Weightlifting Movements: Do the Benefits Outweigh the Risks?

Allen Hedrick, MA, FNSCA, CSCS*D and Hiroaki Wada, CSCS*
1National Strength and Conditioning Association, Colorado Springs, Colorado; 2Colorado State University–Pueblo, Pueblo, Colorado

SUMMARY

This article first defines the sport of weightlifting so the reader has a clear idea of the activity. We include a detailed look of the potential benefits that can be derived from including weightlifting movements in the training programs of athletes from a variety of sports. Finally, a review of the literature evaluating the injury risks associated with performance of the weightlifting movements is presented. The goal is to provide strength and conditioning coaches with relevant information so that they can make an informed decision regarding inclusion of the weightlifting movements in the training programs of their athletes.

INTRODUCTION

The inclusion of the weightlifting movements and associated training exercises has become an area of emphasis in the training programs of athletes from a variety of sports. However, despite the increase in the use of the weightlifting movements, questions persist in regard to both the effectiveness and safety of this form of training. The purpose of this article is to examine the benefits that weightlifting can provide athletes and then review the literature for the safety/injury rates associated with weightlifting to aid coaches in determining the best use of the weightlifting movements in program design.

WEIGHTLIFTING DEFINED

Weightlifting is a sport in which athletes attempt to lift as much weight as possible in the snatch and clean and jerk (5, 19, 32). The snatch and clean and jerk (and their related training exercises) are explosive exercises. It is important for strength and conditioning professionals to differentiate between the terms weightlifting (describing the sport and the associated movements) and weight or resistance training which, in general, can be thought of as any form of exercise against resistance. The term “Olympic lifting,” although common, is incorrect except for elite athletes who are competing in weightlifting at the Olympic Games. The term weightlifter is reserved for individuals training and competing in the sport of weightlifting (25).

COMPARING WEIGHTLIFTING AND POWERLIFTING AND THEIR VALUE TO ATHLETICS

There are 2 primary forms of competitive lifting, weightlifting and powerlifting. As mentioned, weightlifting consists of the snatch and clean and jerk whereas powerlifting includes the squat, deadlift, and bench press. In both forms of competitive lifting, the goal is to lift as much weight as possible. The term powerlifting is a misnomer because greater levels of power output occur in weightlifting than powerlifting. During the relatively slow movement speeds that occur in powerlifting, approximately 12 watts per kilogram of body weight is produced in male athletes. In contrast, the second pull phases of both the snatch and clean may generate 4 times as much power, averaging 52 watts per kilogram for male athletes (15).

Further, on the basis of information from Garhammer (13), power output diminishes in both weightlifting and powerlifting as the weight increases toward 100% of 1 repetition (IRM). This effect is more significant in powerlifting because of the biomechanics of the lifts. For example, power output can be twice as great for a 90% effort as compared with a 100% effort in the powerlifting movements. This is the result of the dramatic increase in time it takes to complete the movement as the resistance increases in the bench, squat, and deadlift (13). Powerlifters require maximal force production at slow velocities. Although the initiation of the movement during powerlifting is explosive, the ensuing movement is at a slow velocity because of the high loads and the biomechanics of the lifts. As a result, weightlifters generate greater power and move at

KEY WORDS:

improving sports skills; power; powerlifting; risk of injury in weightlifting; weightlifting
faster velocities than powerlifters across a load spectrum (5,10).

Developing and assessing maximum strength has received a great deal of attention, however, maximal strength is required in only a few athletic activities such as powerlifting. Most sports require strength at faster velocities (2,18). Many strength and conditioning coaches believe that, as slow velocity strength increases, power output and dynamic performance will also improve; however, evidence to support this is lacking.

To maximally improve power, both the force and velocity components must be trained (2,17,18,26). A program combining high force and high velocity training results in greater improvements in the generation of force at high velocities. This combination of high force and high power training appears to result in adaptation occurring during the most critical portion of the force–velocity curve and thus has a greater impact on improving athletic performance (26). As movement speed increases, less force production is possible (16). However, with high force and high power training (as occurs in weightlifting), the ability to generate force at high velocities is enhanced, increasing power capability (9,26), which is advantageous in terms of improving athletic performance.

