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Mini Review
ISSN 2577-1914

Res Inves Sports Med

A Review of Kettlebell Research and its Implications for Exercise Programming

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Submission: October 20, 2017; **Published:** November 13, 2017

Introduction

A kettlebell is a steel ball with a horseshoe shaped handle. They have been used as an exercise tool in Russia since the 1700's and have seen somewhat of resurgence in the United States and other western countries in the last ten years [1]. This resurgence has been, at least in part, due to the popularity of group fitness classes and high intensity interval training (HIIT) methodology. Training with kettlebells is, in some ways, preferable to conventional resistance training. Kettlebell exercises are simpler and faster to learn than many resistance training techniques and can be instantly switched between bi-lateral and uni-lateral exercises. Purported benefits of kettlebell training include the following: improved core stability, cardiovascular benefits, body composition improvements, and increases in muscular strength, endurance, and power. However, despite its long and storied history, there is little clinical evidence to support the claimed benefits kettlebell training provides. Many gaps in the literature exist and what evidence we do have is less than ten years old. What follows is a brief assessment of what we know about kettlebell training and a summary of the questions that remain unanswered. The most common kettlebell exercise is the swing, which is also one of the oldest competitive sporting events in Russian history [1]. The current commonly accepted swing technique was described by Tsoutline [1]. In brief, a proper swing involves holding the kettlebell by its handle in both hands with the arms fully extended. Initially the subject keeps the back straight; hinging the hips the shoulders come forward, driving the hips back allowing the bell to rest between the legs. This is the initial position. The swing begins as the subject explosively drives the hips forward, generating horizontal momentum, which causes the shoulders to flex and the kettlebell to travel in an arc pathway from the thighs to eye level. Proper technique terminates the swing at eye level, not above. Upon the kettlebell reaching eye level, the muscles of the shoulder and upper back must decelerate the bell's travel and eccentrically resist gravity as the kettlebell returns to the starting position.

Biomechanically speaking, the kettlebell swing is a highly functional exercise involving multiple joints and large muscle groups. Since the swing involves both vertical and horizontal displacement the musculo-skeletal system must perform in a functional nature, generating and re-directing forces quickly and in multiple planes. Furthermore, the core musculature (abdominals and lower, middle, and upper back) must generate both concentric and eccentric forces to both accelerate and decelerate the kettlebell. Therefore, an undeniable advantage of kettlebell training over conventional resistance training is that it stimulates nearly the entire body at once, while conventional training tends to be more compartmentalized. Furthermore, the horizontal forces require the core to contract isometrically, making kettlebell training a powerful core training tool [2]. Recent research on kettlebell training has shown that it causes positive changes in cardiovascular health, but is equivocal regarding body composition. Farrar et al. [3] show that kettlebell training can elicit heart rate responses averaging 86.8% (±6.0%) of age predicted max. This falls within the American College of Sports Medicine's recommended intensity to improve cardiovascular health (ACSM, 2010). In this study subjects performed a kettlebell protocol established by Tsoutline [1], during which subjects perform as many kettlebell swings as possible for 12 minutes, alternating between 30 seconds of work and 30 seconds of rest. All subjects used a 16kg (35lbs) kettlebell regardless of body mass. Results indicate that subjects averaged 265 (±68) swings during the tests with average oxygen consumption equal to 65% of maximal levels. The use of one size kettlebell for all subjects explains the large standard deviation found in average swings per test [3]. While the research by Farrar et al. [3] establishes that Tsoutline's [1] protocol can meet the intensity requirements established by the ACSM to improve cardiovascular health; it fails to establish a minimum size kettlebell that is required or a minimum cadence for proper intensity. Research on injury rates appears lower in the Russian swing (where the kettlebell stops at eye level) versus the "American swing" (where the kettlebell stops in an overhead position). Oikarinen [4] found that lumbar angles are highest in the overhead position, which may contribute to lower back pain. On the other hand, McGill et al. [5] found that the Russian swing hand normal lumbar angles, and due to its unique loading properties may "restore back function" in some individuals. A minimum size kettlebell would be a valuable finding since heavier kettlebells increase lumbar stress and increased risk of injury.

