

Training methods and loads in football performance assessment: A review

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ABSTRACT

In the sport of soccer, there are different methods regarding the approach of periodization and monitoring of loads and the assessment of neuromuscular performance. This literature review aims to identify best practices and evidence-based strategies for increasing the physical and neuromuscular abilities of players. Method; Study sources and inclusion criteria are: PubMed, Web of Science and ProQuest which were used as sources for collecting data for our investigation. The keywords used were; “*Training load*”, “*Load monitoring*”, “*RPE*”, “*Neuromuscular assessments*”, “*Muscular strength*” related to soccer performance in monitoring training load. Studies were selected from the last 10 years and were published in English and Spanish based on our criteria. Results; From No.102 full papers and following a more thorough evaluation, No.48 complete studies were chosen. The list was purged of studies that did not meet the inclusion requirements. Conclusion; In this literature review, we looked at several key elements that influence the improvement of soccer performance. A fuller understanding of the variables that influence the performance of professional soccer players would be possible through a comparison of these data. CMJ height continues to be the most widely used measure for assessing lower extremity strength.

Keywords: Training load, RPE, Monitoring, Muscle strength.

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INTRODUCTION

In addition to skill and strategy, soccer players must have the highest physical performance possible. To achieve peak performance, a thorough approach that takes into account all aspects of training, recovery, and injury prevention is needed. Soccer players today have to perform at the highest level of their physical capabilities because of the game's fast tempo, which has increased the physical demands of the sport in recent years. Additionally, the growing importance of data-driven decision-making in sports has highlighted the need for objective measurements and reliable assessments to guide training programming plans and performance reviews in order to accomplish results. This evaluation attempts to provide valuable information regarding enhancing and maintaining player talents by carefully analysing the data that is currently accessible in this area. This study review is justified by the complex interplay of neuromuscular function, training load, and overall soccer performance outcomes. A comprehensive understanding of athlete characteristics and performance factors is necessary to optimize training load (Reilly et al., 2009). It has long been believed that determining training load is essential to accurately planning to train schedules and ensuring the best possible conditions for a player's performance in competition (Rebello et al., 2012). Additionally, an understanding of the athlete's physiological and mechanical responses to the exerted effort is necessary to improve and appreciate the basic mechanics of the adaptation process (González-Badillo et al., 2015). Adaptation, also known as performance response, happens when the positive and negative effects of stimuli are balanced (Jeffries et al., 2021). S. Malone et al. (2016) state that long training sessions, a high frequency of competitions, and busy schedules are common problems faced by elite athletes. To increase their chances of success, coaches employ training loads that challenge their athletes to the maximum (Piggott et al., 2009). The model proposed by Busso (2003) shows that the link between workload and performance is inverted U-shaped. It is therefore crucial to determine the highest (or closest) location of the inverted U, which is the optimal point of severe load that is both necessary and adequate.

In addition to preventing overuse, which can result in overload (i.e., decreased performance) or, in the worst cases, damage development, reducing a lack of stimulation is sufficient (Owen et al., 2015). In order to achieve optimal management between training and matches, he proposes a methodical strategy that considers load control within a session, week, or month (Gabbett et al., 2017). The athlete's external load is described in the first of his four processes, while the athlete's internal load—or biological response to the strain—is described in the second. The third step involves assessing the player's load tolerance. In the fourth stage, the athlete's preparedness is confirmed.

However, not all of the traits that appear to be related to the training load level show the same association. Because of this, the injury incidence response to the load level displays a U-shape (not inverted in this case) with a higher chance of damage when the athlete is exposed to both extremely low and extremely high loads. This suggests that a load threshold exists that reduces the possibility of harm to both low and high loads. This implies that the stress that athletes experience is one of the main risk factors for injury. It is helpful to assess and keep an eye on training and competition loads in order to reduce injuries and improve performance. In conclusion, this systematic review aims to thoroughly examine the corpus of research on various facets of soccer performance enhancement.

METHODOLOGY

In order to answer the research questions, this literature evaluation was carried out using the recommendations for meta-analyses of (Tricco et al., 2018). Since the data used in this study came from

earlier research that had received ethics board approval, ethics board approval was not required. The study data were handled using Microsoft Excel 2019.

