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Strength Training for Athletes: Does It Really Help Sports Performance?

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The use of strength training designed to increase underlying strength and power qualities in elite athletes in an attempt to improve athletic performance is commonplace. Although the extent to which strength and power are important to sports performance may vary depending on the activity, the associations between these qualities and performance have been well documented in the literature. The purpose of this review is to provide a brief overview of strength training research to determine if it really helps improve athletic performance. While there is a need for more research with elite athletes to investigate the relationship between strength training and athletic performance, there is sufficient evidence for strength training programs to continue to be an integral part of athletic preparation in team sports.

Keywords: resistance training, sport, strength training

Strength or resistance training has been shown to improve strength, power and speed in a number of athletic populations. In addition to improving these physical qualities, strength training also has significant benefits for athletes in terms of increasing muscle mass and decreasing risk of injury. The ultimate goal of athlete preparation is to maximize performance during competition. For those athletes who are not specifically strength athletes involved in sports such as football (ie, soccer), rugby, and basketball, the question can be asked as to whether strength training provides significant benefits to match performance.

It is a common belief that strength training should be an important part of a training program for these athletes. Most strength and conditioning coaches will prescribe strength training to increase strength and power and attempt to transfer improvements in these areas to match-related outcomes, such as speed and agility. Although the extent to which qualities such as strength and power are important to sports performance may vary depending on the activity, the associations between these qualities and performance have been well documented.[1–4] However, limited evidence exists showing strong relationships between strength training and motor performance, such as agility. In this review we will attempt to provide a brief overview of the strength training research to determine whether strength training really helps improve athletic performance.

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Strength Training for Team Sport Athletes

Strength training programs are now considered an integral part of athlete preparation. There are a number of areas of research that provide support for this. Physical capacities that can be developed through strength training have been shown to differentiate the performance levels of athletes. In American football, research has shown that starters and nonstarters can be differentiated by measures of strength and jumping ability.[5] This is similar to research conducted in Australian rules football, where measures of speed and vertical jump performance can delineate between starters and nonstarters.[6] In addition, strength and power measures are different among elite-level rugby league players and subelite and juniors.[7] This has also been seen in rugby union athletes, in whom force and power measures in jump squats differentiate elite from elite junior-level players, in addition to differentiating between fast and slow athletes.[8] It is important to consider that whereas some measures of strength and power are able to discriminate levels of performance, it appears that some measures may be more useful than others and that this may be sport or position dependent. Given the amount of research that demonstrates the positive impact of strength training on these physical capacities and playing level, it is reasonable to conclude that strength training has positive benefits for an athlete's performance.

Another level of evidence for the benefits of strength training on performance is looking at correlational studies. Although the relative influence that strength and power have on performance depends on the requirements of the particular sport, a large body of evidence supports a positive benefit. Research exists showing strong relationships

between physical capacities that can be developed using strength training (force production, power, rate of force development) and sport-specific skills such as speed and agility. For example, relative strength has very strong relationships with speed and change of direction ability over the course of a competitive season in female softball players, although with low subject numbers.[9] Interestingly, the strength of these relationships did change over the course of the season.[9] An examination of the influence of strength and power on golf club head speed revealed the importance of total body rotational power (r = .54) and chest strength (r = .69),[10] wheras rugby tackling ability shows a significant correlation (r = .38) to lower body power, with multiple regression indicating playing experience and lower body power show a significant (r = .60) correlation to tackling ability.[11]

The role of maximal strength in sprint speed and vertical jump height in international soccer players revealed a high correlation between 1RM squat and 10 m sprint time (r = .94), 30 m sprint time (r = .71), and jump height (r = .78).[4] In addition, vertical jump height was correlated with both the 10 m and 30 m sprint (r = .72 and 0.60, respectively).[4] The authors of this study concluded that results confirm the strong correlation between maximal strength, sprinting, and jumping performance in elite soccer players. The ability of countermovement jump height and power to reflect sprint ability has also been demonstrated in a number of sports, including elite Australian football players.[6] Sheppard et al[2] analyzed the relationship between numerous strength and power variables and jumping performance in elite volleyball players and found 1RM squat strength to have moderate correlations (r = .53–.65) with countermovement and spike jump performance.

In contrast to the body of work suggesting a strong relationship between absolute strength and functional performance, Markovic[12] determined that strength was a poor predictor of agility performance. As the subjects in this study were not elite performers and given the complex skill requirements of agility tasks, it is perhaps not surprising that underlying strength qualities and agility were not highly correlated. More research in elite athletes is needed to investigate relationships between strength/power measures and functional performance.

