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С О Д Р Ж И Н А

NAVIGATING THE DYNAMICS OF SPEED IN FOOTBALL: INSIGHTS INTO TRAINING, GENETICS AND DEVELOPMENTAL STRATEGIES

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ABSTRACT

Fast movements are integral to speed as a human motor ability, and in the context of football, speed is considered a dominant ability. The manifestation of speed by elite players manifests a consistent upward trend over time. Although the existing literature lacks definitive data, the hereditary nature of this ability is frequently cited as a dominant factor in speed improvement.
Crucial to enhancing speed is the implementation of training during the sensitive periods of children's development. Emphasis should be placed on developing the latent time of motor reactions, intricately tied to the central nervous system's maturation. Additionally, it is imperative to consider the energy component, with a focus on optimizing creatine phosphate stores (CP) when designing speed transformation training.
During speed training sessions, it is advisable to limit the number of fast movements to a maximum of 30-40 repetitions, each lasting 5-10 seconds, with consideration for CP stores. Morning training sessions are recommended due to the heightened efficiency of the central nervous system, a crucial system responsible for delivering information that triggers muscle contractions. While sprinting (fast running) is a fundamental exercise from a methodological standpoint, a holistic approach should be adopted, incorporating various equipment such as ladders, and different methods including changes of direction.
Genetic predictions of muscle fiber types in the human body are determined through the ACTN3 gene, specifically the mutation of the R577X allele. This mutation is regarded as a factor in determining the hereditary component of speed. However, the inclusion of genetic factors in the success of speed transformation is a complex matter.
The primary focus for speed development should be in childhood. Young players should enhance this ability through various aspects of the game, extending beyond isolated training with quick movements. Such a holistic approach contributes not only to the overall development of young players but also fosters a passion for football, encouraging a lifelong engagement with the sport.

Keywords: external load, football, sprint zones, distances, training monitoring.

ДИНАМИКА НА МОТОРИЧКА СПОСОБНОСТ БРЗИНА ВО ФУДБАЛОТ: ВОВЕД ВО ТРЕНИНГОТ, ГЕНЕТИКАТА И РАЗВОЈНИТЕ СТРАТЕГИИ

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АПСТРАКТ
Брзината е моторичка способност која се смета за доминантна во фудбалот. Способноста за манифестирање брзина од страна на елитните играчи покажува нагорен тренд со текот на времето. Иако сегашната литература нема дефинитивни податоци, сепак, наследната природа на оваа способност се споменува како доминантна кога се зборува за подобрување на брзината.

Важен момент за подобрување на брзината е тренинзите за брзина да бидат имплементирани во сензитивните периоди од развојот кај децата. Фокусот треба да е и на развој на латентното време на моторните реакции (поврзани со развој на централниот нервен систем). Сепак, треба да се има предвид дека енергетската компонента (оптимизирање на резервите на креатин фосфат) е исто така круцијален при креирање тренинзи за трансформација на брзината.
Кога се задава тренинг за брзина, се препорачува да се ограничи бројот на изведби на брзи движења на максимални 30-40 повторувања, при што секое движења се изведува со максимално траење 5-10 секунди. Се препорачуваат утринските тренинзи заради ефикасноста на централниот нервен систем. Од методски аспект, спринтот претставува основна вежба, но треба да се има холистичкиот пристап и да се интегрираат различни реквизити (скали и слично) и методи, како промени на насока на трчање.

Генетска предикција на мускулни влакна преку генот ACTN3 (мутацијата R577X алеите) се наведува како фактор во одредувањето наследната компонента на брзината. Сепак, комплексен е приодот при вклучување на генетските фактори во успехот во трансформација на брзинските способности.

Фокусот за развојот на брзината би требало да биде во периодот на детството. Младите играчи да ја подобруваат ова способност во различни аспекти низ игра, надвор од само изолиран тренинг со брзи движења. Ваков холистички пристап ќе придонесе за севкупниот развој кај младите играчи, а особено ќе влијае да се негува страст за фудбалот поттикнувајќи доживотен ангажман во спортот.

Клучни зборови: фудбал, брзина, моторички способности, наследност, тренинг за брзина.

