JSHP
JOURNAL OF SPORT AND HUMAN PERFORMANCE

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KETTLEBELL TRAINING: A BRIEF REVIEW

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ABSTRACT

Kettlebell training is a relatively new trend that aims to serve many functions in training programs, including increasing muscular strength and power to improving aerobic capacity. Kettlebell training may provide a sufficient stimulus for enhancing both muscular and aerobic performance, possibly with the greatest effect on muscular power. The principle of specificity is discussed in detail as the specific design of a kettlebell program may influence the specific outcomes experienced by those performing kettlebell training. Further research comparing kettlebell training to other training methods may provide a better understanding of the benefits of this training modality in order to draw more definitive conclusions.

Keywords: strength, power, muscular endurance, aerobic capacity

INTRODUCTION

The original use of kettlebells dates back to the early 1700's in Russia where they were used as a counterweight for produce scales, rather than as a method of improving fitness (6). At some point after their initial introduction, individuals began to incorporate them into training regimens aimed at improving fitness; however, the use of kettlebells was limited to primarily Russian athletes and military personnel (6). The use of kettlebells to improve fitness in the United States is still a recent trend (4,12). The increasing use of kettlebells and of kettlebell training may be partially attributable to the increasing popularity of "functional training" in the United States in recent years.

Kettlebells are a ball-shaped weight and handle traditionally composed of cast-iron, but have recently been made from rubber and plastics as well (6). Like most traditional free weights (i.e., barbells and dumbbells), they are highly versatile in that they allow for a wide range of movements and exercises with a minimal amount of equipment and space requirements (8,12). The kettlebell, however, is unique in that the center of mass extends beyond the handle, which allows for a variety of swinging and ballistic movements to be performed. Kettlebells can be used as an alternative to dumbbells or barbells for traditional resistance training movements (e.g., presses, rows, squats, and deadlifts); however, they also allow the exerciser to perform a range of ballistic movements (e.g., two-handed swings, one-handed swings, clean and presses, snatches, high-pulls).

Reported benefits of kettlebell use include improvements in muscular fitness as well as aerobic fitness. Compared to other common methods of resistance and aerobic training modalities, the research supporting the efficacy of kettlebell training is scarce. As the use of kettlebells increases in a variety of settings, including commercial fitness and strength and conditioning, research is needed to support the effects of this training modality on a range of fitness and performance components. Therefore, the purpose of this review is to summarize the efficacy of kettlebell training for increasing muscular power, strength, muscular endurance, and aerobic capacity. Table 1 provides a brief summary of each study that is included and will be discussed in this review.

EFFECTS OF KETTLEBELL TRAINING ON PERFORMANCE

Muscular Strength and Power

The use of kettlebells in training programs has been shown to enhance muscular strength and muscular power (14,15,18,19). Manocchia et al (18) has demonstrated significant improvements in 3RM bench press (51.7 ± 25.0 kg vs. 56.4 ± 27.1 kg, p< .05) and 3RM clean and jerk (30.8 ± 16.7 kg vs. 38.5 ± 17.1 kg, p< .001) performance with a 10-week kettlebell training program. Otto et al (19) has demonstrated increases in maximal back squat and maximal power clean while also showing improvements in vertical jump with a progressive 6-week kettlebell training program. This study was designed to compare two groups, a kettlebell (KB) group and a weightlifting (WL) group. Maximal power clean and back squat improved significantly in both training groups; however, the WL group experienced a greater increase in back squat strength from pre- to post-test (KB: 124.24 ± 31.20 kg vs. 129.82 ± 27.88 kg; WL: 133.08 ± 30.38 kg vs. 151.15 ± 32.41 kg). Other investigations have concluded that kettlebell training can improve muscular power and rate of force development (15) as well as muscular strength (14); however, kettlebell training seems to have a greater effect on power compared to strength (19).