Study sources and inclusion criteria

Four bibliographic databases—PubMed, Web of Science, and ProQuest—were used as flexible sources for the literature review in order to gather the data for our investigation. “*Training load*”, “*Load monitoring*”, “*RPE*”, “*Neuromuscular assessments*”, “*Muscular strength*”, and “*Power assessments*” were among the terms included in the search strategy due to their association with top football performance in training load monitoring and neuromuscular evaluation. Studies that examined training loads, physiological reactions, and sports performance throughout an elite football season were chosen from the past 10 years and published in both English and Spanish.

Following the selection of scientific publications, we determined the most important details, such as methodology, training loads, tests, and key findings. We discovered 102 studies that were appropriate for our needs in the initial searches we conducted. Based on our predetermined criteria, No. 48 studies were chosen for full text examination following preliminary evaluations of abstracts and different complete articles. The list was cleared of studies that did not meet the inclusion requirements. The complete article was reviewed to confirm eligibility if the title and abstract screening did not yield enough information.

RESULTS

We collected No.102 full papers that were appropriate for our needs based on the study methodology's application, and following a more thorough evaluation, No.48 complete studies were chosen. We ultimately gained a comprehensive understanding of the distribution of the loads and also recognized the unique significance of neuromuscular evaluation in the context of football. Neuromuscular performance was primarily measured by strength, power, balance, and other program interventions. Training days up until the match day were subtracted in order to divide the days into micro cycles. The Microsoft Excel system was used to enter the publication's features (year of publication, study type), the study's characteristics (age, gender, performance level, sample size, measures).

DISCUSSION

Tools for measuring internal and external loads and their characteristics

A thorough procedure must be followed to choose which variables to include as selecting which variables to track, evaluate, and report on a regular basis is an essential part of day-to-day work. It is highlighted that coaches of elite teams monitor a large number of characteristics, according to the questionnaires that were given to them (Akenhead & Nassis, 2015). In particular, the authors found that the best teams of these coaches track loads using 56 variables, including exterior load indicators like distance with $>7 \text{ m} \cdot \text{s}^{-1}$, level 1, and internal load indicators like average heart rate. Level 2: acceleration frequency $>3 \text{ m} \cdot \text{s}^{-2}$, Level 3: number of leaps. It is important to keep in mind that some variables can be stated in relative terms (like time or total distance) or absolute terms (like the number of actions taken or the distance travelled in meters). It's crucial to remember that occasionally the team uses different technology for training than for the match, which in some ways explains the variations. During training, the majority of teams employ GPS devices that analyse acceleration based on time-velocity signals. In order to raise the load or intensity of the exercises and finish the training, (Halsen, 2014) suggests that a variety of dimensions be included in the variables and indicators that should be taken into account. It is feasible to gain a better understanding of players' demands at various load levels by controlling these factors and indicators. The criteria are often connected to cardiovascular

impact, high-intensity activities, and the athlete's accelerations and decelerations. The amount of time spent in places with a significant cardiovascular impact is indicated by an internal load variable. The zone with high cardiovascular consequences can be defined using different intensities, even if the particular example uses heart rate at 90% of maximum. To track the amount of time spent on heart rate in relation to ventilation thresholds or the lactate concentration of 4 mmol. This variable should be included since there are strong correlations between players' aerobic development and the amount of time they spend in these locations (Castagna et al., 2010; A. Manzi et al., 2014). An indicator of cardiovascular training effectiveness tells us about the athlete's level of adaptation by connecting exterior and internal load metrics. However, the utility/importance ratio will drop if a particular training session is examined. By examining the behaviour of the factors listed for a longer period of time, it enables us to make judgments. Consequently, daily data recording for this indicator is required. The factors utilized were separated into three tiers by (Buchheit & Simpson, 2016):

- Level 1: The total distance travelled, including the lengths travelled at various speeds. For example, a distance of 250 meters over 21 kilometres equals 2.3% of a total distance of 10500 meters.
- Level 2: All activities pertaining to changes in direction, acceleration, deceleration, and speed fall under this level.
- Level 3: Consists of all data from accelerometer or inertial sensors.

Akenhead and Nassis (2015) observed 41 coaches from top soccer clubs. They discovered that the most popular methods for tracking internal load during training are RPE (71% of teams), heart rate monitoring (98% of teams), and other subjective measures (32% of teams). RPE and heart rate monitoring are not, however, optimally utilized by teams during games. As a result, internal stress is tracked more frequently during training sessions and less frequently during games.