INTRODUCTION

Speed is an ability to perform movements within the shortest possible time (Zaciorski V.M. 1975). Speed can also be defined as human's ability to perform fast movements with low external load (Верхошанский Ю. 1977).
The following forms of speed manifestation can be recognized:

- latent time of motor reaction – time spent / passed from the receipt of the information up to the first muscle manifestation (hidden time/ internal time/ time of transfer of impulses in/from the central nervous system).
- Speed for individual movements – speed of only one movement (no repeated movement).
- Speed in frequent movements – in movements with repetitive character (of movements).

Besides the fact that the elite or professional players have become faster over time (Haugen, T. A., 2014), the hereditary nature of the ability to manifest speed is suggested. However, according to our current knowledge, the available articles do not provide definitive data on this aspect.
When comparing speed as a human ability to other motor abilities, the capacity for speed improvement appears to be relatively low. The ability to develop speed exhibits sensitive periods of improvement, particularly in boys from 7 (or 8-9) to 14 (or 15) years, and in girls from 7 (or 8-9) to 15 (or 16) years (Jovanovski, 2013; Van Hooren, B., & Croix, M. D. S., 2020). This period represents a crucial window of opportunity for the targeted development of speed ability. Beyond this age range, improvements in speed tend to be influenced by strength abilities, mastery of required movements, and training focused on creatine phosphate (CP) reserve (CP overshoot[1], Zoladz, J. A., et all., 2010)

In the context of the match environment and concerning speed ability, players employ quick starts and accelerations as pivotal skills to execute swift movements during competitive matches (Jovanovich at all, 2011). Owen's (Owen A., 2016) key point regarding speed ability is the implementation of training methods aimed at transforming specific power in football, because the fastest player on the pitch shows a higher value in power tests (Cronin, J. B., & Hansen, K. T. 2005).

Given the perception that speed may be less transformable (particularly in adult athletes) compared to endurance and strength, it becomes crucial to avoid embracing a belief in "innate superiority." This concept, suggesting that certain individuals or groups are inherently superior based on traits like athleticism, intelligence, or other qualities, is problematic. Instead, adopting the idea of a "strategic advantage" emphasizes gaining superiority through deliberate strategies, planning, and actions. It acknowledges the importance of skills, knowledge, planning, and adaptability, recognizing the role of effort, decision-making, and environmental factors in achieving success. For instance, in football, strategic advantage can be applied to positions by considering a player's speed abilities, influencing decisions on optimal positioning during a match.
Nevertheless, it's crucial within young players not to forego speed training due to the neuroplasticity effect. This effect, encompassing learning and skill acquisition, adaptation to experience, memory formation, sensory perceptual changes, cognitive rehabilitation, and environmental enrichment, implies that engaging in speed training during youth can positively impact their speed manifestations in later periods.

In addition to the imperative for speed acceleration in football, the pace of the game can be elevated through ball speed—utilizing fast passes, swift changes in gameplay, and other strategies. This approach serves to compensate for any limitations in the manifestation of speed abilities.

[1] Following intense exercise, there is a transient rise in phosphocreatine (CP) concentration, surpassing its pre-exercise levels. This phenomenon is commonly referred to as the CP overshoot.

How to conduct speed training?

When designing exercises, it is essential to consider that the primary fuel for manifesting fast movements is derived from the creatine phosphate (CP) reserves of the individual. From an energy perspective, the methodology of speed training is centered on enhancing the ability to utilize these creatine phosphate reserves, coupled with exercises aimed at improving the latent time of motor reaction directly linked to the central nervous system's response.
Considering the rapid consumption of the creatine phosphate (CP) reservoir capacity, these reserves are available for only a brief duration, typically lasting between 5 to 10 seconds during movement or exercise. However, it is noteworthy that these reserves recover swiftly after maximal intensive movements. Although creatine phosphate reserves are rapidly consumed (in about ten seconds), it is an interesting phenomenon that they could easily replenish, in a period of 40 to 60 seconds (replenishment of above 90%), with immediate post-exercise muscle PC content being 15–16% of the resting muscle content, (Harris, R. C., et al., 1976)

If fast running persists beyond this initial period, energy will shift from utilizing creatine phosphate reserves (anaerobic-alactate regime) to the glycolytic regime (anaerobic-lactate regime). This shift results in a training session with no significant impact on (pure) speed improvement (if once continue to execute maximum fast movements after the depletion of the creatine phosphate reservoir). Therefore, executing a single series of 8-second movements at maximum speed, where creatine phosphate (CP) is effectively provoked, anticipates that within approximately 50 seconds, CP reserves required for the subsequent series will be "nearly" regenerated to the initial level of the previous set. However, it's crucial to acknowledge that this regeneration is not indefinite, and the overall training duration (volume) cannot be excessively long. After engaging in high-intensity exercises, especially predominantly fast movements, the concentration of phosphocreatine (CP) is nearly entirely depleted (Zoladz, J. A., et al., 2010).

