Oxygen Cost of Kettlebell Swings

Ryan E. Farrar, Jerry L. Mayhew, and Alexander J. Koch

Health & Exercise Sciences Department, Human Performance Laboratory, Truman State University, Kirksville, Missouri

Abstract

Farrar, RE, Mayhew, JL, and Koch, AJ. Oxygen cost of kettlebell swings. *J Strength Cond Res* 24(4): 1034–1036, 2010—In recent years, kettlebells have re-emerged as a popular training modality for the conditioning of athletes. We sought to quantify the aerobic challenge of one popularly recommended kettlebell workout. Ten college-aged men (age = 20.8 ± 1.1 years, height = 179 ± 3 cm, body mass = 77.3 ± 7.7 kg, $\dot{V}O_2max$ = 52.78 ± 6.22 ml·kg^{-1}·min^{-1}) completed a graded exercise test to exhaustion for the determination of $\dot{V}O_2max$. Two to 7 days later, subjects completed a kettlebell exercise routine consisting of as many 2-handed swings as could be completed in 12 minutes using a 16-kg kettlebell. During this exercise bout, subjects' expired gases were collected and analyzed for the determination of $\dot{V}O_2$, and heart rate (HR) was continuously measured. Percent HRmax and %$\dot{V}O_2max$ achieved during the kettlebell exercise were compared with each other using a paired *t*-test. Subjects completed 265 ± 68 swings during the 12 minutes and achieved an average $\dot{V}O_2$ of 34.31 ± 5.67 ml·kg^{-1}·min^{-1} and an average HR of 165 ± 13 b·min^{-1}. The average %HRmax (86.8 ± 6.0%) during kettlebell exercise was significantly higher ($p < 0.001$) than the average %$\dot{V}O_2max$ (65.3 ± 9.8%) that was achieved. Continuous kettlebell swings can impart a metabolic challenge of sufficient intensity to increase $\dot{V}O_2max$. Heart rate was substantially higher than $\dot{V}O_2$ during kettlebell swings. Kettlebells provide a useful tool with which coaches may improve the cardiorespiratory fitness of their athletes. However, HRs achieved during continuous kettlebell exercise are significantly higher than actual $\dot{V}O_2$.

Key Words $\dot{V}O_2$, conditioning, interval training

Introduction

Athletes have access to a wide array of training methods and equipment. One such training implement is the kettlebell, which has re-emerged in the United States in recent years as a popular option for athletic conditioning. Kettlebells have been a consistently popular training tool in their native Russia, for many years. The Russian word for kettlebell, *girya*, first appeared in a Russian dictionary in 1704 (9). However, a sport discus search for the keyword "kettlebell" finds no English references before the year 2002.

Currently, kettlebell training has become a staple of popular strength and conditioning programs such as Crossfit and Pavel Tsatsouline's Russian Kettlebell workshops. Training with kettlebells is touted as a viable way to increase muscular strength, muscular endurance, cardiorespiratory fitness, and reduce body fat (9). However, no empirical evidence (at least in English) exists to support these claims. In response to this paucity of information, we examined the cardiorespiratory demand of one popularly recommended kettlebell routine.

Address correspondence to Alexander J. Koch, akoch@truman.edu.

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Methods

Experimental Approach to the Problem

Despite the recent emergence of kettlebell training, there is little documentation of the physiological effects of training routines using this device. The purpose of this descriptive study was to document the heart rate (HR) response and oxygen cost of performing a kettlebell exercise routine that is intended to improve cardiorespiratory fitness. The kettlebell routine we chose to examine is termed "the US Department of Energy Man-Maker" and is described in a popular text on kettlebell training (9).

Subjects performed 2-handed swings, in accordance with the routine's published description, for 12 minutes in duration. Heart rate and $\dot{V}O_2$ were continuously recorded during the exercise.

Subjects

Ten college-aged men (age = 20.8 ± 1.1 years, height = 179 ± 3 cm, body mass = 77.3 ± 7.7 kg, $\dot{V}O_2max$ = 52.78 ± 6.22 ml·kg^{-1}·min^{-1}) were recruited as subjects. Although all subjects were recreationally active, only one had previous experience exercising with kettlebells. Subjects reported to the laboratory for testing on 2 occasions. During the first testing session, subjects completed a health history form, and upon determination that they were of "low risk" for cardiopulmonary or metabolic disease according to ACSM guidelines, they completed a treadmill test for maximal oxygen consumption. On the second testing session, subjects completed the kettlebell exercise routine. All test procedures were approved by the University's Institutional Review Board, and all subjects provided their informed consent before participation in the experiment.