As a result, it may be advantageous to develop resistance–training programs that increase both strength and power (19). However, dispute continues as to what combination of loading, movement velocities, power outputs, and exercises should be included in resistance training programs to optimize the development of muscle power and physical performance (22).

According to Hoffman et al. (18), studies have reported that combining high force and high velocity may be more effective than training programs that emphasize high force or high velocity training (18). Training programs emphasizing high-force, slow velocity training (i.e., powerlifting) appear to improve force at the high force end of the force–velocity curve, whereas high power or high velocity training appears to emphasize greater improvements of force at the high velocity end of the spectrum (18). Some evidence exists that suggests if the exercise is performed with the intent to accelerate the resistance as quickly as possible, even if the actual movement speed is slow, that increases in high speed strength (power) will occur (22).

For example, squat training with heavy resistances (70–120% of 1RM) has been shown to improve maximum isometric strength (26). Although some exercises (i.e., jumping) always require one to develop force rapidly, other exercises (i.e., squats) can also be performed so that force is rapidly developed (26). In contrast, activities that require the athlete to attempt to develop force rapidly, such as explosive jump training with resistances of 30–60% of 1RM, increase the athlete’s ability to develop force rapidly (26). More specifically, explosive resistance training increases the slope of the early portion of the force time curve, or the maximum power. Although heavy resistance training increases maximum strength, this type of training does not appreciably improve power performance, especially in athletes who have developed a strength training base (i.e., more than 6 months of strength training). This occurs because movement time during explosive activities is typically less than 300 ms and most of the force increases cannot be realized during such a brief period (26).

WEIGHTLIFTING AND IMPROVING SPORTS SKILLS

Although empirical evidence suggests that there is a relationship between the weightlifting movements and improving athletic performance (5,30) limited studies have evaluated the relationship of performing the weightlifting movements and improved performance in activities such as sprinting, stopping, changing direction, and throwing (17,19). It is believed by many that performance of the weightlifting movements is similar to the joint/muscular recruitment patterns that occur during the performance of many athletic movements and that the requirements for strength, power, and force development during performance of the weightlifting movements are similar to many movements found in sport. Further, despite the fact that the weightlifting movements require more time for learning than do more traditional exercises, the short-term training effects of the weightlifting movements seem to be more beneficial for improving performance (34). The greater skill complexity required for the weightlifting exercises facilitates the development of a broader physical abilities spectrum, which seems to be better transferred to performance (4,5,11,13,19,20,30,34).

Few studies have investigated the effects of weightlifting as compared with other types of resistance training on improving athletic performance (13,18,24). However, there is no reason to believe that the benefits derived from weightlifting would not transfer positively to improving performance in a variety of sports (5,21,26,34). This transfer to improving performance would be strongest in sports that involve movements similar to those used performing the weightlifting movements (e.g., generating force against the ground as when running and triple extension of the ankles, knees and hips as when jumping) and less effective in sports with less biomechanical similarity to the weightlifting movements (e.g., open water swimming).

POWER DEFINED

Defining power is an important consideration because, for most athletes, optimal sports performance is based upon the ability to develop power (14). Power has been defined as the amount of work produced per unit of time (9,16,26). In most sports, power is more important than force production for enhancing performance (5,25). The specific combination of strength, speed, and power required for optimal performance capabilities varies by sport. Training to recruit a maximum number of motor units in the most efficient use of time requires the use of multiple joint multiple muscle group exercises (14). It is believed by many
that weightlifting movements best meet these requirements and that the complex nature of the weightlifting movements aids in the development of a wide range of physical skills that transfer to enhanced performance (4,5,19,20,30,34).

POWER DEVELOPMENT
Performing weightlifting movements has become quite common, especially among athletes involved in power events (e.g., football, volleyball, throwing events in track). This popularity is based partly on the fact that weightlifting does improve power capability and partly on the opinion of many authors (5,19,20,32). Competitive weightlifters are perhaps the most powerful of all athletes. Indeed, it could be said that weightlifting is one of the best examples of athletic power (32). For example, in the second pull of the clean and the snatch (which is where the greatest power development occurs) (6), power output is notably greater than what occurs in the squat, bench, or deadlift (13,14,18,20,27). Because of the importance of power in many sports, the ability to generate power can be used as a measure of performance (12).

