Relationship Between Strength Skills Performance and Speed Running Performance

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Abstract

Strength is one of the most important physical qualities to train in the post-pubertal phase of athlete development. This physical quality is among the trinomial of the most important physical qualities such as speed and endurance. The relationship between these motor skills affects the development of the athlete's physical qualities and locomotor pattern referring to the intensity and duration of the action. Normation of loads in strength training remains one of the main points of sports training planning to impact neuromuscular adaptations. The production of force and the ways of its generation depend on the norming of exercise loads, where the effect of the loads through exercises will affect the improvement of the athlete's abilities in relation to other physical skills. The aim of this study was to compare the norming of different strength training loads as a stimulating factor in improving speed running performance. To gather as much as possible scientific data, we used "Jab Ref" as a research sector focusing more on navigating Medline, Google Scholar, and Inspire options that this program contains. Without hesitation, the findings of all studies are consistent in showing that the components of strength are direct and important indicators that affect the increase in strength indicators manifested in different ways, where these indicators have a direct correlation with running speed in all neuro-motor parameters of the athlete.

Keywords: strength quality, speed, training, performance, relationship, loads

Introduction

Continuous improvement of athletic sports record results in all disciplines shows that at the same time estimates for the maximum limits of human performance are always relative, it is seen as a subject of study for continuous improvements. Developing strength and power we must improve these as the primary motor skills. As the basic requirements for strength physical skill development are necessary to select the most adequate and efficient training programs. To develop strength in an adequate manner we must follow methodological principles that are focused on training muscles

regime. According to Verkhoshansky different training methods have been studied to develop the exit power of muscle groups focusing on the development of muscular hypertrophy and adaptation of the specific neuro-motor system. Several coaches during their strategy training process regarding running speed improvements are focused more on strength, power, and speed training because these skill parameters are products of the same functional system and dependent parameters on each other. (Delecluse C., 1997) notes that the rate of force development displayed on maximum percentage voluntary isometric contractions rating percentage loads on the maximum of 1 repetition. According to Chestnut J. L., & Docherty D (1999), the minimum threshold on rating strength loads is 66% of 1 RM which is called the critical threshold for the development of isometric and isotonic strength. Important in rating strength loads is the duration of each muscle voluntary contraction in seconds or in hundredths of a second (Delecluse C., 1997). According to John B., Cronin & Keir T. Hansen (2005), rating training loads on 3 repetitions of 1RM have shown a nonsignificant correlation at the strength performance improvement. While power was training by weight depth squats (30 kg) and consecutive depth jump shows correlations in height jump, relative power, and improvement in speed running performance.

The attached study (John B et al 2005) on rating strength training loads (McBride et al 2002) reported strength training on 8 weeks, 1 RP 80% 1RM using squat exercises showed no significant improvement in jump height and speed performance. On rating the number of repetitions and exercise intensity Zatsiorsky states that enhance strength performance are recommended training programs that estimate the intensity of each repetition. Zatiorsky states that lifting above 90% of your 1RM leads to very slow bar speeds and low power outputs. Loads of 90% of 1RM and below are better suited to enhance the RFD (Zatsiorsky VM, 1995.) The study by (Warren B. Young., 2006). & (Harris G.R., et al 2000) focused not only on the improvement of movement structure speed running using strength exercises that mostly involve bilateral contractions of low limbs such as weighted vertical jumps, squats, and depth jumps but even on the improvement of the acceleration phase of speed running.

Force ability is one the most responsible factors in accelerating performance. This ability of the force to improve acceleration is related to the achievement of high-level muscle strength productions. The rate of force development correlates with the ability to accelerate and achieve optimal speed in accordance with the cinematic movement of sports discipline. To achieve optimal parameters of force ability Schimidtbleicher recommended explosive maximal intensity exercises that increase the rate of strength development. (Schimidtbleicher D., (1992).

