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Training Mechanisms and Recovery in Sprinters

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Abstract: *Top sprinters have higher body mass index, relaxed upper arm girths, thigh and calf girths, fat free mass, and fat free mass index than the lowest tertile. Eccentric training has significant changes in body composition, while explosive strength training improves running performance. Training mechanisms include progressive overload, specificity, periodization, individualization, technical training, strength and power training, plyometric training, recovery strategies, and tapering. The sprint start is a key factor in sprint results, with biomechanical performance factors. Recovery strategies include foam rolling, active recovery, passive recovery, and contrast water therapy. Proper nutrition and supplementation of vitamins, minerals and anti-oxidants are essential for sprinters to maintain optimal glycogen stores, muscle repair, recovery, and growth. Collaboration between athletes, coaches, and sports nutrition professionals is needed to develop personalized nutrition plans.*

Keywords: *sprint, strength, power, recovery, training*

INTRODUCTION

Despite a large amount of research on sprint training, we still know very little about how to train for a world-class sprint performance and all the aspects that make an athlete better at sprinting, however there are researches conducted that have proved conclusive in defining training mechanisms and methods to improve sprint speed and mechanisms that don't (Haugen et al., 2019). Such as body types and mass measures play a very important role in impacting sprint performance (Barbieri et al., 2017). Performance at the sprint is closely related to measures of strength and power (Smirniotou et al., 2008). Body mass distribution can be impacted for greater sprint results by inculcating eccentric training which in turn prove with higher sprint speed results (Suarez-Arrones et al., 2018). Listing the recovery strategies for short term perceptual recovery and power performance recovery that also affect results (Crowther et al., 2017). Looking at the effects of altitude on the physiologies of athletes and evidences that the effects of altitude training are marginal and not long lasting (Girard et al., 2017). How explosive strength training, sprinting and endurance training, shows no improvement in certain physical parameters (Paavolainen et al., 1999).

The contribution of neuromuscular function to running performance has received a lot of attention lately. In one single training session, Complex Training (CT) alternates between completing strenuous resistance exercises and plyometric workouts, greatly improving neuromuscular adaptation for sprinting (F. Li et al., 2019). Also, studies show the outcome of a race being heavily determined by the block start (Valamatos et al., 2022). To maximize recuperation and enhance sprint performance, the authors advised coaches and practitioners to combine these tactics and come up with the optimal strategy for results (Crowther et al., 2017). Without leaving out the importance of diet and supplementation and how vitamins, antioxidants and protein have positive impacts on better performance (Slater et al., 2019).

The aim of the review paper is to showcase, highlight and investigate the parameters and methods that have the greatest impact on sprint results and encourage professionals to formulate the best possible training program for athletes with all these aspects in consideration.

BODY TYPES

The study of the science of sprint is, even though a large amount, still in the process of new methodical discoveries (Haugen et al., 2019). As comparison to the lowest tertile, top sprinters had a considerably higher body mass index, relaxed, and contracted upper arm girths, thigh and calf girths, fat free mass, and fat free mass index. There was a noticeable increase in strength and power (Barbieri et al., 2017). Several anthropometric characteristics and measures of lean body mass were shown to be substantially associated with personal best times (Barbieri et al., 2017). The body shape, composition, and size vary according to the sped running performance level (Barbieri et al., 2017). Significant disparities in sprinting performances can be attributed to being less ectomorphic and having a higher fat-free mass and strength (Barbieri et al., 2017). These also have an impact on strength and power parameters (Smirniotou et al., 2008). The study's findings offer a benchmark for sprinter traits that coaches and sport scientists can use to enhance sprinter performance (Barbieri et al., 2017). Eccentric training also has significant measured changes in body composition in professional athletes, with fat tissue being significantly lower in a time period from the beginning of the season to the end of the season (Suarez-Arrones et al., 2018). The muscle mass of arms was also substantially increased at the end of the season in a comparative study conducted on the athletes (Suarez-Arrones et al., 2018). Studies also showcase the fact that explosive strength training, irrespective of load weight used for the explosive exercise, also improves running performance in athletes (Paavolainen et al., 1999). It shows significant changes in neuromuscular characteristics of the athletes as well as considerable increase in overall body mass index (Paavolainen et al., 1999). Evidently, less ectomorphic characteristics, lower fat tissue, higher muscle mass in the arms and legs, a higher muscle explosiveness are all body compositional characteristics that contribute to better performance in sprinting (Paavolainen et al., 1999).