Typically, kettlebell exercises (e.g., swings, cleans, snatches, push-presses, high-pulls) are performed in a ballistic manner in which the stretch-shortening cycle is elicited due to the rapid concentric movement immediately following the eccentric countermovement (16,17). Although the research is limited, this may help explain the greater consistency in the research regarding the effects of kettlebell training on improvements in muscular power. Training for muscular strength requires significant loading of the musculature, typically with loads between 60%-80% of 1RM or greater depending on training status (1,2). When performing ballistic movements with a kettlebell (e.g., clean and press, snatch, push-press, two-handed swing, one-handed swing), this magnitude of loading is not achieved due to the rapid nature of the exercise and the need for a high movement velocity. In research investigations it seems important to distinguish between the types of exercises that are being performed with a kettlebell as doing so will help to clarify the function of the kettlebell and its purpose for inclusion in the training program.

Alternatively, kettlebells may be used in place of dumbbells or other free weights while performing traditional resistance exercises with the goal of increasing muscular strength as opposed to muscular power. It would seem that performing traditional resistance exercises with higher loads and lower velocities would have a greater effect on muscular strength compared to muscular power as the kettlebell is simply replacing a dumbbell or barbell. Much of the original research into kettlebell training uses the two-handed swing, one-handed swing, clean, or snatch (14,15,19) when examining the effects of this training modality on muscular strength and power. However, some of these studies have also included more traditional resistance exercises such as squats or presses (14,19). The selection of kettlebell exercises for a training program would have a significant influence on the specific muscular adaptations experienced by the participants. This might help to explain why kettlebell training seems to have a greater effect on muscular power, as much of the research that has been done with kettlebells has involved primarily ballistic movements performed at higher movement velocities as opposed to traditional resistance exercises performed at lower movement velocities.

Muscular Endurance

The studies that have investigated the effects of kettlebell training on muscular endurance (5,18) often study this component of muscular performance in addition to other components as well (i.e., strength and power). Despite this, kettlebell training has demonstrated significant improvements in muscular endurance. Manocchia et al (18) has demonstrated improvements in the number of repetitions of back extension to failure (PRE: 45 ± 5.7 reps vs. POST: 54 ± 9.3 reps) after a 10-week kettlebell training program that consisted of two sessions each week. Beltz et al (5) showed improvements in the muscular endurance of the abdominals after participants completed an 8-week kettlebell training program. Both of these studies demonstrate the potential for kettlebell training to improve muscular endurance, although the improvements in endurance were limited to the musculature of the torso (i.e., abdominals and back extensors).

In the studies that examined the effects of kettlebell training on muscular endurance, detailed descriptions of the exercise prescription used throughout the duration of the study were not provided. The exercise prescription, particularly the number of sets and repetitions as well as the loads used, would be important to know as these variables would have the potential to influence the outcomes. In regards to muscular endurance, lighter loads coupled with a higher number of repetitions (e.g., 15-25) have been shown to be most successful at improving muscular endurance (1). The magnitude of the improvements in muscular endurance could change with a program that is more focused towards improving this specific component of muscular performance. The specific kettlebell exercise prescriptions are not know for the studies examined in this review, which limits the ability to draw firm conclusions in regards to the effectiveness of kettlebell training on improving muscular endurance.

Aerobic Capacity

Kettlebell training has demonstrated the potential to improve aerobic performance, although the research is somewhat conflicting. For example, Beltz et al (5) demonstrated significant improvements in VO_2 max compared to a control group after 8 weeks of kettlebell training, while Jay et al (14) demonstrated no significant improvements in VO_2 max after 8 weeks of kettlebell training. Both of these studies were of the same duration, but Jay et al (14) had participants perform total-body kettlebell workouts 3 times each week for 15-20 minutes each session while Beltz et al (5) had participants perform total-body kettlebell workouts 2 times each week for 30-45 minutes. The kettlebell program performed by those in the study by Beltz et al (5) was of a longer duration but lesser frequency. The cause of the observed difference in outcomes,

ISSN: 2326-6333

therefore, might not be explained by differences in weekly training volume as both studies had participants perform similar total weekly training volumes. The significant improvements in aerobic capacity demonstrated by Beltz et al could be better explained by differences in the prescribed sets, repetitions and rest periods between studies (only Jay et al (14) reported these specific details), or by other differences that existed between the 2 studies (e.g., training experience of participants, baseline fitness levels of the participants, choice of exercises, etc.).