Relationship between increasing strength skills performance and speed running performance Wilson. Gj has shown significant statistical value on the improvement of 40m sprint with 8 weeks of squat training. Wilson. Gj, emphasize that a 2.2% of

improvement in speed running required a 21% improvement of strength in the squat. (Wilson GJ et al (1996).

Many training methods were studied to determine the most suitable methods for the improvement of running speed and running phases. According to him enhanced speed running performance required high-resistance (HR) methods. These methods concluded that high-intensity loads with few repetitions where the stimulus intensity evokes enhancement of the rate of strength and power. Training methods termed high-velocity training (HV) included low-intensity loads with numerous numbers of repetitions where the stimulus intensity evokes enhancement of speed and velocity. These methods include the use of parachutes, weight vests, and sled pull that evokes improvement of explosiveness, quick acceleration, and first-step quickness. Generally recommended for maximal skill carryover light loads (10% of body weight), because they allow for technique, joint velocities, and loads similar to that for competition. However, many coaches and trainers use loads much higher in order for further overload to develop leg strength specific to speed skills, such as acceleration. (Vives, D., & Roberts, J. (2005).

With the use of ballistic movements, movements in which the weight can be released, power and acceleration are enhanced throughout the entire ROM. Ballistic exercises, Olympic lifts, plyometrics, jump squats, and bench throws are therefore far superior to speed reps for power development and allow the athlete to accelerate throughout the entire ROM. Maximal peak power outputs for the jump squat are seen with loads between 10% and 45% of 1RM (Wilson G.J et al 1993) (Newton RU et al 1996) (Clark RA 2008)

The aim of the study: is to highlight a kinematic analysis of physical and functional performance by emphasizing the strength and power results with their relationships with the speed performance results.

Research Methods

The research method that we used was JabRef 2.10. It is an open-source bibliography reference manager by which everyone can provide data in an easy way from online scientific databases. Because of this, we decided to use this methodology to gather as much as possible scientific information which was directly related to the goal of this review.

Literature was obtained by means of the Medline, Google Scholar, and Inspire search engines and was prompted by the following keywords: strength quality, speed, training, performance, relationship, and loads. Despite the fact that Jab Ref "reference manager" showed more than about 100 articles, we selected only 23 of them because they were directly related to our study aim.

Analysis of Literature Review

Relationship of strength quality components and their impact on running speed.

Strength training is not only focused on the improvement of strength physical skills but also it is more important transferring this performance on speed physical skills and for a consequence of this important training task many researchers have completed their study on the most efficient training methods for improvement of running speed performance.

Speed running athletes´ training in all technical phases is very important and correlated between them. An athlete can possess the acceleration phase and rich maximal speed but can he hold maximal speed for as long as he can?

Starting faze is based on speed reaction time that includes phases between hearing the start-up signal to reaction time. Studies have determined reaction time skills as neural skills and genetically defined but their improvement from training is insignificant. (Young WB, 2006).

This study is focused more on the practical view of the correlation between strength and speed components as physical skills and on the most effective approaches used to improve strength components that affect speed performance. Maximal strength muscular performance and maximal speed performance are made by the same manipulative training parameters. (Zatsiorsky V. M & Kraemer J.W .2006).

Treatment with the training of maximal strength parameters induces at the same time improvement of power, muscular hypertrophy, and muscle perimeter. Power is the production of strength and speed in consequence of this all the changes in strength induce muscular power production. On the above facts, treatment parameters with training show correlations between them (Schmidtbleicher D., 1992). (Hakkinen K., 1994).

According to Verkhoshansky development of strength in the right way must follow the methodological rules according to the muscle's regime during motor activity.

Various training methods have been studied to develop the power output from these muscle groups. Some of the methods focus on the development of muscular hypertrophy and some others on the specific adaptation of the neuromotor system.

Many trainers in creating strategies for sprint training processes keep in main focus that strength, power, and speed are essentially interdependent because they are all the product of the same functional systems.

