

Kettlebells

Part 2

Studien über Kettlebells

- Kraft- und Powersteigerungen
- Biomechanik
- Ausdauer

Effects of kettlebell training on postural coordination and jump performance

- *Effects of kettlebell training on postural coordination and jump performance: A randomized controlled trial, by Jay, Jakobsen, Sundstrup, Skotte, Jørgensen, Andersen, Pedersen, and Andersen, in Journal of Strength and Conditioning Research Publish Ahead of Print*
- **Background**
- Several reviews have found that regular exercise training is an effective treatment for musculoskeletal disorders of the lower back. However, studies have also concluded that increased muscle strength of the back extensors may disrupt the balance between antagonistic muscle pairs and affect postural stability. Additionally, an important aspect of lower back pain is psychosocial. Researchers have noted that a poor work environment and job dissatisfaction is a significant predictor of lower back pain.

Effects of kettlebell training on postural coordination and jump performance

- **What did the researchers do?**
- The researchers wanted to investigate the effects of kettlebell training on postural coordination and countermovement jump height.
- So they recruited 40 subjects and assigned half to the intervention and half to a control group.
- The intervention group completed an 8-week ballistic kettlebell training program while the control group did not. The program comprised progressions from the unweighted swing to the kettlebell deadlift to the two-handed kettlebell swing and finally to the one-handed kettlebell swing.
- The females started with the 8kg kettlebell and the males started with the 12kg kettlebell.
- The intervention group trained using kettlebells 3 days a week for 8 weeks for 20 minutes per session.
- The sessions involved a warm-up of dynamic stretches and exercise practice.
- The warm-up was followed by interval training comprising 10 intervals of 30 seconds with 30 – 60 seconds rest between sets.
- In weeks 1 – 4, the rest between sets was 60 seconds and in the last 4 weeks, the rest was 30 seconds. The intervals were performed using an exercise depending on the skill and strength level of the subject. The progressions followed were: unweighted swing, deadlift with a kettlebell, two-handed swing with a kettlebell, and one-handed swing with a kettlebell. Subjects were able to move up a weight when they were able to complete 10 one-handed swings with their current kettlebell.
- Before and after the 8-week program, the researchers assessed the postural reactions of the subjects to perturbation. This assessment involved three tests whereby the subject stood on a force platform holding a rod with a 2.2kg weight attached to it. The researchers released the weight via an electromagnet and the subject was forced to regain balance. The researchers assessed the postural stability of the subjects depending on how long it took them to stop moving following the load falling.
- The researchers assessed the subjects for maximal vertical jump height in four counter-movement jumps with 30 seconds rest inbetween. They also issued the subjects with a questionnaire to establish what self-perceived changes they had observed.

Effects of kettlebell training on postural coordination and jump performance

- **What happened?**
- *Postural reactions to perturbation*
- The researchers found that the training group displayed a significant reduction in stopping time following perturbation, of 109ms (from 196ms to 21ms), while the control group did not display any significant reduction in stopping time.
- *Counter-movement jump performance*
- The researchers found that only the training group had a significant improvement in the counter-movement jump. However, at 1.5cm, the increase was very small and since the control group improved by 0.7cm, there was no significant difference between groups.
- *Self-perceived changes*
- The researchers found that there was a significant difference between the training and control groups in respect of their self-perceived measures of muscle strength, wellness, socializing with colleagues and job satisfaction after the 8-week period.
- **What did the researchers conclude?**
- The researchers concluded that the 8-week kettlebell training program improved the postural response to perturbation but not vertical jump performance in comparison to a control group. Additionally, they concluded that the 8-week kettlebell training program had important benefits in improving aspects of psychosocial factors in the working environment.

Effects of kettlebell training on postural coordination and jump performance

- **Limitations**

- The study was limited by the small sample size, which was largely a function of the study design in using a control group.
- The study was also limited in that the kettlebells used were very light (8kg for females and 12kg for males) and the training frequency was only 3 days per week.

- **Key points**

- Kettlebell training improves postural response to perturbation, which may be important in avoiding lower back pain.
- Kettlebell training also improves measures of mental wellbeing and job satisfaction, possibly as a result of the group training environment.

Kettlebell swing training improves maximal and explosive strength

- *Kettlebell swing training improves maximal and explosive strength, by Lake and Lauder, in Journal of Strength and Conditioning Research, 2012*
- **Background**
- Some previous researchers have concluded that since the mass of commercially available kettlebells is small (i.e. 16 – 40kg), the force applied is not sufficient to improve either maximum or explosive strength.
- However, other researchers have noted that the peculiar demands of the swing lead to significant forces being required, particularly in the horizontal direction, which may make the swing a useful exercise for athletes whose explosive movements are predominantly horizontal.

Kettlebell swing training improves maximal and explosive strength

- **What did the researchers do?**
- The researchers wanted to investigate the effects on maximum and explosive strength of kettlebell swing training (using Pavel Tsatsouline's Program Minimum protocol).
- So they recruited 24 healthy, physically active university-age men with at least 3-months of resistance training experience and who were able to perform a half-squat with at least 140% of bodyweight.
- The researchers paired the men according to their maximum half squat strength and then randomly assigned them to either a kettlebell swing or jump squat power training group. Both groups trained twice a week for 6 weeks.
- In their training sessions, the kettlebell group performed 12 rounds of 30-seconds of swings alternated with 30 seconds rest.
- In their training, the jump squat group performed at least 3 sets of 3 jump squats with a load that maximized peak mechanical power. Where maximum power was achieved at high percentages of 1RM, the sets and reps were lower than where maximum power was achieved at low percentages of 1RM.
- The researchers reported that kettlebell swing practice was performed in accordance with the technique described in the book *Enter the Kettlebell*, by Pavel Tsatsouline, and was supervised by a certified kettlebell instructor.
- Men under 70kg used a 12kg kettlebell and men heavier than 70kg used a 16kg kettlebell. Before and after the 6-week training intervention, the researchers tested the vertical jump height and maximum half-squat performance of all subjects.

Kettlebell swing training improves maximal and explosive strength

- **What happened?**
- *Half squat (maximum strength)*
- The researchers found that for all subjects the maximum strength in the half-squat improved by 9.8% following the 6-week training intervention.
- There was no significant difference in the gains made by the kettlebell and the jump squat groups. *Vertical jump performance (explosive strength)*
- The researchers found that for all subjects explosive strength improved by 19.8% following the 6-week training intervention. There was no significant difference in the gains made by the kettlebell and the jump squat groups.

Kettlebell swing training improves maximal and explosive strength

- **What did the researchers conclude?**
- The researchers concluded that kettlebell swing training improved maximum half-squat strength and explosive strength, as demonstrated by vertical jump height performance.
- They noted that similar results were obtained with the kettlebell training as were achieved using jump squats. The researchers note that these gains were made with relatively light loads (12–16kg).

Kettlebell swing training improves maximal and explosive strength

- **Limitations**
- The study was limited in that the **volume and intensity** of training were **not matched** between the two training groups. Moreover, the jump squat group may have experienced a **movement-learning effect** in the half-squat that the kettlebell group did not. Additionally, while the researchers noted that the subjects were trained, the 1RM half-squat performances (c. 150 – 170% of bodyweight) suggest that they were **not well-trained**. Finally, it is noted that the study made **use of light** (i.e. 12kg and 16kg) **kettlebells** and significantly different results might have been obtained using heavier weights.
- **Key points**
- Twice-weekly kettlebell swing training using 12kg and 16kg kettlebells produced gains in the half-squat 1RM and vertical jump height comparable to those achieved through twice-weekly jump-squat training.

Effects of weightlifting vs. kettlebell training on vertical jump, strength, and body composition

- *Effects of weightlifting vs. kettlebell training on vertical jump, strength, and body composition, by Otto, Coburn, Brown and Spiering, in Journal of Strength and Conditioning Research published ahead of print, 2012*
- **Background**
- The effects of Olympic weightlifting and its variants on the development of strength, power, vertical jump ability and speed have been subject to much research over several decades of sports science.
- It is well-accepted that weightlifting is one of the most effective means of developing those qualities, given the time and expertise available to learn the lifts correctly.
- On the other hand, kettlebells have not been extensively studied at all, although they are now commonly used in mainstream fitness and are becoming popular tools for strength coaches and personal trainers for dynamic lifts.
- The key attractions of kettlebells are their ease of use, the lower price when compared to Olympic barbells and their ease of transport and small footprint.
- But how do kettlebells compare to the Olympic lifts when it comes to the development of strength, power and body composition?

