

Assisted Methods for Speed Development

Originally published 29 April 2019 · fatchfitness.com



Speed Development

Running velocity is determined by stride rate and stride length, ($\text{Running velocity} = \text{stride rate} \times \text{stride length}$). However, as velocity increases from submaximal to supramaximal, stride rate and stride length do not increase linearly. Sprint research detailed how stride length plateaued as stride rate continued to increase to supramaximal velocity.

Therefore, in order to improve maximal speed of running, attention should be directed towards increased speed of limb movement. This can be achieved by performing a variety of specific exercises that are movement specific and close to the competition rate. The goals of speed training are to increase physical, metabolic and neurological components that are essential to increase an athlete's running speed.

Maximal speed training (100%) must be performed regularly, but even this training modality, if performed too regularly, can lead to speed plateaus, making continued speed improvement very difficult. To ensure these plateaus do not occur, the athlete should use specific speed development exercises that can be divided into two major groups, those of assisted speed exercises that allow the athlete to increase speed or frequency of movement, and resisted methods to increase the force required to run at speed.

The assisted method allows all the systems of the body to adapt to high speed movements that are then transferred to non-assisted competitive movements. The resisted speed exercises recruit more muscle fibers and greater neural activation that is then transferred to the competitive situation.

ASSISTED SPEED METHODS

Assisted Towing

Supramaximal running (>100%) can involve the use of a towing device (Speed Belt), or high speed treadmill running, to create a running velocity greater than that which can be achieved under non-assisted conditions. Researchers have found increases in stride rate, ground reaction forces, muscle stiffness, stored elastic energy, and increased efficiency of muscle contraction and running skill, during supramaximal running.

It was noted that stride rate contributed 6.9% and stride length 1.5% to the increase from maximal to supramaximal running velocity. This led to a significant correlation of 0.64 between changes in running velocity and stride rate from maximum to supramaximal velocity. This could be interpreted as having some benefits in sprint training by adapting human neuromuscular performance to a higher performance level.

Research detailed only a 2.5% contribution by stride rate to increased speed and a 6.2% contribution from stride length. This discrepancy in results was due to a too high supramaximal velocity of 109.0% of maximal.

Speeds above 106% of maximal lead to an increased stride length which in turn increases the braking phase of each ground contact, resulting in a slower rate of stride.

Integrated EMG (IEMG) readings (measurement of muscle activity) have been shown to increase with increased running speed. Research has indicated that EMG of the Gastrocnemius increased sharply, 35 to 45ms after ground contact, and reached its maximum at the end of the muscle stretch. This increase in electrical activity was suggested to be due to an increased input from the spinal stretch reflex. It was suggested that the high IEMG activity would also increase muscle stiffness during impact.

Researchers found that running at supramaximal speeds ($104\% \pm 3.4\%$) resulted in marked increases in horizontal (1052N) and vertical (3481 N) force production during impact when compared to non-assisted values (880N and 2704N respectively). These forces were due to an increase in distance from foot placement to centre of gravity (31cm) as compared to unassisted speed running (27cm).

Increased muscle stiffness is advantageous in the eccentric phase of a stretch shortening cycle activity (such as ground contact during a sprint performance), as it can lead to an increased bouncing action through the muscle tolerating greater stretch loads, possibly storing more elastic energy and improving power. Researchers detailed the contribution of stored elastic energy to

positive (concentric) work to increase with running speed (1.9 to 6.1m/s). Therefore, creating an over-speed environment will further develop the stretch-shortening cycle activity of the neuromuscular system that will in turn improve the efficiency of ground contact in sprint athletes.

These researchers demonstrated that several runs at the supramaximal velocity resulted in decreased eccentric force values in both horizontal and vertical directions from 1052 to 916N, and 3481 to 3176N respectively, which was due to a decrease in stride length (2.21 to 2.19m), increased stride rate (4.65 to 4.69Hz), and lower forward velocity of the foot before contact (2.03 to 1.77m/s).

In more general terms this meant that the athletes were trying to increase the speed with which they placed their lead leg down on the ground that led to a more efficient foot placement at this supramaximal running velocity. This again is believed to contribute to a greater adaptation of the neuromuscular system to higher performance levels.

The above study also highlighted a potential problem with supramaximal running in that many of the athletes initially were allowing the towing device to pull them along and were themselves running submaximally, as indicated by decreased stride rate and IEMG. The importance with supramaximal sprint training is therefore instructing the athlete to run maximally whilst being towed.

