



RESEARCH ARTICLE

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PHYSIOLOGICAL BASIS OF STRENGTH TRAINING AND ITS RELATIONSHIP WITH FOOTBALL - A REVIEW STUDY

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ABSTRACT

Football, like every product of human culture, undergoes evolution, from its concept to the form of its practice. Football is a dynamic sport with unpredictable movements and many variations throughout the game. Nowadays, it is perceived that the game of football has a very high demand for physical strength from the defensive moments and extends to the offensive moments. Belozo and Lopes (2017) calls attention to the fact that during a game and even a training session the athletes will perform several actions of acceleration and deceleration. From what was listed above, we defined, as the objective of this study, to identify and analyze the physiological bases of strength training and relate them to physical preparation in football. As results, we found that strength training generates neural adaptations (recruitment of fibers, intra and intermuscular coordination and better synchronization of motor units) and musculoskeletal adaptations (hypertrophy, alteration of fiber types and hyperplasia) among others, which translates into changes in athlete performance. We concluded that strength training produces very important adaptations to football practice and thus should be included in the programs and/or periods of athletes' training. However, it is important to stress that this modality requires training that takes into account its specificities and peculiarities.

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INTRODUCTION

Football, like every product of human culture, undergoes evolution, from its concept to the form of its practice. This evolution is evident when we compare a football game from the 60's with today's games. Aspects such as speed, strength, tactical and technical application are noticeably different, some to a lesser degree. Because of this, the training focused on the development of the physical skills needed for this sport must follow the evolution in order to meet the needs of athletes for the game. Football is a dynamic sport with unpredictable movements and many variations throughout the game. In this understanding, when analyzing the game, Bloomfield, Polman and O'Donogue (apud SARGENTIM, 2010, p. 21) says that in a football match, the athlete. Moura (2019) says that thanks to the interference of science and technology, football has evolved in all directions and that the players have a much better physical condition than before.

Nowadays, it is perceived that the game of football has a very high demand for physical strength from the defensive moments and extends to the offensive moments. Stronger players can win matches more easily and achieve greater success in medium and long distance finishes. Belozo and Lopes (2017) presents us with the fact that, nowadays, with the advance of studies and technology, the training methodology for football has changed, causing an evolution in the sports form and game models, since there has been an increase in the intensity of actions. About the importance of strength training, Belozo and Lopes (2017) calls attention to the fact that during a game and even a training session the athletes will perform several actions of acceleration and deceleration. In this situation, if his musculature is not strengthened occasionally he will suffer some injury. In view of the above, a study is necessary to identify and analyze the correct way to prescribe and apply training for the development of these valences. In this way we define as object of study the valence force and its variables in football practice. From what has been listed above, we have

defined, as the objective of this study, to identify and analyze the physiological bases of strength training and relate them to the physical preparation in football, from the classical scientific studies and studies of the last 20 years.

METHODOLOGY

For the development of the study we opted for the bibliographic survey through a systematic review, which according to Roever (2017), is a rigorous form of analysis aiming at summarizing the scientific evidence available from the various types of studies on the subject in question. This research has an exploratory and descriptive character. As a method, we opted for qualitative content analysis, which according to Moraes (1999), is used to describe and interpret the contents of all kinds of text and document studies in order to achieve an understanding of meanings that goes beyond common reading. For the bibliographic survey phase, we have defined a 20-year time frame and we have defined SCIELO, Google Academic and LILACS as the database. Besides the articles, we also use books by classical authors who study the subject. The key words used were: strength training, physiological bases, physiology and football. As inclusion criteria, we chose articles and books that clearly pointed out physiological aspects of strength training in their title, abstract and study body respectively. This way we found 11 works that met the criteria.

RESULTS

At first, we call attention, so that there is no confusion of understanding, that the analyzed authors classify strength training as resistance training or resistance training, understanding that the word resistance is related to the overload applied to training. When analyzing the studies found, we found that strength training causes physiological changes in the athlete's body, such as responses to stimuli applied in forms of training loads. These changes are called adaptation processes and can be classified as neural and muscular adaptation. Some studies bring the statement that the football athlete cannot hypertrophy in an exaggerated way that harms the development for the practice of the sport (JUNIOR, 2005). This leads us to the understanding that the development of the capacity to generate more strength through the neural system is the fundamental point of physical preparation, not neglecting other aspects such as hypertrophy and hyperplasia. Backer (2003, apud BELOZO and LOPES, 2017, p.162) pointed out that strength training promotes "greater recruitment of motor units, improvement in the synchronization of electrical impulse shots, decrease in the influence of central inhibitory mechanisms (Renshaw cells) and peripherals (Golgi's Organ/Tendinous) and greater inhibition of antagonist muscles". In addition to the increase in phosphorylation of light chain regulatory myosin, greater release of Ca^{2+} by the sarcoplasmic reticulum, increased tension production by sarcomeres, and increased binding status of weak to strong contractile proteins. The initial stages of training, neural adaptation, brings a significant increase in strength and power through better synchronization of the motor units, intra and intermuscular coordination and a greater increase in the driving speed of motor neurons. (SERPA AND BERNADINHO, 2015; JUNIOR, 2005; MOURA, 2003). In addition to neural adaptations, strength training provides several musculoskeletal adaptations. We highlight the

hypertrophy and alteration in the type of muscle fibers due to their importance for strength gain. Hypertrophy in football is still a very controversial and complex issue. Some questions have not yet been answered in a concrete and definitive way. Questions like "should you look for muscle hypertrophy in football players?" provoke many discussions and many different understandings. Thus it is understood that strength training in football should promote an increase in muscle fiber type IIa, i.e. a change in the type of fiber in the trained muscle due to the demands presented.