Effects of weightlifting vs. kettlebell training on vertical jump, strength, and body composition

- The researchers took 30 men with experience with resistance training but no experience with either Olympic weightlifting or kettlebells, and subjected them to a 6-week, 2-day per week, periodized program of either Olympic weightlifting or kettlebell training.
- Before and after the training intervention, the subjects were tested for their 1RM back squat and power clean and body composition. The kettlebell group performed kettlebell swings, accelerated swings, and goblet squats with a 16kg kettlebell as follows:
 - **Weeks 1-3** – 3×6 (kettlebell swings), 4×4 (accelerated swings), and 4×6 (goblet squats).
 - **Weeks 4-6** – the volume increased to 4×6 (kettlebell swings), 6×4 (accelerated swings), and 4×6 (goblet squats).

While the weightlifting group performed the following program:

- **Weeks 1-3** – 3×6RM (high pull), 4×4RM (power clean), and 4×6RM (back squat).
- **Weeks 4-6** – 4×6RM (high pull), 6×4RM (power clean), and 4×6RM (back squat).

Effects of weightlifting vs. kettlebell training on vertical jump, strength, and body composition

- **What happened?**

- Both groups improved their vertical jump performances following the training intervention.
- Both groups improved their back squat and power clean 1RM performance, although the Olympic weightlifting group improved by a greater margin (13.6% versus 4.5% for the kettlebell group).
- There were no changes in body mass or body composition for either group.

- **What were the conclusions?**

- The researchers concluded that kettlebells can be used to increase back squat and power clean performance in men with at least one year of resistance training experience.
- They also concluded that the improvements in back squat and power clean performance caused by kettlebell training are not as significant as those caused by traditional Olympic weightlifting.
- Finally, they concluded that, with no modifications to diet, neither protocol had any impact on body mass or body composition.

Effects of weightlifting vs. kettlebell training on vertical jump, strength, and body composition

- **Limitations**
- The main limitation of this study is that the **loading and volume was completely different between the two groups.**
- Ignoring the other lifts, the Olympic weightlifting group was squatting twice a week with 4 sets with 80% of their 1RM (which started out at 133kg, therefore 80% would be 106kg) **while the kettlebell group was using the same number of sets with a goblet squat of only 16kg.** There is a big difference between training with 106kg and training with 16kg and the subjects training with barbells would have been much closer to the point of failure than those training with kettlebells, which would likely have produced different anatomical adaptations.

- **KEY POINTS**
- Kettlebells can be used to generate increases in strength and power, although recognizing that with lower loading such increases will be less than would be achieved with traditional barbell training.
- Using heavier kettlebells may help to bridge some of this gap, although the amount of weight that can be used with a barbell will always be greater. But hip extension torque is complicated and the arcing force vector of the kettlebell swings augment the torque curve.

Transference of kettlebell training to strength, power and endurance

- *Transference of kettlebell training to strength, power and endurance, by Manocchia, Spierer, Lufkin, Minichiello and Castro, in Journal of Strength and Conditioning Research Publish Ahead of Print*
- **Background**
- Kettlebells are a popular tool for improving strength and conditioning but there are very few scientific studies devoted to exploring their effects.
- In particular, there has been little research devoted to establishing whether there is any carryover from kettlebell training to traditional strength exercises.

Transference of kettlebell training to strength, power and endurance

- **What did the researchers do?**
- The researchers wanted to quantify the carryover of kettlebell training to strength and endurance on traditional lifts.
- So they recruited 37 physically active male and female subjects who were regularly engaged in cardiovascular, strength and flexibility exercise programs 2 – 3 times per week for at least the preceding 6 months. The researchers divided the subjects into a control group and an experiment group.
- The experiment group then met for 2 kettlebell training sessions per week for 10 weeks. Outside of these classes, they were limited to aerobic and flexibility activities. The 10-week experiment was divided into 5 microcycles of 4 days each:
- The control group was allowed to continue their normal activities while the kettlebell group participated in the two classes per week.
- Before and after the 10-week experiment, the researchers tested the subjects on four traditional strength and power measures: the 3RM bench press, the 3RM clean and jerk, the back extension to failure and the vertical jump.

Transference of kettlebell training to strength, power and endurance

- The first microcycle lasted from days 1-4 and focused on swing cadence, utilization of momentum and neuromuscular coordination. The movements used were bilateral swings, unilateral swings, high pulls, push presses, squats and bilateral presses, side squats and transfers, iso pushups and unilateral hip extension and push ups. The subjects performed each exercise for 2 sets of 15-20 repetitions.
- The second microcycle lasted from days 5-8 and focused on more complex movements, building on the exercises used in the first microcycle, with the same set and rep format.
- The third microcycle lasted from days 9-12 and consisted of larger and more full body movement including oblique exercises, woodchoppers, walkovers and windmills. The subjects performed exercises for 2-3 sets of 15-10 repetitions.
- The fourth microcycle lasted from days 13-16 and used similar movements to those in the third microcycle but with a faster swing cadence for 2-3 sets of 10-5 repetitions.
- The fifth microcycle lasted from days 17-20 and used complex movements such as the “Turkish Get-Up”, the “Wood Chopper” and the “Clean and Press” for 2-3 sets of 8-4 repetitions

Transference of kettlebell training to strength, power and endurance

- **What happened?**
- The kettlebell group improved their bench press 3RM significantly from $39.9 \pm 22.6\text{kg}$ to $54.1 \pm 30.3\text{kg}$ while the control group only improved from $54.5 \pm 28.8\text{kg}$ to $58.2 \pm 36.5\text{kg}$.
- Additionally, the kettlebell group improved their 3RM clean and jerk from $34.9 \pm 3.6\text{kg}$ to $39.1 \pm 3.8\text{kg}$ while the control group only improved a non-significant amount from $40.1 \pm 5.4\text{kg}$ to $40.9 \pm 5.8\text{kg}$. The researchers did not observe any significant improvements in the vertical jump or back extension.
- **What did the researchers conclude?**
- The researchers concluded that kettlebell training can produce a transference of strength and power to weightlifting and powerlifting activities, as after 10 weeks of a structured kettlebell training class, participants experienced significant improvements in 3RM clean and jerk and 3RM bench press.

Transference of kettlebell training to strength, power and endurance

- **Limitations**
- The main limitations in this study center around the fact that the **population was extremely heterogeneous** and included subjects with very different backgrounds and training routines. The range of the 3RM clean and jerk was 9 – 145kg and for the 3RM bench press was reportedly 20 – 215kg (obviously a typo)!
- The researchers did not specify the **loads used in the kettlebell** groups but they were likely **very low** and therefore the study was probably also limited by the use of light weights. Different results might have been obtained by the use of heavier loads.
- In addition, there was **no control over what training the control group was doing** and by specifying that the experiment group should only perform aerobic exercise and flexibility outside of the kettlebell classes could have led to increased aerobic training beyond what the subjects would have normally performed.
- Finally, it is noted that **push-ups are not a kettlebell exercise** and could have improved bench press performance due to movement pattern specificity.
- **KEY POINTS**
- Kettlebell training can produce a transference of strength and power to weightlifting and powerlifting activities.