In contrast to weightlifting, powerlifting training programs emphasize exercises that require high force and low velocity movements. This method of training is thought to be most beneficial in developing muscle strength. The rationale for athletes performing slow velocity, heavy resistance training typically is based on the fact that all explosive movements start from zero or from slow velocities, and it is at these phases of the movement that slow velocity strength can contribute to power development as the body attempts to overcome the inertia of the mass being acted upon it (2,9,26).

In contrast to training for powerlifting, or in programs in which a powerlifting approach to training is used, weightlifting emphasizes exercises that combine both high force (i.e., squats) and high velocity (i.e., cleans) movements and, according to Hoffman et al. (18), this approach is likely better suited for developing strength, power, and speed. This method allows for the use of both heavy loads and high velocities simultaneously, thus producing high power outputs (24,34).

The classic weightlifting movements (snatch, clean and jerk) and related training exercises (hang pulls, hang cleans, power snatch, power clean, push press, power jerk) have been suggested as being of value for developing power (13,21). This is likely because during execution of the weightlifting movements, despite the significant resistance used, the intent is always to move the load as quickly as possible. This emphasis on speed of movement may stimulate greater motor unit synchronization and increase power generation capabilities (14,31).

Training programs that emphasize high velocity training, such as those found in the sport of weightlifting, are believed to be superior for bringing about increases in power output and speed (34). This is based on the high levels of force development and improved contractile speed associated with high force, high velocity resistance training. The greatest advantage occurs in sports that require explosive dynamic movements (5,14,19,20,34).

High velocity training combined with plyometric training may be advantageous (9,28,34). According to Harris et al. (17), it better develops the elastic properties within the muscle as compared with slow speed training. As a result, training programs for athletes should include both plyometric drills and resistance training exercises that involve stretch–shortening movements (where a concentric muscle action immediately follows an eccentric muscle action) (28) emphasizing quick amortization phases. Shortening the amortization phase (the time between the rapid deceleration of the body followed almost immediately by rapid acceleration of the body in the opposite direction) is trainable when correct coaching and training methods are implemented.

This stretch–shortening cycle can be observed in experienced lifters during performance of both the snatch and clean (11). It is this phase of the lift (occurring immediately after the first pull in both the snatch and clean and commonly known as the second knee bend) that needs to be developed in athletes for maximal benefits of the weightlifting movements to transfer to sports performance (32). This is important because, according to Stone et al. (32), most critical aspects of sports performance occur in very short timeframes (<250 milliseconds). If athletes can develop the ability to produce greater forces within this time frame, then greater acceleration and, thus, greater velocities, can occur.

ADDITIONAL BENEFITS OF THE WEIGHTLIFTING MOVEMENTS FOR ATHLETES
As has been established, power development capabilities may be the primary physiological factor in determining successful performance for many athletes, and the performance of the weightlifting movements result in high power outputs. However, there are additional potential benefits resulting from performance of the weightlifting movements that are of potential benefit to athletes, as discussed to follow.

BIOMECHANICAL BENEFITS
An examination of movements commonly found in many sports indicates that the majority of exercises comprising the training program for athletes should be closed kinetic chain movements because most sports involve closed kinetic chain actions (1).

Further, these exercises should result in the generation of high power outputs in the large muscle groups (especially around the legs, hips, and trunk) in a brief period of time. Performance of the weightlifting movements specifically meets both of these requirements.

Another biomechanical benefit of the weightlifting movements is the rapid acceleration of the resistance that occurs with no intention to decelerate the resistance at the end of the range of motion (9,20). In weightlifting, there is no need to limit the upward movement speed to decelerate the barbell because
this slowing occurs naturally as a result of gravity. Although gravity is always acting on mass, regardless of velocity, the difference is that, unlike what occurs in weightlifting, in other types of strength training, slowing the implement must occur because the athlete is required to decelerate the load at the end of the range of motion (2,19). If this slowing does not occur, the weight has to be released from the hands or injury may occur because of the stresses on the musculoskeletal system. For example, when performing a bench press, the athlete must decelerate the bar as he or she nears the lock out position so as to not injure the elbows and shoulders. Further, as the speed of movement increases the deceleration phase must be initiated earlier and earlier in the range of motion.

Again, this need to decelerate the bar does not exist in the sport of weightlifting because this is achieved by the influence of gravity. Athletes never intentionally decelerate the upward movement in weightlifting exercises until extension is complete. Thus, weightlifting exercises, from a biomechanical evaluation, are an excellent method to train high-load speed strength. In contrast, other types of strength training movements intrinsically contain deceleration movements.

