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The Relationship among Training Load, Recovery Level, Neuromuscular Fitness and Success in Ethiopian National League Soccer Players By Belayneh Chekle

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A DISSERTATION SUBMITTED TO
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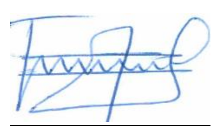
Approval of Dissertation for defense

I hereby certify that I have supervised, read, and evaluated this dissertation titled "The Relationship among Training Load, Recovery Level, Neuromuscular Fitness and Success in Ethiopian National League Soccer Players" prepared under my guidance. I recommend the dissertation be submitted for oral defense (mock-viva and viva voce).



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Approval of Dissertation for defense result

We hereby certify that we have examined this dissertation entitled "The Relationship among Training Load, Recovery Level, Neuromuscular fitness and Success in Ethiopian National League Soccer Players" by ____________________. We recommend that ___________________ is approved for the degree of "_____________ __ _______________"

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Chair person's name	Signature	Date

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ABSTRACT

Despite training load being the main intervention in soccer performance enhancement, there is minimal evidence concerning its nature and relationships with the perceived psychological and physical conditions, soccer-specific fitness components, and most importantly with success. The purpose of this study was to examine the nature and relationships of perceived training load and stress or recovery level, soccer-specific neuromuscular fitness parameters, and success. To this end, a correlation study designed was used. To collect data from volunteered soccer players (n=88), five National League teams found in Amhara Regional State were participated. In this research, the variables/behaviors in question were measured using specific tools. The measurement was taken for about five weeks with each variable measured five times with five consecutive scores. The collected data were analyzed using descriptive statistics, ANOVA, zero-order and partial correlations, and general linear model (GLM.) The ANOVA findings show significant differences in neuromuscular fitness components and success across teams. In addition, there is a significant difference in NMF levels among players of different positions. Both the correlation and GLM results of the study showed that there is a significant correlation between perceived weekly training load and the players' perceived stress and recovery level. In addition, there is a significant correlation between the training load and neuromuscular fitness components. In addition, both perceived stress and recovery have a significant relationship with neuromuscular fitness. Similarly, stress and recovery level significantly correlated with fitness. Eventually, training load, stress or recovery, and neuromuscular fitness found to correlate with success. Overall, there is a significant positive correlation between training load, perceived stress and recovery, neuromuscular fitness, and success. Based on these findings, this research recommends that soccer team players of the National League and their coaches and trainers need to focus on the training load for the performance enhancement of their team. From the practical perspective, it is recommended that coaches and trainers should prepare optimal training load adaptation for their soccer players at the National League level, so that their soccer players get adequate opportunities to needs-based NMF improvement to increase both NMF parameters and team success, at the same time.

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LIST OF ABBREVIATIONS'

AU: Arbitrary Unit

CODS: Change-of-direction speed

GR: General recovery

GS: General stress

HIA = High Intensity Actions

NMF: Neuromuscular fitness

RESTQ: Recovery stress questionnaire

RPE: Rate of perceived exertion

RSA: Repeated sprinting ability

SSG= Small-sided game

SSR: Sport specific recovery

SSS: Sport specific stress

VO2max= The maximum volume of oxygen

Declaration

I ______________________________ declare that this dissertation entitled "The Relationship among Training load, Recovery Level, Neuromuscular Fitness and Success in Ethiopian National Legue Soccer Players" is an original report of my research, has been written by me and my supervisors and has not been submitted for any previous degree. The research work is almost entirely my own work; the collaborative contributions have been indicated clearly and acknowledged. Due references have been provided on all supporting literatures and resources.

Signature ______________________

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CHAPTER ONE: INTRODUCTION

1.1. Background of the Study

In elite level soccer, performance and success are commonly measured using the rate of winning and losing. Successful teams are those with more winning attributes and records. Unequivocally in the world of soccer, winning teams are superior in terms of various performance parameters. These parameters may be the result of varied modifiable factors such as training, training load and recovery. Thus, the issue of dose-response relationship is an important area of study that needs further elucidation. For example, the relationships of these factors in connection with soccer specific physical fitness as well as success have been highlighted as key areas of study in contemporary soccer.

In soccer, as in many other sports, performance improvement is the prime goal sought by coaches, players, and others around soccer clubs or teams (Bangsbo, Mohr, & Krustrup, 2006). Reaching a peak performance and the sacrificing for its maintenance is the ultimate target of coaches and players to work hard in today`s soccer (Millard-Stafford et al., 2005). This is most needed for winning or success because nowadays success and winning in soccer are a matter of big business. However, there is a greater emphasis placed on winning, this does not happen out of the blue because soccer as a sport is too demanding (Bradley et al., 2013a). It is indicated that the game is becoming even more demanding in terms of high-intensity running distance, number of high intensity actions, sprint distance and number of sprints (Barnes, Archer, Hogg, Bush & Bradley, 2014). Also, it is demanding physically requiring not only simple sprinting speed, endurance or strength, but also speed in different distances from 5m to 60m of 40-60 sprints with a short recovery in between (Bangsbo, 2014; Bradley, Di Mascio, Peart, Oslen, & Sheldon 2009a). It is becoming more demanding in terms of technical proficiency (Bradley et al., 2013a) that requires the most difficult skills (Durate, Araujo, Vanda, & Davids, 2012; Frencken, Lemmink, Delleman, & Visscher, 2011). Most importantly soccer requires the execution of technical skills at high tempo or at the highest level (Carling, Le Gall & Dupont, 2012a).

Moreover, the need to make instant decisions now and then within a fraction of seconds by using the available cues is one performance factor, which occurs throughout the game (Alghannam, 2013; Gonzalez-Villar, Garcia-Lopez, & Contreras-Jordan, 2015). With this, the ability to play against the pressures from the coach, peers, family, club owners and fans and the ability to have the required commitment and concentration for entire matches played week-by-week is another performance factor in today`s soccer. The bottom line is that, soccer is the most complex sport in the world where players are required to possess technical-tactical skills, high-level psychological make-up and excellent soccer fitness (Durate et al., 2012; Gonzalez-Villar et al., 2015).

Technical-tactical ability is one of the distinguishing factors that differentiates successful teams from unsuccessful teams (Bradly, et al., 2013a; Haugen, Tonnessen, Hisdal, & Seiler, 2014), but without physical fitness it does not stand alone, and deteriorates (Carling, et al., 2012a; Faude, Koch, & Meyer, 2012; Gabbett, 2016). This highlights the necessity of physical fitness development and maintenance in soccer. When fitness decays, technical-tactical proficiency and psychological vitality can be flooded away. Because of its invaluable role, physical fitness in soccer triggered teams to have a fitness coach, a nutritionist, strength and conditioning specialist, and a physiotherapist. Even those world-class players pay a due attention to their soccer specific fitness. For example, Ronaldo is well known for his astonishing fitness and for his hard work to get the most out of his physical quality. What makes the concern of fitness in soccer more sensitive is that, a couple of weeks off training can result in a significant fitness reduction as GAS theory suggests (Joo, 2018). Therefore, competing at high level soccer places heavy demand on players to have well developed physical qualities, and these can help them to utilize their technical-tactical qualities and excel expectation of the game demands. For example, strength, power, speed, and repeated sprinting ability (RSA) are important fitness components to fight and win the limited ball contacts encountered during match play (Bradley, Lago-Penas, Rey, & Diaz, 2013b; Haugen et al., 2014b).

Soccer is an intermittent sport with numerous short, explosive, high intensity bouts as sprinting, change of direction and jumping interspersed with short recovery periods over the 90 minutes duration (Bangsbo, 2014; Bradley et al., 2013a). Therefore, for training to suit the physical demands of the game, emphasis should be placed upon the ability to repeatedly execute high-intensity bouts. The economical approach that simultaneously uses both technical-tactical workouts with physical fitness is advocated as it could result in highly effective performance (Little & Williams, 2007a & b). Thus, it is believed that high intensity interval training can induce a greater improvement in the required fitness elements. However, with this stimulus strength, working 2 hours a day, 6-7 sessions a week can pose a burden (Bangsbo et al., 2006; Burke, Loucks & Broad, 2006), because it is difficult to get recovery and the required physical and mental vitality for week by week matches. Though the importance of physical fitness, technical-tactical capability and psychological makeup upon soccer match performance is well established and acknowledged, there is minimal research investigating the impacts of weekly training load and recovery on soccer specific fitness and match performance. The problem of performance fluctuation that teams face at varied stages of a season may be accounted to the issue of weekly load management. For example, when seasonal variation in aerobic endurance have been well studied (Mohr & Krustrup, 2014; Silva, et al., 2011; Tonesen, Hem, Leirstein, Haugen & Seiler, 2013), but literature is limited and contradictory regarding the anaerobic segment (Haugen, 2018).

Soccer is well known for its specific fitness requirements. For example, agility, acceleration, deceleration, speed and RSA are its critical components. This is so because during matches players are expected to accelerate, decelerate, sprint and change direction throughout the game (Farrow, Young, & Bruce, 2005; Faude et al., 2012; Shepard, Young, Doyle, Sheppard, & Newton, 2006). Moreover, time-motion analysis indicated that short distance sprint occurs more frequently during soccer matches (Bradley, et al., 2009a, b; Bradley et al., 2013a). Players perform 150–250 intense anaerobic actions during a game (Bangsbo, Iaia, & Krustrup, 2007; Bangsbo, 2014). The capacity of soccer players to produce varied high-speed actions can greatly impact match performance. Although high-speed actions (anaerobic activities) account only for approximately 11% of the total distance covered in a match (Andrzejewski, Chmura, Pluta, & Konarski, 2015), they constitute the most crucial moments of the game, that is, mainly the difference between losing or winning ball possession, scoring or missing, saving or clearing and conceding goal. For example, linear or straight sprinting is the most common high-speed action before those crucial moments during games (Faude et al., 2012). Therefore, it is worth studying this segment of soccer fitness (i.e., speed and RSA), from the perspectives of TL, stress and recovery.

The ultimate goal of any physical training is to have adaptation or super-compensation (Bompa & Haff, 2009). Until we reach the pinnacle of our physical fitness climax, we strive to get a new fitness level from the baseline. Adaptation occurs during the time of recovery or rest (Haff, 2004;

Plisk & Stone, 2003). This implies that recovery is a vital necessity of adaptation (Reilly & Ekblom, 2005). In addition, it is a means to mitigate the potential maladaptive physiological and psychological effects of training (Kellmann, 2010). This emphasizes the importance of a carefully monitored recovery process though there is no vivid or well-established method of recovery in soccer (Turner, 2011). The strength and duration of exercise as a stimulus determines the length of the required time for recovery (Turner, 2011). This suggests that the higher the intensity, the longer the required recovery time and still the longer the duration of the training the longer the required recovery time (Stimulus-Fatigue-Recovery-Adaptation theory (SFRA). Players perform intense repeated anaerobic actions during games and training. This quality training coupled with extended time duration of 2 hours per-session throughout the week can potentially pose a lot of stress (Alghannam, 2013; Bangsbo, et al., 2006; Burke et al., 2006). As long as the issue of adaptation and recovery are concerned, soccer training and game plays deserve a longer period of time for recovery as per the SFRA.

1.2. Statement of the Problem

There is nothing more worthwhile than realizing outstanding performance in soccer, which is one of the keys to be a winner. In the international arena, a team performance has become a huge political, business and identity question. This has also come true locally, particularly these days as local clubs regardless of the league level primarily stress on the political side of winning and club identity beyond its football statues and principles. Hence, it is prudent that coaches, players and administrators work hard day-in and day-out to reverse this and decency to the values placed on performance and its product winning in soccer. Thus, the main intervention, training is the major duty of coaches and players to bring about worthwhile change and its effect relies on other factors as nutrition and rest (Fullagar et al., 2015: Kellmann et al., 2018). Load, the stimulus to impose adaptation, is a significant factor for performance improvement. Thus, load management sounds to be a key factor in soccer training, though little is known about the impact of load imposed on players and the changes in fitness across the entire season (Haugen, 2018). Therefore, a robust finding based on scientific study is useful in reducing injury, preventing overtraining and to help coaches in predicting desired training responses (Drew, Cook, & Finch, 2016; Drew & Finch, 2016; Gabbett, 2016).

Research shows that overload and under-load are associated with poor performance and increased risk of injury (Cross, William, Trewartha, Kemp & Stokes, 2016; Malone et al., 2017a; Malone, Roe, Doran, Gabbett & Collins 2017b; Malone et al., 2018; Meeusen, et al., 2013; Moreira, et al., 2013), though the findings are not consistent. For example, while Gabbett, (2016) found that higher load has a protective function against injury, Malone et al., (2017a) showed that a weekly (acute) load of 1500 AU-2120 AU has higher risk of injury when compared with a load of ≤1500 AU. Similarly, Malone et al., (2017a) found that a higher chronic load (2-weekly TL of ≥5980 AU and 3-weekly TL of ≥9154 AU) is associated with increased risk of injury than lower chronic load during the preseason. Training load reduction in the preseason is associated with reduced rate of injury (Gabbett, 2004). Malone et al., (2017a) also found that, 2-weekly (≥5980 AU) and 3-weekly ≥9154 AU) workloads had reduced risk during the in-season compared to the reference groups of <3250 AU and <7260 AU, implying that the same load may have different effect on different periods of the season. Still Malone et al. (2017b) showed that higher chronic loads (21 days) coupled with more HSR distance of 701 to 750m is associated reduced risk of injury, while low chronic training loads coupled with the same distance of 701 to 750m is associated with greater risk of injury. Here, injury risk is greater when chronic load is low which is similar with Stares et al. (2018) finding. Faced with this dilemma, trainers strive to determine precise dose-response relationship between training load and adaptation. As a result, monitoring the balance between load and recovery still remains one of the most important puzzles that need resolution (Kellmann, 2010; Lundqvist & Kentta, 2010).

The relationship that training load (TL) had with physical fitness and match performance is not well established despite research findings in the area. A study in soccer have indicated the relationship between load and fitness to be inverse (Cross et al., 2016), although Brink, Nederhof, Visscher, Schniki & Lemmink (2010), associated more training with improved performance. In futsal, training load results decreased sprinting performance (Morreira et al., 2013). Still in Rugby training load and injury are found to be strongly correlated (r=0.82) (Gabbet & Jenkins, 2011). In Australian football it is studied how recent training load affects match performance (Aughey, Elias, Esmaeli, Lazarus & Stewart, 2016). In Australian football weekly-load and training-stress balance for strain is shown to be the best predictors of match success (internal load for wins than loses) (Aughey et al., 2016). But in soccer, to my knowledge, there is no study in this regard. These controversial findings call for further investigation on the matter (Jones, Griffiths, & Mellalieu, 2017), which witnesses the significance of this research.

Periodization as an approach and plan of training (Plisk & Stone, 2003), is not well established in soccer (Bompa & Haff, 2009; Malone et al., 2015) (i.e., coaches have periodization based on one`s philosophy and experience (Malone, et al., 2015). For example, performance maintenance in most sports is for about a length of 2 or 3 weeks (Turner, 2011). Thus, the job of maintaining performance for 35 weeks is too difficult in soccer (Hoffmann & Kang, 2003; Kraemer et al., 2004). Reaching up peak performance in the preseason preparation and maintaining it for a time period of more than 30 weeks is the aim of soccer training. This extended challenge is not well studied as how load relates with performance against time period of a season and even the studies carried out in this area are short duration of about 4-10 weeks and participants with limited training experience (Cissik, Hedrick, & Barnes, 2008). Despite being crucial for on-field performance, anaerobic fitness variables are sensitive enough to the varying season times (Haugen, 2018) and players' threshold to injury and fatigue also varies during the season

(Malone et al., 2017a; Rogalski, Dawson, Heasman & Gabbett, 2013). Therefore, the commonly observed performance fluctuation with soccer teams (Haugen, 2018) can be attributed to periodization problems. This implies that the effects of load on performance at different cycles or periods need to be identified as only anecdotal evidence exists to validate the use of periodization in soccer (Cissik et al., 2008; Turner, 2011).

Training should adhere to the principle of individual difference, for a reason that the response players will have to a stimulus (load) is likely to be different (Jones et al., 2017). A team-based training approach by default caused this principle to be compromised. In a squad of 25 or more players, where there is difference in chronological age, soccer age, physiological predisposition and lifestyle, collective training approach is common. Here the amount of daily load or weekly load may not be monitored closely. As a result, in season-long team sports, the application of appropriate load is still challenging for coaches (Cross et al., 2016). This approach can pose overload or under-load for players (Malone et al., 2017a; Malone et al., 2017b; Stares et al., 2018). With both extremities of load as overload or under-load, performance deterioration and increased risk of injury is likely to occur (Rogalski et al., 2013; Moreira, et al., 2013). This deems a study to identify how individual players respond to such a training approach in terms of internal load and physical condition or performance.

Nevertheless, the explanation of performance fluctuation as a function of fitness is not negligible. The assessment of neuromuscular function such as speed, agility, power and RSA performance are highly recommended (Twist & Highton, 2013) because they are simple to administer, they induce minimal fatigue and most importantly they are crucial for soccer. Therefore, a research that can target the relationship between load and NMF with its impact on match performance is too necessary. Where there is less professionals' involvement (i.e., no team physician, no fitness coach, etc.,) the problem of load monitoring can immensely drain performance. To the worst level, poor load management can even jeopardize the normal development of promising youngsters. Since this study is going to identify the relationship between internal load and NMF and indirectly the association between load and match performance, it will provide a contribution to fill the knowledge gap in the area in general and help teams to be able to have a clear understanding of how they are improving or ruining performance with the training they are running.