Kettlebell training for musculoskeletal and cardiovascular health

- *Kettlebell training for musculoskeletal and cardiovascular health: a randomized controlled trial by Jay, Frisch, Hansen , Zebis, Andersen, Mortensen and Andersen, in Scandinavian Journal of Work and Environmental Health, 2011*
- **Background**
- *Back and neck pain*
- The prevalence of back and/or neck pain in the US has been estimated by various studies and has been recorded as high as 31% for the 3-months prior to the survey. In Scandinavia, the percentage of adults reporting back pain in the previous year has been recorded as 39%. Such musculoskeletal problems appear to contribute significantly towards absence from work.
- *Neck and shoulder pain*
- Similarly, a study of the Scandinavian population reported that 31% of the population had experienced neck pain in the previous year. A Canadian survey, found that the prevalence of neck pain in the general population was >50% over the course of the preceding 6 months. Moreover, neck and shoulder pain has been reported as being particularly prevalent in sedentary occupations involving repetitive movements, such as are carried out by office workers.
- *The importance of exercise*
- Many researchers have found that exercise is an effective intervention for pain and discomfort in the neck and lower back. However, the exact type of exercise that is most effective remains unclear

Kettlebell training for musculoskeletal and cardiovascular health

- **What did the researchers do?**
- The researchers wanted to perform a randomized controlled trial to investigate the effect of kettlebell training on neck/shoulder and lower-back pain, as well as muscular strength and aerobic fitness in a group of subjects who worked in occupations that had previously demonstrated a high prevalence of musculoskeletal pain.
- So they recruited 40 subjects from a pharmaceutical firm, including individuals who participated in repetitive office work.
- The subjects rated their average neck/shoulder and low back pain during the previous month on a visual-analog scale from 0 – 10. The subjects then participated in several tests to measure the muscular strength of the lower back, trunk, and shoulders as well as their aerobic fitness, using an incremental sub-maximal cycle ergometer test. Following the tests, the subjects were randomized into one of two groups, a control and an intervention group.
- The intervention group trained using kettlebells 3 days a week for 8 weeks for 20 minutes per session. The sessions involved a warm-up of dynamic stretches and exercise practice. The warm-up was followed by interval training comprising 10 intervals of 30 seconds with 30 – 60 seconds rest between sets. In weeks 1 – 4, the rest between sets was 60 seconds and in the last 4 weeks, the rest was 30 seconds.
- The intervals were performed using an exercise depending on the skill and strength level of the subject. The progressions followed were: unweighted swing, deadlift with a kettlebell, two-handed swing with a kettlebell, and one-handed swing with a kettlebell. The female subjects began by using an 8kg kettlebell and the male subjects began with a 12kg kettlebell. Subjects were able to move up a weight when they were able to complete 10 one handed swings with their current kettlebell. The subjects in both groups received the recommendation to continue their usual physical activities in addition to the intervention.

Kettlebell training for musculoskeletal and cardiovascular health

- **What happened?**
- The average weight and number of sets of intervals of kettlebell exercises in the intervention group was 8.3kg and 23.2 sets in weeks 1 – 2 and 12.4 kg and 22.1 sets in weeks 7 – 8.
- The researchers found that the pain intensity of the lower back and the muscular strength of the back extensors improved more in the intervention group than in the control group. However, trunk flexion strength, shoulder elevation strength and aerobic fitness did not differ between groups.
- **What did the researchers conclude?**
- The researchers concluded that 8 weeks of kettlebell swing and kettlebell deadlift training improved neck/shoulder and lower-back pain by more than a control group.
- They also concluded that the training increased the muscular strength of the trunk extensors but did not significantly improve aerobic fitness or strength of the shoulders and trunk flexors.
- **Limitations**
- The strength increases reported in this study were not very large and this is likely because of the use of very light kettlebells. Different results might have been reported had the researchers made use of heavier weights in the subjects' programming.
- **KEY POINTS**
- Eight weeks of kettlebell swing and kettlebell deadlift training improved neck/shoulder and lower-back pain by more than a control group. Eight weeks of kettlebell swing and kettlebell deadlift training increased the muscular strength of the trunk extensors but did not significantly improve aerobic fitness or strength of the shoulders and trunk flexors.

Kettlebell swing targets semitendinosus and supine leg curl targets biceps femoris: an EMG study with rehabilitation implications

- *Kettlebell swing targets semitendinosus and supine leg curl targets biceps femoris: an EMG study with rehabilitation implications, by Kreutzfeldt Zebis, Skotte, Andersen, Mortensen, Petersen, Viskær, Jensen, Bencke, and Andersen, in British Journal of Sports Medicine, 2012*
- **Background**
- The hamstrings muscle group comprises the biceps femoris (long head) (BFLH) and biceps femoris (short head) (BFSH), the semimembranosus (SM) and the semitendinosus (ST). The BFLH, SM and ST are all two-joint muscles that cross both the hip and the knee joint and perform hip extension and knee flexion.
- The hamstrings can be subdivided into medial (SM and ST) and lateral (BFLH and BFSH) groups. Some researchers have proposed that the ST is important in respect of ACL injury prevention. It is thought to be helpful in compressing the medial knee joint compartment, which is understood to reduce the incidence of knee valgus, which is a risk factor for ACL injury in female athletes.
- Kreutzfeldt Zebis et al. note that while the normal strengthening exercises for the leg muscles including squats and leg presses activate both the quadriceps and the hamstrings, they tend to recruit the lateral rather than the medial hamstrings. These common exercises may therefore predispose the athlete to knee injury.

Kettlebell swing targets semitendinosus and supine leg curl targets biceps femoris: an EMG study with rehabilitation implications

- **What did the researchers do?**
- The researchers wanted to find exercises that preferentially recruited the medial hamstrings (SM and ST) rather than the lateral hamstrings (BFLH and BFSH) in order to use these exercises in a program to help reduce the risk of ACL injury.
- So they recruited 16 young female elite team sports athletes (handball and soccer) who were strength-trained but had no previous history of knee or hamstring injury.
- The researchers measured the EMG activity of the various hamstring muscles using surface electrodes while the subjects performed 5 different balance/coordination exercises and 9 strength exercises, as follows:
- Two hand kettlebell swings, Nordic hamstring lowers (negative glute-ham raises), Supine one-leg curls (Val slides), Supine pelvis lifts (one leg glute bridge), Romanian deadlifts (RDL), Hyperextensions of table (horizontal back extension), Hyperextensions of table with barbell, Seated leg curls and Prone leg curls.

Kettlebell swing targets semitendinosus and supine leg curl targets biceps femoris: an EMG study with rehabilitation implications

- **What happened?**
- *Medial-lateral hamstring activation balance* The researchers found a preferential activation of the ST over the BFLH during the RDL and kettlebell swings.
- They found a preferential activation of the BFLH over the ST during supine leg curls and hyperextensions. *Joint angles at peak EMG* The researchers found that three of the exercises activated both hamstrings the most at high degrees of hip flexion ROM (seated leg curl, RDL and kettlebell swing).
- The other exercises activated the hamstrings the most at low degrees of hip flexion ROM. This means that the hamstrings were activated to the highest degree in varying degrees of stretch; either in the shortened or lengthened positions.
- The researchers also found that there were three groups of exercises that activated the hamstrings the greatest at high, medium and low degrees of knee joint ROM. The Nordic hamstring curl and supine pelvic lift both activated the hamstrings the greatest during high degrees of knee flexion, which is in a more shortened position. The seated leg curl, supine leg curl and prone leg curl all activated the hamstrings during medium degrees of knee flexion.
- The kettlebell swing, hyper (horizontal back) extensions and RDLs all activated the hamstrings the greatest during low degrees of knee flexion ROM.

Kettlebell swing targets semitendinosus and supine leg curl targets biceps femoris: an EMG study with rehabilitation implications

- **What did the researchers conclude?**
- The researchers concluded that some hamstring exercises preferentially recruit the ST and some preferentially recruit the BFLH. The RDL and kettlebell swings recruited the ST more than the BFLH and supine leg curls and hyperextensions recruited the BFLH more than the ST.
- The researchers suggested that the ST dominance during the RDL and kettlebell swings might be explained by the fact that the ST is much longer than the BFLH and this means that its total shortening capacity and absolute velocity of contraction is higher.
- During the RDL and kettlebell swings, the hamstrings have the highest load in the most stretched position and this may imply that the ST was more effective at this type of movement.
- Conversely, the supine leg curl and hyperextension were found to recruit the BFLH preferentially. These exercises cause the hamstring to generate maximum contractions at short lengths and since the BFLH is a shorter muscle with a greater physiological cross-sectional area than the ST, it may be more effective than exercises involving strong contractions at short lengths.