TRAINING METHODS

The most widely used training mechanisms for sprint specific training are Progressive overload, specificity (application of velocity), periodization, individualisation, specific sprint training, technical training, strength and power training, plyometric training, recovery strategies, and tapering (Haugen et al., 2019). However, there is a disconnect between the scientific vs practical information and knowledge about each of these methods (Haugen et al., 2019). Strength and power models and methods have the best agreement and connect between science and practice because they are more objective measures compared to the other methods and models (Haugen et al., 2019). Plyometric training models are also in conjunction with the science (Haugen et al., 2019). Recovery methods used by athletes have little or incomplete science behind them however show effects on application (Haugen et al., 2019). Tapering training methods have high science and practice agreement behind it. (Haugen et al., 2019). Simultaneous explosive strength training, including sprinting and endurance training, showed no change in V˙o2 max or other aerobic performance variables in well-trained endurance athletes over 5,000 miles (Paavolainen et al., 1999).

Compared to most forms of training methods, complex training of 1rep max explosive methods has a more direct effect on neuromuscular function and therefore results in better coordination (chain linking between muscle and brain) (F. Li et al., 2019). Relatively small volume of plyometric training in combination with complex exercises have more prominent effects on sprint performance in comparison to overload training (F. Li et al., 2019). Also, a study concluded that the efficiency factor of athletes was improved by giving attentional focus on sprint movements rather than power (D. Li et al., 2022). However, attentional focus was seen to have more of a significant effect on lower skilled athletes and less significant on higher skilled sprinters (D. Li et al., 2022). Using repeated sprints as a performance measure for athletes is less effective in comparison to measures directed to their specific sport (Charron et al., 2020). Acute hypoxic exposure challenges multiple regulatory systems by increasing cardiorespiratory (higher heart rate, minute ventilation), metabolic (slower muscle re-oxygenation responses), and/or neuromuscular (incomplete muscle activation) requirements during sprinting and subsequent recovery periods (Girard et al., 2017). Acute hypoxic exposure also decreases convective O2 transport (i.e., reduces arterial O2 saturation values) (Girard et al., 2017). The advantages of traditional techniques of altitude/hypoxic training, such as living at altitude, on sprint performance are still up for debate (Girard et al., 2017). This may be because sprint-based disciplines do not heavily rely on haematological adjustments (Girard et al., 2017). Resistance training in hypoxia or repeated-sprint training in hypoxia have recently emerged as innovative "live low-train high" techniques, either alone or in combination with chronic HH/NH exposure, with the idea that up-regulated non-haematological peripheral adaptations (i.e., additional activation of anaerobic and neuromuscular pathways) may further improve performance of multiple sprints compared to similar normoxic interventions (Girard et al., 2017). But in terms of competitive sporting events, these assertions need to be supported further (Girard et al., 2017).

THE BIOMECHANICS OF SPRINTING

The sprint start holds one of the most crucial parts in sprint results and is a defining factor in competition (Valamatos et al., 2022). Generating high acceleration during the initial phase of the race and achieving an optimal body position for efficient force production and propulsion is one of the most researched aspects of a sprint race (Valamatos et al., 2022). Through a systematic review of existing research, there are several biomechanical performance factors that significantly influence the sprint start (Valamatos et al., 2022). These include reaction time, block configuration, block force production, step characteristics, and body position during the start. (Valamatos et al., 2022). Optimising the biomechanical factors of strength and power parameters in also is showcased for their importance in determining performance factors in sprinting (Smirniotou et al., 2008). They both play key roles in even the block start, explosivity of the beginning part of the race and the glide of a 100m sprint (Smirniotou et al., 2008). There is a huge importance in evaluating and targeting these parameters in training programs for sprinters, as they can provide valuable insights into an athlete's potential and areas for improvement (Smirniotou et al., 2008).