It has been found that starting and non-starting soccer players showed reductions in performance over an 11-week period, although the problem was more pronounced with the starters (Kraemer et al., 2004). Another recent finding however, showed that starter soccer players develop sprinting speed more than non-starters and substitutes (Dalen & Loras, 2019). On the other way findings revealed that to further improve and maintain anaerobic fitness, soccer specific fitness alone is not enough (Beaton, Bianchi, Coratella, Merilini & Drust, 2018; Negra et al., 2018). These findings showed how unclear was the issue of relationship among TL, recovery, and NMF (anaerobic fitness). Basically, the training and developmental methodology of speed, agility, and RSA is vigorously studied, and need to be acknowledged. Nevertheless, the effect of weekly TL combined with stress and recovery level over a number of microcycles on physical fitness was not that clear in soccer (Brink et al., 2010). Thus, the issue of identifying the relationship between TL and recovery level with NMF would be too contributing. What is equally important is portraying the association of the variables with success. Since there is no direct relationship between fitness and soccer match performance, it was paramount to test the association of stress, recovery, TL and NMF with match success indicators. Finally, the examination of how the factors as weekly TL, level of recovery and NMF test scores determine match performance was another focus of the research. Perceived TL is the product of load imposed (external load) and the condition of the players. Internal TL is presumed to be the factor to cause homeostatic disruption and the resulting adaptation process. The stressors from personal life and sport related issue affect soccer player`s body and psychological characteristics. Similarly, the perceived recovery level can affect soccer players’ readiness to work and their abilities to adapt (because adaptation occurs during recovery). The literature in this area makes clear that soccer players’ ability to recover is dependent on varied conditions. What the literatures does not make clear is the relationship and interdependency of the extent of stress, recovery and TL, as well as, how these relate with NMF and match success levels. Hence, research in this direction was found worthy of investigation.

1.3. Objectives of the Study

General objective

The general objective of this PhD research project was to demonstrate how perceived stress, recovery and weekly TL relate with players` neuromuscular fitness (NMF) and the soccer clubs match success at Amhara regional state.

Specific objective

More specifically, the study included the following objectives.

1. To expore how significantly different are the teams in their players NMF performance and success level
2. To identify the association of soccer players` NMFs with perceived stress, recovery level and weekly TL
3. To explain how perceived stress and recovery level relate with perceived weekly TL
4. To disclose how perceived stress, recovery and TL determine NMF of the players
5. To examine the relationship between team success and the players` perceived stress, recovery, TL and NMF
6. Explore how perceived stress, recovery, TL and NMF predicts team success level

Research Questions

1. Are the studied teams' significantly different interms of the players` NMF and success level?
2. What is the relationship of perceived TL, stress and recovery level with that of the players` NMF?
3. What is the extent of the relationship that the players perceived TL has with their perceived stress and recovery level?
4. How significant is the prediction capacity of perceived recovery, stress and TL as a factor to the players NMF performance score?
5. How significant is the relationship that team success has with the players perceived TL, stress, recovery and NMF of the players?
6. Is success prediction capacity of the players perceived TL, stress, recovery level and NMF score statistically significant?

1.4. Significance of the study

Theoretical significance

One of the main goals of training in team sports is to develop physical fitness in preparation for competition (Jeong, Reilly, Morton, Bae & Drust, 2011). However, preparing a training program can be challenging for the most part since coaches are required to prescribe TLs that maximize positive physiological adaptations, at the same time preventing overtraining and injury. Therefore, the precise control of TL and individual responses to training is essential for maximizing training adaptations (Borresen, & Lambert, 2009). The finding of this study, on the practical relationship of TL, stress, recovery and performance thus may help to come up with a TL level that is productive and safe.

Though there is credence on RPE to assess internal load (Haddad et al., 2015; Weston, Seigler, Bahnert, Mcbrien, & Lovell, 2015), there is minimal evidence examining the dose-response relationship between RPE (internal TL) and physical fitness in most sports, including soccer (Aughey et al., 2016). Therefore, identifying the relationship between perceived load (using RPE), physical fitness level and match performance can have a theoretical as well as practical implication to realize match success. So far, in the literature on this field, researchers assessed the relationship between perceived load (RPE) and aerobic performance (Castagna, Impellizzeri, Chaouchi & Manzi, 2013). The NMF components, which are inherently frequent actions in soccer match (Rampinini et al., 2011; Thorlund, Agaard & Madsen, 2009), and their relationship with perceived load have been minimally studied (Brink et al., 2010). For example, a recent study that investigated the relationship of perceived load and NMF even focused only on 15- and 5-meter speed tests, CMJ, arm swing CMJ and single leg CMJ (Los Arcos et al., 2014) without considering full linear speed, CODS and RSA. Therefore, a study that instigate the interdependency of perceived TL, recovery level, NMF (40m linear sprinting speed, RSA and CODS), and match success will have a theoretical significance in addressing the identified gaps in the literature on this field.

Managing daily TL is important, since subtle TL variations can potentially modify the physiology and wellness status of highly-trained soccer players during intense training phase (Malone et al., 2017a & b; Buchhet et al., 2013). Also TL can affect match success or performance (Aughey et al., 2016). In soccer, the effect of weekly TL on physical capacity and match success has not been investigated, though it is studied in other team sports, for example rugby (Aughey et al., 2016).

To sum up, studying the existing relationship between weekly-load, recovery, physical fitness and match success is very relevant for knowledge (Borresen & Lambert, 2009). This research can portray how load dictate NMF test score and how this effect translated to match success. This is because that, though the general idea of U-shaped relationship between load and performance (Cross et al., 2016), there is no information regarding how the internal load that each player experience affect field based fitness test score and how these phenomena determine success is an area that this research would fill up. Therefore, GAS theory which claims the relationship of TL and performance to be U-shaped will benefit from this study as it figure out the existing relationship between TL, recovery, stress and physical fitness and match success.

Fitness maintenance is a constant challenge because of short duration window for peak performance maintenance in elite sports (i.e., only for 2-3 weeks) (Turner, 2011). Thus, long term study of the relationship between load and fitness and its association with match success will aid the process of developing performance maintenance strategies. There is no clear insight about training-recovery-adaptation in elite soccer, so that the study will potentially add something to the existing literature about the interrelationship between those variables as load, recovery, NMF and match performance. This will also help to understand how players` NMF levels account for match performance.

Practical significance

The targeted teams are those found in Amhara regional state, participating in the national league level ("Andegna League"). These teams were expected to have 20 matches in their respected group with the expected future high performance demand to join the premier league. Here a context-based insight about the relationship and interdependence between load, recovery, fitness, and match performance is too critical in the long journey of attaining and maintaining peak performance. Generally, from the practical perspective, the study was meant to help these clubs in identifying how the training they conducted was optimal enough. Hence, the findings help to practically evaluate the relevance of what they have done so far and provide them tools and strategies for improvement. As a modifiable factor, they can be informed and take appropriate measures if the training is resulting under-load or if there is overtraining, which both of them are accountable for ruining soccer players' performance and wellbeing. In addition, it informs how to ensure appropriate recovery level as a competitive edge and preparation.

Performance indicators depend upon the number of matches, the quality of opponent and the physical demands of match (Castellano, Alvarez, Figueira, Coutinho & Sampaio, 2013; Shafizadeh, Taylor & Lago-Penas, 2013). In studied context, the physical match demand of the league has not been explored yet. Hence, examining how fitness test scores relate with success can show how physicality is important in this specific league. Although studies show similar findings in relation to successful performance indicators in soccer, many of them also suggest that a number of differences occur in different leagues, due to the local context, culture and tactics deployed. For example, Dellal et al. (2011) found that England premier league players cover greater distance in sprinting while La Liga players found to won more aerial heading duels. Therefore, indication of success prediction capacity of fitness and related variables will help these teams to work accordingly.

Technical-tactical performance is one of the dominant success predictor (Bradley et al, 2013b), though differences exist between leagues and competition type. For example, in world cups, possession, conversion of possession into shots, total shots and on-target shots are the best success predictors (Hughes & Franks, 2005). The same thing is found in Euro 2000 (Hook & Hughes, 2001). In another finding, it was reported that possession is not a discriminating parameter of successful and unsuccessful teams in the 2002, 2006 and 2010 world cups (Castellano, Casamichana & Lago, 2012). As the level or status of soccer is higher the technical-tactical quality becomes the primary success determinant. But with low status soccer, the contribution of the physical quality is high. In the studies context the success prediction capacity of physical fitness is presumed to be high. However, it was not studied whether it is the physical quality or technical-tactical quality that matters the most. Therefore, this study was too worthy to show which factor and which specific performance parameters are contributing for success and it would be informative and guiding to work accordingly.

1.5. Delimitation of the Study

The study was concerned about perceived TL which is internal load, with out the consideration of external load. The same way, perceived stress and recovery were considered without any physiological measures which are believed to be markers of stress and recovery level. In relation with physical fitness or NMF, field based test scores of 40m dash linear speed, 9-3-6-3-9 CODS and 6*35m RSA were considered. There were no match physical work measures as NMF measure. Success was considered only using the number of goals scored, goals conceded and points obtanined per match.

The study was on national league level soccer players only. Though, the staudy was conducted with the national league soccer players, those clubs who have their resident in Amhara region were taken. There were 11 clubs in the region and out of these, 5 clubs were randomly seleted for the study. Interms of considereing the matter over a course of time, the data was collected only for the first 5 consecutive weeks during the competitive period.

Operational Definition of Key Words and Concepts

External Training Load: The physical work referring to variables such as time, distance, weight or repetition. In a football language, it is the exercise prescription by the coach independently of the individuals' internal response.

Internal Training Load: The physiological or psychological stress imposed on players, and measured through physiological variables or using RPE. This can be measured by assessing internal response factors within the biological system, which may be physiological and psychological.

Recovery: In this research, the word recovery understood as physical and psychological condition that involves normalization of physiological functions (i.e., blood pressure and cardiac cycle), return to homeostasis (resting cell environment), restoration of energy stores (i.e., blood glucose and muscle glycogen) and replenishment of cellular energy enzymes (i.e., phosphofructokinase, a key enzyme in carbohydrate metabolism). Specifically recovery in soccer can be considered with four specific divisions: a) neuromuscular recovery, b) recovery of the large scale systems that power the body during movement, c) restoration of energy stores and d) psychological recovery.

Stress: it is a state of mental (emotional) and physical strain resulting from adverse or demanding circumstances. These demanding circumstances include experiencing something new (unexpected) or something that threaten self-feeling or feeling that we have little control over a situation. The responses (symptoms) can be emotional (anger, anxiety or depression) and physical (headache, back pain, jaw pain or muscular tension)

Success: It is the level of achievement teams realized in terms of scoring goals and cumulative points from match results (win, draw and lose).

Training Load: The dose of physical work and the cumulative amount of stress placed on individual player from a single or multiple training sessions.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.0. Overview

In this section of the research, the prevailing theories underpin the relationship among training, recovery and adaptation are addressed. Also the basic tenets of the theories and the potential limitation with their dogmatic assumption are evaluated. Importantly, the compensation which should be considered with the theories is also discussed. Generally, the process of adaptation because of training load (TL) as well as the physical fitness and technical-tactical demands of soccer are critically analyzed. Also the facts and reasons, which make soccer the most demanding sport, are addressed. In relation with its demand, the extent and nature of high-intensity actions in contemporary soccer were explored in depth. Thus, linear sprinting speed, RSA, and agility versus CODS were among the focus of the review. As a critical issue, this literature review explored how soccer is undergoing revolution in its demand and how physical fitness fluctuation can be explained.

2.1. Training Load (TL), Adaptation and Recovery

In the pursuit of getting a competitive edge, players go through a specific training regimen, which is supposed to induce adaptation in the muscular, metabolic, and neurological systems (Borresen & Lambert 2009). The principles that govern sports training can be summed up into a simple dose-response relationship between the stresses associated with the load of training and the training adaptations or responses (Borresen & Lambert 2009). The response in this relationship can be measured as a change in performance or the adaptation of a physiological system, but the assessment and provision of optimal dose based on the nature of the training is difficult. This is so because soccer players have an inherently high training load due to short recovery periods between games and subsequent training sessions (Nedelec, Halson, Abaidia, Ahmaidi & Dupont, 2015). Elite players are often exposed to yearlong training and high match frequencies, with periods of a congested calendar, which can cause higher injuries (Gabbett, 2016). The paradox is that a well-developed physical quality is required to withstand the stress imposed by competition and frequent training (Gabbett, 2016).

Though training is a major intervention to bring about adaptation, the importance of adequate recovery for adaptation is well acknowledged (Loren, Chiu & Barnes, 2003). For this, training load should be in a constant adjustment to either increase or decrease fatigue incurred in order to handle the different training cycle and competition phases (Halson, 2014). Research shows that, decreasing TL during taper weeks by reducing training duration and frequency while maintaining intensity is positively associated with an increase in physical activities during matches (Fessi, et al., 2016). However, it is not clear whether tapering or other match factors led to the changes in match activity (Fessi et al., 2016). Therefore, we need to ensure a well-planned work to rest ratio to eliminate fatigue and reduced stimulus for adaptation. Stone and colleagues (2007) indicated that three theories describe well this trade-off. These theories are the general adaptation syndrome (GAS), stimulus-fatigue-recovery-adaptation (SFRA), and fitness-fatigue (Fit-Fat).

I. The GAS Theory

The GAS was the original model from which periodization evolved (Turner, 2011). The GAS describes the body`s physiological response of an organism to stress (training). The GAS theory also offered a physiological rationale as to why adequate recovery is an essential part of training program. It argues that adaptation or technically, super-compensation can be realized when the player gets optimum recovery. However, GAS proposes that all stressors result in similar response. This is actually one of the major limitations of this theory as different exercises have varying effects (Beaton et al., 2018; Negra et al., 2018). GAS suggested that the best training effect occurs when training loads stress the athlete's body. But the problem here is that there is no that golden guide to prevent the occurrence of overtraining or non-functional overeaching. Thus, with its limitations, GAS theory is valuable to sport training theorists because it can explain the physiological rational as to why adequate recovery is essential. GAS has three basic stages: alarm, resistance and exhaustion stage.

The alarm phase or alarm reaction stage represents the recognition and initial response to exercise or training stress. Sports' training as a stressor disturbs the athletes' body homeostasis (Crevecoeur, 2016). It takes a certain level of load to disrupt the internal equilibrium of the cell, tissue or organism (i.e., principle of overload). However, the resistance phase or adaptation stage is the stage where the organism starts producing more metabolic and structural elements that are required to enhance its ability to withstand another exposure (Crevecoeur, 2016). The body is returned to either its baseline (pre-exercise homeostasis) or its newly adapted higher state (super-compensation) at this stage. The adaptation stage occurs, if the stress continues or recurs for a period of time and accompanied with time for recovery and rebuilding to take place. If the accumulation of stress is too high (e.g. absence of unloading week or tapering), the exhaustion phase occurs. Exhaustion can be considered synonymous with overtraining (Stone et al., 2007). Thus, the third stage is a stage where the organism's adaptive capacity is overwhelmed, or exhausted, because if homeostasis is disrupted profoundly, recovery becomes impossible. We become more susceptible to a range of biopsychosocial symptoms (Crevecoeur, 2016). This is due to the inability of the body to meet energy demands and due to side effects of extreme or exaggerated stress reactions. To the extent, the consequences of this stage can be huge (Drew et al., 2016). Therefore, GAS and the concept of super-compensation are important to researchers and practitioners alike. They are important as these two entities provide a conceptual basis for the study of the human in relation with exercise.

The principle of recovery is part of the adaptation process (Cross et al., 2015; Drew et al., 2016; Stares et al., 2018). Always incorporate the recovery time as a recognizable part of the players training program or time need to be long enough to allow super-compensation. Short recovery time between training sessions can yield a more persistent fatigue induced by each training (Busso, Benoit, Bonnefoy, Feasson, & Lacour, 2002). Still the recovery time should not be too long to the level of involution. The underlying principle of GAS theory is provision of training stimulus that results the alarm and resistance stage while preventing the exhaustion stage. However, the week by week matches, the day by day training and the psychological burden of life as a stressor may not enable players to achieve the required level of recovery easily. Even as a matter of individual difference some players may not recover while others get involution. The way coaches or trainers working in line of this complicated interdependency of the variables as load, intensity, recovery, fatigue, and adaptation or super-compensation may be questionable.

II. Stimulus-Fatigue-Recovery-Adaptation (SFRA)

In the trajectory from training to fitness gain or adaptation, soccer players' body experiences disruption of homeostasis, which calls a rest time for adaptation to come about. According to the theory of SFRA, the level of fatigue a soccer player experience is directly proportional with the intensity and duration of exercise (Turner, 2011). Allowing a soccer players body to have rest enables to dissipate fatigue and to experience adaptation. This concept also suggests that if the stress is not applied with sufficient frequency (density), detraining (involution) will occur. The accumulation of fatigue from the sequential execution of similar training sessions can pose additional burden or sever stimulus. The trend of seven or more sessions per week in soccer can cause accumulated fatigue, which is not logically possible to get recovery from this with one day off-training or something else. This strategy however, is reserved for elite level athletes, whose window for adaptation is small, and therefore requires more intense interventions to bring about super-compensation (Bompa & Haff, 2009).

Complicating the issue, recent findings recommended additional training to soccer specific training so as to maintain and further improve some important fitness elements (Beato et al., 2018; Negra et al., 2018). For example, additional plyometric and high intensity interval training are regimens to be incorporated during the in-season (Negra et al., 2018). Match, daily life stress, soccer specific training and additional training protocols may highly impact the body in the way that we cannot predict easily. This complication alone is worthy of investigation on the matter.

III. Fitness-Fatigue theory

The fitness-fatigue theory is the most prevailing theory of training and adaptation (Loren et al., 2003; Plisk & Stone 2003 & Stone et al., 2007), and it is considered as the basic tenet of a taper (Mujika & Padilla, 2003). Unlike the GAS and SFRA theories, which assume that fitness and fatigue share a cause and effect relationship, the Fit-Fat model suggests an inverse relationship. It argued that training has two aftereffects, which can either positively or negatively influence performance: fitness & fatigue (Turner, 2011). While the fitness after-effect is a positive physiological response, the fatigue after-effect is a negative one.

This, therefore, implies that strategies that maximize fitness and minimize fatigue will have the greatest potential to optimize soccer players' preparedness (Stone, et al., 2007). The other difference between the Fit-Fat concept and the other two theories is that it differentiates between actions of various stressors, such as neuromuscular and metabolic stress (Chiu & Barnes, 2003) and therefore implies that the aftereffects of fitness and fatigue are exercise specific (Stone, et al., 2007). Thus, Fit-Fat model argues that different training stress result in different physiological response. This suggests that if the player is too tired to repeat the same exercise with the required quality standard, they may still be able to perform another exercise for satisfaction though the quality of work may in question. This is practically the common trend in this contemporary soccer, as soccer players perform different exercises with different objectives sequenced one after the other. However, the potential exhaustion effect of such a perspective is not elucidated.