Kettlebell swing targets semitendinosus and supine leg curl targets biceps femoris: an EMG study with rehabilitation implications

- **Limitations**

- Only one of each of the medial (ST) and lateral (BFLH) hamstrings were studied.
- Since the medial and lateral hamstrings each have one muscle that has a long fiber length (ST, BFLH) and one muscle that has a large physiological cross-sectional area (SM, BFLH), if the researchers had tested the other hamstring muscles, they might have achieved very different results.
- Moreover, only light weights were used for the kettlebells and the exercises were not standardized in terms of their proportion of 1RM.

- **KEY POINTS**

- Different exercises recruit different muscles within the hamstrings group. Also, different exercises recruit the same muscles at different degrees of joint ROM and muscle lengths

Kettlebell swing, snatch and bottoms-up carry: Back and hip muscle activation, motion, and low back loads

- *Kettlebell swing, snatch and bottoms-up carry: Back and hip muscle activation, motion, and low back loads, by McGill and Marshall, Journal of Strength and Conditioning Research, 2011*
- **Background**
- Kettlebells are now being increasingly used by many weight lifters and fitness enthusiasts both as their sole training tool and in conjunction with barbells and calisthenics. The anecdotal evidence from weight lifters appears to be mixed.
- Some weight lifters credit certain kettlebell movements, such as the swing, as being instrumental in assisting rehabilitation from lower back injury. Others indicate that the swing in particular is one of the few movements that aggravate their lower back, while they can perform barbell lifts without pain.
- In addition, some kettlebell practitioners perform the swing with a technique attributed to the revolutionary martial artist, Bruce Lee. This technique, called “kime” is a brief muscular pulsing to train muscle contraction and relaxation. It is done at the top point in the swing movement.
- Research has identified that mixed martial artists do in fact use rapid muscle contraction and relaxation during striking to enhance the effect of their blows.
- However, no previous studies have been done that seek to quantify the mechanics and back loading during typical kettlebell exercises.

Kettlebell swing, snatch and bottoms-up carry: Back and hip muscle activation, motion, and low back loads

- **So what did the researchers do?**
- The researchers set out to quantify spinal loading and muscle activity of various trunk, leg and back muscles during the following kettlebell exercises: kettlebell swings, kettlebell swings with kime, kettlebell snatches, kettlebell bottoms-up carry, and kettlebell racked carry.
- The researchers wanted to find out whether there is a unique feature of the kettlebell swing that makes it therapeutic for some but discomforting for others.
- They also wanted to find out what effects kime has. The researchers used seven subjects for the swings and snatches and five subjects for the carries. They also obtained permission to record the characteristics of a swing performed by Pavel Tsatsouline.
- A 16kg kettlebell was used for the study. 3D body segment kinematics was assessed using reflective markers placed on anatomical markers and a nine-camera motion capture system.
- Ground reaction forces were measured using two force plates, one under each foot.
- EMG data were recorded using surface electrodes. The researchers normalized the EMG data to a maximum voluntary isometric contraction (MVIC). The MVIC position used for the gluteus maximus was the higher of either the Biering-Sorensen position or hip extension with the knee in 90 degrees of flexion, while lying prone on a table. The normalization position for the gluteus medius was resisted side lying hip abduction combined with 45 degrees of external rotation.

Kettlebell swing, snatch and bottoms-up carry: Back and hip muscle activation, motion, and low back loads

- **So what happened?**
- *Swings: movement characteristics*
- The researchers reported that lumbar spine motion (defined as being between L1 and the sacrum) ranged from 26 degrees in flexion at the beginning of the swing to 2 degrees of extension at the top of the swing. They also reported that there was 2 degrees of lateral bend and 4 degrees of spine twist at the beginning of the swing.
- The researchers reported that hip motion ranged from 75 degrees of flexion at the beginning of the swing to 1 degree of hyper-extension at the top. They noted that the knee ranged from 69 degrees of flexion at the bottom to 2 degrees of extension at the top.
- *Swings: EMG activity*
- The researchers looked at where the activity of the various muscles were highest in the swing and noted that while the leg muscles were primarily associated with knee extension, the gluteal activation peak occurred later in the swing cycle and was more closely associated with the final point of hip extension.
- *Swings: spinal loads*
- The researchers reported that both shear and compressive loads were the highest at the beginning of the swing. Compressive loads were 3,195N at the bottom of the swing, while shear loads were 461N.
- *Swings with kime: movement characteristics* The researchers reported that the observed movement characteristics were similar between the swings and the swings with kime.
- *Swings with kime: EMG activity*
- The researchers reported that the addition of “kime” to the swing mostly affected the abdominal muscles, with the largest increases in activation occurring in the external oblique muscles (101% increase in the right external obliques and 140% increase in the left).
- *Swings with kime: spinal loads*
- The researchers reported that both shear and compressive loads were similar in the swings and the swings with kime with the exception of the top of the swing, where the shear and compressive loads during the swings with kime remained high while they reduced significantly during the normal swings. The researchers note that less shear loading is considered to be more optimal.

Kettlebell swing, snatch and bottoms-up carry: Back and hip muscle activation, motion, and low back loads

- *Swing to snatch: movement characteristics*
- The researchers found that the swing to snatch increased the activation of almost all muscles, which they deduced was because of the greater effort needed to launch the kettlebell into the snatch position.
- *Snatch: spinal loads*
- The researchers found that spine compression and shear loads were similar at the beginning of the snatch to the Swing.
- *Snatch: EMG activity*
- The researchers reported that the muscle activity during the snatch was different to the swing only in three muscles: the right external obliques, the right rectus femoris and the left internal obliques.
- *Kettlebell carries: movement characteristics*
- The researchers reported that spine, hip, and knee kinematics were similar to normal walking when carrying a kettlebell in both the racked and bottoms-up positions.
- *Kettlebell carries: EMG activity*
- The researchers noted that the muscle activity was very low in all walking exercises. However, they did also note that the EMG activity of all muscles except the left external obliques was higher during the bottoms-up carry when compared with the other walking tests.
- *Kettlebell carries: joint loads*
- The researchers reported that the joint compression and shear loads were also significantly greater in the bottoms-up position compared with that in the racked position and normal walking.
- *Case study*
- The researchers recorded the EMG activity of Pavel Tsatsouline while he performed a swing with a 32kg kettlebell with his right hand and with two hands. During this experiment, Pavel displayed 150% MVC in his left erector spine and 100% in his left gluteal muscles.

Kettlebell swing, snatch and bottoms-up carry: Back and hip muscle activation, motion, and low back loads

- **Limitations**
- The study was limited in that only light kettlebells were used in all of the movements and the subjects were mostly inexperienced.
- Moreover, the form shown on the picture included in the study did not look like correct hip hinge swing form. Finally, it is noted that no data for spinal loading was included for the case study, which might have been more useful for those coaches working with athletes who are more capable of correct hip hinge swing form and gluteal activation.
- **What are the conclusions?**
- The researchers conclude that the kettlebell swing seems to create a hip-hinge movement together with patterns of rapid muscle activation and relaxation of large magnitude. However, the researchers also note that the kettlebell swing appears to result in unique compression and shear load ratios in the lumbar spine. Shear stability and tolerance to posterior shear loading are therefore required in order to gain the benefits of this movement pain-free.
- **KEY POINTS**
- The researchers note that the kettlebell swing can provide a unique training stimulus but may be contraindicated for some individuals who have spine shear load intolerance.

The Modified Kettlebell Swing

- *The Modified Kettlebell Swing, by Matthews and Cohen, in Strength and Conditioning Journal, 2012*
- **The Review**
- *Background*
- The hamstrings produce hip extension and are therefore heavily involved in many sporting movements, such as jumping and sprinting. They often operate through very large ranges of motion and bear large forces at extreme joint angles and muscle lengths, which is thought to contribute to the high incidence of hamstring muscle tears in sport.
- However, the reviewers suggest that it is not easy to train the hamstrings dynamically, in the way that they operate during sports. They observe that the staple exercises for hamstrings, the Romanian deadlift, the Nordic curl, glute-ham raises and machine leg curls, are all high-force exercises that are typically performed at slow velocities.
- Therefore, they propose that there is a gap in traditional training methods, which is that the hamstrings are not normally worked at higher velocities, which would be more sports specific.