Test Session 1–$\dot{V}O_2$max Testing

After the completion of a medical history form, and the determination that the subjects were eligible for maximal exercise testing, subjects' anthropometric data were obtained using a stadiometer and a calibrated digital scale. Subjects were then outfitted with a chest strap HR monitor (Polar USA, Lake Success, NY) and connected to a metabolic cart (Truemax 2400; ParvoMedics, Salt Lake City, UT). Subjects then completed a graded exercise test for the determination of $\dot{V}O_2$max using the Bruce protocol (4) on a motorized treadmill (Quinton model Q45; Bothell, WA). All subjects were deemed successful in achieving $\dot{V}O_2$max, as they obtained at least 2 of the following criteria: an HR within ± 12 $b \cdot min^{-1}$ of age-predicted maximum, a respiratory exchange ratio (RER) of ≥1.10, and a rating of perceived exertion of ≥17 on the 16-point Borg scale (3). After completion of the $\dot{V}O_2$max test and a brief rest, subjects were familiarized with the technique for the kettlebell swing exercise and allowed to perform a few practice swings.

Test Session 2–Kettlebell Exercise

Two to 7 days after the $\dot{V}O_2$max test, subjects returned to the laboratory. On arrival, they completed a 2-minute warm-up on a cycle ergometer (Monark, Varberg, Sweden) at a self-determined workload. Subjects then donned an HR monitor and were connected to the metabolic cart to allow continuous monitoring of HR and expired gases.

Subjects completed a 12-minute exercise bout, known as the "US Department of Energy Man-Maker" (9). The bout consisted of performing 2-handed swings, using a 16-kg kettlebell (Perform Better, Cranston, RI) for 12-minute duration. A 16-kg kettlebell was used in this study because that is a recommended weight for beginning men (9). Subjects were told to work at their own pace, resting as needed, while aiming to complete as many swings as possible in the 12-minute time frame. Heart rate was monitored continuously and recorded every minute of the bout.

Data Analysis

All data are presented as mean ± *SD*. Average HR and $\dot{V}O_2$ during the kettlebell routine were calculated, and the percent of HRmax and $\dot{V}O_2$max achieved during the bout were determined. Percent HRmax and %$\dot{V}O_2$max were compared using a paired samples *t*-test. A linear regression analysis was used to describe the relationship between %HR and %$\dot{V}O_2$. Statistical significance was set at the $p \leq 0.05$ level.

Results

Subjects completed an average of 265 ± 68 swings during the 12 minutes, for an average work rate of 22 ± 6 swings·per minute. Relative $\dot{V}O_2$ averaged 34.31 ± 5.67 $ml \cdot kg^{-1} \cdot min^{-1}$ (65.3 ± 9.8% of $\dot{V}O_2$max) during the exercise bout, for an accumulated oxygen consumption of 26.5 ± 4.78 $L \cdot min^{-1}$ in 12 minutes. The average RER during the bout was 1.00 ± 0.05. The HR was 165 ± 13 $b \cdot min^{-1}$ (86.8 ± 6.0% of HRmax) during the exercise bout. Figure 1 illustrates the average $\dot{V}O_2$ and HR data for the 12-minute exercise bout.

The average %HRmax during kettlebell exercise was significantly higher ($p < 0.001$) than the average %$\dot{V}O_2$max. The equation describing the regression line to predict %$\dot{V}O_2$max