Monotonous loads and training methods can predispose to stagnation (Stone, et al., 2007). This is true according to the principle of "diminishing returns", where the nervous system of the player is no longer challenged to have adaptation. This ideology serves as the rationale for the regular application of novel and semi-novel tasks and training loads (Stone et al., 2007), or the simple logic behind the need for progressive overload. However, it should be noted that too much variability in training stimulus could reduce the opportunity for the soccer players' body to adapt to the stimulus, and further impede the development (SFRA theory) (Bompa & Haff, 2009). Both extremes of the spectrum may not help for generating adaptation. Therefore, soccer coaches should be curious about the issue, and its resulted consequences.

As per Fit-Fat theory the factors such as the overall training load, training intensity or quality, and total work done are the real determinants of the level and duration of fitness and fatigue after-effects (Busso et al., 2002). This point illustrates the differing perspective of the GAS and fitness-fatigue theory. Regardless of being the main theory in training and adaptation relationship, GAS theory neglects the intensity and specificity of training stimulus. It simply considers the effect of any intensity level and exercise or training protocol to have the same effect. Thus, only the work alone regardless of the intensity level and training type is responsible for the coming adaptation. However, the fitness-fatigue model acknowledges the effect of both type and intensity of training to contribute for the adaptation or homeostatic disruption.

The inevitable occurrence of varied fitness parameters and fatigue after-effects can potentially justify why individual physical qualities respond differently to variations in training. For example, empirical evidence in weightlifters finds that in periods of maximal strength training, explosive strength and muscular endurance suffer and when the emphasis is on explosive strength, strength is impaired (Belzer et al., 2003). Thus, when the emphasis of training is on a specific physical quality, the other specific fitness after-effects diminish and that specific aspect of performance increases. Therefore, adherence to the principle of specificity has a double merit in that it cultivates the required fitness and it helps to minimize the fatigue effect on other elements.

2.1.1. Compensation of the GAS theory with SFRA and Fit-Fat

These are important tenets of training for sport, though they do have differences to an extent. From each theory there are principles and concepts which are useful for soccer training. The issue of progressive overload and inclusion of recovery are fundamental scientific principle which is the belief of these theories. However the weakness held with the GAS theory, the belief that says any form of stress or training has the same effect, need to be compensated with the SFRA and Fit-Fat model that holds a firm stand about the specific effect of a training or exercise type (Stone et al., 2007).

The other limitation of GAS theory is that fatigue or homeostatic disruption level is not related with the volume and quality of stimulus which is not true as per both SFRA and Fit-Fat theories (Turner, 2011). This means that according to SFRA theory, the level of fatigue is a direct function of both intensity and volume of training. This theory however, argues that because of a perfect specific effect of each kind of training the fatigue incurred from one form of training do not affect at all the other segment or potential. For instance, speed training does not affect endurance capacity of a player. Nevertheless, this belief of SFRA does not hold water as the effect of a specific training is not that much clear enough (Chiu & Barnes, 2003). The fit fat theory can better guide to understand the specific and non-specific effect of a training stimulus (Chiu & Barnes, 2003; Stone et al., 2007). As the current exercise physiology knowledge is evidenced, each exercise type has a corresponding fatigue effect and some nonspecific effect (Busso et al., 2002; Johson, 2003). For example, a 40-minutes speed or explosive strength training has a specific effect of fatigue on speed or strength capacity of players. Still this kind of training can affect the endurance capacity of players to an extent.

The key in soccer training is the relationship between fatigue, recovery and adaptation. As it is explained by the SFRA theory, the level of fatigue depends on the intensity and volume of the training (Turner, 2011) and the recovery time required is dependent on the level of fatigue or TL (Stones et al., 2007). Therefore, the adaptation achieved is dependent on the intensity, volume and type of stressor (Fit-fat theory). However, the immediate effect of training as a stressor is negative that means it results a temporary reduction in fitness, fuel store, or damage to cells biochemical structure (the alarm stage of GAS theory) (Haddad et al., 2015). But during the recovery time the body starts to rebuild the structures and work capacity to the base line level or to a level which is greater than the base line (the resistance or adaptation stage of GAS theory) (Bompa & Haff, 2009). Therefore, an integration of the three theories is mandatory as far as the knowledge of contemporary exercise physiology concerned. Progressive overload, specificity, recovery, adaptation, and load monitoring are issues which are the basic in sport training aiming improvement. Hence, out of these theories, Fit-Fat can better consider the complicated concept and demand of training intervention for competitive soccer players.

2.1.2. Fit-Fat Theory for Elite Athletes

Elite soccer players are expected to have a well-developed high level of fitness. Therefore, the training emphasis shifts to specific fitness adaptations. The maximum possible performance can be realized if fatigue after-effects are lower and fitness after-effects are higher. The main which is important is that either fitness or fatigue cannot exist autonomously. Rather one can be higher while the other is relatively less. How can we realize high fitness with moderate fatigue, rather than moderate fitness and low fatigue? The main concern here is how manipulating the training parameters can alter the magnitude and durations of these after-effects, at the same time, producing the optimal level of performance. Following a period of stressful training, the magnitude of specific fitness and fatigue aftereffects is high (Bompa & Haff, 2009; Turner, 2011). A period of training that involves reduced total work is required to remove the fatigue after-effects, as per the principle of recovery (Bompa & Haff, 2009). This is what is needed as a method of supersaturating physical vitality before a game, technically this phase is called the taper. Without a period of taper, it is difficult to have adaptation or super-compensation and this makes the estimation of a training program impact underscored.

During the days before a match day, elite players do not completely abstain from training (Nédélec et al., 2012). Although a drastic reduction in volume load occurs during these few days, intensity remains high. This approach is advocated and common, because brief and less frequent imposition of high-intensity training is believed to maintain or increase the specific fitness after-effects without substantially affecting fatigue after-effects (Hoffman, & Kang, 2003). Therefore, this period is more than simply eliminating the fatigue after-effect; this period also maximizes the magnitude of the fitness aftereffect, though the exact effect is not clearly confirmed.

However, all these approaches are not well-established to be productive and further research is needed on the matter (Marqués-Jiménez et al., 2017; Nédélec et al., 2012). Although fatigue and recovery in soccer has been extensively studied, there are still uncertainties about the underlying mechanisms because they are influenced by physiological and psychological demands (Marqués-Jiménez et al., 2017).

2.2. Soccer as a Demanding Sport

Performance in soccer requires myriads of player`s qualities and highly depend upon a subtle blend of the individual qualities (Barnes et al., 2014; Stølen, Chamari, Castagna & Wilosff, 2005). A philosophical view of considering the different performance factors as a unit is a sound ground for soccer training (Pimenta, 2014), to adhere to the principle of specificity. Competing within the elite level of the sport, soccer players are expected to possess well-developed physical capabilities complementing the technical and tactical demands of contemporary soccer. In particular, superior aerobic capacity (Chamari et al., 2005), muscular strength, power (Wisloff, Castagna, Helegerud, Jones, Hoff, 2004), and repeated sprint ability (RSA) could be critical components to combat the limited ball contacts encountered during match play (Dellal et al., 2011). Therefore, teams with these qualities may be better off, though a congested schedule, as is often found among elite clubs, makes it problematic for coaches as they attempt to simultaneously integrate the different training parameters (Iaia, Ermanno & Bangsbo, 2009).

Playing soccer requires players not only to be strong and powerful, but also aerobically fit and able to recover from high intensity intermittent exercise (Hoffman, Rreed, Leiting, Chiang, & Stone, 2014). Due to this, coaches and sport scientists pay attention for a complex range of variables when developing training programs. At the elite levels, the quest for success in soccer continuously leads practitioners, researchers and sports scientists to explore different means to evaluate and improve these main areas of performance. What makes the challenge more pronounced is that performance and success in the complex soccer game relies on multitude of factors, including technical skills, tactics, mental aspects, and physical capacities (Lockie, Schultz, Callaghan, Jeffriess & Berry, 2013). For example, in a single game, a soccer player performs nearly 1400 activities during a match. These include between 150 and 250 brief intense actions of acceleration or deceleration, change of direction, and achieved 200 displacements at high speed at varied distance. In addition, he executes high-speed run either with the ball or without the ball. All these activities are interspersed with brief recovery periods (Bangsbo, 2014; Bangsbo et al., 2006). When the player is in ball possession, these intense exertions include technical actions of approximately 15 tackles, 10 headings, and 50 involvements with the ball (Stølen et al., 2005). Running with the ball or being in possession is too demanding, because manipulating the ball and resisting the opponent charge more energy.

2.2.1. Physical Activity Profile of Soccer Players and Level of Play

Contemporary male professional outfield soccer players cover a running distances on average ranging between 10 to 13km (Dellal et al., 2011; Mascio & Bradley, 2013) at an average intensity close to the anaerobic threshold (i.e., 80–90% of maximal heart rate). However, most of the distance is covered by walking and low-intensity running and it is mainly the high-intensity exercise periods which are important (Bangsbo, 2014). The majority of high-intensity actions, irrespective of player`s position, are short in both distance (less than 20m) and duration (less than 4 seconds) (Spencer, Bishop, Dawson & Goodman, 2005).

While high intensity movement makes up only a small part of the total distance covered, elite soccer players perform between 150 and 250 intense actions per game (Iaia et al., 2009). For example, in the English Premier League it has been shown that players run at high-intensities (>19.8 km/hr.) every 72 seconds (Bradley et al., 2009b) and they observed a change in running activity every 3.5s, a high-intensity bout every 60s, and a maximal effort every 4 minutes. Still only a small percentage (approximately 2%) of the total distance covered by players is achieved in individual possession of the ball (Di Salvo et al., 2007). Relative to the overall distance covered by players, approximately 7-12% is covered at high-intensity and 1-4% whilst sprinting (Bradley et al., 2009a; 2009b; Di Salvo et al., 2010).

In some studies, it has been shown that, the amount of high-speed running is what distinguishes top-class players from those at a lower level. For example, Mohr and colleagues (2003) noted that international top-class players perform 28% more high-speed running and 58% more sprinting than professional players at a lower level (i.e., when top-class international players run 2.43 km in high-speed running and 650m sprinting, professional players at lower level cover 1.90km in high-speed running and 410 m in sprinting) (Mohr et al., 2003). On the contrary, Ingebrigtsen et al. (2012 & 2014) found that top teams in the Danish League covered 30–40%

more high-speed running distance compared to the middle and bottom teams. Still, Di Salvo, Pigozzi, Gonzalez-Haro, Laughlin & De Witt (2013) observed that Championship players did more high-speed running and sprinting than players in the Premier League did. Along the same lines, a comparative study of the top three competitive standards of English football highlights that, players in the second (Championship) and third (League 1) categories performed relatively greater volume of high-speed running (>19 km/h) than those in the Premier League (803, 881 and 681 m, respectively) (Bradley et al., 2013a). . The same was true for sprinting (308, 360 and 248 m, respectively) (Bradley et al., 2013a). These differences accounted for all positions. The difference in the level of physical workload may be related to the playing style that Premier League teams utilize possession-based play. Higher level and successful teams have a low physical exertion than lower level or low level teams. For example, successful Italian teams appear to cover less distance with high-intensity running compared to unsuccessful teams, but more distance while in possession of the ball (Rampinini, Impellizeri, Castagna, Coutts & Wisloff, 2009a). In addition, players run and cover more distance with high-intensity running when playing against higher quality opponents than lower quality teams (Castellano, Blanco-Villasenor & Alvarez, 2011; Di Salvo et al., 2013). Playing against strong opponents has been found to be associated with lower ball possession (Bloomfield, Polman, & O`Donoghue, 2005; Lago, 2009). Thus, players from lower ranked teams are expected and taxed to cover more distance so as to compensate their opponents' technical-tactical superiority and possession domination.

In general, soccer players should perform many types of exercises over 90 minutes, ranging from walking to maximal running and the intensity of movement can vary at any time in a way that makes it intermittent in nature (Bangsbo et al., 2006). In this circumstance, numerous explosive bursts of activity are required, including jumping, kicking, tackling, turning, sprinting, changing pace, and sustaining forceful contractions to maintain balance and control of the ball against defensive pressure (Bangsbo et al., 2006). However, as there are teams from lower divisions with as high aerobic capacity as professional teams, the anaerobic factor probably plays an important role (Stølen et al., 2005*).* As a result, successful or higher ranked teams need to keep working to increase their physical capacities further, though the total distance covered by each player has remained relatively constant over the last few years. This is basically because that, the frequency and length of high intensity action (i., sprinting and sprint related qualities) demand is increased (Barnes et al., 2014). It meant that soccer players` possess complex demands on the majority of the body's energy systems (Krustrup et al., 2006). To cope with this, soccer players must have outstanding physical capacities to perform the aforementioned actions for prolonged time with a brief recovery between high-intensity actions.

2.2.2 Soccer Demands across Playing Positions

Across players` positions there is a significant variation in the general fitness components (Boone, Vaeyens, Steyaert, Bossche & Bourgois, 2012) and competitive physical activity profiles (Bloomfield, Polman, & O`Donoghue, 2007; Burgess, Naughton, & Norton, 2006) mainly linked to the tactical demands specific to each position. In the contemporary soccer game, fullbacks and wide midfield players cover the largest distances in high-intensity running (Di Salvo et al., 2007). Moreover, it has been shown that physical activity profiles even differ significantly among central midfield players depending on individual tactical role (e.g., offensive midfielder versus holding midfielder) (Dellal et al., 2011). Surprisingly, studies in the area reported large differences in high-intensity characteristics across playing positions (Di Salvo, Gregson, Atkinson, Tordoff & Drust, 2009; De Salvo et al., 2010). This suggests the need for a criterion model in order to tailor training programs to suit the particular needs of each player's position, and the situations individuals commonly experience during a game (Boone et al., 2012). The contemporary essence of training objective argued that in order to optimize the players' match-play performance, training sessions should induce similar physiological and technical demands to that encountered during competition (Dellal, Wong, Moalla, & Chamari, 2010).

The modern soccer has become a game of increasingly limited space and time that the combination of improved training methodologies, increased resources dedicated to individual players, and better understanding of human physiology has helped soccer players to become faster, quicker, and stronger than ever before. One of the results of these improvements has been the development of players who are capable of covering ground quicker and applying pressure to the opposition higher up the field for longer periods. It is physically demanding for teams to play with a high line of confrontation. For this to happen, it is a prerequisite to have a high level of fitness and athleticism, high degree of coordination and an aggressive and positive team mentality (Lavers, 2009). However, the common approach of group or team exercise where players experience and perceive different load (Los Arcos et al., 2014), make trainings without adherence to the principle of individual difference (Impellizzeri, Rampinini, & Marcora, 2005).

2.2.3. The Physical Demand of Being in Possession

In elite soccer, only a small amount of the total distance covered by players is in possession of the ball (Di Salvo et al., 2007; Rampinini, Coutts, Castagna, Sassi & Impellizzeri, 2007b). Players are only in possession for approximately 2-3% of the entire match duration (Di Salvo et al., 2007). Across player positions, possession varied significantly ranging from 1.5% of the total distance (in fullbacks, center backs and center forwards jointly) to 2.2% in wide-midfielders (Di salvo et al., 2007). This means, only 1.2-2.4% of the total distance covered by professional soccer players is in possession of the ball (Di Salvo et al., 2007) and confirming that efforts in this component of play are strongly dependent on playing position (Bloomfield et al., 2007).

As part of the multifactorial demands of soccer play, the ability to run with the ball is considered essential for successful play (Huigjen, Elferink-Gemser, Post, & Visscher, 2010). However, highly ranked professional soccer teams are shown to run greater distances with the ball than counterparts from lower ranked teams (Rampinini et al., 2009a). In Italian professional soccer it has been has shown that distance covered in high-intensity running with the ball was highest in top-5 ranked compared to bottom-5 ranked teams (Rampinini et al., 2009a). Research has also shown that physical efforts of players when in possession of the ball have increased in the contemporary game compared to in previous decades (Di Salvo et al., 2007).

The majority (34%) of the total distance in possession covered at speeds >19.1km·h (Carling, 2010). Thus, despite the small percentage covered with the ball in relation to the overall efforts of players, these results suggest that running with the ball at high speeds is a fundamental component of physical performance in match-play. In order to develop this component of play, players should perform training drills during which they run with the ball at high speeds. But high energy expenditure is evident when running with the ball compared to normal running (Rupf, Thomas, & Wells, 2007). This is because running with the ball substantially increase physiological stress (Rupf et al., 2007). Thus, the cost of running or being in possession of the ball is relatively high (Rupf et al., 2007). In other words, ball-oriented running drills performed at high-intensities would provide a useful means to develop fitness whilst simultaneously aiding technical development (Carling, 2010). In addition, player motivation during physical conditioning drills is suggested to be higher when the ball is used (Helgerud, Engen, Wisloff & Hoff, 2001) and may encourage adherence to physically intense training programs. The implication is straight forward that, the modern perspective of economical training paradigm that advocates having the ball with most training drills may pose extra burden as a load. An extensive training session, where each player has higher possession time can induce excessive load that can cause detrimental effect. The impact of this kind of regimens is not well studied and it seems worthy of investigation with a clear examination of load-response relationship.

Physical activity profile analysis of soccer generally indicates a decline in second half and end-match running performance (Iaia et al., 2009; Reilly, Drust, & Clrke, 2008). However, with Carling, Espie, Gall, Bloomfield & Jullien (2010a) research, no drop in the physical efforts in ball possession was observed across match halves. The same result was observed in the final third of games with results also unaffected by playing position. This positive finding suggests that players' efforts in ball possession were unaffected by game-related accumulated fatigue and they were able to maintain performance over the course of games. Strengthening the above finding, Di Salvo et al. (2007) reported that an increase in distance run with the ball in the second half (~5%) in European professional soccer players.

Cognizant of these, a reasonable suggestion could be that players consider individual movement with the ball to involve a degree of risk and might be less willing to attempt such actions over the course of the first half. The other explanation may be the reason that most teams decide to have a safe kind of play rather than taking risks as it is common in the final thirds of the game. In this regard a study has shown that professional players perform less high-intensity activity when winning than when losing (Lago, Casais, Dominguez, & Sampaio, 2010). However, none of these studies considers the effect of acute and chronic load on match physical and technical performance of players or teams.