The Modified Kettlebell Swing

- *Kettlebell swings for hamstring development*
- The researchers suggest that it is possible to use kettlebell swings to produce dynamic training of the hamstrings at higher, more sports-specific speeds.
- They note that the typical kettlebell swing involves both hip and knee extension to produce the movement and then both hip and knee flexion to decelerate the kettlebell at the top of the movement.
- They observe that when the hip and knee angles change similarly during the swing, this leads to the hamstring being shortened at one joint and lengthened at the other, which does not significantly change its overall length.
- However, the researchers suggest that by using a stiff-legged version of the kettlebell swing, in which the knee angle range-of-motion is reduced, the hip extension at the beginning of the movement can lead to a significant contraction and reduction in the length of the hamstrings to propel the kettlebell upwards, followed by a large increase in length and a stretch of the hamstrings in returning to the flexed-hip position.
- They note that this has several benefits, including the extensive use of the stretch-shortening cycle, training the hamstrings at much longer lengths, and training the hamstrings at higher velocities, such as are used in sports.
- They note that this exercise may therefore be useful for sports-specific, injury prevention and rehabilitation programs.

The Modified Kettlebell Swing

- *Practical considerations*
- The reviewers suggest that this stiff-legged version of the kettlebell swing should need a weight that is around 30% lighter than would be used for a traditional swing.
- Additionally, the researchers recommend that weights and volume are increased in a conservative manner to maintain a focus on movement quality and to ensure that the stress of the movement is placed upon the hamstrings and not diverted to the knee extensors.
- They suggest that low-repetition sets are used, with no more than six repetitions being performed at one time.
- **What did the reviewers conclude?**
- The reviewers conclude that stiff-legged kettlebell swings are an excellent alternative to traditional hamstring exercises. They conclude that they place a greater emphasis on rapid eccentric control of the hamstrings and also allow training of the hamstrings at more sports-specific speeds.

The Modified Kettlebell Swing

- **Limitations**

- The review was limited in that it **did not discuss the use of speed deadlifts or deadlifts with accommodating resistance** for the development of speed-strength in the hamstrings.
- Moreover, it did not compare these with kettlebell swings.

- **KEY POINTS**

- Stiff-legged kettlebell swings are an excellent alternative to traditional hamstring exercises.
- Stiff-legged kettlebell swings place a greater emphasis on rapid eccentric control of the hamstrings and also allow training of the hamstrings at more sports-specific speeds.

Mechanical demands of kettlebell swing exercise

- *Mechanical demands of kettlebell swing exercise, by Lake Lauder, in Journal of Strength and Conditioning Research, 2012*
- **Background**
- Kettlebells are promoted as being useful tools for developing both aerobic fitness and muscular strength simultaneously.
- Some previous researchers have reported significant aerobic demand during bouts of kettlebell exercise but others have found that this does not translate to improvements in aerobic fitness when measured over a period of a number of weeks.
- In terms of muscular strength, some reviewers have proposed that kettlebells are unable to produce any significant gains.
- However, research has since shown that it is possible to improve strength, power and muscular endurance using common kettlebell routines lasting for several weeks.

Mechanical demands of kettlebell swing exercise

- **What did the researchers do?**
- The researchers wanted to understand the mechanical demands of kettlebell exercise, starting with the most fundamental exercise, the two-hand kettlebell swing.
- They also wanted to compare the mechanical demands of the swing with the jump squat. So they recruited 16 men, who then performed two sets of 10 repetitions of two-handed swings with single 16, 24, and 32kg kettlebells while standing on a force plate.
- Additionally, the researchers recorded the sagittal plane of motion movements using a digital camera positioned to the side.
- In addition to the swings, the subjects performed back squats with 40, 60 and 80% of 1RM and jump squats with 0, 20, 40 and 60% 1RM, having first established their back squat 1RM.

Mechanical demands of kettlebell swing exercise

- *Comparison between kettlebell weights*
- The researchers observed that the mechanical demand of the kettlebell swings, as determined by ground reaction forces, power outputs and impulse, were all maximized when using the 32kg kettlebell.
- Of no surprise, both mean and peak velocity were maximal when using the 16kg kettlebell.

- *Comparison between kettlebell swings and squats*
- The researchers observed that the results of comparing the mechanical demands of the jump squat and the kettlebell swing were mixed.
- In general, the largest values of net impulse were produced when using the 32kg kettlebell.
- On the other hand, the researchers found that the highest peak and mean force occurred during the back squat.
- Moreover, peak and mean forces were higher in the jump squat than during the kettlebell swing.
- The researchers found that power output during the swings with the 32kg kettlebell was greater than the power output during back squats but similar to the power output during jump squats.

Mechanical demands of kettlebell swing exercise

- **What did the researchers conclude?**
- The researchers noted that the back squat with 80% of 1RM produced the highest measurement of peak force.
- They observed that since peak force is closely related to muscular strength, strength is best developed using the heavy back squat rather than with the jump squat or kettlebell swing.
- The researchers also suggest that since the back squat produced very much greater ground reaction forces than the kettlebell swing with 32kg, kettlebell swings are likely not sufficient for developing muscular strength.
- The researchers observed that the 32kg kettlebell produced similar mean and peak power to jump squats. They therefore propose that kettlebell swings could be suitable for a power-based program as an alternative to jump squats.

Mechanical demands of kettlebell swing exercise

- **Limitations**

- The researchers note that **the ground reaction forces were stated in total** and included both vertical and horizontal forces.
- Moreover, the kettlebell swings produced much greater horizontal forces than the squats and jump squats. Therefore, it may be the case that for sports-specific applications where force-direction is important, there may be a significant difference between the use of jump squats and kettlebells for power.
- Moreover, the researchers stopped at 32kg and did not use a heavier kettlebell.
- However, **different results might have been obtained with heavier weights.**

- **KEY POINTS**

- Ground reaction forces are greatest in the order: heavy back squats > jump squats > kettlebell swings.
- Kettlebell swings may therefore not be optimal for developing strength.
- Power outputs are similar in jump squats and kettlebell swings, particularly with heavier kettlebells such as the 32kg weight.
- Kettlebell swings may therefore be appropriate for substituting into a power-based program.

Kettlebells: Twice the Results in Half the Time?

- *Kettlebells: Twice the Results in Half the Time? By Schnettler, Porcari and Foster with Mark Anders, in ACE Fitness Matters, 2010*
- **Background**
- In light of the recent increase in interest in kettlebells, the American Council on Exercise (ACE) commissioned a study to look into certain aspects of kettlebell exercise.

Kettlebells: Twice the Results in Half the Time?

- **What did the researchers do?**
- The researchers were commissioned to investigate the energy cost and exercise intensity of kettlebell workouts.
- So they recruited 10 volunteers, including both male and female subjects, with an age range from 29 – 46 years. They specifically picked subjects who had experience in kettlebell training.
- The researchers performed two separate tests. Firstly, they performed an incremental treadmill test while monitoring oxygen consumption and heart rate. After the test, they asked the subjects for a rating of perceived exertion (RPE).
- Secondly, they performed a 5-minute kettlebell snatch test. The subjects used a 12, 16 or 20kg kettlebell as required. The number of snatches was increased each minute. The subjects performed 8, 12, 15 and 20 repetitions in each of the first four minutes and then as many repetitions as possible in the final minute.
- During this test, oxygen consumption and heart rate were again recorded. Blood lactate and an RPE were recorded afterwards.
- Following these two maximal tests, the researchers then deduced a specific kettlebell workout, based on the results of the kettlebell maximal snatch test.
- This workout comprised 15-seconds of snatches, followed by 15-seconds of rest, alternating over 20 minutes. During this workout, the researchers recorded heart rate. After the workout, the researchers measured blood lactate.

Kettlebells: Twice the Results in Half the Time?