An additional benefit of the weightlifting movements is the relationship between the weightlifting movements and performance in explosive sports (4,5). Canavan et al. (4) note that empirical observations suggest there is a strong relationship between the weightlifting movements and athletic performance, and Chiu and Schilling (5) point to the similar mechanical structure between weightlifting movements and explosive sports. Although some contend there is no benefit to include sport-specific exercises because exercises cannot replicate sport movements, the most common method used in selecting exercises included in the strength/power training programs of athletes is based on the concept of specificity (4,5,18,30,31,33). That is, exercises are selected based on their similarity to movements that occur in the sport being trained for in terms of both muscle actions and contractile forces.

The musculature involved when performing the weightlifting movements (i.e., dorsiflexion of the ankle, extension at the knee and hip) are the extensors of the hip and knee and the plantar flexors at the ankle (5,19). The movement pattern that occurs in weightlifting is biomechanically very similar to movements found in a variety of sports (4,5,19).

This requirement to push aggressively against the ground when performing the weightlifting movements is evident in the strong biomechanical relationship that has been shown between performance of the weightlifting movements and vertical jump (4,12,19). It has been reported that performing the weightlifting movements improves vertical jump performance significantly. For example, Carlock et al. (3) showed a strong correlation ($r = 0.98$) between weightlifting performance and countermovement jump performance. Although these studies are not definitive, they suggest that weightlifting exercises are effective for improving jump performance. This assertion is supported by the fact weightlifters are consistently shown to be among the most powerful of athletes when measured by vertical jump performance (3,26).

Simply increasing maximal strength in untrained individuals will increase vertical jump height. However, in strength-trained individuals, training only for maximal strength will not improve vertical jump performance (5), which suggests that power training is most important for jump performance in trained individuals. Thus, although heavy strength training is necessary for optimal performance adaptations, this training should be performed in an explosive manner, as occurs in weightlifting (5). In power sports involving rotation, lateral and unilateral movement exercises that replicate these movements should be added to the training program because these movements may not be optimally enhanced with the weightlifting movements (26). Further, depending on the sport, it may also be appropriate to include specific injury-prevention exercises if the vulnerable joints are not effectively trained with the weightlifting movements (e.g., strengthening the hip flexors for sprinting) (27).

**NEUROMUSCULAR BENEFITS**

One important aspect related to use of the weightlifting exercises is that this type of training may assist with neuromuscular adaptations, which potentially can result in improved sports performance (14). Because the weightlifting movements involve multiple joints and multiple muscle groups, these total body movements require intra/inter sequential muscle coordination which has a positive effect on neural efficiency and balance (4,12–14,26,33) (Figure 1). As with other sports that have a technical component, training in weightlifting is associated with improvements in motor control. The most noticeable changes in motor control are an improved coordination of the activation of muscle groups and motor units. Regarding motor unit activation, weightlifters are better able to activate more fast twitch fibers than nonweightlifters during submaximal muscle contractions (10).

**FIBER ADAPTATION**

Athletes in strength or power sports (i.e., football, volleyball, basketball, throwing or sprint events in track) possess greater percentage of fast-twitch fibers than do athletes in endurance sports (10). Although genetic factors contribute greatly to fiber type characteristics, nongenetic factors, such as neural and endocrine environments and functional demands, also can influence muscle morphology and physiology (10). Skeletal muscle is quite elastic and possesses the ability to adapt to functional demands.

It is probable that different training programs used by various strength/power athletes (i.e., bodybuilding, powerlifting, weightlifting) result in training-specific muscle adaptations. Further study of the muscular characteristics

Copyright © National Strength and Conditioning Association. Unauthorized reproduction of this article is prohibited.
of strength-trained athletes is required to differentiate between different types of athletes and the training methods specific to their sport (10).

One of the principle characteristics of weightlifting is the large power production. An elite 125-kg lifter can produce almost 7000 watts during the top of the clean pull. This extreme power production exposes these athletes to a unique physical stimulus (10). In contrast, powerlifters perform movements characterized by high forces but low velocities, producing relatively low power. Bodybuilders train with the goal of maximizing hypertrophy and adhere to training protocols that optimize anabolic processes and focus less on power and maximal force production. Because it is likely that each of the various training protocols result in specific physiological adaptations, study of the muscular characteristics of strength-trained athletes needs to differentiate between various types of athletes and the type of training make use of (10).