Transfer of Strength Training to Athletic Performance

The use of training programs designed to increase underlying strength and power qualities in elite athletes in an attempt to improve athletic performance is commonplace in strength and conditioning. There is a large body of literature that shows that strength training can increase strength, power, vertical jump, speed, and acceleration in a range of different sports.[13–15] For example, explosive strength training has been shown to increase maximal sprinting speed and vertical jumping in soccer players,[14] whereas heavy lifting has been shown to improve 5 m acceleration speed and throwing velocity in elite handball players.[16] Gorostiaga et al[17] also showed that strength training in elite handball players increased throwing velocity in addition to other capacities such as vertical jumping and sprinting. This is a common finding across a wide range of team sports. However, the question that remains unanswered in many sports is to what extent do these physical capacities and their development contribute to success in terms of improved match performance. There are also issues concerning the extent of transfer that occurs from strength training to these measures of performance.

There is some evidence that strength training can improve other more specific motor abilities such as agility. However, this research is less compelling, with mixed findings on the potential benefits on measures such as change in direction.[18] One of the challenges with this area of research is that there is no clear agreement on which types of measures best reflect these types of capacities. It could be that straight-line sprinting and planned changes of direction are unlikely to represent the specific cognitive and physical demands of team sports, such as soccer and rugby. Reactive agility tests involving reacting cues such as audio, visual, and/or kinesthetic signals could be more specific. In addition, studies that have used short training periods have had limited success with improving speed and agility.[19] These factors could be associated with why the results of training studies concerning motor abilities have been mixed.

There are also studies that have demonstrated positive transfer of specific strength training on sport-specific skills such as kicking velocity[20] and bat velocity in baseball.[21] McEvoy and Newton[22] showed that 10 wk of ballistic resistance training improved throwing speed and base running speed in baseball players. The study used ballistic bench press throws, which removed the deceleration phase of the exercise. This highlights the importance of exercise specificity and the effect this can have on the adaptations seen in sport-specific tasks. Ballistic training has also been shown to improve kicking speed and force in martial artists.[15]

However, the research is not conclusive with some studies, showing improvements in strength and power, without concurrent changes in more specific sport skills. There is a fairly limited body of research on the transfer of strength to motor performance. It would appear that this occurs but is low, with large increases in strength resulting in only minor changes in motor performance. The concept of lag time has been proposed as a possible explanation. This refers to the period of time that it takes for an athlete to "learn" how to use their increased strength and power.[3] This has some support from the longitudinal studies in high-level athletes, with large improvements being seen in strength and power, particularly at the early stages of an athlete's career.[13,23] Studies have also shown that improvements in speed and agility are smaller and tended to occur later in an athlete's career.[23]

Researchers have attempted to account for differences in playing ability by using objective skill criteria.[1] The results of this study demonstrated that skill characteristics but not physiological or anthropometric

characteristics discriminated between successful and less successful rugby league players. However, all physiological and anthropometric characteristics were related to playing ability. Another study investigated the relationship between American football playing ability (as determined by coaches) and selected physiological measures.[24] Of all the measures conducted in the athletes, the strongest predictor of playing ability was vertical jump performance. These studies further highlight the issue of identifying measures that are most critical to performance. Only when this is done effectively is it possible to assess the impact of strength training on athlete performance.

Sprinting is a critical factor in most team sports performance, and strength training has been shown to improve speed. Sprint ability has been shown to be linked to making a team in the NFL, but only for the running back position.[25] For other physical performance tests, such as agility, bench press, and vertical and horizontal jumps, the relationships were very low. This highlights the importance of selecting tests that accurately reflect on-field performance and taking into consideration sport and also position-specific differences and requirements. Clearly, more research is needed to determine these key sports performance variables and how they can be influenced by strength training.

Conclusions and Practical Applications

The use of strength training designed to increase underlying strength and power qualities in elite athletes in an attempt to improve athletic performance is common. Although the extent to which qualities of strength and power are important to sports performance may vary depending on the activity, the associations between these qualities and performance have been well documented in the literature. An increasing number of training studies with high-performance athletes are attempting to address questions concerning the role of strength training for improving athlete performance.

Notwithstanding the difficulties with conducting research in elite athletes, there is clearly a need for more well-controlled research studies in this population. Alternative approaches could be considered by researchers to answer some of these questions. It has been suggested that research design and conclusions from interventions in elite athletes often miss benefits to individual athletes; the group means show no statistically significant difference with training or experimental interventions. This approach is also useful when sufficient subject numbers are not possible, which is often the case in research conducted with elite athletes. Single case study research design in elite sport could potentially give the ability to detect positive intervention outcomes in individual athletes and continue to allow for the athlete's training and performance to be optimized continuously.

Even though there is little doubt that strength training has significant benefits for athletes, it should be remembered that not all training programs are created equal. The program design, specificity, and periodization are critical components that contribute to the overall impact of a strength training program on athletic performance. Well-trained athletes require a greater amount of specificity, individualization, and variation with their strength training programs. Additionally, the challenge in team sports is having to develop physical capacities such as strength and endurance simultaneously to maximize performance. Evidence exists that strength and power can be a discriminator of performance level in various sports. While more research needs to be conducted to investigate the relationship between strength training and athletic performance, there is sufficient evidence for strength training programs to continue to be an integral part of athletic preparation in team sports.

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