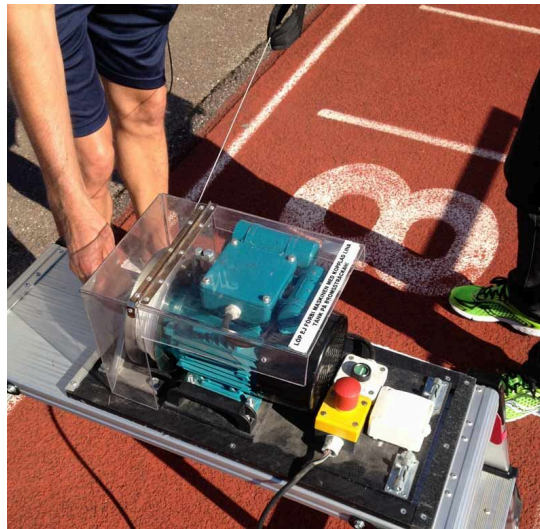
Two over-speed devices in use are the **Speed Band** and a **Mechanical speed device**, both having advantages and limitations.



Over-speed Band

The Speed Band is valuable in that it allows the athlete(s) to practice starts, accelerations, and maximal (supramaximal) running velocity. For short distance accelerations, two athletes can be attached to the one device, and for top speed running athletes can be towed over distances greater than 100m.

Limitations are that it is quite hard to control the speed with which the athlete is being towed and is dependent upon the amount of stretch of the rubberized cord and the pace of the front athlete). Also, it is not possible to slow down quickly when at top speed (which may be required if the athlete detects any muscular problems). The rubberized cord is hollow and could easily tear if trodden on by spikes or sharp studs. From personal experience, the cord should only be stretched 5 to 10m longer than it's resting length (15m) to give an adequate towing effect to the rear athlete if supramaximal velocity is required.



A second option, a Mechanical Speed Device (Dragon 3), uses a mechanical system that can lead to over-speed sprint running. If the athlete feels they are going too fast, the system has a safety catch that will release and allow the athlete to slow down before leading to a muscle strain. Disadvantages are that the device is cumbersome and expensive and requires a solid immovable object to be attached and athletes can only be towed over a maximal of 100m (this could be adapted with more cord).

Downhill sprinting

A second method of producing supramaximal speed running has been the use of downhill sprinting. Research analysing maximal sprinting on a 3% decline showed an increase in horizontal velocity of 0.5m/s from level maximal sprinting. This study did not find any increase in stride rate, only in stride length, so the increased velocity is due to this factor alone, therefore having minimal effect upon the neural system unlike the other forms of supramaximal sprinting training.

The researchers in these studies felt that a greater decline (>3%) would lead to an even longer stride length, resulting in increased braking forces and loss of sprinting technique.

High Speed Treadmill Sprinting



A third method of training at supramaximal speeds is using a high speed treadmill. A study analyzed the biomechanics of using such a device and found that the overspeed training effect was primarily focused on the hamstring muscle group.

Significant increases in peak hip extensor and knee flexor torques were recorded immediately following treadmill training.

This study also indicated a lower knee lift to previous studies was now indicated as the optimal movement pattern, with stronger hip extensor activity throughout.

This statement was reconfirmed by a kinematic study by of the men's 100 meters at the 1991 World Athletics Championships in Tokyo.

The study compared the lower limb joint velocities of the first two placegetters (C. Lewis and L. Burrell) to a group of sub-elite (10.60 to 11.50) athletes. The major difference between the groups was the superior hip extension velocities attained by Lewis and Burrell.

These researchers also stated that the increase in running velocity led to increased late hamstring activity, requiring extra energy to slow the lower leg before each ground contact and ensuring the relative velocity of the foot to the ground was still close to zero. This led to the hamstring group being placed under considerable stress and all components of this muscle group were found to be lengthening, i.e. contracting eccentrically just before ground contact.

The muscle component that undergoes the greatest stretch is the biceps femoris and it is here that tears occur most often. For methods of decreasing the potential of hamstring muscle damage during maximal sprinting, regular training at supramaximal velocities will increase the eccentric load on this muscle group.

When placed under stress from non-assisted maximal sprint conditions, the angular velocity about the knee, and therefore stress prior to ground contact will be less, leading to less injury to the hamstring group.

A limitation to high speed treadmill sprinting may be the kinetic differences due to the ground moving horizontally backwards and not the athletes having to propel their mass horizontally forward, which could interfere with the normal sprint kinetics on solid unmoving ground.

Coaching Implications

It may be concluded that this method of supramaximal effort training has a positive effect upon stride rate. Supramaximal speed training should be a year round training component that is more beneficial if incorporated with both unassisted and resisted methods of speed development.

Like all high intensity training modalities, volume should initially be low and progressive, with the main training emphasis placed on maximal effort by the athlete and the maintenance of good sprinting technique.

Finally, it is important that the athlete is not towed at too great a speed, and as soon as the athlete feels they cannot maintain quality technique, the run should be halted.

Check out my article on [Resisted Methods for Speed Development](#).

Please review this paper for a recent [analysis on Assisted Methods](#).