Perceived exertion scale

One instrument that has been used and improved since the 1980s is the scale of perceived exertion (RPE) (Borg, 1982). However, a number of scientific research have been carried out recently to ascertain its validity and reliability, mostly because of its affordability and ease of use. RPE is a useful tool for tracking and measuring training loads and how they change over the course of micro cycle days (Dodaj and Kaçurri, 2023). This measurement technique was used for a variety of acyclic, individual, or group sports, including football (Impellizzeri et al., 2004), even though it seemed to assess the load in cyclic or repeated individual sports (Foster, 1998). The reasons for this are its simplicity, adaptability (Alexiou & Coutts, 2008), high repeatability, low adaptation (Hill-Haas et al., 2007; P. Manzi et al., 2001; Rampinini et al., 2007), and validity in determining the session's intensity in both stable scenarios, where the exercise's intensity is maintained (Foster et al., 1995; Foster et al., 2001), as well as non-stable scenarios (Impellizzeri et al., 2004; V. Manzi et al., 2010). Furthermore, its use enables us to reduce the possibility of player injury, particularly during high-load situations like the first stages of the preparation phase (Killen et al., 2010).

The micro cycle is one of the primary components of monitoring. The distribution of the burden over the week is explained in the literature. Training days till the match day were deducted as a starting point for the micro cycle's day division (Martín-García et al., 2018). The days are designated with a negative; they are -4, -3, -2, -1, and the match day, respectively. Based on this division, we enable the distribution of loads that are tracked by GPS for exterior loads and RPE for interior loads, both of which are highly effective techniques according to the research that have been examined.

In recent years, several authors have published descriptions of the load soccer players face based on various factors including the day of the week. On the one hand, some research has used absolute values to represent

the demands that players face throughout different training sessions according to their locations on the field of play. For instance, Owen, Djaoui, et al. (2017) discovered that player position significantly altered the variables for average speed, RPE, and total distance travelled. The players are under more pressure during training sessions three and four days before to the game than they are during those held one and two days prior (Swallow et al., 2020). There are greater accelerations and decelerations between 2 and 4 m/s² on the fourth day before to the game, and less on the day of training (Querido & Clemente, 2020). However, compared to days -4 and -3, compensatory training, which takes place the day following the game when the squad is separated for less than 60 minutes, had greater accelerations and decelerations. J. J. Malone et al. (2014) and Kelly et al. (2019) had the greatest needs for average speed at -3 and -2, respectively, whereas (Owen, Djaoui, et al., 2017 and J. J. Malone et al., 2014) had the lowest requirements at -4 and -1, respectively, running at a high intensity. The demands on the players are at their maximum during the three days (Rey et al., 2020) and four days (J. J. Malone et al., 2014) leading up to the game, while the demands are at their lowest the day before (J. Malone et al., 2015). This variable's load can be stated in distance and m/min (Rey et al., 2020). Days -3 had the greatest requirements (Owen, Lago-Peñas, et al., 2017), whilst days -4 and -1 had lower requirements (Anderson et al., 2015).

It appears that in order to maximize the choice of loads, a limited number of variables must be used while assessing the training load. It is important to highlight the necessity of choosing indicators and variables that offer data on the three energy systems or dimensions: neuromuscular (acceleration/deceleration, direction changes, turns, jumps, and maximum speed) and aerobic metabolic processes (or high-intensity running). In light of the aforementioned, a range of pertinent internal and external athletic performance measures should be used to assess the intervention (training) and performance (Weaving et al., 2014). Football players must do a variety of activities throughout training, and these tasks' various qualities frequently co-occur (Castellano, J., 2016).

Within a micro cycle, sessions

Over the past few years, other authors have used additional factors to illustrate how the load players get varies by day of the week. On the one hand, some studies have used absolute values to characterize the load that a player receives throughout different training sessions, taking into account the player's location on the field. For instance, Owen, Djaoui, et al. (2017) discovered that a player's location caused discernible variations in RPE, average speed, and overall distance. However, the characteristics associated with high-speed activities did not alter much as a consequence of their investigation. The variations examined, however, were predicated on the training session with various factors, where the values decreased progressively as the match approached. The goal of "tapering," or lowering the athlete's values, is to encourage recuperation. According to research by (Owen et al., 2015; Anderson et al., 2015), the largest load values occurred during session three on the day of the match, and these loads declined as the game day drew near.