Despite these conflicting results, kettlebell training may elicit a cardiovascular and metabolic response sufficient for improvements in aerobic performance (7,9,10,11,13,20,21). A typical kettlebell routine used in many of the included research investigations involved 15-60 seconds of exercise using a dynamic, total-body KB exercise (e.g., two-handed swing, one-handed swing, snatch, clean and press, etc.) followed by 15-60 seconds of rest, repeated for 10-20 minutes (7,9,11,13,14,20,21). The American College of Sports Medicine (ACSM) recommends that, for improvements in cardiovascular fitness, aerobic exercise should be performed at an intensity of moderate (64%-76% HR max; 46%-65% VO_2 max) or vigorous (76%-96% HR max; 64%-91% VO_2 max) in bouts of at least 10 minutes duration (2). The cardiovascular responses to the kettlebell routines included in this study would all be classified as at least moderate- or vigorous-intensity. In particular, Farrar et al (9) and Fortner et al (10) demonstrated a vigorous-intensity cardiovascular response as evidenced by VO_2 achieved by the participants. Husley et al (13) compared a kettlebell routine with treadmill running at an equivalent rating of perceived exertion (RPE). Both groups achieved a vigorous-intensity cardiovascular response as evidenced by heart rate (HR) (kettlebell group: 89% HR max, treadmill group: 90% HR max). Fung et al (11) and Schnettler et al (20) also showed that a kettlebell routine could elicit a vigorous-intensity response in its participants (average HR response was 88% HR max and 93+/-4.5% HR max respectively). It would seem that as long as a kettlebell training routine is performed for an appropriate duration and intensity (i.e., >10 minutes duration and at least moderate-intensity), it may provide a sufficient stimulus for improving aerobic capacity.

Interestingly, Fung et al (11) also demonstrated that the weight of the kettlebell used in relation to body weight affected the type of cardiovascular response. The authors of this research found that using a kettlebell resistance of >13% of the participant's body weight elicited a more anaerobic response as evidenced by a respiratory quotient (RQ) of >1.0. While both aerobic and anaerobic cardiovascular exercise are potent stimuli for increasing aerobic capacity (3), these results point to the importance of intensity (load) during kettlebell training as heavier loads may elicit different responses and, therefore, different adaptations.

CONCLUSION

Based on the available literature regarding kettlebell training and its effect on muscular and aerobic performance, it seems that there is efficacy regarding improvements in muscular strength, power, endurance, and aerobic capacity. The inclusion of kettlebells in a training program may have more merit when the goal is an increase in muscular power or rate of force development compared to muscular strength due to the ballistic nature of typical kettlebell exercises (17,19). Kettlebell training may have the potential to increase muscular endurance, but this area of research is very limited. The specific nature of the KB program (i.e., frequency, intensity, duration, etc.) will elicit specific cardiovascular and metabolic responses (e.g., elevated heart rate and oxygen consumption), with greater demands being placed on anaerobic energy pathways when the resistance of the KB load is heavier (e.g., >13% body weight). However, it seems that kettlebell training does have the potential to improve aerobic capacity, regardless of the energy pathway that is emphasized during training (5,9,10,11,13,20,21).

The principle of specificity is an important consideration when prescribing any type of exercise program. Therefore, it makes sense that the specific nature of the kettlebell training prescription results in specific adaptations. Kettlebell training may have a place in training programs regardless of goal, just as long as the principle of specificity is adhered to. When training for muscular power, ballistic movements performed at higher movement velocities should be utilized (1). Improving muscular strength requires a significant loading of the musculoskeletal system; therefore, heavier loads and slower movement velocities should be used with more traditional resistance exercises (e.g., squats, presses, rows, etc.) (1). When training for muscular endurance, higher repetitions (e.g., 15-25) and lighter loads will be needed to maximize improvements in this component of muscular performance (1). Finally, kettlebell training designed to improve aerobic performance should be of a sufficient duration (e.g., >10 minutes) and of an appropriate intensity (e.g., moderate-/vigorous-intensity) (2).