- **What happened?**
- The researchers estimated that during the 20-minute workout, the average calorie expenditure was 272 calories or 13.6 calories per minute. However, this measurement was based purely on assuming that the effort was entirely aerobic, which therefore likely underestimated the calorific expenditure.
- Based on the blood lactate measurements, the researchers further estimated that another 6.6 calories per minute might have been used through anaerobic respiration, making the total up to 20.2 calories per minute.
- The researchers noted that this effort is similar to cross-country skiing uphill at a fast pace and equivalent to running at 6- minute mile pace. They suggest that the unusually high result is likely because of the full-body aspect, like cross-country skiing, and the use of intervals rather than steady-state effort

Kettlebells: Twice the Results in Half the Time?

- **What did the researchers conclude?**
- The researchers concluded that kettlebells provided a much higher-intensity workout than standard exercise routines.
- It seems clear that the workout protocol described in this study was more intense than traditional cardiovascular exercise modalities, such as treadmill or cross-trainer use.

Kettlebells: Twice the Results in Half the Time?

- **Limitations**
- The study did **not directly compare the kettlebell workout with another similar workout using a different tool**. They could have quite easily performed exactly the same workout protocol using a Concept 2 rowing machine or a full-body barbell exercise such as the squat or sumo deadlift. This would allow us to understand whether it is the exact nature of the dynamic kettlebell movement that causes the large calorific expenditure or simply that the movement involves contribution from a large percentage of the body's musculature.
- Finally, it is again noted that kettlebells only up to 20kg were used and **different results might have been obtained with heavier weights**.
- **KEY POINTS**
- Kettlebell workouts provide a much higher-intensity workout than standard exercise routines. They are more intense than traditional cardiovascular exercise modalities, such as treadmill or cross-trainer use.

Oxygen cost of kettlebell swings

- *Oxygen cost of kettlebell swings, by Farrar, Mayhew and Koch, in Journal of Strength and Conditioning Research, 2010*
- **Background**
- The researchers explain by way of background that kettlebells have been a popular training tool in Russia for a long time.
- However, they note that the scientific literature only began to investigate them in 2002.
- Moreover, there has been little work done on the currently popular training routines that involve kettlebells.

Oxygen cost of kettlebell swings

- **What did the researchers do?**
- The researchers wanted to record the heart rate response and oxygen cost of performing a commonly-used kettlebell exercise routine. So they recruited 10 young, recreationally active males as subjects. Only one of the subjects had previously used kettlebells.
- First of all, the subjects performed a maximal incremental treadmill test, while the researchers measured oxygen consumption using measured expired gases and heart rate using a heart rate monitor.
- This allowed the researchers to determine their VO₂-max based on the achievement of two of the following: a heart-rate within 12 beats of their age-predicted maximum, a respiratory exchange ratio of >1.1 and a rating of perceived exertion (RPE) of >17 on the Borg scale.
- In a separate session, the subjects returned to perform a kettlebell exercise test. Before the kettlebell exercise test, they warmed up using a cycle ergometer.
- Then they performed a 12-minute bout of kettlebell swings using a 16kg kettlebell in a specific routine, known as the “man maker”. This routine requires subjects to perform as many two-handed swings as possible within a 12 minute timeframe.
- The researchers again measured their oxygen consumption using measured expired gases and heart rate using a heart rate monitor.

Oxygen cost of kettlebell swings

- **What happened?**
- *Number of swings performed*
- The researchers recorded that subjects completed an average of 265 ± 68 swings during the 12 minutes, for an average work rate of 22 ± 6 swings per minute.
- *VO₂-max*
- The researchers found that during the 12-minute kettlebell exercise bout the average VO₂ consumed was 34.31 ± 5.67 ml/kg/min. This was $65.3 \pm 9.8\%$ of the VO₂-max measured in the maximal treadmill test. The average accumulated oxygen consumption during the 12-minute swing test was 26.5 ± 4.78 L/min.
- *Heart rate*
- The researchers found that the average heart rate during the 12-minute kettlebell swing test was 165 ± 13 beats per minute. They also noted that the average heart rate as a percentage of maximum heart rate during the kettlebell exercise bout was $86.8 \pm 6.0\%$, which was significantly higher than the percentage of VO₂-max

Oxygen cost of kettlebell swings

- **What did the researchers conclude?**
- The researchers concluded that the 12-minute kettlebell exercise bout required a percentage of VO₂-max that was higher than 60%, which would classify it as “hard” exercise according to the definitions used by the American College of Sports Medicine.
- The researchers concluded that the relatively low percentage of VO₂-max (c. 65%) in comparison with a relatively high percentage of maximum heart rate (c. 87%) was in a similar ratio to that observed in circuit-training with weights.
- However, the researchers also concluded that the kettlebell routine required a greater oxygen consumption and higher heart rate values than previously reported values for circuit-training (c. 30 – 47% VO₂-max and c. 62 – 76% of maximum heart rate).
- They therefore suggest that this kettlebell routine seems to produce a greater challenge to the cardiorespiratory system than traditional circuit-training with weights.

Oxygen cost of kettlebell swings

- **Limitations**
- The researchers **did not test the VO₂-max of the subjects while performing kettlebell swings** so it is difficult to assess whether the percentage of VO₂-max obtained during the swing workout was a high proportion of what the subjects were capable of performing or not.
- Moreover, they **did not compare the kettlebell swing workout with other workouts**, such as cycle ergometer intervals, rowing intervals or treadmill running. Additionally, the subjects only used a 16kg kettlebell and **different results might be achieved with heavier weights.**
- **KEY POINTS**
- Commonly-used kettlebell training drills can improve the cardiorespiratory fitness of athletes. The heart-rate percentages during these routines greatly exceed the percentages of VO₂-max, just as they do during circuit-training.

The Influence of Nontraditional Training Modalities on Physical Performance

- *The Influence of Nontraditional Training Modalities on Physical Performance: Review of the Literature, by O'Hara, Serres, Traver, Wright, Vojta and Eveland, in Aviation, Space, and Environmental Medicine, 2012*
- **The Review**
- The reviewer begins by noting that the American College of Sports Medicine (ACSM) guidelines for improving muscular strength, endurance and aerobic fitness are currently used by the Air Force (USAF) to produce fitness instructions for their personnel.
- As a result, USAF fitness assessment is based around four tests: waist circumference, a 1.5-mile run, a 1-mile walk, and push-ups and sit-ups for 1-minute. The walking test is performed where there is medical reason why personnel are unable to perform the run. Failure to pass the test leads to a requirement to go through a 42 – 90 day reconditioning period before a retest is performed.
- The reviewer explains that it is estimated that 90% of active duty airmen in the USAF pass their annual Fitness test. However, the remaining 10–15% struggle to pass the annual fitness test despite following instructions based on ACSM recommendations for physical training. The guidelines specify that individuals should exercise for a minimum of 3 – 5 times weekly, at an exercise intensity that is 60 – 90% of age-adjusted predicted maximum heart rate ($220 - \text{age in years}$) for a total of 150 – 300 minutes per week of moderate or vigorous activity.
- For resistance exercise, it is also recommended that individuals perform a minimum of 8 – 10 separate exercises that train all major muscle groups, including the arms, chest, back, shoulders, abdomen, and legs. It is suggested that minimum of one set of 8 – 12 repetitions is performed to fatigue for these exercises.
- Consequently, traditional USAF training typically involves mainly aerobic activity, such as running, 3 – 5 times weekly at 60 – 90% of maximum heart rate for 30 – 60 minutes followed by muscular strength and endurance training, usually push-ups and sit-ups.
- Consequently, there is an interest in alternative methods of training that may produce better results. Such alternative methods include heavy resistance training, kettlebell training, CrossFit and agility training.

The Influence of Nontraditional Training Modalities on Physical Performance

- **What did the reviewer do?**
- The reviewer investigated four forms of non-traditional training modalities, including heavy leg resistance training for the legs, CrossFit training, kettlebell training, and agility training.
- *Heavy resistance training for the legs*
- The reviewer suggest that heavy leg resistance training may better prepare individuals to meet USAF fitness standards. Based on various studies involving concurrent resistance and aerobic training, where the aerobic training is less than traditional USAF training methods, the reviewer suggests that these methods can provide an improved preparation for the tests than current approaches. Moreover, studies show that heavy resistance training with the legs leads to increased muscle fiber type recruitment as well as a higher lactate threshold and consequently improved endurance performance.
- *CrossFit training*
- CrossFit training has not been studied in the academic literature. However, it is characterized by high intensity, circuit-training type activity, with short rest intervals between sets and high exercise heart rates. Proponents of this type of training suggest that the neuroendocrine responses to this form of exercise lead to beneficial anatomical adaptations. However, the literature regarding the relationship between the neuroendocrine responses to exercise and subsequent adaptations is currently conflicting and it is not certain that such adaptations are affected by the release of different hormones following exercise. Moreover, the frequent and high-intensity nature of the program, combined with the relative difficulty of some of the exercises, has drawn many criticisms from within the strength and conditioning community.