Various heavy resistance-trained athletes, including weightlifters, have exhibited fast twitch fibers ranging from 53% to 60% (10). Although this ratio between fast twitch and slow twitch fibers is not greatly different from proportions found in untrained individuals, the cross-sectional areas of the fast twitch fibers are considerably larger in competitive lifters and strength athletes (10).

Muscle fiber adaptations occurring as a result of resistance training include both conversion of fiber types and hypertrophy of fibers. With training, myosin heavy chain proteins (the protein primarily responsible for contraction force and velocity), shift from IIX to IIA. Fibers containing myosin heavy chain IIA proteins have the greatest capacity for hypertrophy. In U.S. National caliber weightlifters, virtually no muscle fibers contain heavy chain IIX proteins. With hypertrophy, the cross-sectional area of muscles increases, resulting in increases in muscle force producing capability (10).

It is interesting to note that differences in fiber cross-sectional area have been identified when comparing weightlifters and powerlifters (10). The authors of previous investigations have grouped weightlifters with other strength athletes or reported only percentages of fast-twitch and slow-twitch fibers and potentially missed minor differences between weightlifters and other strength athletes (10). The fiber cross-sectional areas of weightlifters were similar to what has been previously reported for highly strength-trained individuals, although greater than what has been reported in short-duration resistance training studies. When compared with competitive powerlifters, the weightlifters have slightly larger fiber areas for all the major fiber types. Compared with previous reports on powerlifters, the area for the weightlifters were slightly greater for type IIA fibers and less for type I fibers. The greater area for IIA fibers for the weightlifters may be attributed to the greater power generation required for weightlifters as compared to powerlifting (10).

**INCREASES IN LEAN BODY MASS**

During general preparation training cycles in weightlifting, which are characterized by a higher volume of training, increases in lean body mass and decreases in body fat occur in as little as 5–8 weeks in an untrained individual. The average body fat percentage in male weightlifters ranges between 6% and 12%, partially as the result of differing body sizes found in weightlifting, as larger athletes tend to have greater body fat percentages (7). As hypertrophy occurs, the cross-sectional area of muscle increases, enhancing muscle force producing capability. These increases in skeletal muscle mass occur simultaneously with decreases in body fat, allowing athletes to express greater strength and power while remaining within weight class limits (10).

Weight training, including the weightlifting movements, can also increase bone density and strength. Speed-strength exercises in particular may
be of importance in stimulating bone remodeling and enhancing bone tensile strength (33). Increases in lean body mass are the result of an increase in bone density and skeletal muscle adaptation (5).

NEUROENDOCRINE ADAPTATIONS

Another benefit to prolonged training using weightlifting movements may be the positive influence on the neuroendocrine system, supporting a biochemical environment advantageous to enhancing performance (5). The authors of previous studies have demonstrated the potential to increase testosterone levels during a 2-year period of training in weightlifters (23). This increase in testosterone is well correlated to one’s power generating ability (23). When weightlifters of varying training experience were compared, those with more than 2 years of experience were able to elicit increased testosterone levels in response to training, whereas those with less than 2 years of experience were not (23).

BALANCE, COORDINATION, FLEXIBILITY, KINESTHETIC AWARENESS

Additionally, the development of balance, coordination, and flexibility also can result from performing the weightlifting movements (34). The kinesthetic sense developed as a result of performing the weightlifting movements may also reduce the chance of injury when participating in other sports because these lifts not only strengthen the muscles, tendons, and ligaments but also increase the athlete’s overall coordination (19,27).

HIGH OXYGEN CONSUMPTION AND MECHANICAL WORK RATES

Because weightlifting involves short duration, exceptionally high-intensity efforts, the assumption is that weightlifting does not result in sizeable aerobic energy system adaptations. However, it has been reported that maximal oxygen consumption values in weightlifters are considerably greater than those found in sedentary individuals (5). Furthermore, weightlifters, as well as other strength and power athletes, have a capacity to perform work at a greater level than athletes who had greater maximal oxygen consumption. The adaptations related to maximal oxygen consumption may also be related to the strength or functional capacity of the heart (5). These adaptations seem to be byproducts of training because there is no apparent relationship between the level of performance in weightlifting and aerobic or anaerobic metabolic performance (5).