Future studies involving kettlebells and kettlebell training should employ randomized controlled trials (RCTs) in order to directly compare kettlebell training with other training modalities. The number of RCTs comparing kettlebell training is very limited, and very few studies included in this review have utilized this study design. Future research should also aim to identify the optimal kettlebell training prescription for each component of muscular and aerobic performance. The optimal frequency, intensity, duration, and type of kettlebell exercise should be identified for improving muscular power, muscular strength, muscular endurance, and aerobic capacity. Research investigators should also be very detailed in describing the specific kettlebell prescription that is used as this will help in determining an optimal exercise prescription. Promising research has been done thus far with kettlebell training, however, further research is required in order to draw more definitive conclusions regarding the efficacy of kettlebell training and its effects on human performance.

Conflicts of Interest

The authors report no sources of funding or conflicts of interest. The results of this review do not constitute endorsement of any products by the authors or the Journal of Sport and Human Performance.

Table 1. Summary of Investigations into the Effects of KB Training			
Study/Purpose	**Subjects**	**Training Protocol**	**Results**
Beltz et al. (5) Purpose: To analyze the fitness benefits of KB training	30 healthy adults (15 male, 15 female; age range 19-25 years) with some strength training experience	Experimental group (n = 18) performed 8 weeks of two, 30-45 minute KB sessions each week; KB exercises: one- and two-handed swings, snatches, cleans, presses, lunges and Turkish get-ups	Experimental group significantly increased VO_2 max, leg press, grip strength, and abdominal endurance compared to the control group
Budnar et al. (7) Purpose: To examine the acute metabolic, testosterone (T), growth hormone (GH) and cortisol (C) response to a KB swing exercise session	10 recreationally resistance trained males (mean age 24+/- 4 years)	1 session of 12 rounds of KB swings with a 16 kg KB; 30 seconds of work followed by 30 seconds of rest	Blood lactate was higher immediately post compared to pre; T was higher immediately post compared to pre; GH was higher immediately post compared to pre; C was higher immediately post compared to pre
Farrar et al. (9) Purpose: To examine the cardiorespiratory demand of a popularly recommended KB routine	10 college-aged males (age range 20.8+/1.1 years)	As many two-handed KB swings as possible in 12 minutes with a 16 kg KB while expired gasses and HR were analyzed	Subjects achieved a VO_2 of 34.31 +/- 5.67 ml/kg/min and an average HR of 165 +/- 13 bpm
Fortner et al. (10) Purpose: To compare the acute metabolic and cardiovascular effects of a Tabata-style KB swing interval protocol with a traditional KB swing protocol	15 adults (age range 18-25 years) with at least 6 months of resistance training, but no previous KB training experience	Tabata protocol: 4 minutes of KB swings (20 seconds of work, 10 seconds of rest, repeated 8 times); Traditional protocol: 4 sets of KB swings (# of reps from Tabata divided by 4 sets) with 90 seconds of rest between sets	Tabata intervals elicited a vigorous-intensity cardiovascular response as evidenced by % VO_2 peak (71.0+/-0.3%)
Fung et al. (11) Purpose: To examine the aerobic and anaerobic work during KB exercise	8 healthy adults (age range 25–33 years)	Three 6 minute cycles of a KB ‘snatch’, ‘clean to press’, and ‘swing’; each exercise was performed for 30 seconds with 30 seconds of rest	HR reached 88% of age-predicted maximum and VO_2 reached an average of 23.8 +/- 0.9 ml/kg/min; RQ was measured at 1.1 +/- 0.006
Husley et al. (13) Purpose: To compare the metabolic demand of a typical KB routine with treadmill (TM) running at an equivalent RPE	13 adults (11 male, 2 female; mean age 21.4+/- 2.1 years)	10 minute KB swings (35 seconds of work:25 seconds of rest; men used 16 kg KB, women used 8 kg KB) compared to 10 minute TM run at equivalent RPE (TM run performed on separate day)	No difference in avg. HR and RPE between KB and TM; average HR for TM was 90% HR max compared to 89% HR max for KB