DISCUSSION

The strength training brings as results, neural adaptations (recruitment of fibers, intra and intermuscular coordination and better synchronization of motor units) and musculoskeletal (hypertrophy, alteration of fiber types and hyperplasia) among others, which translates into changes in athlete performance. Bringing to the study the principle of physical training that deals with specificity, we understand that when we apply the training taking into account the motor gestures, energetic demands and preponderant physical valences in the modality in question, it is possible to provide a significant evolution in the athlete's performance. We already have the understanding that any and every voluntary movement of the human body is only possible thanks to muscular action, which in turn depends on nervous stimuli coming from the cerebral cortex. During a football match, at certain times, players need to perform movements with a certain intensity of force in order to reach the proposed goal within a specific period. The levels of strength that the muscles reach depend directly on the activation of the central nervous system, neuromuscular coordination, recruitment of motor units and the motor pattern. In this follow-up study, Carvalho, Gonçalves e Costa (2012) state that neural adaptations play a major role in muscle strength production. According to McCardle, Katch and Katch (2003), strength training promotes several neural adaptations that bring as results a greater efficiency in neural recruitment patterns, a greater activation of the central nervous system, better synchronization of motor units, blurring of neural inhibitory reflexes and inhibition of Golgi's tendon organs. The author also brings that in situations where there is greater excitement and an ideal recruitment of motoneurons, either because of a very reduced neuromuscular inhibition or through the use of "uninhibiting" substances, some people can achieve "super maximum" performances.

According to Sargentim (2010) and Pinho, Alves and Ramos Filho (2005) the neural adaptation caused by strength training promotes greater activation of agonist and antagonist muscles. This adaptation also promotes the activation of the synergistic muscles in order to promote the balance of the joint, resulting in an improvement in the execution of the proposed movement and consequently a greater production of strength and improved performance. At the level of physiological adaptation inherent to strength training, which is already of general understanding that it is necessary for the development of the football athlete, hypertrophy is essential, due to the benefits it dispenses to the muscular system. Júnior (2005), states that too much hypertrophy is harmful in football athletes, but when performed works of maximum force and power specific to football, the gains in hypertrophy do not hinder the development of the athlete, since it is not exaggerated. Hypertrophy is an adaptation that occurs in muscle fibers. That's when there's an increase in size and

muscle cross-section area. It is also understood as the regeneration of fibers after they suffer microlesions due to strength training. As a result of this process, another adaptation is generated, which is the increase of connective tissue and vascularization, which brings a significant improvement in body movements and oxygen transport and absorption (SARGENTIM, 2010; MOURA, 2003). Gomes (2009) presents that hypertrophy as an adaptation happens at sarcoplasmic and myofibrillar levels. The first corresponds to the resistance capacity of the muscle, while the second is responsible for the effective increase of maximum strength in training. The occurrence of each one depends on the type of stimulus applied during the training. Mcardle, Katch and Katch (2003), point out that the process of hypertrophy may occur as a result of subsequent injuries to muscle fibers, where through the anabolic effect produced by protein synthesis, increases the number and size of myofibrils and new sarcomeres are formed. According to Sá Junior (2012), hypertrophy promotes a better balance of large muscle groups, which leads to muscle "harmonization", which in turn serves as a preventive method of injury. Applying this aspect to football, which has in its main characteristics sudden changes of direction and speed, situations of many physical contacts, the player who has a greater muscle balance can support the loads of matches and training more efficiently, thus reducing the incidence of injuries. Another adaptation resulting from strength training is the alteration of the type of muscle fiber trained and, therefore, a preponderant factor during sports physical preparation. On this subject we have not found a satisfactory number of articles and/or books, a fact that does not allow us to present with clarity and precision about this type of adaptation.

For Sargentim (2010) the most requested muscle fibers during a soccer match are the fast contraction type IIa fibers, because it has a higher oxidative capacity, which allows the athlete to perform intense efforts, but with submaximal characteristics, followed by type IIb fibers, for maximum and intense efforts and type I fibers, which are those of slow contraction, and are present only in the passive period of the game. According to the understanding of Mcardle, Katch and Katch (2003), the modification of muscle fibers, at the level of metabolic characteristics and subdivisions, occur between 4 and 8 weeks of training, and the reduction of type IIb fibers and the increase of type IIa fibers stand out because it is a faster adaptation to training. According to Junior (2005), there is the possibility that, as a result of strength training, the conversion of type I fibers into type II fibers occurs, that is, the conversion of fast contraction fibers into slow contraction fibers. Another musculoskeletal adaptation cited by the authors is muscular hyperplasia, but despite the mention, there are no concrete data on this type of adaptation in humans (MCARDLE, KATCH AND KATCH, 2003). There are other physiological adaptations from strength training, and Leite et al. (2004) highlights the improvement in mechanical efficiency, promoting economy of movement; an increase in lactate threshold for untrained individuals in endurance modalities; an increase in time to exhaustion in short or long distance exercises.

Conclusion

From the studies analyzed, we can conclude that the strength training produces very important adaptations to the practice of football and thus should be included in the programs and/or periods of training of athletes. However, it is important to

stress that this modality requires training that takes into account its specificities and peculiarities. Even having found rich contents in relation to the proposed theme, there is still a need for a more in-depth study on the physiological basis of strength training and to make an alignment with the practice of physical training for football.

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