In speed sports training it is very important to maintain a balance in the training loads of the specific primary and secondary components. To achieve these trainers should consider specific strength training according to individual characteristics, based on performance capacity and technical stages of running. (Delecluse C., 1997).

The relationship between strength and performance indicators in sprinting is different according to the stages of running. Measurements performed on muscle contraction (concentric, stretch-shortening cycle (SSC)) and isometric, showed that the parameters of absolute maximum force were more related to the speed of distance running than to the starting ability. (Young, W. B et al 1995)

The type of contraction (stretch-shortening cycle or SSC) is important in the production of muscle strength, emphasizing that during the execution of this contraction the muscle-tendon connection is heavily loaded, increasing and transmitting the production of energy to the limbs. During this phase (SSC) a considerable amount of energy is deposited to be used for the production of force during the exchange of contractions from concentric to eccentric and vice versa. This cycle of contractions is very important in the manifestation of strength. It is very important to standardize the exercises that are characterized by this cycle (SSC) where researchers recommend plyometric exercises as the best form of development of this cycle (SSC).

Plyometric training, including one-sided exercises and horizontal movement of the whole body, causes a significant increase in the acceleration performance in the sprint, emphasizing the importance of the movement pattern and the speed of muscle contraction (Paavo V. Komi., 2000), (Chimera et al 2004) (John B., Cronin, and Keir T. Hansen., (2005), (C. Boreham 2006).

The importance of finding the minimum limit to normalize force loads is important for trainers. Recommendations refer to loads that are normalized as a percentage of 1 repetition or with the duration of each single muscle contraction in seconds or in hundreds of seconds. Load reduction to 66% of 1 repetition is classified as the critical threshold for the development of isometric and isotonic force. (Chestnut J. L., & Docherty D., 1999).

Referring to load norming for strength and power exercises, according to the study of John B., Cronin & Keir T. Hansen, who in their study norming squat jump with weight 30 kg and depth jumps, results showed a correlation with the height of the jump, relative strength, and in improving performance in sprinting. Joining the study of John B et al, on load norming for strength (McBride et al 2002) reported that subjects who trained for 8 weeks using 80% of the maximum of 1 repetition in the reclining, showed that it was not much significant in improving jump height or speed performance. (John B., Cronin & Keir T. Hansen., 2005) (McBride et al 2002)

On the regulation of the number of repetitions and the intensity of the exercise, Zatsiorsky shows that in order to increase the performance of the power, he recommends programs that promote the quality of each repetition. Zatiorsky states that lifting above 90% of your 1RM leads to very slow bar speeds and low power outputs. Loads of 90% of 1RM and below are better suited to enhance the RFD (Zatsiorsky VM, 1995.) in the other side based on Newton et al 1996 studies speed

repetitions performed with 30% of 1RM will not improve the RFD (Newton et al 1996)

Consequently, the study of the rate of force development related to that strength is a directly responsible indicator of an athlete's accelerating ability. This can be argued with the fact that the faster it is produced or the higher level of muscle strength production is achieved in relation to the time the faster a response acceleration occurs. As a consequence of the running functions, the rate of force development is related to the ability to accelerate and achieve the optimal speed required according to the movements of the sports disciplines.

The most recommended exercises (isometric and dynamic) which affect the rate of force development, are characterized by explosive movements with maximum intensity (Schimidtbleicher D., 1992). Where to confirm this statement are attached the facts brought by the above works.

The importance of increasing strength and power performance has been shown to have a positive correlation in increasing speed running performance where the studies of Wilson GJ et al; Harris G.R et al, showed that training for 8 weeks with squats showed statistically significant values in gaining performance in the 40-m sprint. Improved performance by 2.2% in sprinting, is related to performance improvement of 21% of strength in the squat. (Wilson GJ et al 1996), (Harris G.R et al 200).