The Influence of Nontraditional Training Modalities on Physical Performance

- *Kettlebell training*
- The reviewer notes that one of the main attractions of kettlebell training programs is their simplicity. A small number of studies have been carried out in respect of investigating typical, dynamic kettlebell routines and the heart rates and percentage of VO₂-max involved in performing them. The studies certainly indicate that kettlebell training is capable of improving aerobic performance.
- *Agility training*
- The reviewer explains that agility training, such as those programs involving reactive drills, directional force change drills, foot speed drills, agility ladder runs, and hurdle crossings have also been used to help improve physical fitness. In this case, the reviewer notes two studies that have been performed on service personnel and found that it is able to improve various measurements of both cognitive and physical performance, including aerobic capacity.

The Influence of Nontraditional Training Modalities on Physical Performance

- **What did the reviewer conclude?**
- The reviewer concluded that the addition of heavy leg resistance exercises to an existing aerobic training regimen appeared most promising for improving aerobic fitness in USAF personnel to help them pass the annual fitness test.
- **KEY POINTS**
- Concurrent resistance and aerobic training may be superior to traditional methods for helping service personnel pass their annual fitness test.

Comparison of Kettlebell Swings and Treadmill Running at Equivalent RPE Values

- *Comparison of Kettlebell Swings and Treadmill Running at Equivalent RPE Values, by Husley, Soto, Koch and Mayhew, in Journal of Strength and Conditioning Research Publish Ahead of Print*
- **Background**
- Kettlebell exercises have not been extensively studied in the academic literature and yet there is some indication that they may be effective for developing aerobic capacity

Comparison of Kettlebell Swings and Treadmill Running at Equivalent RPE Values

- **What did the researchers do?**
- The researchers wanted to compare the metabolic demand of a typical kettlebell swing routine to a treadmill run at an equivalent rating of perceived exertion (RPE).
- So they recruited 13 moderately-trained subjects (11 males and 2 females) for the study. The subjects had no previous experience with kettlebells. The subjects performed a 10- minute swing routine in which the men used a 16kg kettlebell and the women used an 8kg kettlebell.
- They performed 35-second swing intervals followed by 25- second passive rest intervals. In a second visit to the laboratory, the subjects performed a 10-minute treadmill run at an equivalent RPE, as was recorded following the swing workout.
- The treadmill run was adjusted to maintain the same RPE throughout as the swing workout. During both tests, the researchers measured heart rate and RPE were assessed at minutes 5, 7, 9, and 10.
- They also recorded expired gases in order to calculate oxygen consumption and therefore estimate the calorific expenditure, assuming that only the aerobic system was utilized.

Comparison of Kettlebell Swings and Treadmill Running at Equivalent RPE Values

- **What happened?**
- *RPE*
- The researchers found that RPE increased by 2 – 3% from minutes 5 through 7, 9 and 10 for both the swing routine and the treadmill running workout.
- They noted that there was no significant difference in RPE between the two different exercise modes at any point. They noted that RPE averaged 76 – 77% of maximum for both exercise modes.

- *Heart rate*
- The researchers found that heart rate increased by 7 – 9%, from minutes 5 through 7, 9 and 10 for both the swing routine and the treadmill running workout.
- They noted that there was no significant difference in heart rate between the two different exercise modes at any point.
- They also noted that heart rate averaged 85 – 93% of age-predicted heart-rate maximum for both exercise modes.

- *Metabolic indicators*
- The researchers observed that oxygen consumption and calorie expenditure were significantly higher for treadmill running than for kettlebell swings as performed in this routine. Moreover, they found that this was the case at each time point.
- They reported that oxygen consumption was 19% \pm 12% higher during treadmill running than kettlebell swings at minute 4 and 32 \pm 10% higher at minute 10.

Comparison of Kettlebell Swings and Treadmill Running at Equivalent RPE Values

- **What did the researchers conclude?**
- The researchers concluded that when matched for RPE, subjects were likely to have higher oxygen consumption and burn more calories per minute during treadmill running than during kettlebell swings.
- However, the researchers also concluded that, according to the guidelines produced by the American College of Sports Medicine, the kettlebell routine could provide sufficient exercise stress to produce gains in aerobic capacity since the percentage of heart-rate maximum exceeded 85% in most of the subjects.
- They therefore suggest that kettlebell swings can be used to carry out aerobic training as an alternative when required.

Comparison of Kettlebell Swings and Treadmill Running at Equivalent RPE Values

- **Limitations**
- The study was performed with **matched RPE and not by matching the maximal performance** that could be attained in a limited period of time.
- Therefore, it is possible that kettlebell swings could be more effective where the individuals were allowed to train as hard as possible.
- Also, the comparison was made **between steady state continuous running versus interval kettlebell training**. Different results might have been achieved had the researchers compared sprinting intervals with the interval kettlebell training routine.
- **KEY POINTS**
- When matched for RPE, trainees are likely to have higher oxygen consumption and burn more calories per minute during treadmill running than during kettlebell swings.
- Kettlebell swing routines are able to provide sufficient exercise stress to produce gains in aerobic capacity since they meet the guidelines set out by the ACSM for aerobic exercise.

Zusammenfassung der Studien

- Zweimal wöchentliches Kettlebell Swing Training mit 12 und 16 kg Kettlebells verursacht ähnliche Verbesserungen in der Halbkniebeuge (1RM) und Sprunghöhe wie ein zweimal wöchentlich stattfindendes Squat-jump Training
- Kettlebells können für Verbesserungen in Kraft und Power eingesetzt werden, allerdings sind diese Verbesserungen aufgrund der niedrigeren Gewichtsbelastung geringer als die eines traditionellen Langhanteltrainings
- Kettlebell training kann zu einem Transfer von Kraft und Power auf Gewichtheber- und Powerlifting –Übungen führen
- Acht Wochen Kettlebell Swing und – Deadlift Training führen zu einer größeren Verbesserung des Nacken-, Schulter und Lendenwirbelsäulenschmerzes als in der Kontrollgruppe. Es führte zu einer Verbesserung der Kraft der Rückenstrecker, aber nicht zu einer signifikanten Verbesserung der Kraft der Rumpfflexoren oder zu verbesserter Kardiovaskulärer Fitness.
- Der Kettlebell Swing produziert einen einzigartigen Trainingsreiz, der allerdings für Menschen mit einer Intoleranz für Scherkräfte in der WS kontraindiziert sein können.
-

Zusammenfassung der Studien

- Stiff-legged kettlebell swings sind eine hervorragende Alternative zu traditionellen Übungen der Ischiocruralen Muskulatur
- Stiff-legged kettlebell swings erlaubt das Training der Ischios bei sportspezifischeren Geschwindigkeiten, es fokussiert mehr auf schnelle exzentrische Kontrolle.
- Bodenreaktionskräfte sind am größten in folgender Reihenfolge: heavy back squats > jump squats > kettlebell swings.
- Kettlebell swings könnten daher nicht optimal sein um Maximalkraft zu verbessern.
- Power outputs sind ähnlich bei jump squats und kettlebell swings, insbesondere mit schwereren Kettlebells wie z.B. der 32kg KB
- Kettlebell swings sind daher für ein Explosivkraft basiertes Programm geeignet.
- Kettlebell workouts haben eine höhere Intensität als Standard. Sie sind Intensiver als traditionelle Ausdauerübungen wie Laufband oder Crosstrainer.
- Kettlebellübungen können die Kardiorespiratorische Fitness von Sportlern verbessern. Die Pulsfrequenz-Prozentanteile übersteigen während dieser Übungen die Prozentanteile des VO₂-max, ähnlich wie bei Zirkeltraining.
- Bei gleicher RPE haben Trainierende einen höheren Sauerstoffverbrauch und verbrennen mehr Kalorien beim Laufen auf dem Laufband als bei Kettlebell Swings.
- Kettlebell swing Routinen setzen einen asäquaten Reiz, um Verbesserung in der aeroben Kapazität hervorzurufen.