The source of energy for weightlifting is primarily the phosphagen system. The adaptations of the oxidative and glycolytic energy systems are the result of the recovery process that occurs during training for weightlifting. Recovery between sets during a training session first uses the fast glycolytic system, followed by oxidative metabolism to restore high-energy phosphates. The large demand placed on anaerobic metabolic pathways from exercise and recovery leads to elevated postexercise oxygen consumption, in which aerobic metabolism is increased for up to 90 minutes after training. Return to homeostasis may take up to 36 hours after exercise (5). Because of the duration of these metabolic responses, training programs must be manipulated to allow sufficient recovery (5), because repeated bouts of high intensity training, without sufficient recovery time, could lead to decrements in performance and or overtraining. In addition, trained weightlifters are able to perform more mechanical work and reach greater blood lactate levels than untrained individuals (5). Furthermore, weightlifters have both lower blood lactate levels and ratings of perceived exertion at the same intensity of exercises as compared to untrained individuals. These adaptations seem to be the result of training because there appears to be little relationship between performance capabilities in weightlifting and aerobic or anaerobic metabolic performance. Most likely these aerobic and anaerobic metabolic adaptations occur during general preparation training, which is characterized by greater volumes and lower training intensities as compared with specific training phases (5).

NONPHYSIOLOGICAL BENEFITS OF WEIGHTLIFTING

COST EFFECTIVENESS AND ECONOMY OF TIME

Barbells need to be of high quality so that the shafts rotate smoothly during the catching phase of the clean and snatch to avoid injury to the wrists, elbows, or shoulders (19). Although not inexpensive, purchasing barbells, plates, and platforms allow athletes to perform a variety of exercises that allow the training of almost all of the major muscle groups. Purchasing weightlifting equipment is much less expensive than purchasing several single-movement machines, and this is a further advantage of this form of training. In addition, weightlifting can be performed by a great number of athletes simultaneously. Although it is not within the scope of this article to recommend specific manufacturers, a high-quality barbell and set of bumpers can be purchased for $2000 or less and a simple but functional platform can easily be built for less than $500.

In addition to being cost effective, total body movements feature economy of time—an important consideration when strength training time is limited (27). Weightlifting involves virtually every muscle group in the body, along with many smaller stabilizer muscles (27). As a result, it becomes easier to train all of the major muscle groups by performing 1 or 2 of the weightlifting movements as compared with performing multiple single joint exercises to train the same amount of muscle mass. Of course, actual exercise selection will be dependent on the specific training goal. For example, if the goal is to achieve maximal strength in the squat or bench press, those exercises would have to be performed in place of or in addition to the weightlifting movements.

VARIETY IN WEIGHTLIFTING MOVEMENTS

The weightlifting movements include the snatch, clean and jerk, and
Weightlifting Movements

variations of those such as the hang snatch, hang cleans, and clean pull. Perhaps the most commonly used weightlifting exercise variation is the hang power clean. However, the hang power clean is just one of a variety of exercises that can and should be used to enhance performance. The benefits of weightlifting are best attained by strategically using a variety of weightlifting exercises (5). The majority of time spent training should involve the squat and power versions of the snatch and clean, as well as the push and split jerk.

Depending on the needs of the athletes, lifts from the hang or boxes may be of value, as would the clean or split snatch. One important variation of the weightlifting movements that may not have been given adequate attention during training is the pulling movements in both cleans and snatches (21). The pull is responsible for the majority of the power in the clean and snatch movements. For example, an elite 125-kg lifter can generate almost 7000 Watts during the top of the clean pull (21). As a result, when training for sports other than weightlifting, a greater emphasis should be placed on developing a proper pull than any other phase of the movement (21).

When deciding the value of including the pull in a training program, peak power production should be one of the first considerations. Peak power is the highest amount of power an individual can produce. Any athlete who requires very high power outputs in a very short time period should train for peak power (21).

The pulls by themselves should not replace snatches and cleans, either from the floor or from the hang position, but instead be used to complement them. There are numerous benefits to be gained from the snatch and clean done both from the floor or hang position, including but not limited to, balance, coordination, flexibility, and overall athleticism.

