed (2 minutes), subjects rotated to the next station alternating kettle bell and battle ropes exercises and strength and body composition in the college-aged population.

Analysis of tables

Table 2: Participant characteristics (N=25).

Participant Characteristics	Mean	Standard Deviation
Age (years)	20.54	1.17
Height (cm)	169.41	11.39
Pre Weight (lbs)	157.95	40.48
Post Weight (lbs)	159.62	40.47

Table 3: Comparison of body composition and grip strength between pre- and post-test.

Measurement	Group	Mean	Pre-Test SD	Mean	Post-Test SD
BF (%)	Exp	22.46	7.81	22.00	7.45
	Control	20.67	5.43	20.83	6.39
RHGS (kg)	Exp*	39.50	10.63	42.08	11.45
	Control	39.42	14.85	39.92	17.03
LHGS (kg)	Exp	36.85	12.18	38.19	11.57
	Control	38.54	15.35	38.08	16.29

Note: *Indicates significant pre- to post-test difference at ($p<0.05$). SD=Standard Deviation, BF: Body Fat

Percent, RHGS: Right Handgrip Strength, LHGS: Left Handgrip Strength.

In the HIIT group, but not in the control group. RHGS was calculated with a paired sample t-test to distinguish pre- to post- test differences between HIIT and control groups.

Results

Subject characteristics and dependent variable measures are presented in table 2. We analyzed a total of 25 out of 26 possible subjects, with one subject being dropped from the study for personal reasons. Table 3 depicts changes in body fat percent and handgrip strength from pre- to post-test for the high intensity interval training group (HIIT) and control groups. To analyze the body fat percent data, we used a two-way repeated measures ANOVA using SPSS 19.0 software. There were no significant changes in body composition between the control group and HIIT group at significance level set at ($p<0.05$) as can be seen with the given interaction effect for body composition ($p=.517$) and group effect ($p=.590$).We used a split file output to compare pre-and post-test differences for control and HIIT groups separately at

significance level set at ($p<0.05$). This can be seen with the given interaction effect of left handgrip strength (LHGS) ($p=.887$) and group effect ($p=.139$). There were no significant changes in LHGS in either groups pre- to post-test. Right handgrip strength (RHGS) over the 5-week study from pre- to post-test showed a significant time effect ($p=.025$) in both groups and a significant increase ($p=.016$)repeated this process for the entirety of the 20 minute workout. Intensity for this study was monitored by using rate of perceived exertion (RPE). Subjects were told to aim for an 8-10 range on a 10 point scale.

All members from both experimental and control groups were notified to attend one of three post-test sessions (week 7). They were given the same instructions as the initial testing with what to wear etc. and were told to bring their completed nutritional data sheet. The same variables, height, weight, hand grip strength and body composition, were measured during this post-test.

Discussion

To the best of our knowledge, this study comparing the effects of high-intensity interval training (HIIT) utilizing kettle bells and battle ropes on body composition and handgrip strength among college-aged active adults. We found no significant difference in body composition over the 5-week period, which does not align with our hypothesis or previous studies that investigated the effect of HIIT on body composition. However, in one specific study the subjects exercised for 50 minutes per session, three days per week, for 12 weeks total. Another study utilizing a high intensity running protocol 3-days per week for 8 weeks found insignificant improvements in body composition similar to our study. In our study, we utilized a 1:1 work to rest ratio similar to Romero-Arenas et al. and Musa et al., however, most studies used 30 seconds or greater for their work and rest periods, whereas we used 15

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