2.2.4. Evolution of the Physical Demand

Research in soccer has shown that the physical characteristics of players and the fitness demands in soccer match have substantially evolved over recent decades (Barnes et al., 2014; Nevill, Holder, & Watts, 2009). Contemporary competitive soccer had increased physical demands during match-play, as well as a larger number of matches per season. Hence, the main purpose of any contemporary strength and conditioning process is thus to equip players with the optimal blend of fitness-related skills to respond to the ever-evolving demands competitive soccer. These demands refer to a wide range of characteristics that are essential in assisting players in competing for possession of the ball, reacting quickly and optimally to continually changing game situations, and maintaining high performance levels throughout the entire duration of games and across the competitive season. Indeed, a thorough understanding of the athletic requirements specific to match play and factors potentially affecting competitive performance can ensure the execution of objective and realistic decisions for structuring the physical conditioning elements of training. Thus, the study of how fitness status found from test scores relates with actual match performance is indeed worthy of scientific endeavor.

For the increased necessity of anaerobic actions and fitness in the modern soccer, well known people in the area assured that the players have to react faster. More specifically, the evolution of football essentially involves three elements: speed, space and technical and strength. The game is becoming “faster, stronger and played at a higher pace with more ingenious tactics.” (Petr Cech). The implication is that “The quick transition is the most important aspect; quickly restructuring to defend or exploiting the opponent with speed when the ball is regained.” (José Mourinho) and “Acting quickly and effectively by avoid anything that could slow play down.” Carlo Ancelotti “You must capitalize on the space in front of you.” (Sir Alex Ferguson. “We won all one-on-one-situations and that is why we won the match.” (Sir Alex Ferguson). This highlights the necessity and evolution of anaerobic actions as 1v1 situations involve high intensity actions. One-on-one situations are decisive actions which involve intensive exertions, and here speed, agility, and quickness are determinant fitness segments. Still the ability to carry out this repeatedly throughout the game is one big factor. The other thing which need to be taken in to account when we think of the physical demands of the game is that the physiological demands have changed as the nature of the game has further evolved (Barnes et al., 2014; Malone et al., 2015).

2.3. Fatigue and Variation in Physical Performance across a Match

In the contemporary soccer, objective analysis of soccer play showed that there is physical performance declined and variations across a match (Bradley et al., 2009b; Iaia et al., 2009) or matches (Gregson, Drust, Atkinson, & Di Salvo, 2010). Studies showed that players may experience impaired performance transiently after short-term intense activity, at the beginning of the second half, overall from the first half to the second half. In relation to this, Di Salvo et al. (2007) reported no statistical difference across halves in high-intensity running performance for players in professional Spanish football clubs and other top players participating in UEFA Champions League games. On the contrary, Di Salvo et al., (2009) observed a decline in English Premier League matches and the same thing reported in Italian Serie A (Rampinini et al., 2007b). This mixed research results are inconclusive of the equality dilemma in the nature of the first half and second half players. This suggests the absence of clarity in characterizing the two halves. A critical analysis of these studies shows that none of them have tried to associate the decline or maintenance of performance over the course of a match with the corresponding acute or chronic load and recovery levels that players experienced the week/s before the match.

Analysis of play in the English Premier League (Bradley et al., 2009b) and other high standard players (Mohr et al., 2003) have reported substantial declines in high-intensity running both during the last 15-minute interval of games (drops up to -45%) and in the 5-minute interval following the 5-minute period during which activity peaked (drops up to -47%). Research has also demonstrated a significant drop in sprint performance in sub-elite players during a test of repeated sprint ability performed immediately after an intense period of match-play (Krustrup et al., 2006) suggesting that soccer players transiently experience fatigue temporarily during the game.

Research into the underlying physiological mechanisms suggests that accumulated fatigue setting in towards the end of a soccer game may be caused by reduced glycogen concentrations in individual muscle fibers which is something about recovery level (Mohr, Krustrup, & Bangsbo, 2005). The physiological mechanisms behind temporary fatigue observed after dense periods of intense exercise in soccer remain unclear although accumulation of potassium in muscle and a concomitant change in muscle membrane potential has been suggested to be a contributing factor to fatigue (Bangsbo et al. 2007). A significant fall in physical activity at the beginning of the second-half notably in comparison to the opening period of the first-half has also been reported (Mohr, Krustrup, Nybo, Nielsen & Bangsb, 2004). Nothing has been even done to examine the way that pre-match weekly load and recovery level determines match performance decline during the course of a game.

Yet no consistent results, which confirm whether declines in physical performance are associated with changes in technical-skill of players. A concomitant decline in measures of physical and skill-related performance was observed in the second-half of games in the Italian Serie A League (Rampinini et al., 2009a), though a different result obtained by Carling & Dupont (2011) showed that skill related performance was not affected even during physical performance decrement. From the results, Rampinini and his co-researchers (2009a) suggested that the onset of physical fatigue observed over the course of games is accompanied by a drop-in skill-related performance. Research conducted in non-competition environments has come across with a concomitant relationship in variations in physical and skill-related performance (Ali & Williams, 2009; Stone & Oliver, 2009). While the reported findings provided useful information on variations in skill-related performance after the exercise protocol was performed, investigations were frequently conducted in controlled laboratory or field environments using simulated soccer activity (Ali & Williams, 2009; Stone & Oliver, 2009).

Though, physical performance decrement is evident in soccer match, the possible factors which can reduce the speed and extent of fatigue onset is not clearly identified. The impact of pre-match week TL and recovery level can have their impact on match performance and level. The onset of fatigue and physical performance deterioration need to be examined to identify how it affects match success. For coming up with new insight, the investigation of the relationship among weekly load, recovery level, NMF (anaerobic fitness) and match performance or success deems scientific investigation. No study had investigated whether anaerobic fitness are affected by pre-match week's acute and chronic loads.

2.4. Fitness Variation Across a Season

It is acknowledged that natural variations in physical activity profiles occur over consecutive games, at different stages of the season and across seasons (Gregson et al., 2010). For example, the total distance covered and running at high-intensities in a professional Italian soccer team increased during the second-half of the season (Rampinini et al., 2007b). Across the season, changes in performance might be linked to alterations in the physical condition of the players as the activity profile in match-play can fluctuate in conjunction with the amount of fitness training (Drust, Atkinson, & Reilly, 2007). In addition, physical performance can be affected during periods of fixture congestion, in which subsequent matches are played successively over a short time-frame (Dupont et al., 2010; Rey, Lago-Penas, Lago-Ballesteros, Casais & Dellal, 2010). However, there is no consistent finding in this regard, because Carling, Gregson, McCall, Moreira, Wong & Bradley (2015) has found, as congested fixture do not affect match physical performance, reminding the need for further elucidation on the matter.

With the evolution of soccer demand, the training approach and methodology is vividly subjected to change. The common challenge of coaching is how to ensure TL and recovery levels to get the required optimum level of match fitness. The amount of weekly load that imposes adaptation without overtraining has not been clearly known yet. The common injuries that soccer players experiences as a result of under-load and overload can be accounted for the lack of knowledge and guideline in terms of TL monitoring and recovery (Gabbet & Jenkins, 2011; Malone et al., 2017b). Moreover, what makes the challenge more pronounced is that the physical demand of soccer match is affected by myriads of factors as researches in the area witnessed (Shafizadeh ety al., 2013).

2.5. What Matters the Physical Demands of Soccer Match?

While individual playing position is probably the most determining element of physical performance in soccer match, there are other important factors that need attention. Standard of soccer play relates with less physical demand (Bradley et al., 2009a), though the quality of the opponent is considered as one determining factor (Di Salvo et al., 2009). Soccer teams are physically taxed when they play against a better-quality team (Di Salvo et al., 2009). Still team formation is another factor of match physical burden (Bradley et al., 2011a; Tierney, Young, Clarke, & Duncan, 2016). For example, high-speed running and total distance is found to be higher in 3-5-2 than 4-4-2, 4-3-3 or 3-4-3 formation (Tierney et al., 2016). Moreover, the players age (Harley et al., 2010), fitness level and score line status (Lago-Penas & Dellal, 2010), home/away games (Lago et al., 2010), congested fixture (Dupont et al., 2010), environmental conditions as heat and humidity (Nassis, 2013) can affect match physical demand to an extent.

Therefore, elite or competitive players of competitive soccer are highly expected to be able to perform repeated high-intensity exercise or actions. Innumerable factors however, can influence the game demand including playing position, tactical role, style of playing, ball possession of the team and quality of the opponent, importance. Thus, the identification of effects of the above factors on physical performance in competition is beneficial to applied coaching and fitness practitioners. It is also beneficial for informing training and pre-match preparation strategies to aid the team and individuals to maintain and adapt performance whenever they encounter such situations. Even the implication is that physical performance variation or decline can be accounted for numerous variables, calling for context specific investigations (Bangsbo, 2014).

2.6. Work-rate of Substituted Players

Though the ultimate of physical conditioning processes is to provide players with maximal ability to resist fatigue, the introduction of substitutes before the onset of fatigue towards the end of games is seen by practitioners as a valuable means for restoring potential imbalances in physical performance (Drust, Atkinson & Reilly, 2007; Reilly et al., 2008). The substitute may not be as good as the substituted player but only for a reason of being fatigued or inability to maintain the physical performance. This can cost substituting a player who is better in technical-tactical skill with the one who is inferior in this regard. Mohr et al. (2003) reported that the amount of high-intensity running performed in the final 15-min interval of games was 25% higher in substitutes compared to players who had participated in the entire match and still the finding of Carling et al. (2010) prove the same thing. Still it is found that, substitutes cover greater high-intensity running distance specially in attacks, though no difference in passes (Bradley, Lago-Penas & Rey, 2014). These results would indicate the value of replacing players when an increase in the ability of the team to carry the ball and maintain possession especially towards the end of games is required. More importantly it reminds the need for interventions and mechanisms to improve and monitor physical vitality and match fatigue reduction.

When players participate in match plays or games as a starter and substitute, the benefit or adaptation they can have relies on largely on their time of participation. The longer the time they played during matches, the better adaptation they can have. In this regard a study done by Dalen & Loras (2019), showed that playing soccer matches as a starter can help to develop sprinting speed and related qualities (i.e., adaptations in running at high-speeds) more than non-starters or substitutes. This indicate that the development of NMF seem to favor players who mostly play as a starter in the team. Thus, when players are not challenged in a real game condition, their anaerobic quality development can potentially be under question. The contribution of physical work load for NMF therefore ought to be examined with research. Can differences in NMF among teams be accounted to the difference in the number of matches (load) teams play?

2.7. Technical Proficiency and Physical Performance Fluctuation

With observations obtained from controlled simulations of match or using set amounts of exercise to induce fatigue, players technical ability in shooting or passing at a target declines substantially (Ali & Williams, 2009; Stone & Oliver, 2009). No drop of performance across halves in passing and shooting skills reported in professional Italian soccer match-play (Rampinini et al., 2009a). In contrast, the number of skill involvements dropped in the second half in the Italian players whereas this was not the case of other findings (Bradley et al., 2014; Carling & Dupont, 2011), indicating inconsistent results and calling further investigation. However, the reduction in the distance covered in high-intensity exercise was accompanied by a drop in the frequency of several skill-related variables performed during the final 5-minutes of competition in the players (Carling & Dupont, 2011). For this Carling suggest that accumulated fatigue towards the end of competition affected the player's involvement in game actions.

A study conducted on Italian professional soccer players has showed that immediately after completing a match, a field test showed that while the players' repeated sprinting ability declined, proficiency in short passing remained stable (Rampinini et al., 2011). An alternative explanation for these findings might be that the players adopted a pacing strategy (Edwards & Noakes, 2009) to control physical exertion in an attempt to reduce energy expenditure and maintain skill-related performance in the second-half and especially towards the end of games.

Interpretation of the reductions in running performance in the second half or temporarily after the most intense period of games is highly complex, as it could be attributed to physical or mental fatigue, pacing strategies, contextual factors or a combination of mutually inclusive factors (Paul & Nassis, 2015). Moreover, the observed lack of a drop post-match in passing proficiency in professional players mentioned earlier deems further investigation (Rampinini et al., 2011). Despite the technological advancement, scientific investigation and most importantly a more systematic approach to physical conditioning, data indicate that even at the highest standards of competition players are susceptible to transient and end-game fatigue (Carling, 2013). As a result, Carling (2013) reminds that the association between competitive physical performance and success in professional soccer need to be well established with extensive investigations.

2.8. Impact of Opponent Formation on Physical and Technical Performance

In relation to today`s competitive soccer, there is scientific evidence that indicates own team formation can influence match physical performance or demand (Bradley et al., 2009a; Tierny et al., 2016). For example, it has been shown that in the case of English Premier League, high-intensity activity profiles and different technical elements of a team's and player's performance is a direct function of individual playing formations employed by teams (Bradley et al., 2009a). Still while in some instances the playing style of the opposition team impacts the physical demand of a soccer match play (Di salvo et al., 2009; Rampinini et al., 2009b), on some other cases opponents team formation do not affect teams match physical performance (Carling, 2011). But skill-related demands of match-play varied as a function of opponents' formation (Carling, 2011). Even though Comparison of the total distance covered by English premier league (FAPL) and La Liga players showed no difference across individual playing positions, FAPL players generally covered greater distances in sprinting (Dellal et al., 2011). Generally, studies showed teams exhibit differences in various physical and technical aspects of match-play, suggesting that cultural differences may exist across soccer leagues.

Indeed, there are several climatic conditions that raise major concerns in relation to performance notably high altitude, heat and humidity, cold temperatures and pitch condition (Dvorak & Racinais, 2010). There is also speculation about the negative effects on physical performance of playing in cold environments because physical performance characteristics related to soccer such as muscular strength and power output can be affected (Nimmo, 2004) and prolonged exercise in very cold conditions can predispose players to dehydration which in turn can lead to impaired high-intensity endurance performance (Edwards & Noakes, 2009).

2.9. The Effect of Congested Fixture on Recovery and Performance

One of the visible manifestations of congested match fixture is that time for recovery can be short to restore or maintain physical performance and to prevent injury. But the effect of congested fixture on physical and technical performance is not clear as findings in the area are inconsistent. For example, Carling, Le gall and Dupont, (2011), Dupont et al., (2010), Folgado, Duarte, Marques & Sampaio (2015), Rey et al., (2010), and showed that congested match fixture do not adversely affect physical and technical performance to a significant level, but poor tactical performance (Folgado et al., 2015) and higher injury rate (Carling, McCall, Le gall & Dupont, 2016) was evident. However, none of these studies investigated whether impairments in skill-related measures occurred across successive games and these studies don not consider the long-term effects of congested match fixtures on perceived TL and recovery. Physical performance parameters were not significantly affected by the number of matches per week (1 match versus 2 match), though injury rate was significantly higher when players played 2 matches per week versus 1 match per week (25.6 versus 4.1 injuries per 1000 hours of exposure) (Dupont et al., 2010). Accordingly, Dupont and his co-researchers generalized that a recovery time of 72 to 96 hours between 2 matches is sufficient to restore base line physical performance but not long enough to maintain a low injury rate, highlighting the necessity of player rotation and recovery strategies to maintain a low injury rate during congested match fixtures.

In contemporary soccer, teams can participate in over 60 official matches per season (Carling, Gall & Reilly, 2010b). Research has demonstrated accumulated physiological stress and muscle trauma and a reduction in the anaerobic performance of players with perturbations persisting up to 72 hours after competition (Fatouros et al., 2010). Thus, when the time span between games is short, the physiological changes in players might still be present in the ensuing match. Poor weekly load management or periodization can even worsen the problem of the physical preparedness for the upcoming match. A 6-fold increase in match injury incidence was reported in a professional soccer club when two games were played in a week compared to a single match (Dupont et al., 2010). In contrast, Carling et al., (2011), and Carling, Orhant, & Le Gall, (2010c) showed that a very short interval between three successive fixtures did not result in a higher incidence of match injury in players. With these discrepancies in research finding, the possible explanation could be the difference in the weekly load management or periodization employed as a golden rule of periodization is not evident. Therefore, context specific investigations in this regard are warranted. This is because that in a soccer season, players are subjected to training and matches in different environmental conditions with different recovery modalities, and most importantly with different training and periodization approach.

The study by Russell, Benton & Kingsley (2011) has shown that academy players' passing accuracy was maintained across halves in a game simulation whereas the speed of actions was slower during the second-half compared with the first-half. Thus, in consideration of this, ecologically specific investigations are too necessary. For example, with appropriate recovery modalities, neuromuscular and sprinting performance, muscle soreness and passing proficiency in professional soccer players recover to baselines levels 48 hours post-match (Rampinini et al., 2011). Still Dupont et al. (2010) showed that 72-96 hours is mandatory between matches for performance to be maintained. Further research is nevertheless necessary to confirm whether similar results might occur in soccer players during even a normal match and in-season training.

Recently, tactical performance seems to be affected by fixtures distribution as poor tactical performance with congested matches in comparison with non-congested matches is revealed (Folgado et al., 2015). There were no differences in high-intensity running across games (Folgad et al., 2015) although a high coefficient of variation (~34%), suggesting that players did not reproduce consistent high-speed activity profiles across games (Gregson et al., 2010). Beyond this, physical performance has been found unaffected by congested match fixture (Folgado et al., 2015). However, deterioration of tactical performance still can be seen as due some forms of poor or low recovery level. Further analyses showed that the total distance covered and high-intensity running efforts was unaffected across match halves over the period of fixture congestion (Gregson et al., 2010).

Though there is no significant decline in physical performance due to match congestion (Carling et al., 2015), tactical deteriorations are evident (Folgado et al., 2015) as a result of residual fatigue for match congestion. Analysis of attacking play by Carling & Dupont (2011) showed that a greater number of shots (15 vs. 18), shots on target (33% vs. 39%), crosses (26 vs. 29), successful crosses (23% vs. 24%), duels won (52% vs. 57%), and more time in possession (51% vs. 63%) were achieved in the final versus the first game in the sequence. Variation of the players' technical performance can also be accounted for match context, with effects from team and opposition strength greater than effects from match location and match outcome (Liu, Gómez, Goncalves & Sampaio, 2016). Thus, these results tend to suggest that unlike the physical performance these elements of match-play were affected even after playing many games over a short time period (Carling et al., 2011). Teams sometimes may able to cope well and able to respond physically to the demands of a prolonged period of match congestion (Carling et al., 2015). In agreement with this, no significant changes in physical performance demonstrated over two or three games played consecutively within a tight time-frame (Dupont et al., 2010; Rey et al., 2010). We can forward several reasonable explanations for the positive nature of these findings. These include squad rotation strategies, post-match recovery techniques and self-regulation of efforts. These studies did not consider things for extended period. Thus, the long-term relationships of load, recovery and match performance need considerable attention.