Thomas et al. [6] show similar benefits to kettlebell training. The goal of the Thomas et al. [6] study was to compare the cardiovascular stress of continuous kettlebell training to brisk treadmill walking. Subjects completed three sets of kettlebell swings and sumo dead lifts at a cadence of 80 hertz; each set lasted ten minutes, followed by a three-minute rest period. A control group completed a treadmill protocol of similar duration, with a similar rest period. Results from this study indicate that continuous kettlebell exercise at a moderate pace can produce similar rates of oxygen consumption and slightly higher heart rates as brisk treadmill walking. The kettlebells for this test were selected based on gender; males used a 16kg (35lbs) and females used a 12kg (25lbs) kettlebell. This represents an improvement in methodology from Farrar et al. [3] but only a slight one; a more individualized approach to selecting the resistance would have been ideal.

In addition to its cardiovascular benefits, kettlebell training has been shown to increase muscular strength and power [5,7,8]. Muscular power is defined as the maximum amount of work that can be accomplished in minimal time. In other words, power is load versus speed. Traditional resistance training methods for power development focus on increasing load and include the following: dead lift, power clean, and snatch. While extremely effective, these techniques are technically difficult to master, requiring months of formal instruction. Furthermore, when performed incorrectly, they have a higher injury rate than other resistance training techniques. On the other hand, kettlebell techniques are relatively simple to learn and utilize far lighter loads. Due to the lighter loads, it seems counter-intuitive that kettlebells would have any positive effect on muscular strength or power. However, they utilize the same musculature as the traditional power lifts and require a much greater speed of contraction. It is this higher velocity work rate that most likely leads to improvements in muscular power. In addition to specific exercises, specific exercise intensities are required to trigger power adaptations. According to the National Strength and Conditioning Association (2016) "the optimal intensity prescription for power development is 87-95% of one repetition maximum with a set and repetition volume of 2-5 each". This prescription cannot be applied to kettlebell training due to its ballistic nature. Furthermore, due to the rapid eccentric phase of the kettlebell swing, testing its one repetition maximum has a higher risk of injury than traditional power lifts (where the eccentric phase is often abridged or avoided altogether).

In 2012 Lake et al. [7] put 21 adult males through Tsoutline's protocol (outlined above) or a jump squat protocol of similar volume for six weeks. Subject's muscular power was measured via half squat and vertical jump testing. Results indicate that kettlebell training is just as effective as jump squat protocols at improving lower body power (measured via maximal half squat and vertical jump height). Kettlebell loads for this study were 16kg and 12kg for subjects above or below 70kg respectively. Similar to other studies, Lake et al. [7] stratified their kettlebell loads based upon body mass. Subjects performed this routine at their own pace with no set cadence. In addition to the work by Lake et al. [7], other studies have shown the efficacy of kettlebell training in improving strength and power. Otto et al. [9] found that kettlebell training improved improves muscular strength and power but not to the extent that traditional resistance training does. In this study 31 subjects were assigned to either a kettlebell training protocol or a resistance training protocol, which acted as the control. The control group trained twice per week, performing high pulls, power cleans, and back squats with an intensity consistent with power development (four sets of six repetitions at 80% of one repetition maximum) [10,11]. The kettlebell training group used one size kettlebell (16kg) and performed swings, accelerated swings, and goblet squats. It is likely that only using one size kettlebell is the reason why improvements in strength and power were not as strong in the kettlebell group as they were in the control group; the control group used an individually set resistance (80% of one repetition maximum) versus a standard resistance for everyone (16kg) in the kettlebell group. Similar to the work by Lake et al. [7] the Otto et al. [9] protocol had no set cadence for training, but rather a self-selected pace.

While not unanimous, the body of research on kettlebell training strongly supports the conclusions that it can have positive benefits for cardiovascular fitness, muscular strength and muscular power [12,13]. However, there are numerous gaps in the literature that need to be addressed. One such gap is the lack of evidence regarding load selection. A thorough search of EBSCO host and other online research databases has failed to yield a single study where kettlebell load was selected in an individualized manner [14]. At best research studies have stratified two or three levels based on body mass or gender. This runs contrary to established guidelines and recommendations from the National Strength and Conditioning Association and the American College of Sports Medicine which call for a percentage of the subject's maximum strength or maximum cardiovascular ability. However, applying those guidelines to kettlebell training would not be appropriate. A novel approach must be developed and tested.

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