Study/Purpose	Subjects	Training Protocol	Results
Jay et al. (14) Purpose: To investigate the effectiveness of a KB intervention and its effects on musculoskeletal and cardiovascular health	40 adults (6 male, 34 female; mean age of 44 years)	8 weeks of 3 full-body sessions/week consisting of 15-20 minutes of two-handed swings, one-handed swings, and deadlifts; each exercise was performed for 30 seconds with 30-60 seconds of rest	KB training group increased muscular strength of the trunk extensors compared to control; VO_2 remained unchanged within both
Jay et al. (15) Purpose: To investigate the effects of a worksite KB intervention on postural perturbations and jump performance	40 adults (6 male, 34 female; mean age of 44 years)	8 weeks of 3 sessions/week consisting of 10-15 minutes of 30 second work periods followed by 30-60 seconds rest periods; two-handed swings and one-handed swings performed in a progressive fashion	Maximal jump height increased significantly in the intervention group; however, this increase was not significant when compared to the control group
Lake et al. (16) Purpose: To establish the mechanical demands of the KB swing exercise compared to a back squat and vertical jump	16 physically active males (mean age of 24+/- 2 years); all subjects had at least 6 months of KB exercise, back squat, and jump squat experience	2 sets of 10 repetitions KB swings (16, 24, and 32 kg KB) compared to multiple repetitions of back squats (20, 40, 60, 80% 1RM) and jump squats (body-weight, 20, 40, 60% 1RM)	Peak force applied was maximized with the back squat; peak and mean power output with the KB swing were comparable to the jump squat and both were greater than the back squat
McGill et al. (17) Purpose: To quantify the spinal loading and muscle activation patterns during different KB exercises	7 healthy males (mean age of 25.6+/-3.4 years)	KB swing variations, one-handed snatches, and carries were performed using a 16 kg KB	KB swing produces hip hinge pattern characterized by rapid muscle activation-relaxation cycles of substantial magnitudes (50% MVC of low-back extensors, 80% MVC of gluteal muscles)
Manocchia et al. (18) Purpose: To examine the effects of a 10-week KB program on muscular strength, power and endurance	15 adults with varying levels of fitness (age range of 20-72 years)	10-weeks of 2 sessions/week, periodized, group exercise program consisting of KB exercises only	Significant increases in the barbell bench press, clean and jerk and back extension endurance; no significant differences seen in the vertical jump

Study/Purpose	Subjects	Training Protocol	Results
Otto et al. (19) Purpose: To compare the effects of 6 weeks of traditional weightlifting vs. KB training on power, strength and anthropometric measures	30 adult males (age range of 19-26 years) with at least 1 year of resistance training experience	6 weeks of 2 sessions/week, linear periodization program; sets/reps ranged from 3-6/4-6 respectively KB group: traditional swings, accelerated swings and goblet squats Weightlifting group: high pulls, power cleans and back squats	Both groups significantly increased back squat, vertical jump, and power clean performance Weightlifting group significantly increased back squat compared to KB group
Schnettler et al. (20) Purpose: To analyze the energy cost and exercise intensity of a KB workout	10 male and female adults (age range 29-46 years) considered experienced in KB training	20 minute routine consisting of KB snatches; 15 seconds of work followed by 15 seconds of rest, repeated for 20 minutes	Participants achieved an average HR of 164+/-14.7 bpm (average of 93%+/-4.5% HRmax), an average VO_2 of 31.6+/-3.71 ml/kg/min (average of 78+/-8% of VO_2 max), an average kcal expenditure/minute of 13.6+/-3.08 and an average RPE of 15.9+/-2.21 (Borg scale)
Thomas et al. (21) Purpose: To determine if continuous prolonged KB activity could be used to produce cardiovascular stress similar to that of brisk walking	10 adults (5 males, 5 females; age range 21-31 years)	30 minutes of KB exercise; 3 continuous rounds of 10 minutes each consisting of 10 swings followed by 10 sumo-deadlifts 30 minutes TM walking; 3 rounds of 10 minutes each at 4% grade; matched for VO_2 achieved during KB exercise	VO_2, RER, kcal/min, and BP were similar for KB and moderate-intensity TM exercise, but RPE and HR were greater during KB exercise

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