While studies in amateur players have shown that physiological perturbations and declines in fitness scores occur up to 72-hours post-match (Fatouros et al., 2010), a study has shown that neuromuscular fatigue, muscle soreness and sprint performance in professional players returned to baseline levels within 48-hours after a match (Rampinini et al., 2011). Thus, players at professional level are seemingly able to recover more quickly than peers at lower standards. This possibly explains the lack of decline in physical performance during short congested fixture periods (Dupont et al., 2010; Rey et al., 2010). Unfortunately, all these studies have only tracked post-match changes after a single game. Similar research addressing the cumulative physiological and physical effects of playing a greater number of matches over a short time frame is definitely warranted.

2.9.1. Match-to-Match Technical Performance Variation

As performance indicator of today`s soccer, technical performance significantly differs between players from strong teams and players of weak teams (Liu et al., 2016). Moreover, technical performance varies significantly from match to match for a player as a function of factors such as opposition strength, match location and match outcome (Liu et al., 2016). However, match technical performance is shown to be affected more by opposition strength than match location and match outcome (Liu et al., 2016). Still as a matter of practical evidence, positional interchanges can cause players to have different physical, technical and tactical performance scores across matches (Schuth, Carr, Barnes, Carling & Bradley, 2016) and this can account for match-to-match performance variations. In addition, it has been showed that match congestion in elite soccer players even can result residual fatigue that can cause underperformance in ensuing competition (Carling et al., 2015). To sum up, findings indicate that soccer players are challenged to fine-tune their technical actions and tactical behavior to the extreme dynamical and challenging conditions (Folgado et al., 2015; Liu et al., 2016; Scuth et al., 2016). For a clear understanding of the relationship between weekly load, recovery level, NMF and match performance, researches so far did not address it extensively.

2.9.2. Level of Play and Match Physical Performance

A study by Bradley et al., (2013a) showed that players in league 1 and championship perform more ($p<0.01$) high-intensity running than those in the premier league. However, technical indicators such as pass completion, frequency of forward and total pass, balls received and average touches per possession were found 4-39% higher ($p<0.01$) in the premier league compared to lower standards. Thus, it is clear that there is more high-intensity running in league 1 and the championship than the premier league, while technical indicators are superior in the premier league compared to lower standards. On the contrary, research has shown that players at a higher standard of play perform more high-intensity running than peers at lower standards (Andersson, Randers, Heiner-Moller, Krustrup, & Mohr, 2010; Mohr, Krustrup, Andersson, Kirkendal, & Bangsbo, 2008). In addition, Mohr et al., (2003) found that elite Italian League players performed 28% more high-intensity running than sub-elite Danish League peers. Moreover, Ingebrigtsen et al. (2012), reported that distance covered in high-intensity running was 30–40% greater in players in top versus middle and bottom ranking Danish teams. However, in our context, it is not known how players in the lower level (national league) are physically taxed than higher-level (premier league) players. Even the physical demand of matches or the impact of physical preparedness on match performance indicators or the association of fitness and match success is not studied.

2.10. Fitness Test Score and Match Performance

A strong relationship has been observed between player fitness determined in selected field tests and physical performance in competition obtained from motion analysis. For example, individual field test scores of RSA (Rampinini et al., 2007a) and intermittent running performance (Bradley et al., 2011b) are notably associated with the distance covered in high-intensity running by elite players in match-play. However, the association between this fitness test score and match success in terms of winning or losing, number of goals scored or conceded and points obtained from matches is not addressed. Unfortunately, no information is currently available on the relationship between weekly load and fitness score of players. Performance in repeated sprint tests and repeated high-intensity activity in match-play especially as the latter is considered to be a fundamental contributor to success in contemporary elite soccer (Gabbet & Mulvey, 2008). And there is no information regarding the association between before match field test scores and match success, though a decline in technical performance in the later stages of matches is reported (Rampinini et al., 2009a). Identification of the association between anaerobic fitness field test scores and match performance or success is worthy of intensive investigation.

2.11. Repeated High-Intensity Actions in Soccer Match

The physical preparation of elite player has become an indispensable part of contemporary professional soccer mainly due to the high fitness levels required to cope with the ever-increasing demands of the game (Gabbet, 2016; Nedelec et al., 2015). Along with a player's capacity to run with the ball, sprint-type activities are widely considered to be a crucial element of performance in high level soccer competition (Bradley et al., 2013a). For example, per game, top-class soccer players perform 150 to 250 intense running actions (Mohr et al., 2003) and perform high intensity running (>19.8 km/h) every 72s (Bradley et al., 2009a). The ability to recover and subsequently reproduce intense efforts is widely accepted among practitioners and sports science personnel to be a critical component of contemporary performance (Iaia et al., 2009). This intermittent exercise is characterized by short-duration sprints (<5s) separated by recovery periods that are sufficiently long (>60s) to allow near or full-recovery after an intense effort (Bangsbo, 2014; Girard, Mendez-Villanueva, & Bishop, 2011). Thus, it would seem that players generally had adequate time to recover following a high-intensity effort (Girard et al., 2011). In contrast, repeated-sprint type actions in which similar sprints of short-duration are interspersed with shorter recovery intervals (<60s) can lead to marked decrements in subsequent running performance (Girard et al., 2011).

The term "repeated sprint ability" (RSA) was first introduced by Fitzsimans, Dawson, Ward & Wilkinson, (1993) and team sports like soccer require players to repeatedly perform brief bouts of near maximum or maximum efforts interspersed with periods of brief recovery. As a result high-intensity running and sprinting in soccer have been extensively researched due to the assumption that they are crucial to performance (Bradley et al., 2013a; Faude et al., 2012). Linear sprints are the single most frequent actions in goal situations by either the scoring player or the assisting player (Faude et al., 2012). The ability to repeatedly sprint with short recovery is a component of physical fitness that require a specific assessment method and training approach (Aziz, Mukherjee, Chia & Teh, 2008; Bradley et al., 2009a). Due to the high-intensity intermittent nature of soccer (Bradley et al., 2009b; Stølen et al., 2005), players are required to reproduce maximal or near-maximal sprints of short duration (1–7 s), with only brief recovery periods (consisting of complete rest or low-to moderate-intensity activity), over an extended period of time (90+ min) (Carling & Dupont, 2011; Girard et al., 2011).

Yet, there is limited information on the ability of elite soccer players to perform specific bouts of exercise during which they repeat several successive intense running efforts of short duration over short time intervals (Carling, Bloomfield, Nelsen, & Reilly, 2008). Furthermore, no information is available on the capacity of players to maintain performance in consecutive sprints within these repeated-sprint bouts. While there is a strong relationship established between physical fitness in elite soccer players and work activity profiles in competition (Carling et al., 2008**)**, data examining the relationship between match performance and scores obtained from tests of RSA are scarce (Rampinini et al., 2007a). This highlights the potential invaluable contribution of my investigation in the area.

The ability to produce high rates of power output and to sprint at high intensity is essential to performance in the invasion game of soccer. Though sprinting has been shown to represent not more than 11% of the distance covered in a match, it is considered crucial to the outcome of a game. Players are required to sprint repeatedly in any direction with varying distance or intensity. As a result, players are expected to possess well developed physical qualities including

RSA which complement the technical and tactical demands. It has been argued that games can potentially be won or lost on occasions where repeated sprinting is required from one or more players and that the ability to resist fatigue during these bouts of repeated sprinting may be of great relevance to the outcome of the game (Girard et al., 2011).

With the contemporary soccer of different competition and teams, RSA is evident though the number of sprints and the recovery time between consecutive sprints is so varied. For example, the study done by Schimpchen, Skorski, Nopp, & Meyer, (2015), showed that in average players are subjected to 17.2±3.9 sprints. With that of the Norwegian elite team, it was found that on average players executed 16.6±7.9 sprints per game (Ingebritsen et al., 2014). Moreover, in the European Champions league and UEFA cup matches on average players performed 27.2 sprints per game. Pronouncedly in the English Premier League (EPL), an average of 57 ± 20 sprints per player and game for the 2012–13 season (Barnes et al., 2014). While it has been argued that the EPL is renowned for its physicality (Barnes et al., 2014), it is questionable whether a difference of that magnitude can solely be attributed to a perceived difference in playing style. This difference can be accounted in part to is the level or quality of opponent teams. Indeed, previous studies have shown that opponent level influences running behavior.

Players of more successful teams have been found to cover less total distance as well as less distance in high-intensity running (running speed > 14 km/h) and very high-intensity running (running speed >19 km/h) compared to players of less successful teams (Rampinini et al., 2009a). Additionally, it has been shown that players cover greater distances sprinting (running speed >24 km/h) against top-level opponents compared to bottom- level opponents (Castellano et al., 2011). However, sometimes this may not be the case. For example, when we see the German when playing up against lowest ranked and highest ranked teams they do not have that big difference in the number of sprints. When they play against the lowest ranked opponent (Faroe Islands, 154th in the FIFA ranking) they had 16.8 sprints and when against the highest ranked opponent (Netherlands, 7th), it was 19.5 sprints (Castellano et al., 2011), indicating that the effect of the level of opposition might not be that large. Moreover, even when singling out the game with the highest number of sprints performed (USA, 28th, 29.7 sprints per player), it shows that this still half what happened in other cases Barnes et al. (2014). Thus, there is no that clear indication of what exactly increases or decreases the number of sprints, despite the clear knowledge that RSA is a crucial element for soccer performance. Further empirical evidence deems worthwhile in this area of soccer.

High level soccer match demands players to have frequent sprinting and high intensity bouts within shorter recovery periods (i.e., over 90 minutes) (Gabbet, Wiig & Spencer 2013). National players of the 2014 FIFA World Cup winning team performed repeated sprinting bouts with no decrement in performance across multiple bouts or sprints (Schimpchen et al., 2015). To this end, the ability to produce high-speed is considered an important quality for performance (Haddad et al., 2015). Well-developed high-speed and sprinting running ability are required from players in order to gain advantage in attacking and defensive situations (Johnston, Watsford, Pine, & Spurrs, 2014). But it is also indicated that players only occasionally obtained near maximal speed during game (Schimpchen et al., 2015). Therefore, the importance of RSA is questionable in elite football match play and results indicate that current tests as well as conditioning programs that aim to assess and improve the ability to perform repeated sprinting work might not be adequate to reflect game demands. Thus, the study of the relationship between the common RSA test scores with match performance or success is really worthy of scientific investigation. While it has been shown that training interventions emphasizing an RSA specific protocol can effectively induce football specific training adaptations (Ferrari-Bravo et al., 2008), it is questionable that RSA is a determinant factor of team performance and predictor of team success. Therefore, future researches need to address whether the capacity of repeated sprinting is competition specific (Schimpchen et al., 2015), because physical capacity is believed to be match performance limiting factor (Barnes et al., 2014).

2.11.1. RSA and Fatigue

As the number of sprints increases, the athlete will fatigue, which results in a decline in sprint speed. Reduction in sprint speed is common toward the end of matches (Aziz et al., 2007). Due to fatigue players suffer towards the end of the match, and temporarily after high-intensity periods (Bradly & Noakes, 2013). A greater loss in sprint speed may result in decreased performance. Players reporting the lowest performance decrements in the RSA test performed statistically more consecutive high-intensity efforts separated by short recovery times (≤20s) compared to those with higher decrements (Carling, Le Gall & Dupont, 2012b). From this study it has been found that resistance to fatigue as measured with treadmill test is significantly related with a better match physical performance in terms of high-intensity actions with brief recovery during a match. Despite the relationship between fitness test score and match physical performance, there was no statistically significant relationship between the RSA test scores and match technical performance indicators such as number of passing, passing effectiveness and other performance parameters. But, a study in a professional soccer team showed no relationship between the fatigue decrement observed in a field test of repeated sprint ability and distances covered at high-intensities in match-play (Rampinini et al., 2007a). A related research in sub-elite players has shown that performance in repeated sprints is reduced immediately after compared with before a game and after an intense period of activity during match-play (Mohr et al., 2005). Thus, a study that examines the relationship between field based RSA test scores and match performance parameters is expected to be worthy of investigation.

Fernandes-Da-Silva et al. (2019), found that players with faster RSA mean time covered significantly more distance sprinting during matches (606±204m, +47.0%t=4.953; effect size=1.88, 1.24; 2.52, P≤0.001) compared to their slower counterparts (322±145m). A large negative correlation (r=-0.63, -0.77; -0.44, P≤0.001) was found between RSA best time and (4.59±0.27 seconds) and match sprint distance (457±229m). Likewise, RSA mean time (4.76±0.25 seconds) was also largely associated (r=-0.60, -0.75, -0.39; P≤0.001) with in-game sprinting performance. The results of this study provided evidence to support the construct and ecological validity of the 5*30m performance explained the amount of sprinting activity performed during match (Fernandes-Da-Silva et al., 2019). But the point is how this physical performance obtained from tests and achieved during matches can be translated to much success?

2.11.2. RSA, Level of Play and Position

A mere total sprint distance may not provide sufficient information about the football-specific physical demands. Studies have shown conflicting evidence whether high-intensity running distance alone can discriminate between players of different standards (Bradley et al., 2013a). But RSA has been shown to discriminate professional players from amateur players (Aziz et al., 2008; Rampinini et al., 2009b). Still the so-called fitness quality, RSA, is found to be position specific (Di Salvo et al., 2010; Schimpchen et al., 2015). Though being an athlete of the same sporting event and more closely regardless of being in the same team, players may be subjected to have different number of sprints and recovery time between sprints. With regard to position of play, Di Salvo et al. (2010) found that wing players performed significantly more sprints than any other position group, followed by attackers, wide-defenders, central midfielders and center backs. The study by Schimpchen et al., (2015) also revealed that holding-midfielders perform about 30% more sprints compared to attacking-midfielders, while also performing significantly more sprints with short recovery durations of 30 seconds or less. This position specific burden calls for recovery and training interventions, which are individual and position specific.

2.11.3. RSA as A Research Focus

Maximal sprinting speed is shown to be a great influencing factor for RSA best (Lopez-Segovia, Pareja-Blanco, Jimenez-Reyes & Gonzalez-Badillo, 2015) and RSA mean (Chaouachi et al., 2010; Dardouri et al., 2014). Thus, sprinting speed is the main predictor of overall RSA performance (Buchheit & Mendez-Villanueva, Simpson & Bourdon, 2010; Dardouri et al., 2014). Still the magnitude of force generated during dynamic muscle contraction is related to sprint performance (Lopez-Segovia et al., 2015). More clearly, Lopez-Segovia et al. (2015) showed that the relationship between strength and RSA mean is significant ($r=-0.52$; $p<0.05$) & the association between muscular strength and RSA best is even more significant ($r=-0.76$; $p<0.05$). Thus, investigating the association between weekly TL & RSA could be considered as a study of TL in connection with a myriad of physical qualities. Finding out how RSA dictates success or match performance is a study that aims how anaerobic qualities determine success. And this is one of the underlying reasons for me to be concerned about RSA on the expense of other biomotor qualities.

The study done by Lopez-Segovia with his colleagues (2015) assured that there is statistically significant relationship between muscular strength and the first 3 sprints of RSA test ($r=-0.64$; $p<0.05$). However, the relationship tended to be non-significant as the number of sprints performed is increased, showing the adverse effect of fatigue. As RSA strongly correlates with the velocity at which VO_2max (da Silva, Guglielmo & Bishop, 2010), aerobic fitness may contribute for RSA performance to an extent. The physiological justification may tell us that the burden of each bout needs to be countered during the recovery between sprints as it relies on the aerobic capacity of clearing lactate to enable the muscle to produce the required force during the subsequent sprints. If no, performance decrement may be pronounced and it can result fatigue and lower RSA mean performance. However, RSA more relates with anaerobic. Because, it is well established that vertical jump performance is a big factor of RSA (Kenney, Wilmore & Costill, 2015; Stojanovic, Ostojic, Calleja-Gonzalez, Milosevic & Mikic, 2012; Tonnessen, Shalfawi, Haugen, & Enoksen, 2011; Te Wierike et al., 2014). For example, as anaerobic quality sprinting performance is largely correlated with RSA performance of 7X35m RSA test performance (Ingebrigtsen et al., 2014).

2.11.4. Training and Testing Methods for RSA

Low-volume high-intensity interval training (HIT) appears to be an efficient and practical way to develop RSA (Cipryan, Tschakert & Hofmann, 2017). But additional speed endurance training is associated with an improved ability to perform repeated high-intensity work (Nyberq et al., 2016). Thus, repeated-sprint training appears to be an effective and practical means for the simultaneous development of fitness (i.e., speed and RSA) relevant to team sports. More specifically it is found that a direct and simplified repeated-sprinting training can induce small to large improvements in power (CMJ), speed, RSA, and endurance (i.e., high intensity intermittent running performance) and it is advocated for training in team sports (Taylor, Macpherson, spears & Weston, 2015). But what challenges this is that endurance training can negatively impact speed. However, the significant association that exists between power and RSA, speed and RSA and between strength and RSA indicates the importance of power, speed and strength training to impact RSA performance. But what is found untouched or unexplored is the volume and total load of these kinds of trainings to impact RSA.

Sports scientists and coaches alike have suggested that the ability to perform repeated sprints with minimal recovery between sprint bouts is an important fitness aspect in team sports. Thus, continuous intervention and testing for RSA need to be part the conditioning program. A number of performance tests have been developed in order to evaluate RSA in soccer players with the aim to identify potential weaknesses and prescribe individualized training protocols tailored specifically to the demands of different positional roles. Typically, these tests incorporate sprint distances of between 15 and 40 m with 3–15 repetitions, while recovery periods last for 15–30 s (Haugen et al., 2014). But before any credence can be placed on test results, test`s validity, reliability and sensitivity need to be established (Paul & Nassis 2015). So that practitioners should endeavor to use testing procedures that are informative yet not time consuming or labor intensive.