RECOVERY

Naturally, recovery being a key part in athletic performance would be to say the least. There is a considerable prevalence in delayed onset muscle soreness, which refers to the muscle discomfort and reduced performance experienced after intense or unfamiliar exercise (Pearcey et al., 2015). More and more the need for effective strategies to mitigate DOMS and accelerate recovery, as prompt recovery is essential for maintaining optimal training and performance levels. foam rolling can be an effective strategy for reducing DOMS and enhancing recovery of dynamic performance measures (Pearcey et al., 2015). Findings support the potential benefits of foam rolling in alleviating muscle soreness, improving flexibility, and promoting recovery after intense exercise (Pearcey et al., 2015). Coaches, athletes, and practitioners can consider incorporating foam rolling as part of their overall recovery and performance enhancement strategies (Pearcey et al., 2015). However, not just that, there is also importance in effective recovery strategies in optimizing athletic performance and reducing the risk of overtraining and injury (Crowther et al., 2017). Athletes must employ various recovery methods to expedite the recovery process and enhance their readiness for subsequent training or competition (Crowther et al., 2017). Such as active recovery, passive recovery, and contrast water therapy. Active recovery involves low-intensity exercise or movement, while passive recovery involves complete rest (Crowther et al., 2017). Contrast water therapy alternates between warm and cold-water immersion (Crowther et al., 2017).

DIET AND SUPPLEMENTATION

Proper nutrition and supplementation are essential for sprinters to maintain optimal glycogen stores, muscle repair, recovery, and growth (Spriet, 2014). Nutrients, carbohydrates, electrolytes, and supplements are also important for hydration, muscle function, and overall health (Spriet, 2014). One of the most widely used enhancers for energy is caffeine. It is necessary for athletes and coaches to be aware of the impact of caffeine consumption at moderate to low doses on various aspects of physical performance, including endurance, strength, power, and cognitive function. moderate caffeine consumption can enhance endurance, strength, power, and cognitive function (Spriet, 2014). However, individual variations and considerations should be taken into account, and athletes should be mindful of anti-doping regulations and potential side effects associated with caffeine use (Spriet, 2014). Another supplement that cannot be ignored for its benefits is creatine (Izquierdo et al., 2002). creatine supplementation can enhance maximal strength, power output, muscular endurance, and sprint performance (Izquierdo et al., 2002). Athletes and practitioners can consider incorporating creatine supplementation as part of their training and performance enhancement strategies, particularly for activities that involve high-intensity, explosive efforts.(Izquierdo et al., 2002). Lastly and most importantly, diet, beginning with pre-exercise meals rich in carbohydrates can optimize glycogen stores and enhance performance, while post-exercise meals with a combination of carbohydrates and proteins facilitate muscle recovery and adaptation (Slater et al., 2019). Micronutrients such as vitamins and minerals play vital roles in energy production, immune function, and muscle contractions (Slater et al., 2019). Antioxidants help combat oxidative stress and inflammation, which can occur during intense sprinting efforts (Slater et al., 2019). All research suggests stress the importance of individualization in dietary approaches, considering factors such as training load, body composition goals, and personal preferences (Spriet, 2014), (Izquierdo et al., 2002), (Slater et al., 2019). They highlight the need for collaboration between athletes, coaches, and sports nutrition professionals to develop personalized nutrition plan (Slater et al., 2019).

CONCLUSION

This considers the different body types that are genetically predisposed to be better sprinters with training such as higher BMI's, wider thigh and calf girths, wider upper arm girths, etc. Also highlights the various body measures that sprinters develop due to training. It also showcases the effects that different training methods that have been researched upon have on performance like altitude training having no effect, while plyometric training having a significant effect. It showcases how explosivity, muscle mass, strength, power, all are a factor in assisting and enhancing sprint performance. It summarises the main biomechanical aspects of sprinting such as technique, the block start, reaction time, etc. It gives insight into the research done into different recovery strategies for greater performance outputs such as foam rolling, stretching, contrast water therapy. And shows the value and data behind different supplementation approaches as well as dietary approaches. The improvements to this paper would be use and reviews of more literature on the subject, conduct more research on the subject. The limitation is also that this is short and not exploring this topic in detail. However, the strength is that there are many credible citations all based on the subject matter. It can be a help to researchers, sports scientists, coaches, athletes, and anyone interested in the subject.

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