According to our best practices in speed training, it is advisable to restrict the total number of fast executions to no more than 30-40, with each involving maximum speed movements lasting between 5 and 10 seconds.

Considering the number of sprints executed in matches, as reported by Vuksanovikj V., Tanceski A., Aceski A. (2023), the FIFA Physical Database reveals that in the Qatar World Cup 2022, the average number of sprints exceeding 25 km/h was 41. Notably, players Raphinha (Raphael Dias Belloli) from Brazil and Jude Bellingham (England) recorded the maximum number of sprints, reaching 87 each. In the Women's World Cup in Australia and New Zealand, the average number of sprints above 25 km/h was 35, with players Racheal Kundananji (Zambia) and Sophie Román Haug (Norway) holding the record for the highest number of sprints at 86 on FIFA Women WC 2023.

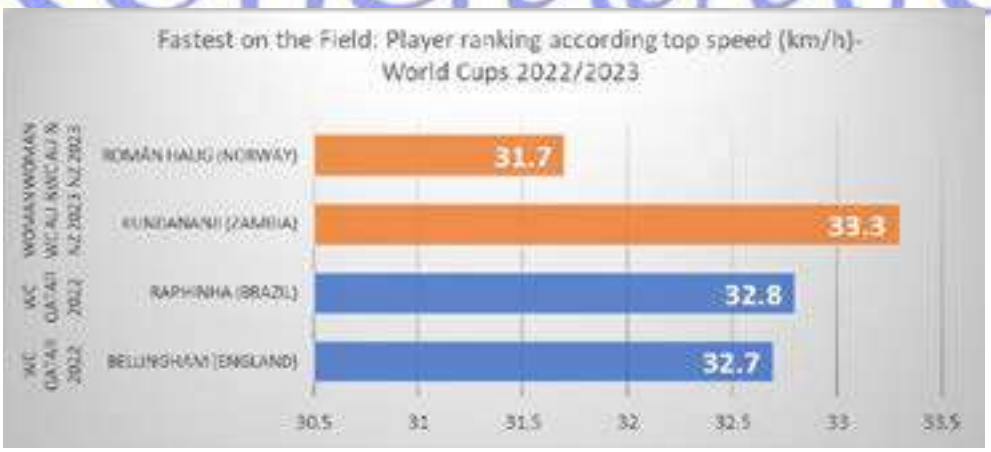

Table No.1: Data retrieved from FIFA (Physical data) Woman World Cup

Additionally, it is advised conducting speed training in the morning when the central nervous system is rested. Morning training sessions are favoured for their association with efficiency in the central nervous system (CNS), a vital component responsible for coordinating and delivering signals that initiate muscle contractions. The CNS plays a pivotal role in motor control. The significance of the CNS in muscle contraction lies in its ability to transmit signals from the brain to the motor neurons, ultimately triggering the desired muscle actions. When the CNS is optimally functioning (well rest), the coordination of these signals is enhanced, contributing to better motor performance, speed, agility, and overall responsiveness during physical activities.

The recommended frequency for speed training within a single micro-cycle is suggested to be one to two sessions, particularly if conducted as a separate training session (Rey, E., Padrón-Cabo, A., Costa, P. B., & Lago-Fuentes, C., 2019). However, adhering to our best practices, and in alignment with Malone et al. (2018), it is advised not to exceed one session per microcycle. But, in situational training on the pitch, where speed is included, there is no set limit for performing fast movements. The volume of situational training on the pitch, which incorporates speed, is typically lower than the volume in separate training exclusively focused on speed.