Training of the neuromuscular system

According to Myer et al. (2011), neuromuscular training is a strength training technique that incorporates fundamental and sport-specific movements, such as plyometrics, agility-speed workouts, trunk strengthening, balance, muscle resistance, and dynamic stability. For soccer players, strength training has a favourable impact on several facets of performance and health. The main function of the neuromuscular system is strength. The first person to describe the connection between force and speed was (Hill, 1938). The force-velocity curve is a notion that is used to describe and apply this connection. According to this theory, force is represented on a continuum with different velocities. Since the suggested training approach will change from term to term, it is vital to differentiate between neuromuscular control and coordination. According to Fort-

Vanmeerhaeghe et al. (2016), neuromuscular control can engage the muscle that is in motion during the movement and promote its efficient and coordinated growth. Coordination is often described as a regulator of movement. On the basis of this, two distinct ideas that enhance one another are put forth. While neuromuscular coordination makes it easier to do an activity as efficiently as possible, neuromuscular control is utilized in any exercise that requires adequate movement control to avoid harm. Depending on the mass of the item being accelerated and the movement's inertia, athletes must apply force at varying speeds in different sports or duties within sports. The different velocity demands on muscle contraction during athletic performance, such as those associated with sprinting, throwing, and passing at the high-velocity end of the force-velocity curve, must also be taken into account. To increase strength at rapid speed, one can lift lighter or body weights (Jones et al., 2001). Muscle contraction types must be taken into account when evaluating a sport's strength requirements. The majority of soccer motions use isometric, eccentric, and concentric action cycles to strain muscles and tendons. Eccentric movements happen when the muscle lengthens under strain, whereas isometric contractions happen when the muscle contracts without changing length. Muscles that shorten and contract produce concentrated contractions.

Football players must possess the critical athletic ability of running speed, which is more significant for some positions than others. Increasing strength and power can help one run faster (Amonette et al., 2014; Panagoulis et al., 2018). Soccer's nonlinearity makes it crucial to comprehend the various facets of pace. These elements can be used to classify speed: Change of direction, acceleration, peak speed, and deceleration. Understanding the demands of each component is crucial to determining the kinds of acts that should be practiced since each one puts the athlete under varied stress. Strength and power assessments are required since football involves a lot of motions, including leaps, throws, and other interventions. Sprint and jump height have been found to positively connect with soccer performance.

Tests

The most weight an athlete can lift during a particular activity for one repetition (1RM) is their maximal strength. A description of the 1RM testing technique and how to calculate loads using the %1RM method—which states that, for example, six repetitions can normally be completed in 85% of 1RM—which relates the number of repetitions that can be performed to the relative load lifted. *Countermovement Jump (CMJ)*; Soccer players generally agree that CMJ is a reliable indicator of lower extremity strength (Datson et al., 2014; Slimani & Nikolaidis, 2018). Although lower extremity strength undoubtedly influences CMJ height, CMJ height by itself might not be a reliable predictor of maximum strength. Nonetheless, the most popular metric for assessing lower limb strength is still CMJ height. It's interesting to note that end-of-season rankings have been linked to the average CMJ height of all clubs in the same league (Arnason et al., 2004). *The 505 Test*; According to Thomas et al. (2015), the 505 test is regarded as a valid tool for evaluating soccer players' and other people's direction-changing skills.

CONCLUSION

In this examination of the literature, we looked at a few key elements that affect soccer performance improvement. We now understand the significance of tracking training loads and assessing neuromuscular abilities thanks to a number of research. Finding talent, enhancing performance, and keeping an eye on general health and fitness may all be facilitated by evaluating physical performance using a variety of tests and tracking players' abilities and performance. A thorough understanding of the variables affecting the performance of professional soccer players would be possible through a comparison of these data. Our chosen studies were centred on using GPS and RPE to monitor both internal and external stressors. If at all feasible, a wide range of dimensions should be included in the variables and indicators that should be taken

into account in order to finish the training and raise the load or intensity of the exercises. CMJ height continues to be the most often used measure for evaluating lower extremity strength. We may say that the 505 test is considered a reliable method of evaluating the ability to shift direction for soccer players and others. Our objective is to develop a practical model for professional football clubs that will benefit all of our nation's coaches and footballers.

AUTHOR CONTRIBUTIONS

Prof. Dr .Agron Kasa as an expert in the field of training and sports science, has made a special contribution to the selection of this topic. Mark Dodaj has followed every piece of his advice, on researching the literature on training methods and loads for football players' performance. This collaboration will also continue in the practice of new training methods in football.

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No potential conflict of interest was reported by the authors.

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