Sprint distances of 15-40 m x 3-15 repetitions have been used in elite or professional soccer, and most tests have included 15-30 s recovery periods between sprints. Several tests have combined agility and repeated sprints (da Silva et al., 2010). But as it is common with any measuring device and method, the issue of reliability with these test protocols has been an area of investigation to establish reliability and credence. For example, Impellizeri et al. (2008) examined the reliability of repeated-shuttle-sprint ability (RSSA) by comparing players of different competitive ability and different position. And the result showed that professional players showed better RSSA mean than amateur players. Moreover, a test protocol of 10X5m shuttle run test (SRT) has showed a significant difference between the amateur and professionals, implying something positive about the validity of repeated running tests (Kaplan, Erkmen and Taskin 2009). Accordingly, RSSA test is showed to have adequate construct validity. The study done by Aziz and his colleagues (2008), to test the validity of running repeated-sprint ability (rRSA) (6/8X20m, 20 seconds recovery) by examining its ability to discriminate players of different level and position has shown that rRSA is associated with a higher level of competitiveness ($p=0.02$). Forwards had significantly better rRSA performance compared to defenders and midfielders ($p=0.02$). In this result it was also shown that outfield players achieved better rRSA performance than goalkeepers ($p<0.01$). The same thing was true with 5*35m RSA test as performance with this test correlated with more sprinting distance during matches (Fernandes-Da-Silava et al., 2019).

The majority of field and laboratory tests involve repetition of approximately 6 sprints over a distance of 30m with an active recovery period between efforts of 25s (Gabbett, 2010; Wong, Cahn, & Smith, 2012). Analysis of the most extreme demands of match-play showed that players performed up to five consecutive high-intensity actions (HIA) within a 1-min period (one bout every 12s) and 7 HIA within a period of 111s (one bout every 16s approximately) (Carling et al., 2012a). The duration of these recovery intervals are substantially lower than those frequently employed in test protocols. To ensure the design of more ecologically valid assessment protocols of a player’s capacity to respond to the most extreme demands based on these observations, these findings tend to suggest that fitness personnel use RSA tests containing 6-7 successive high-intensity actions (running speed >19.8km/h) sustained over a length of ≥20m) with 15s active recovery intervals between efforts. During these recovery intervals, both low and moderate-intensity exercise could be performed as analysis showed that players spent 61% of their recovery time between high intensity efforts moving at running speeds ranging from 0.7 to 7.1km/h and 30% at speeds from 7.2 to 14.3km/h. Yet most importantly, the relative importance of repeated high-intensity efforts to team performance and notably to the overall outcome of matches remains unexplored and definitely merits investigation (Carling et al., 2012a).

In order to optimally prepare players for high-speed elements of match-play, players require regular exposure to periods of high-speed running and sprint running during training (Gabbet 2016; Malone et al., 2017b). These physical qualities can be highly used and cultivated during SSGs and specific form of running drills or exercises. However, there is no evidence within a soccer specific context that allows coaches to understand the dose-response phenomena of these exposures to higher speeds (Malone et al., 2018). Malone et al., reported that soccer players are at increased risk of injury when they experience higher weekly cumulative training loads of ≥1500 to ≤2120AU. Injury risk is found to be greatest when chronic load was low and acute to chronic workload ratio is either low or high. This heightened risk remained for up to 4 weeks (Stares et al., 2018). A session that involves repeated exertion of such bouts as high-speed running and sprint running can pose a serious magnitude of load as it is quality work out. Therefore, the issue of improving high-speed running or sprint running and being capable of repeating such actions now and then without causing injury or draining performance with nonfunctional overreaching compels further research.

According to Carling et al., (2012a), the common RSA test protocols do not directly imitate the typical match environment. This is because during matches most consecutive high-intensity actions performed after recovery duration of 60 seconds and beyond. Hence the recovery activities separating these efforts are generally active in nature with the major part of this spent walking, players perform less repeated high-intensity bouts (consecutive high-intensity bouts with mean recovery time of 20 seconds or less separating efforts) per game. Based on positional roles, central-midfielders performed more high-intensity actions separated by short recovery times (<20 sec) and spent a larger proportion of time running at higher intensities during recovery periods. Pronouncedly, fullbacks performed the most repeated high-intensity bouts. It is also found that players with the lowest performance decrement in RSA test performed more high-intensity actions interspersed by short recovery times (≤20 sec, $p<0.01$ and ≤30 sec, $p<0.05$). These remind that the common RSA test protocols capacity to predict match performance success is not addressed. In the area of RSA field test there is no a single test protocol although most of the commonly used protocols share something in common.

Table 1. RSA test protocols used for elite soccer players

Study	Protocol	Recovery (s)	Total distance (m)	Mean time (s)
Aziz et al., 2007	6x20m	20	120	3.08±0.09
Aziz et al., 2008	8x20m	20	160	3.08±0.08
Chaouachi et al., 2010	7x30m	25	210	4.46±0.16
Gabbett, 2010	6x20m	<15	120	3.48±0.08
Impellizzeri et al., 2008a	6x20+20m	20	240	7.12±0.17
Little & Williams, 2007a	15x40m	8-12	600	5.73±0.07
Little & Williams, 2007b	40x15m	20-30	600	2.59±0.05
Meckel, Mancnai & Eliakim, 2009	6x40m	25	240	5.85±0.25
Mujika, Spencer, Santisteban, Goiriena & Bishop, 2009	6x30m	30	180	4.42±0.14
Tønnessen et al., 2011	10x40	60	400	5.32±0.17
Wong et al., 2012	6x20m	25	120	Not reported

Different measures have been used to quantify RSA; total time, mean time and deterioration in performance. Total time or mean sprint time have been used as performance indices, and this has been shown to differentiate professionals from amateur players (Aziz et al., 2008; Impellizzeri et al., 2008; Rampinini et al., 2007a, b). Deterioration in performance, calculated as sprint decrement, has generally been used to quantify the ability to resist fatigue during such exercise of subsequent sprints (Glaister, 2005). In this regard fatigue resistance (maintenance of performance over subsequent sprints) depends upon a wide range of physiological factors, mostly related to aerobic metabolism, and athletes with higher maximal oxygen uptake (VO2max) have smaller performance decrements during repeated sprint exercise (Aziz et al., 2007). However, a finding which stands against the above explanation was reported by Chaouachi et al. (2010). As they stated intermittent high-intensity endurance (measure with Yo-Yo IR1) is poorly associated with RSA performance ($r^2=0.19$). Thus, RSA performance can be accounted for some other factors, which are not previously addressed, such as previous weekly load and recovery level.

2.11.5. Individual Approach for RSA

Physical performance during matches is commonly assessed using automated video tracking systems. These systems utilize standardized absolute speed thresholds to classify different types of running speed behavior, without considering inter-individual differences in maximal sprinting speeds. However, Abt & Lovell (2009) explained that due to the highly individualized nature of the exercise intensity continuum, there is a need for an individualization of speed thresholds, since the stress produced by a given speed will vary considerably between athletes (Schimpchen et al., 2015). While the use of absolute speed thresholds in football can be justified to a certain degree because of the imminent direct competition with opponents (Buchheit et al., 2013), an individual characterization of players' physical load and performance during a game can only be obtained using individualized velocity thresholds. Hence, it is desirable to establish a system which defines sprinting thresholds individually for each player (Schimpchen et al., 2015). The reminder extends to the issue of ensuring appropriate load quantification, recovery design and provision for a functional adaptation to be realized. An individual based load association with gain or overtraining need to be seen critically.

Generally, detailed information about overall conditioning load, intensity and structuring of training are challenging variables to control. If improvement of sprinting is the primary goal for in-season, future studies should explore whether it is more effective to structure the players` weekly soccer training rather than introducing an additional physical conditioning regime. A perfectly designed conditioning program for certain capabilities may limit other important qualities and vice versa. Coaches and conditioning experts have to balance their training methods and exercises in order to optimize different skills in relation to their contribution to overall soccer performance. More sprint training sessions per week or a longer intervention period could increase the potential for developing faster players. If the load is too high, still overtraining or injury may result. The optimal level of load or volume that can induce speed improvement without affecting other qualities negatively is not yet known.

2.11.6. Injury and High-Speed Training

Intensity and volume of anaerobic kind training which is not in line with the principle of adaptation (GAS) is supposed to cause maladaptation or non-functional overreaching. Exposing players to large and rapid increases in high speed running (HSR) (14.4km/h) and sprint (SR) (>19.8km/h) running distances can increase the risk of injury (Malon et al., 2018). The research by Malone et al., (2018) showed that, players who completed moderate HSR (701-750m) and SR (201-350m) were at reduced risk of injury when compared to low HSR (≤674m) and SR (≤165m). Moreover, injury risk was significantly lower with players who exerted higher training load (≥284AU) when they covered a weekly HSR distance of 701-750m when compared to players who covered <674m. And as a result, training load has been reported as a modifiable risk factor for subsequent injury in soccer (Malone et al., 2017b). However, within elite soccer the frequency of competitive matches is high and players are frequently required to play consecutive matches with 3 days recovery (Nedelec et al., 2015). Therefore, these players have inherently high training load due to poor recovery periods between games and subsequent training sessions. Soccer players may be exposed to year-long training and matches which can potentially cause higher risk of injury, reminding the need to closely adhere to the issue of load monitoring as under load and overload are likely causes of injury and impaired performance.

The importance of designing specific conditioning elements of training for players in their particular positions is persuasive. The ultimate of training or conditioning program is to mimic the nature of match condition and enabling player to withstand the demand. Thus, for this specific physical quality, training should be tailored based on the specific demand of each position and the individual quality of the players. For example, practitioners ought to specifically develop the ability of central-midfielders to recover actively at higher levels of intensity. Practitioners also need to consider the inclusion of additional repeated sprint training interventions to enable fullbacks to repeatedly perform and reproduce high levels of performance in periodic but sequences of high-intensity running. The failure to have such an individual based specific training intervention may cost losing match fitness or cause match performance fluctuation in a season based contemporary soccer competitions. However, it is difficult to quantify the energy cost of brief high intensity bouts. In soccer, the short sprint distances allow adequate replenishing of the phosphocreatine system between consecutive efforts (Abt, Siegler, Akubat, & Castagna, 2011). Whereas, sprints longer than 30m demanded a markedly longer recovery time than the average sprint (10-15m) during the game (Bangsbo et al., 2006). The bottom line is that high-intensity and sprint-running activities during training and match can pose a high level of internal load, which is not critically examined against fitness and wellbeing.

2.11.7. The Necessity of Studying about RSA in Soccer

Carling, et al., (2012b) result showed that a measure of repeated sprint ability was either unrelated or inversely associated to measures of accumulated and transient match fatigue. This cast doubt on the utility of repeated sprint tests in predicting players' capacity to repeatedly perform high-intensity exercise as well as resisting fatigue during match-play and moreover it is not in line with the theory of Fit-fat. Still there is speculation on the impact of high-intensity activities in relation to their contribution in deciding the outcome of games (Di Salvo et al., 2009). However, a descriptive study has shown that out of 360 goals scored in the German Bundesliga, the majority was preceded by a sprint action performed by the player who either scored the goal or provided the assist (Faude et al., 2012). Moreover, Anderson et al., (2010) accounted RSA for higher and successful match performance. But the findings from Carling et al., (2012a) and Bradley et al., (2013a) tend to argue against the importance of their contribution to overall success in a high-ranked professional soccer team. The inconsistent results in this area and lack of context-based studies, examining the relationship between RSA field test scores with match performance parameters is thus worthy of research.

Recently in elite footballers, hamstring injury rate is increasing substantially (Esktrand, Walden, & Hagglund, 2016). The major incidence of hamstring injury occurs during sprinting (Ekstrand et al., 2012). As a potential cause of this pronounced injury rate, the number of sprinting actions can be accounted for. As it is an inherent part of match play, frequent actions of change of direction, acceleration and deceleration are inevitable (Akenhead, Hayer, Thompson, & French, 2013). As a result, congested matches are shown to be a cause of hamstring injuries (Carling et al., 2016; Wollin, Thoroborg, & Pizzari, 2018), because of higher number of sprinting actions within a week. During congested match, players are taxed more sprinting action that can aggravate the likelihood of hamstring injury (Mohr et al., 2016). The entire load imposed on the players therefore can hurt health and performance though training and matches are part of the weekly schedule. This witnessed that development of weekly periodization and weekly TL management is an area that craves for further research.

2.12. Speed in Soccer

Aerobic endurance capacity is not a distinguishing variable separating players of different standard (Tønnessen et al., 2013). However, sprinting velocity is a crucial performance factor in soccer. Linear sprinting speed distinguishes players from different standards of play and positions. There is still positive development in sprinting velocity among male and female elite players over time (Haugen et al., 2014b). Studies in the area have reported that elite players run faster than non-elite players, while others do not show a clear trend (Reilly, Bangsbo & Franks, 2000). Boone et al. (2012) concluded that forwards were faster than defenders, midfielders and goalkeepers, respectively, while Taskin (2008) did not observe significant differences in straight sprinting speed by playing position.

Faude et al. (2012) analyzed videos of 360 goals in the first German national league. They reported that the scoring player performed a straight sprint prior to 45% of all analyzed goals, mostly without an opponent and without the ball. This study also showed that straight sprinting was also the most frequent action for the assisting players. This way it is indicated that well developed sprinting speed is an advantage in competitive soccer. Out of the total distance covered by players, 8-12% is with high intensity running or sprinting (Gabbett & Mulvey, 2008). However wide midfielders and external defenders perform more high intensity running and sprinting compared to the other playing positions (di Salvo et al., 2007). Reported peak sprint velocity values among soccer players are 31-32 km/h (Rampinini et al., 2007a & b). Sprint frequencies in the range 17-81 per game for each player have been reported (Burgess et al., 2007; di Salvo et al., 2007). Mean sprint duration is between 2 and 4 s, and the vast majority of sprint displacements are shorter than 20 m (Gabbett & Mulvey, 2008). The broad range in frequency estimates of sprints reported is likely due to varying intensity classifications, as different running velocities (18-32 km/h) have been used to distinguish sprint from high speed running. Players perform 8 times as many accelerations as sprints per match, and the vast majority of these accelerations are too short in duration to cross the high-intensity running threshold (Varley, Elias & Aughey, 2012). Thus, high intensity running and sprinting load may be underestimated (Varley et al., 2012).

The anaerobic qualities' including speed is indicated to be key quality. While the physiology, metabolism, match activity and fatigue mechanisms have been well explored from an aerobic perspective (Bradley et al., 2013a; Haugen, Tonnesen, Hem, Leirstein & Seiler, 2014a; Tønnessen et al., 2013), there is less information available regarding anaerobic demands to be successful. Therefore, this study targeted to identify the relationship between anaerobic fitness (speed, RSA and agility) with match success. Presuming the impact of anaerobic quality on success, it was found to be worthwhile to reveal how TL, stress and recovery level predicts anaerobic fitness. How TL and recovery level determine sprint performance was an area where there is nothing said and reported. Carling et al. (2012a) demonstrated as there is a slight trend towards faster soccer players over time, indicating that linear sprinting ability is a performance distinguishing factor in male and female soccer. It is convincing to claim that improved sprinting skills can make a football player more effective, and therefore more valuable. Faster players are probably able to utilize their technical and tactical skill better than slower players with otherwise identical skills. The chance of dribbling an opponent out of position, or successfully defending an attack, increases with improved sprinting skills. Soccer athletes must develop multiple qualities, and coaches should consider sprinting velocity within the larger skill set of soccer. To this end the consideration of sprinting speed from different perspective is worthy of research.

2.12.1. Sprint Performance and Playing Position

Sprinting speed performance differences across playing positions are significantly evident. Forwards are the fastest players ahead of defenders, while midfielders and goalkeepers were slowest (Boone et al., 2012; Carling, 2012a). Physical characteristics may vary across clubs and nations, depending on tactical dispositions and differences in the athlete selection process over time (Buchheit et al., 2010). For example, Coaches may select the fastest players for attacking positions due to the belief that team success depends primarily on the forwards. Buchheit et al. (2010), claimed that the impact of physical capacities on game physical performance is position dependent. To this end, sprinting ability must be seen in relationship to the physical demands of the different positions on the field. Generally, forwards and defenders are probably the fastest players because they involve in most decisive duels during match play (Rampinini et al., 2007b). This implies that the training regimen should consider this and expose these players to have more sprinting training and other specific training protocols which can potentially improve sprinting ability and repeating these actions without undue fatigue. Therefore, players in different positions should prioritize different physical conditioning regimes to solve different tasks during play.

2.12.2. Testing and Training for Sprint Performance

Sprinting speed performance can differentiate soccer players performance level. As such it can distinguish average players from excellent players, though the difference is rather small. Moreover the sprinting speed performance with soccer players is highly resistant to training (Miller, Herniman, Ricard, Cheatham & Michael, 2006). However, less exposure to specialized training provides more potential for stimulating positive effects. Well-trained soccer players adaptation to anaerobic training depends on specificity, progression, intensity, volume and frequency (Shalfawi, 2015). Here under are some recommended guidelines to work on sprinting and future research regarding dosing strategies should be designed to validate these recommendations.

Specificity

Common in sports training, adherence to the principle of specificity in sprinting is highly acknowledged. For example a training regimen which involves simple sprint kind of training improves linear sprinting performance (Tønnessen et al., 2011), but not performance in sprints with changes of direction (Young, McDowell & Scarlett, 2001). While agility training improves the specific agility performance scores (Shafawi, 2015), exercises which involve sprinting repeatedly over short distance can significantly improve RSA performance (Ferrari Bravo et al., 2008; Tønnessen et al., 2011). It is also found that that a combination of high-intensity interval training and strength kind of training can enhance sprinting performance of soccer players (Wong, Chamari & Wisloff, 2010). In addition, findings in this regard recommend high-intensity aerobic interval training (with a level of intensity about 80-90% of VO_{2max}) plus repeated sprint exercise to further enhance soccer players RSA performance (Bishop, Girard, & Mendez-Villanueva, 2011; Spencer et al., 2005). However, Ferrari-Bravo et al. (2008) on the other hand demonstrated that repeated sprint training is better than high-intensity aerobic interval training in terms of soccer specific training adaptations. Tønnessen et al. (2011) showed that elite soccer players can perform repeated sprints with a better sprint quality (speed) after repeated sprint training once a week without additional high-intensive intervals. Therefore, it can be summed up that, printing skills in soccer may be improved in several ways, but adherence to specificity can result a better gain, though the issue of chronic and acute load for sprinting improvement and maintenance is overlooked.