A variety of training programs have been studied to define methodologies to improve the performance of speedrunning, one of these methods is high-resistance (HR) training. This method includes in their content loads with high intensity and a small number of repetitions where the intensity of their stimulus promotes the development of strength and power. Termed high-velocity training (HV) training methods, include low-intensity loads but with a large number of repetitions where their stimulus promotes the development of speed and velocity. Other methods include teaching types of equipment such as parachutes, weight lifting, and stuffed vests that help develop explosiveness, quick acceleration, and first-step quickness (Delecluse, C., 1995).

Several studies have shown that to enhance maximal power, athletes should train with the velocity and resistance that maximizes mechanical power output (McBride et al 2002)

To maximize power and speed and to be enhanced throughout the entire ROM, coaches recommend the use of ballistic movements, jump squats, bench throws, and plyometrics (Newton et al 1996) (Clark et al 2008.)

The optimal load to maximize power outputs in Olympic lifts are higher compared with the jump squat. Maximum power outputs in Olympic lifts occur between 60% and 80% of 1RM and are therefore perfect to develop strength-speed (N Kawamori & G G Haff (2004). The optimal load at jump squats is a load above 60% of 1RM but

poses safety concerns because of the high impact forces on landing (Kaneko et al 1983) (N Kawamori & G G Haff, 2004). Without hesitation, the findings of all studies are consistent in showing that the components of strength are direct and important indicators that affect the increase in strength indicators manifested in different ways, where these indicators have a direct correlation with running speed in all neuro-motor parameters of the athlete.

Discussion

After the review of the literature, we identified facts brought through various studies on the components that affect the increase in the ability of the speed of running, but also the importance of the rationing of training loads as a necessary requirement and influencing the performance of speed running. All studies without question have in common that the components of strength are direct and responsible indicators that influence the increase of strength indicators displayed in different ways, where these indicators have a direct correlation and relationship in all neuro-motor parameters to athletes with running speed. The strong connection that is based on the correlation I of strength quality, not only shows a positive correlation and a relationship between the two physical abilities, but it has shown that training according to the rationing of loads and different strength methods has an impact on the improvement of movement parameters according to the technical phases of running.

Studies have shown that training strength qualities in relation to performance and speed runs have improvements from their training, but these skills have a wider genetic basis than the percentage of improvement as a result of training.

- For a more accurate and efficient methodology, the relevant rules must be followed according to the main regimes of muscular work that appear during movement activity.
- In sports training, strength training should be extended to all its components in a specific way, since the relationship of these components changes according to the technical phases of speed running.
- All training loads of strength, power, and speed are loads with high neuro-muscular intensity, which shows that the relationship of these physical qualities appears in direct correlation with one another.
- The rate of maximum force loads should start at least with 70% of 1 RM to 100% of 1 RM. If 100% of the load at the maximum strength exercises with more than 1 RM, there is no improvement in the performance of the maximum force display.
- The performance of speed runs is significantly improved by using exercises that include bilateral contractions of the leg muscles in vertical movement (leg extension, leg extension jumps with or without weights), which are adapted to the speed of muscle contraction in speed runs.
- In order to regulate the most efficient loads for the development of strength and power, studies recommend exercises with high intensity and a small

number of repetitions, while for speed training they recommend low intensity with a large number of repetitions.

- From the studies, it was noticed that the most recommended exercises for improving running speed are ballistic exercises with weights, deep jumps, and Olympic lifts.

Conclusion

All of the training loads for speed, power, and strength have significant neuromuscular demands, suggesting that these physical attributes are directly related to one another. • Since the relationships between these components fluctuate depending on the technical stages of sprinting, strength training should be extended to all of its components in a specific method for sports training.

To improve running speed indicators, exercises are recommended that have a wide impact on muscle mass, especially on the relationship between agonist and antagonist muscles, olso promoting rapid muscle contraction reactions. The optimization of the exercise's volume and intensity is also to be given attention as important influencers on the effect of the exercise.

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