**IMPORTANCE OF QUALITY INSTRUCTION**

Proper technique in performing the weightlifting movements is essential (19,30,33). As a result, coaches instructing these movements should, at a minimum, have completed a course of study involving hands-on practice of the snatch, clean, jerk, and their variations (5). Because of the high degree of technical difficulty involved in the performance of the weightlifting movements, it is essential that these exercises be taught by well-qualified and experienced instructors who know the correct technique of the exercises. Equally important is the knowledge of the correct progression leading up to performing these movements, thus minimizing injury potential (31).

Some coaches are reluctant to use the weightlifting movements, even though they may be of value for the athletes they coach. There can be 3 reasons for this (33): 1) The coaches do not understand the relationship of weightlifting exercises to training for other sports. 2) The coaches believe these exercises are not safe and may cause excessive injuries 3) The coaches do not know how to teach their athletes the proper technique.

Because beginners have difficulty in learning the correct techniques of the clean and snatch from the floor, it may be better for strength coaches to introduce the clean and snatch from the hang position so that the technique is simplified and lifters can take advantage of the second pull phase. A 12-step approach for teaching the clean has been proposed (19): education, modeling, foot position, hand position, grip, start position, jump shrug, low pull, high pull, catch, adjusting foot position, and squat clean. This teaching progression can also be applied for teaching the snatch. By following the 12 steps, athletes will learn the second pull phase of the snatch and clean more easily.

To learn correct techniques of weightlifting exercises, athletes should begin the teaching progression with weights that can be lifted easily. When initiating training, athletes may want to initially use a wooden pole and then a bar without weights. As quickly as possible, athletes should add 10 to 20 lb to each set as their technique progression. If the strength coach notices that an athlete does not use correct technique, he or she should have the athlete use lighter weights until proper technique is learned (19).

**RISK OF INJURY IN WEIGHTLIFTING**

A limited number of studies have been performed evaluating the injury rate of speed-strength exercises such as those used in weightlifting (31). One problem is that this type of study is difficult to perform from a practical standpoint because this type of training is usually performed in conjunction with other types of training.

Unfortunately, as noted by Faigenbaum and Polakowski (8), it has been incorrectly suggested that the weightlifting movements are more dangerous to perform than more traditional types of training. Further, as suggested by Newton and Kraemer (26), some strength and conditioning coaches focus on single joint exercises with the belief that these types of exercises are as effective as the weightlifting movements in terms of increasing power and thus enhancing performance.

However, as long as the weightlifting movements are performed with good technique and proper equipment, they are as safe or safer than other sports or training activities. There is no evidence that weightlifting causes excessive injury. Indeed, the rate of injury in weightlifting is less than many sports, including football, basketball, and gymnastics (Table 1). Although injury certainly does occur both in weightlifting and weight training, injuries are uncommon (15,31,33).

The most common injuries in weightlifting occur to the soft tissue of the wrists, shoulders, hips, back, knees, and ankles. Typically, the injuries that occur in weightlifting appear to be the result of overuse, poor technique, or excessive collisions with the bar, particularly when performing heavy clean and jerks. Program design that limits the number of heavy clean and
jerk repetitions should be considered (27,29,33).

However, compared with most sports, the injuries that occur in weightlifting do not seem to be excessive and are generally not serious. To further reduce the chance of injury attention should be paid to equipment, the athletes’ footwear and clothing, proper training procedures (program design), proper warm-up and proper exercise technique (19).

For athletes in sports other than weightlifting, it has been suggested that using the weightlifting movements may actually reduce the risk of injury. This reduced risk of injury occurs by increasing kinesthetic sense—strengthening the muscles, tendons, and ligaments while enhancing the athlete’s coordination (27,33).

The low injury rate in weightlifting appears to hold true in children training and competing in weightlifting as well. Using data from a 2-year period, it was determined that while performance improved, there were no injuries and no training days lost as a result of injury in a group of children who participated in an average of 8 competitions (5). The authors emphasized that these children were supervised by professionals training in coaching weightlifting, which may explain the low injury rate.

Because of the complex nature of the weightlifting movements, a knowledgeable coach is required (15). Also aiding in the low injury rate is the need to learn the movements while first using light resistances (8). In fact, it is common in some countries for children as young as 8 to begin learning the weightlifting movements, but weight is not added to the bar until they have perfected the necessary coordination and skill (19).