Individualization

To the researcher's knowledge, there is lack of controlled intervention studies evaluating the effects of physical conditioning programmes on actual performance in match play (Carling, 2010). Moreover, it is important to mention that no research in professional soccer has investigated the degree to which competitive physical demands are adequately replicated in training. However, implementation of individualized speed thresholds tailored according to individual scores of fitness to enable a more precise interpretation of the physical efforts of individual players in training and match play is better recommended (Carling, 2010). Indeed, a research by Abt and Lovell (2009) has demonstrated that the speed at which professional soccer players run at high-intensity can greatly vary. Similarly, other researchers (Rampinini et al., 2007b) have reported the between match variability for high-speed running activity as a composite value of different types of running activity (e.g. sprinting and high-intensity running combined). Thus, the distances covered at high-intensities calculated using a non-personalized default speed threshold can be substantially underestimated. This can be a potential cause for poor load estimation and provision of under load or overload.

A speed kind of training approach which highly acknowledges the principle of individual difference is supposed to be important prerequisite. For example, high-intensity interval training with a due consideration of individual performance level (potential) has produced a statistically significant improvement in speed and speed related performance indicators or parameters (Arazi et al., 2017). This study reminds the importance of having individual based speed threshold for intensity, quantity (TL) prescription and quantification. Against this principle, most intervention studies could be able to provide answers only to the typical question, which is whether certain types of training is more effective than others, based on group based considerations. However, coaches and trainers need to be concerned with what kind of training, to which individuals, and at what time period in the season. Individualized training is difficult to organize and run in soccer teams where team staff is smaller. In such cases, soccer coaches are constrained to perform similar training for all outfield players within the team, despite large individual differences. However, it is unlikely that similar training doses lead to similar responses for players belonging to opposing extremes. In this regard, how TL and recovery interventions commonly used in soccer are affecting individual players' performance level positively and negatively is not studied.

Sprinting and sprint trainings are mostly associated with hamstring injuries (Ekstrand, Hagglund & Walden, 2011). About 17% of all injuries in soccer are hamstring injuries, and more than 15% of all hamstring injuries are recurring injuries (Ekstrand et al., 2011). The commonly observed and reported hamstring injuries can be accounted to poor conditioning (deconditioning) of the players Elliott et al. (2011). This reinforces the need of higher or optimal TL imposition on the players with a strict adherence to the principles of individuality and progression. Nothing is identified in the research literature regarding progression or periodization models of sprint training in soccer. Tønnessen et al. (2011) performed a sprint training intervention with a progression model and reported positive effects on sprinting. Further studies are warranted in order to establish progression and periodization models for sprint development (Ekstrand, et al., 2011). Still playing soccer match or training games is an important contribution to the fitness level of the players. For example, Dalen and Loras (2019) reported that starters developed sprinting to a higher level compared to non-starters. This means that varied training protocols can have a significant burden on the structural and functional units of the body and may call up on sprinting. Thus, a higher load is associated with a better sprinting performance in soccer players.

2.12.3. TL and Recovery for Speed Training

The belief and recommendation during sprint training is that the spirit velocity to be maximal entirely. But still other evidences in endurance and strength training demonstrates that high, but sub-maximal intensity loading effectively stimulates adaptation through the interaction between high intensity and larger accumulated work (Gibala, Little, MacDonald & Hawley, 2012). But, here sets and repetitions need to be related to distance and intensity when designing a sprint conditioning program (Little & Williams, 2007b). Protocols ranging from 40x15 m to 20x40 m have been used in repeated sprint training sessions of professional soccer players (Little & Williams, 2007b; Tønnessen et al., 2011), which involves a total distance of 600-800 m sprint with maximal intensity in a session. With these common RSA test protocols, the recovery time between the consecutive sprints is mostly brief enough (Little & Williams, 2007b). this is because that RSA test target mainly to represent the most intensive and demanding part of the contemporary elite soccer (Spencer et al., 2005). For their presumed importance RSA is a practical consideration of today's competitive soccer training regimen. In terms of RSA training frequency, most training regimens showed positive effect. For example, sprint kind of training regimens conducted on competitive soccer players with a frequency of once in a week have shown positive effects (Tønnessen et al., 2011).

Specific protocols of repeated sprint trainings during the period of the in-season are showed to have positive effect on RSA performance of soccer players (Dupont, Akakpo, & Berthoin, 2004). Confirming the benefits, other studies have also demonstrated that repeated sprint training protocols can significantly improve speed and RSA performance when this kind of training is employed during the transition period or the preparation period (Tønnessen et al., 2011). To the authors` knowledge, no studies have compared sprint training effects across different phases of the season. The study of the cumulative effect of weekly TL at a specific time point in the season is therefore worthy of research. Depending on the manipulation of training variables, different sprint training protocols can induce different effect. Coaches and training experts must take into account the demands of the sport and each athlete`s capacity when designing a conditioning program. This implies that it is too important to examine how coaches are training or ruining this important quality because of the load they impose on the players.

2.13. Agility

There is no universally shared definition for agility (Sheppard & Young, 2006). Previously it has been considered as exclusively a change-of-direction speed (Brown & Ferrigno, 2005). But contemporarily agility is defined as a rapid whole-body movement with change of velocity or direction in response to a stimulus (Sheppard & Young, 2006). This definition is now accepted and adopted by several authors in the field (Scanlon, Humphries, Tucker, & Dalbo, 2013; Young & Farrow, 2013; Young & Rogers, 2014), based on the conception, agility has relationships with both physical and cognitive components. A change of direction task that is pre-planned has been described as change-of-direction speed (CODS) (Sheppard, & Young, 2006), and this phrase has become increasingly common to distinguish this closed skill from agility involving a reaction (Meylan, 2009; Salaj & Markovic 2011). It is a change in velocity or direction in response to an external stimulus. This recognizes that players do not randomly change velocity or direction; rather they typically do so in response to external stimuli to either evade a defender or place pressure on an attacker.

The difference between reactive agility and planned agility (change-of-direction-speed), need to be acknowledged. The concept of agility that is said as reactive-agility is different from a change of direction speed (CODS) or planned agility. These are with a different meaning and most importantly they are different qualities in the wider spectrum of performance related fitness. Even there is no significant relationship between reactive agility and change of direction speed (Matlak, Tihanyi & Racz 2016). However, Matlak et al. (2016), found that total time was shorter in the CODS test than in the reactive agility test ($p<0.001$. this actually may remind different training type is necessary to improve each. For example, a study done by Young and Rogers (2014) compared the effects of SSG and change-of-direction training on reactive agility over 7 weeks of 11 sessions and planned agility test score and it came across with a finding that SSG improved reactive agility by enhancing speed of decision making rather than movement speed. However, the change-of-direction speed training found to be ineffective to improve reactive agility and planned agility. From this finding we can deduce that movement and exertion in SSG can be based on the individual's capacity and pacing strategy unlike that of change-of-direction training where load is the same regardless of individual difference (i.e., the same external load as the repetition and set is equal). Therefore, the effect of load on CODS and its impact is worthy of intensive investigation in soccer. Though the correlation tested between agility tests and CODS tests indicate that they represent independent skills, a study by Young, Dawson and Henry (2015) indicate that the development of strength qualities can transfer to gains in CODS meaning that CODS can impact agility.

2.13.1. The Importance of Agility during Soccer Match

In team sports such as soccer, agility is an important quality for evading opponents when attacking or for placing pressure on opponents when defending (Young & Willey, 2010). Soccer also involves perceptual motor skills that operate simultaneously in a rapidly changing environment (Bullock, Panchunk, Broatch, Christian & Stepto, 2014). Thus, soccer as invasion sport involves opposing teams attempting to invade their opponent`s territory to enhance scoring opportunities that can benefit from agile players. In soccer, agility is beneficial to attackers to evade their opponent`s pressure, and for defenders to reduce space on the field to limit attacking movements. The need of agility from players indicates that soccer involves perceptual-motor skills that operate in a rapidly unpredictable open environment. Successful performance in soccer, requires well-developed perceptual and decision-making skills that are evidenced by superior anticipatory motor performance (Gabbet, Kelly & Sheppard, 2008). Fitness, kicking accuracy and dribbling performance have been shown to deteriorate towards the end of match play or fatiguing exercise (Rampinini et al., 2009a; Stone & Oliver, 2009), with declines in the amount of sprinting, and high intensity running (Bangsbo et al., 2006; Rampinini et al., 2008), as well as decreased RSA and sprint speed after match fatigue (Krustrup, Zebis, Jensen & Mohr, 2010). Match analysis, however, does not allow one to determine the contribution of perceptual-cognitive declines to overall player and team performance (Bullock, Panchunk, Broatch, Christian & Stepto, 2012).

There are also situations in many sports where players need to change velocity or direction to get into the desired position on the field, but if they are not performed at maximum speed, it cannot be usually considered as agility (Davies, Young, Farrow, & Bahnert 2013). This means that the stimulus players have to respond, which is the opponent's player movement with change of direction and speed in our case, is something which is deceptive and fast. As such soccer match play inherently requires many change-of-direction-speed (CODS) actions, though this condition alone (change-of-direction) is not an agility by itself. For this, the model developed by Young, James, & Montgomery (2002) indicated that agility is comprised of two main components; perceptual and decision-making factors and (CODS). CODS in-turn depend on technical factors such as stride adjustments, physical elements such as straight sprinting speed and leg muscle qualities, which include strength, power and reactive strength.

2.13.2. The Difference between Agility and CODS

Studies have examined the extent of the relationship between agility and CODS performance (Henry, Dawson, Lay & Young, 2011; Scanlon et al., 2013; Serpell, Ford & Young, 2010). Three of these studies used a video-based display of an attacker (Henry et al., 2011) and the others used a live tester who performed side-steps (Scanlon et al., 2013). From this, the correlation between agility and CODS test yielded Pearson coefficients of r=0.68 (Henry et al., 2011), r=0.321 (Sheppard et al., 2006), r=0.434 (Scanlon et al., 2013), r=0.70 (Farrow et al., 2005), and a Spearman correlation of -0.08 (Serpell et al., 2010). As a result, agility and CODS are seen as independent qualities (Young et al., 2015). But still it should not be neglected that in other instances CODS and agility showed a correlation of 0.434 (Scanlon et al., 2013), 0.68 (Henry et al., 2011) and 0.70 (Farrow et al., 2005). These results are in line with most conceptual models of agility. Therefore, since the main difference between the agility and CODS tests in these studies was the cognitive component involving a reaction to an opponent, a reasonable amount of relationship can be expected between CODS and agility.

Several studies have shown that higher level players to be superior in an agility test but this was not the case in a CODS test in as indicated the case of Australian football (Henry et al., 2011; Young, Farrow, Pyne, McGregor & Handke, 2011) and rugby league players (Serpell et al., 2010). This implies that agility is more performance level discriminator than CODS with these kinds of multi-sprint team sports which rely on cognitive and perceptual skill. Thus, the bottom line is that cognitive and perceptions are qualities for successful performance in higher level matches with these sports. However, this should not be perceived as CODS is not important at all. As a performance factor, issues need to be examined against CODS as it can be affected by varied factors as recovery level or due to load.

2.13.3. Perceptual skill and Decision-Making in Agility

Based on its contemporary definition, agility requires the ability to perceive relevant information about opponent's movements and the ability to react quickly and accurately for. Some agility tests can isolate the time taken to make decision from the total agility action time. This is can be done by using high-speed video to determine the time from the stimulus (i.e., attacker's initial change of direction movement) to the tested player`s first response (Gabbett & Abernethy, 2013; Henry et al., 2011; Scanlon et al., 2013). Using high-speed video system, a study (Young & Willey, 2010), the decision time only represented 3.6% of the total agility time, but the correlation between decision time and total agility time was r=0.77. The magnitude of the correlation between response movement time and the overall agility time was r=0.59. This reinforces the importance of decision-making time for soccer player agility performance. Scanlon et al. (2013) also reported that decision time and agility test score are significantly correlated ($r=0.577$, $p<0.05$) in basketball players. Thus, we can conclude that cognitive qualities are important for agility in multi-sprint team ball games. Still it is too important to notice that the correlation level between decision time and agility (total) time is worthwhile enough but not perfect enough. This implies that the physical element (CODS) is also important. But it did not say the physical (CODS) element is a negligible factor. The higher-standard players found to have faster decisions ($p<0.05$) than the lower-standard players in rugby league (Gabbett & Abernethy, 2013) but others found the difference between the groups statistically non-significant (Henry et al., 2011).

A study with Australian Rules football measured decision-making time only by requiring participants to react to video footage of an attacker changing direction by pressing a switch in the hand to indicate as quickly and accurately as possible whether the movement was to the left or right (Carlon, Young, Berry, & Burnside, 2013). This study found that, professional Australian Rules football players were slightly faster ($p>0.05$, effect size=0.26) than elite junior players, but were significantly more accurate ($p=0.034$, effect size=0.60) in their decisions, indicating better overall decision-making skill. However, this finding cannot be directly connected to actual match performance as this scenario is different to an extent. Further, it has been found that higher-standard players are less susceptible to deceptive actions of attackers, such as a fake pass in rugby union (Jackson, Warren, & Abernethy, 2006) and a fake side-step in Australian football (Henry, Dawson, Lay & Young, 2012). These studies still did not address how CODS performance relates with success and they did not examine how perceived TL, recovery and stress affect or relate with CODS.

Higher-standard Australian football players found better than their lower-standard counterparts when reacting to a video-display of an attacker changing direction, but they were not better reacting to a generic stimulus of a flashing arrow (Young et al., 2011) or light (Henry et al., 2011). This indicated that agility performance or agility tests are more sport specific quality which is capable of discriminating performance level of players or athletes. But the ultimate of this endeavor in this regard was not selection of the most important performance factor, instead it is all about examining how and to what extent CODS as a fitness is vulnerable or sensitive to TL and as well to recovery level. In addition, examined how significantly CODS changes alter match success.

2.13.4. Training Methods for CODS

Though physical fitness is extensively studied as a performance factor in contemporary soccer, CODS specifically has not been considered in this regard. CODS have not been associated with match performance or success in any study so far. Determining the relative importance of a CODS is necessary for a coach to know how much training time and effort to devote to develop it. Ultimately, the issue that coaches are interested in is the effectiveness of a particular training approach and volume or load for enhancing performance, and therefore more convincing evidence comes from training studies.

Strength Training

A study involving eight weeks of jump squat training with a heavy load (80% 1 repetition maximum-RM) produced a 10.2 % gain in 1RM squat strength, and this was accompanied by a 2.4% improvement in T-test CODS (McBride, Triplett-McBride, Davie & Newton, 2002). In contrast, when three sets of three repetitions of heavy squats with 90 % 1 RM were performed five times per week for 3 weeks in addition to CODS training by professional soccer players, no benefits in a CODS test were realized (Jullien et al., 2008). The authors concluded that the added strength training did not offer a greater advantage over CODS and coordination training. One explanation for the lack of benefit to CODS in this study could be the short three-week training regimen and being highly trained participants who are resistant to change in performance. A study by Keiner, Sander, Wirth, & Schmidtbleicher (2014) investigated the effects of two years of strength training with parallel squats in addition to normal soccer training in elite-junior soccer players. The supplementary strength training produced large gains in leg strength and this transferred to significant improvements in a CODS test. However, two years of strength training in developing athletes is likely to result in meaningful gains in any physical quality utilizing the leg muscles (Ratamess, 2012), and therefore the relevance of general strength training for enhancing CODS remains unclear. Thus, utilization of strength training regimens may not provoke the desired outcome if we intend to influence CODS with strength kind of training. If we did so (i.e., utilize strength kind of training to cultivate or maintain CODS) we may only pose load without objective realization. On the other side the load may have something detrimental to CODS as a fitness, this area alone deserves scientific investigation.

Power and Reactive Strength Training to Improve CODS

Jump squat training for eight weeks with an additional load of 30% of 1 RM has been found to produce a 10% greater peak power in a jump squat with that load and a 1.7% improvement in the T-test of CODS, indicating that power development can transfer to enhanced CODS (McBride et al., 2002). Reactive strength may be expected to correlate highly with CODS because changing direction involves knee flexion with a short ground contact time, and high eccentric loads (Young, et al., 2002). The studies by Miller et al. (2006) and Thomas, French & Hayes (2009) have demonstrated that 6 weeks of plyometric training was effective for improving CODS. Training with the drop jump exercise induced significant improvements in the 505 CODS test (Thomas et al., 2009), and a range of multi-directional plyometric exercises produced improvements in both the T-test and Illinois CODS tests (Miller et al., 2006). Another study by Tricoli, Lamas, Carnevale, & Ugrinowitsch, (2005) showed that a program that combine half squats (4 sets of 6 repetitions) with bilateral and unilateral plyometric exercises for eight weeks induced a significant gain in both strength (1 RM squat) and power (CMJ), but no significant improvement in a CODS test.

A study with rugby league players showed that trainings using video stimulus can significantly improve decision time (from 340 ms to 40 ms) (Serpell, Young & Ford, 2011). In addition, video game training protocols are shown to be capable of in enhancing agility performance (Su, Chang, Lin & Chu, 2015). But another study on elite junior Australian football players (Young & Rogers, 2014) showed that decision-making time in an agility test improved by 31% following 11 sessions of small-sided games designed to have agility workouts. Thus, the point is that agility performance with lower level and higher level multi-sprint ball game players in relation with the cognitive element can be substantially improved by agility workouts. But what is missing with the matter is that none of the studies so far relate how important is CODS as a performance or success factor.

Sprint Training for CODS

Linear sprint training can positively and significant (2.9%) improve in sprint performance and CODS performance by 2.3% increment (Young et al., 2001). But with complex CODS test protocol the effect or benefit of linear sprinting training on CODS performance is not possible.