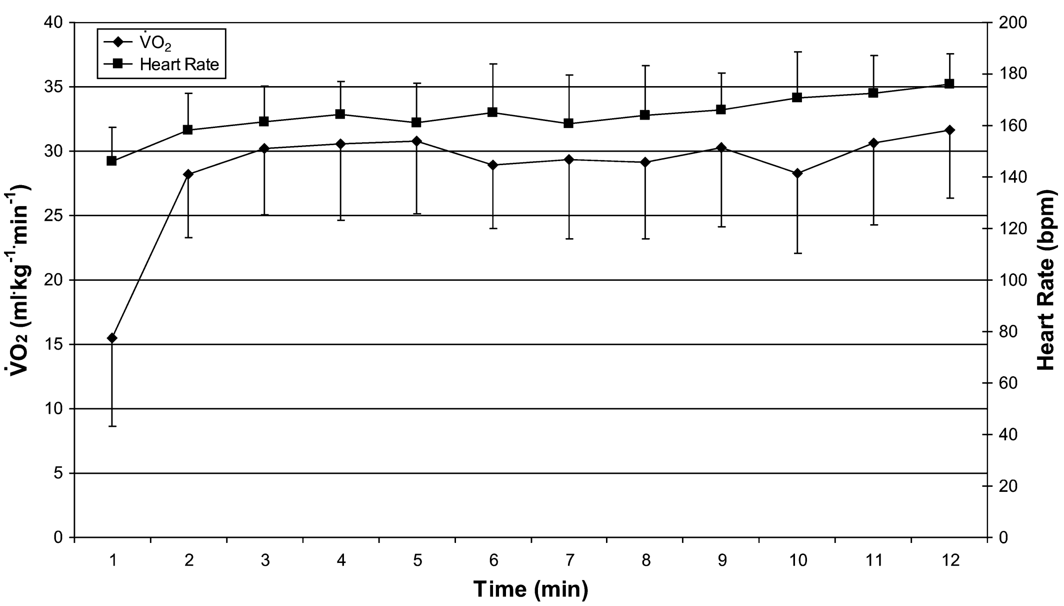

Figure 1. Average HR and $\dot{V}O_2$ for a 12-min kettlebell swing exercise in college men ($n = 10$).

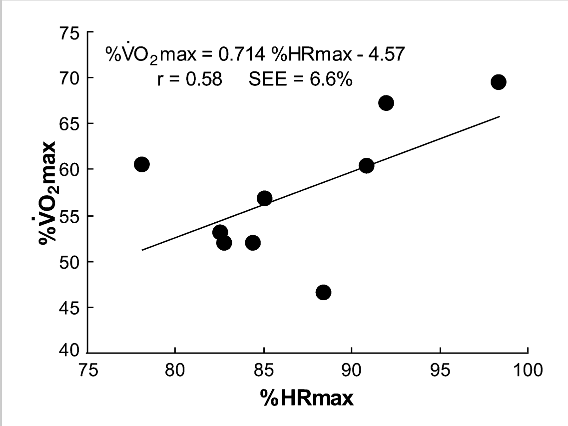

Figure 2. Relationship between average %HRmax and $\dot{V}O_2$max during a 12-min kettlebell swing exercise in college men ($n = 10$).

from %HRmax was %$\dot{V}O_2$max = 0.714%HRmax − 4.57, with a significant correlation of 0.58 and an *SEE* of 6.6%. Figure 2 illustrates the relationship between %$\dot{V}O_2$max and %HRmax.

Discussion

Performing kettlebell swings at a self-determined pace for 12 minutes, attempting to complete as many swings as possible during that time, maintained subjects' HR and $\dot{V}O_2$ at an average of 87 and 65% of their respective maxima. Based on these observations, the "man-maker" kettlebell drill provided a metabolic challenge of sufficient intensity to increase $\dot{V}O_2$max. The American College of Sports Medicine recommends an optimal intensity of 60–85% $\dot{V}O_2$max to improve cardiorespiratory fitness (1). The average HR and $\dot{V}O_2$ achieved during this exercise bout would classify it as "hard" exercise according to ACSM standards (1). Furthermore, the high RER values (average of 1.0), relative to the moderate exercise $\dot{V}O_2$ (~65% of maximal), are indicative of a substantial contribution by nonoxidative metabolism to the total energy requirement of the bout. These gas exchange data observed during kettlebell exercise were of a similar pattern (high RER, moderate $\dot{V}O_2$) to those previously reported during circuit weight training (2,5,8).

The kettlebell exercise in this experiment produced an increased HR that was substantially higher than the increase in $\dot{V}O_2$. While the pattern of the relationship between %HRmax and %$\dot{V}O_2$max was similar to those previously reported during circuit weight training (2,5,8), the manmaker drill required a greater oxygen consumption and HR values than previously reported (approximately 30–47% $\dot{V}O_2$max 62–76 %HRmax) for circuit weight training (2,5,8). The slope of the linear regression predicting %$\dot{V}O_2$max from %HRmax during the kettlebell exercise was substantially lower (0.714) than the slope previously reported (1.369) during treadmill running (7) but higher than the slope reported (0.582) during circuit weight training (6). Thus, the "man-maker" kettlebell drill appears to impart a greater challenge to cardiorespiratory system than has been shown with traditional circuit weight training.

Practical Applications

Kettlebells provide a useful conditioning tool for coaches. Performing 2-handed kettlebell swings in the "man-maker" drill can improve the cardiorespiratory fitness of athletes. However, coaches should be aware that HRs achieved during continuous kettlebell exercise are significantly higher than the corresponding exercise $\dot{V}O_2$ demand. Furthermore, the relationship between the 2 variables is greater than that noted for circuit weight training but less than that for treadmill exercise.

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