Because children are required to learn the weightlifting movements with a light weight while being supervised by experienced coaches, these movements may be safer than other training methods commonly used (8). It is also interesting to note that a review of the incidence of injury rates in retired Swedish weightlifters shows that these athletes demonstrate the same incidence of low back and knee pain as the general population (5). It does not appear that weightlifting increases the incidence of degenerative joint disease.

As a result of the relatively low incidence of weightlifting injuries relative to the high forces generated during some movements, it seems as if a training adaptation occurs that reduces injury potential (33). The overall impression is that weightlifting is much safer than many other sports, especially when supervised by qualified coaches (15).

CONCLUSIONS
Concern still exists as to the efficacy of including the weightlifting movements in the resistance training programs of athletes in sports other than weightlifting. These concerns generally fall into 3 broad categories: 1) The perceived time required to learn the movements because of the complex movement patterns required to perform the exercises. 2) A lack of understanding of the potential benefits that can be derived from performing the weightlifting movements. 3) Concern over the potential for injury resulting from performing the weightlifting movements.

There is no arguing that the weightlifting movements take longer to learn than do the more traditional exercises. However, as was shown, the extensive list of potential benefits that can result from performing these movements warrant the inclusion of the weightlifting exercises in the training programs of a variety of athletes. Finally, on the basis of the evidence presented, it can be stated with confidence that the risk of injury is as low or lower than most sports as long as there is qualified supervision provided by certified strength and conditioning specialists who have been trained in coaching the weightlifting movements.

Table 1

<table>
<thead>
<tr>
<th>Sport</th>
<th>Injuries per 100 participation hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Age Soccer</td>
<td>6.2</td>
</tr>
<tr>
<td>U.K. rugby</td>
<td>1.92</td>
</tr>
<tr>
<td>U.S. basketball</td>
<td>1.03</td>
</tr>
<tr>
<td>U.S. track and field</td>
<td>0.57</td>
</tr>
<tr>
<td>Squash</td>
<td>0.10</td>
</tr>
<tr>
<td>Badminton</td>
<td>0.05</td>
</tr>
<tr>
<td>Powerlifting</td>
<td>0.0027</td>
</tr>
<tr>
<td>U.S. tennis</td>
<td>0.001</td>
</tr>
<tr>
<td>Weightlifting</td>
<td>0.0017</td>
</tr>
</tbody>
</table>

*Adopted from Hamill (15).

REFERENCES
Weightlifting Movements


30th Anniversary Year!

Become a Contributor to
Strength and Conditioning Journal
Now Published by Lippincott Williams & Wilkins

Researchers and NSCA members… When it’s time to publish practical applications of your research or review papers with practical applications, consider submitting to Strength and Conditioning Journal, the professional journal of the National Strength and Conditioning Association. Now celebrating its 30th year of publication! SCJ provides strength and conditioning pros with practical information they can use every day. Each issue is read by the 33,000 strength and conditioning professionals who are NSCA members.

Strength and Conditioning Journal is now published by Lippincott Williams & Wilkins, a leading international publisher of professional health information resources. It’s the start of a new era for SCJ, including:

- More pages. SCJ has expanded to include more than ten percent additional pages per issue.
- Renewed emphasis on applied science. Increased focus on research that’s directly applicable to everyday work with athletes and clients.
- New web site offers access to complete contents, including fully searchable archives: www.nsca-scj.org.
- State-of-the-art publishing services and support for readers and reviewers, including shorter time to press and an online manuscript submission system.
- Access via Ovid Technologies for libraries and other institutions, will expand SCJ’s global reach, offering an enhanced Web presence in Europe, Asia, and around the world.
- Indexed on MEDLINE/PubMed.

As always, Strength and Conditioning Journal reflects the NSCA’s commitment to leadership in supporting the highest-quality scientific research and evidence-based practice.

To learn about submitting to Strength and Conditioning Journal, visit http://scj.edmgr.com.

Strength and Conditioning Journal www.nsca-scj.org
T. Jeff Chandler Ed.D., CSCS®-D, NSCA-CPT®-D, Editor-in-Chief

Copyright © National Strength and Conditioning Association. Unauthorized reproduction of this article is prohibited.