According to Laursen and Buchheit (2019), Repeated-Sprint Training (RST) is recommended to be conducted at all-out maximal intensity without the need for individual pretesting. RST blocks should consist of 5-second efforts followed by 15 to 25 seconds of passive recovery, repeated over 4 minutes for 2 sets. Additionally, the incorporation of Change of Directions (COD) is encouraged, preferably in the form of curve running, position-specific running patterns, and technical sequences.

The same authors (Laursen and Buchheit, 2019) recommend applying Repeated-Sprint Training during the final stages of the preseason, with substitute players in-season, or with rehabilitation players at the end of their return-to-play process. Understanding the principle underlying the potential improvement or transformation of speed capacities, the coach is tasked with creating a selection of exercises. Once the clarity of this speed transformation principle is established, it becomes essential to choose exercises for implementing this method (CP method) to ensure the efficacy of speed training.

In the realm of injury prevention, it is recommended to incorporate speed training, with or without the ball, into training sessions when there is an insufficient total sprinting distance during a macrocycle. This may include executing 6-10 sprints weekly at >95% VMax, as suggested by Malone et al. (2018), to effectively mitigate the risk of injuries.

While sprint running is a fundamental exercise, it doesn't have to be the sole focus. Additional tools such as floor ladders, cones (for changing directions), exercises for latent time (from a still position to fast sprinting), and similar activities can be incorporated (particularly within youth players). However, it's emphasized that "sprinting remains the only means of providing this specific stimulus required for football players" (Owen, 2022), recognizing the importance of maintaining and stimulating the biomechanical component essential for executing fast movements.

Genetic determinism of the skeletal muscle fibers type

Engagement and efficiency of muscle tissue depends on the given activity. In case of fast activities, certain mechanisms are included to support the demand for performing fast movements (MacIntosh, B.R., Gardiner, P.F., & McComas, A.J. 2006). The body performs a similar (yet different) activity (different mechanisms) in case of performing long-term movements. With such

different demand regarding the type of movements, different types of muscle fibers are activated in the muscle tissue which could meet the need for the type of movement.
Three types of muscle fibres have been defined: (type I) slow-oxidative, (type IIA) fast oxidative-glycolytic, and (type IIB) fast glycolytic. Fast muscle fibres, because of the physiological energy-generating mechanisms (creatine phosphate + glycogen anaerobically used), are directly related to the strength and speed movements performance success (Zatsiorsky V.M., Kraemer W.J. 2006).

How to check muscle fibre domination in human body? In the ACTN3 gene, the genetic mutation R577X was detected, which results into lack of the alpha-actinin 3 protein (North KN, et all. 1999). This method is used to define whether people have a mutation of this gene or not. If there is no mutation, then there is domination of fast muscle fibres (Niemi A.K., Majamaa K. 2005).

Apart from the option of genetic determinism, the influence of genetic factors on the success of transformation cannot be fully integrated, as suggested by Vuksanovikj V., Aceski A., Hristovski R., Popovski Z., (2021). This perspective aligns closely with interpretations from Davids and Backer (2007), indicating that the likelihood of a specific "magic gene" dictating motor ability is highly improbable. Perhaps this complexity is reflected in the acknowledgment that "the long step from polypeptide sequences to motor behavior is a step that covers much incompletely understood theories" (Johnston and Edwards, 2002).

CONCLUSION

Recognizing the intricacies of the human system, it is essential to adopt a comprehensive perspective when evaluating the potential of football players, especially those in younger age groups. While acknowledging the hereditary aspect of speed and the notion that speed transformation may have minimal influence, the emphasis is on providing every football player with the opportunity to actively engage in football.
The recommendation is to avoid limiting younger players in their football activities solely based on potentially lower results in fast movements. The reasoning behind this advice lies in recognizing the complexity of the human system. Rather than analysing individuals in segmented aspects (such as speed or resourcefulness on the field alone), a holistic analysis of the entire system is recommended.
In essence, the suggestion is that if children do not excel in fast movements, they may still possess other valuable abilities.

Therefore, this conclusion underscores the importance of offering young players opportunities to explore different facets of the game, enabling them to discover and nurture their inherent abilities beyond the narrow confines of fast movements. This holistic approach not only contributes to their overall development but also instills a sense of joy and passion for the sport, fostering a lifelong engagement with football.

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