Kettlebells als Athletiktraining

- Kettlebells haben ihren weg in das Athletiktraining gefunden
- Insbesondere Kampfsportler haben die Vorzüge entdeckt



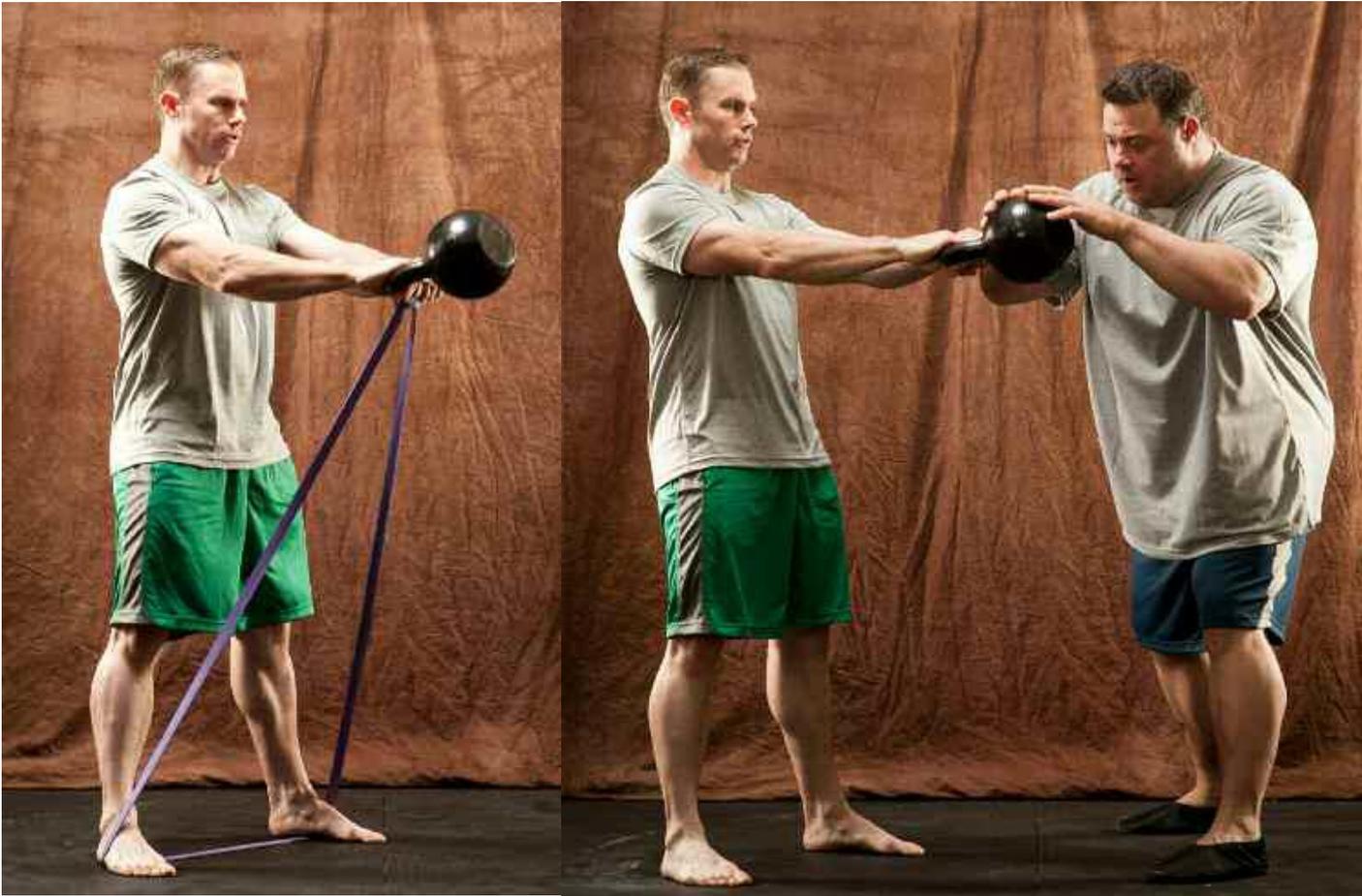
Kettlebells und Powerlifting

- Donnie Thompson: *„We honestly have not seen anything that 100% transferred over to a sport like kettlebells. I mean, there is nothing about kettlebells that doesn't transfer over to powerlifting“*
- The kettlebell swing is one of the best deadlift assistance exercises one can do. It develops a hard driving lockout and bulletproofs the back. Donnie Thompson, RKC was undoubtedly the first elite powerlifter using the swing for this purpose. He credited kettlebells with taking his pull from 766 to 832—and saying farewell to his persistent back problems.
- Bei den klassischen Powerlifts treten höhere Kräfte auf, da höhere Gewichte verwendet werden können

Kettlebells vs Gewichtheben

- Beim olympischen Gewichtheben sind weit größere Gewichte möglich
- Kettlebells ermöglichen einfacher hohe Wiederholungszahlen
- Kettlebells ermöglichen „overspeed eccentrics“ (Gewichtheben quasi rein konzentrisch“)
- Technisch kompliziertes Unterhocken, das (bei Anfängern) die Hüftendstreckung behindert entfällt.

Overspeed eccentrics



Kettlebells für Athletiktraining

- Als reines Maximalkrafttraining der Langhantel unterlegen
- Gut geeignet zur Entwicklung von Explosivkraft in den Hüftstreckern insbesondere in den Endstreckung
- Als Kraft (Explosivkraft-) Ausdauertraining für die Hüftstrecker hervorragend geeignet
- Hohe horizontale Kraftkomponente bei hüftbetonten Swings
- Als Ausdauertraining mit intensiver Kraftkomponente anwendbar (hoher Energieverbrauch)
- Zusätzlich Förderung der Gelenkstabilität und Ganzkörperspannung
- Bei richtiger Ausführung geringe Verletzungs-/Überlastungsgefahr, evtl sogar verletzungsvorbeugende Effekte
- Sprungtraining ohne Impacts bei der Landung möglich → geringere Gesamtbelastung

Horizontale vs. vertikale Kraft

Style	Load (lbs)	Peak Vertical Force (N)	Peak Horizontal Force (N)
Squat Style	70	2,170-2,349	166-182
Squat Style	140	2,431-2,444	278-353
Hip Hinge Style	70	1,935-2,140	340-402
Hip Hinge Style	140	2,325-2,550	499-520

Tabata

- High intensity interval training
- Beispiel 20:10, 8 Runden

Komplexes

- Aneinanderreihung von Übungen, die dann ohne Unterbrechung ausgeführt werden
- „metabolic Conditioning“ – gleichzeitige Beanspruchung der Muskeln und des Herz- Kreislauf- Systems
- Snatch – 10 Reps; One Arm Long Cycle Clean and Jerk – 10 Reps; Reverse Lunges – 10 Reps; Single Arm Kettlebell Row – 10 Reps
- Double Swings – 15 reps; Double Snatch – 15 reps; Double Front Squat – 15 reps; Double Clean and Press – 15 reps; Push Ups on Bell Handles – 15 reps
- Durch Beanspruchung unterschiedlicher Muskelgruppen wird durch Einsparung von Pause Zeit gespart

Kettlebell als (Personal) Trainingstool

- Platz- und Geldsparend
- Vielseitig anwendbar
- Übungen mit Progressionen und hohem korrektivem Wert
- Leicht zu Transportieren

Empfehlenswerte Literatur

- Enter the Kettlebell – Pavel Tsatsouline
- Viking Warrior Conditioning – Kenneth Jay
- The RKC book of Strength and Conditioning
- Intervention – Dan John
- Deadlift Dynamite – Pavel, Andy Bolton