This is because that the transfer of sprint related training adaptation to complex tests of change-of-direction speed is too less (Young et al., 2001). Thus, CODS activities, which involve acceleration, decelerations, re-accelerations and constant adjustments of steps and body posture, cannot be significantly influenced or improved by linear sprinting training (Young et al., 2001). However, due to the fact that soccer match does not involve much sharp angle changes in direction, the association of soccer specific CODS and linear sprinting speed can be inevitably significant.

There is a credence for the significant contribution of sport specific SSGs to improve sport specific agility performance (Young & Rogers, 2014). This can be one scientific reason to recommend coaches and trainers to use specific kind of SSGs to induce positive influences on agility performance of the players. Here the simulation of game environment can be enhanced when there is creativity during the design of SSGs as it is inherent with game like training to impact a lot of physical and cognitive elements of the players. As matter of scientific fact the perceptual and cognitive component of agility is highly trainable (Serpell et al., 2011; Young & Rogers, 2014). Thus, video trainings which require the players to make instant decisions and initiate explosive movements can be taken as another or additional means to cultivate agility performance of the players (Gabbett, Rubinov, Thorburn & Farrow, 2007). Basically video-based agility training can be taken as best options when field based trainings are impossible due injury, environmental conditions, travel or physical fatigue.

When evaluating the evidence related to the importance of the other physical factors for CODS performance, the challenge is the availability of varied CODS tests used to assess this quality. The prevailing fact about the different nature of invasion sports is that the typical movement pattern is so different and the test protocol is highly expected to be different. Not only this, players in different playing position can inherently have different movement pattern, though still it is questionable whether it is mandatory to have position specific tests in even a single sport. What can be too common all CODS tests is that the players are required to complete a pre-planned course of changing direction over a certain distance within the shortest possible time. CODS tests also vary greatly due to differences in the angle of directional change and the number of changes of direction (Sheppard et al., 2006; Tricoli et al., 2005). For instance, one study which compared six different CODS tests protocols for assessing soccer players reported low to moderate inter-correlations (the correlation direction and magnitude ranges from-0.028 to 0.554) (Sporis, Jukic, Milanovic & Vucetic, 2010). Accordingly, the authors concluded that CODS are different enough and specific because their complexity and the typical movement pattern. This implies that there is no “gold-standard” generic CODS test that can be used for all invasion sports.

2.13.5. CODS for Agility

Evidence for the importance of physical qualities (CODS) for agility development is limited. However, there are some correlational studies so far (Gabbett et al., 2008; Scanlon et al., 2013; Sheppard, et al., 2006). These studies examined the correlation between sprint test performances with both COD and sprint performance with agility performance score (table 1). The result of these studies indicates that sprint speed and CODS performance share common characteristics (19-55% common variance). However, the shared variance declines substantially considerably for agility performance (19-55% common variance versus 11-17% common variance). The possible reason for this the sheer physical quality presence requirement with linear speed and CODS and the cognitive demand of agility (Young & Willey, 2010). The greater variance in agility performance can be accounted to the cognitive element instead. This implies that the transfer of linear speed performance to agility performance can be accounted to their small level of correlation. Still there is limited research to examine the relationships of strength, power, CODS and reactive strength with agility. One study (Henry, Dawson, Lay, & Young, 2016) correlated vertical, forward and lateral jump performance tests scores with an agility performance. The correlation these jumping performances are small as the correlations ranged between -0.12 to -0.28. For this, the authors suggested that agility performance is more depend on cognitive rather than physical or strength factors. Signifying the physical element contribution for agility (reactive agility) performance, it has been found that planned agility (CODS) significantly related performance quality with reactive agility (r= 0.40-0.60) (Fiorilli et al., 2017). Thus, the contribution of CODS performance for soccer players and teams success cannot be negligible.

Table 2. Correlations between 10 m sprint performance with CODS and agility

Authors	CODS	Agility
Gabbett et al., (2008)	"505" test 0.57 (32) "L Run" test 0.64 (41)	0.41 (17)
Sheppard et al., (2006)	0.74 (55)	0.33 (11)
Scanlon et al., (2013)	0.439 (19)	0.406 (16)

10-meter sprinting speed correlated with CODS (r=0.439-0.74) indicating that sprinting training as stimulus can have a significant positive impact on CODS. Still sprinting speed is showed small to moderate correlation with agility (r=0.33-0.41). All these showed that in a negative or positive way (most commonly in positive way), each training kind or stimulus (i.e., strength training, speed training or plyometric training can impact agility performance or CODS. This implies that all these training regimens can impact the physiology or muscle groups which are responsible for agility or CODS, implying that they pose load on these systems or muscle to an extent. Logically the residual (accumulated) stimulus (load) can potentially pose overload on that specific system and muscle groups. Thus, this remains an area, which compels extensive investigation to identify the mechanisms to which chronic or acute load, and recovery impacts CODS and agility.

2.13.6. Modeling the Importance of CODS for Agility Performance

Models are evident in the area of agility by conceptualizing the determining factors with a generic perception of the physical and cognitive factors. It is important to acknowledge that the relative contribution to performance from these factors is variable, with some exerting a large influence (e.g., cognitive factors), some having a moderate influence (e.g., straight speed), and many others exerting an unknown influence. It should be acknowledged that all of these models consider CODS as part of agility performance. Anything that can affect CODS may affect agility. There is good evidence that the perceptual and decision-making element is important to agility performance. In addition, a number of studies confirmed that agility is independent of other physical qualities as CODS, linear sprinting speed, strength or power. But all the available models of agility are not out of the perspective of the invaluable role of the physical element next to the cognitive element. In this regard, this research is about the relationship of TL with CODS, recovery level with CODS and mainly CODS test score as part of match success predictor.

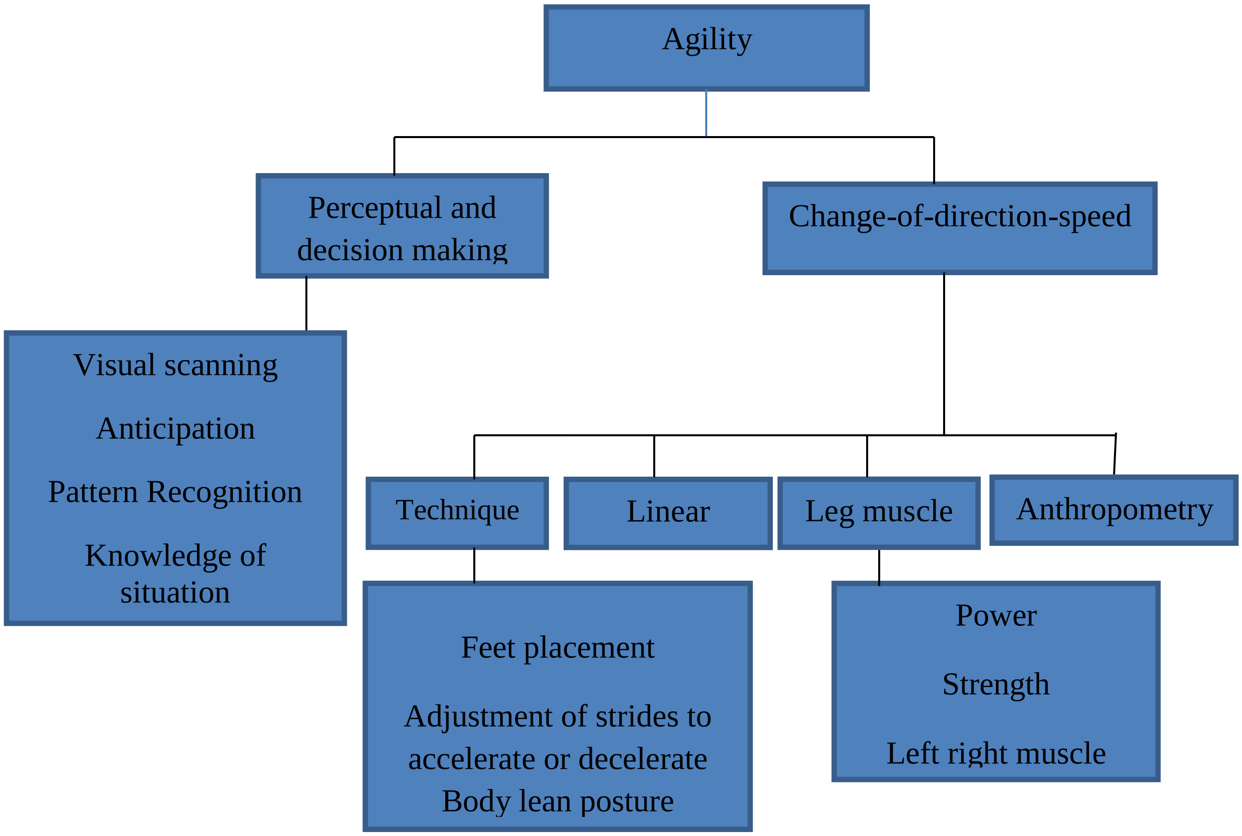

Figure 1 Models of Agility performance factors (Sheppard & Montgomery, 2002; Sheppard & Young, 2006; Sheppard et al., 2014; Spittle, 2013; Young et al., 2002

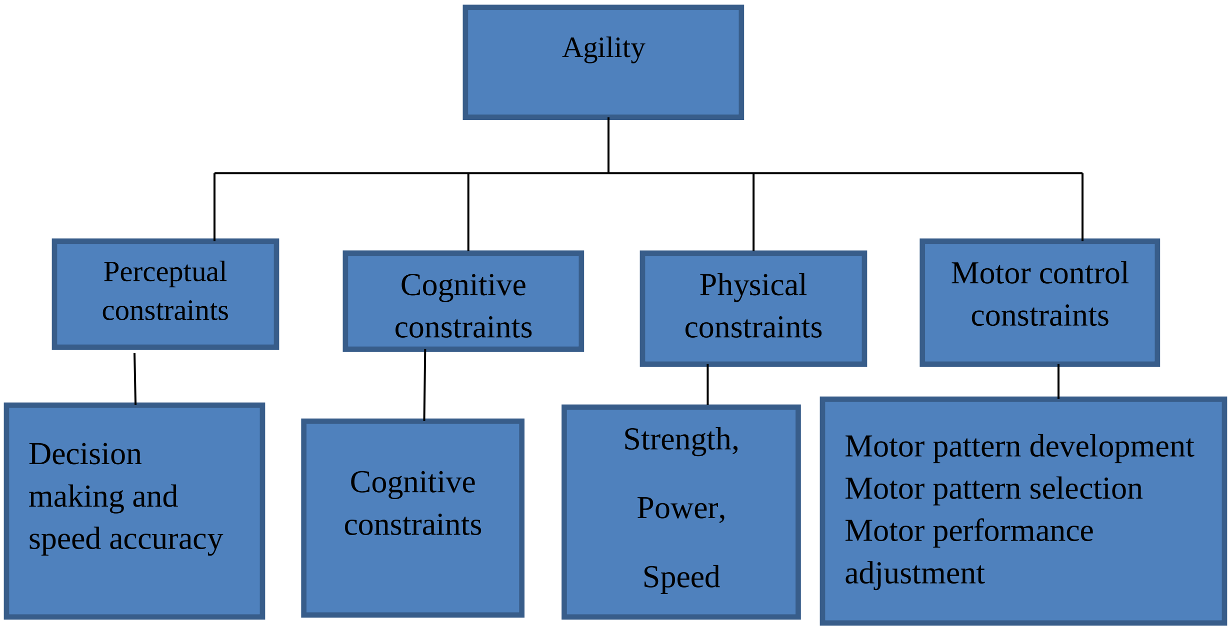

Figure 2. Agility Performance factors summary in invasion sports (Hojka et al., 2016; Jeffreys Spittle et al., 2013; Young et al., 2015)

Here with this model the physical qualities as speed, strength and power are acknowledged to be agility performance predictor factors. These physical qualities are also shown to be factors for CODS as well. Even recently the contribution of speed, strength & power for agility performance is witnessed (Sheppard, Dawes, Jeffreys, Spiteri & Nimphius, 2014; Young et al., 2015). The multiplicative allometric models with the best statistical fit showed that structural growth of 1cm predicts 1.334 seconds and 1.927 seconds of improvement in agility and dribbling speed respectively (Valente-dos-Santos et al., 2014). In parallel, recent findings by Spittle et al., (2013), Sheppard et al. (2014) and Young et al. (2015) assured that physical qualities related with linear sprinting speed, strength and power can largely matter agility and CODS. This reminds the impact that CODS performance can have up on agility.

Soccer as a game that involves an issue of creating or denying space and time demands not only speed or power but importantly pose a demand of CODS and agility. However, the process of cultivating these biomotor qualities is not easy and straight forward as there is no a golden way. As a result, coaches and practitioners employ lots of regimens and interventions to impact the desired quality. A problem of load and recovery application is suspected there as group kind of training is common in soccer. As a performance factor, CODS and agility is not studied before in this perspective. Except the generic concept of the value of physical fitness for soccer performance or success the specific context-based role of CODS for match success against certain objective parameters of soccer match performance is not yet investigated. The practical contribution of this endeavor is straight forward that based on its contribution for match success coaches will be aided to work accordingly and most importantly they will be made informed about the factors that can affect it as it could be mattered by load and recovery level.

2.14. Match Performance Analysis and its Indicators

Performance indicators in sport can be defined as the selection and combination of action variables that can define some aspects of performance and which help to achieve success (Hughes & Barlett, 2002). In modern soccer, match performance analysis should be considered as an integral part of the training and evaluation process so as to be successful as a team or an individual player. For those who are responsible as a coach and conditioning specialist, the information and feedback from the analysis can serve as a ground to evaluate performance and success level and the information will help highly to plan and set objectives for the coming matches or season (Carling, Williams, Reilly, 2005). The contemporary soccer analysis provides game-related statistics about player`s actions (such as balls received, passing, shots etc.) that may provide valuable information about the performance of teams and players during a match. For this reason, a number of studies have been conducted to test whether these action varibles such as passing, passing effectiveness, possession, number of shoots etc., can discriminate successful teams from unsuccessful teams (Bradley et al., 2013a; Collet, 2013). Results from match analysis can also be used as a way of optimizing the training process of players and teams (Hughes & Frank, 2004). Therefore, the ultimate purpose of match analysis is to identify the strengths and weaknesses of one`s own team, thereby enabling the former to be further developed and the latter to be worked upon.

Match analysis is specifically necessary to clearly communicate and to provide training content for coaches or players. For this, identification of the indicators or parameters is mandatory to assess performance against. These variables may be single or a combination of action variables which are related to success (Hughes & Barlett, 2002). Researches in this regard has already shown the indicators or variables which are key for success (Kempe, Vogelbein, Memmert, & Nopp, 2014; Maleki, Dadkhak & Alahvisi, 2016).

Goal

The number of scored goal/s is the ultimate objective measure in soccer (Tenga, Holme, Ronglan & Bahr, 2010a) and scoring goals is the main determinant of success (Kempe et al., 2014). The existing fact with soccer is that there is low number of goals in soccer in comparison with the other ball games. Therefore, relying solely on the goal/s to measure performance and success level may not be an adequate measure. As a result, a number of performance measures and indicators are common in today's soccer performance analysis. For example possession, total number of passes, passing effectiveness or efficiency, number of crosses, number of on-target shots, number of off-target shots, balls won, number of ball recovery, and performance consistency. Still the numbers of goals scored or conceded are the most objective and common measures of performance and success level in competitive soccer.

Possession

Possession of the ball is a well acknowledged performance indicator of today's soccer (Castellano et al., 2011; Kempe et al., 2014) and as a performance indicator it was found that possession is among the distinguishing characteristics or behavior of successful teams (Lago-Peñas et al., 2010; Lago-Peñas, Lago-Ballesteros & Rey, 2011). However, the studies done on European leagues, UEFA and FIFA tournaments indicated that while possession time and passing predicted aggregated team success in domestic league play, both possession and passing found to be poor predictor at the individual match level once team quality and home advantage were accounted for (Lago-Peñas & Dellal, 2010; Lago-Peñas et al., 2010). Moreover, it has been found that possession to be unrelated to success in national team tournaments (Stanhope, 2001). However, it is shown to be a good success predictor in leagues, reminding the need to have a well-established insight about it.

Despite the strong correlation between possession and success, possession alone is not enough to win. Possession in soccer can be seen as the percentage of time in which a given team held the ball (Collet, 2013). Possession is considered gained when a player had sufficient control of the ball to have a deliberate influence on its subsequent path. And possession need to be seen lost when the ball goes out of play, an opposing player touched the ball or the referee blow whistle for infringement (Jones, James & Mellalieu, 2004). Winning teams mostly perform offensive process mainly using the possession play strategy (Sgro, Aiello, Casella & Lipoma, 2016). Generally, possession alone is not enough to measure success as other important factors are there to determine success and the way possession used is still another issue. Conversion of possession into shots on goal is another attribute of successful possession. Thus, how possession leads to a positive attacking play is more important than possession. To this end, using goals scored, goals conceded and points obtained per match is fairly simple.

A lot of factors can affect or determine ball possession percentage of teams. For example, Jones et al. (2004) attributed ball possession percentage of teams to match status as teams have more possession when losing than winning regardless of being successful or unsuccessful teams (Lago & Martin, 2007). More over higher ball possession can be explained by playing home or away (Thomas, Reeves, & Davies, 2004). This means that home teams achieve higher ball possession than away teams (Lago & Martin, 2007). Out affecting all these factors, individual style of coaching, the characteristics of players, team formation and philosophy of play based on tradition of club affects possession percentage (Hughes & Frnaks, 2005). For example, in the 2003/04 of the English premier league season, Chelsea, Arsenal & Manchester united dominated their opponents in possession regardless of being winning, losing or drawing and home or away (Bloomfield et al., 2005). To sum up, a mere possession percentage cannot serve as a variable to estimate the likelihood of success.

Passing and passing effectiveness

Passing accuracy, shooting accuracy and passes-to-shots on goal ratio are shown to be more strong success or winning predictors than possession time (Collet, 2013). Thus, as a measure of performance parameters as total passes completed, passing effectiveness, total shots, and on-target shots need to be more preferable than possession. Beside to the technical demands, the physical demand of soccer has showed evolution even in the recent times. For example in the English premier league from the season 2006/7 to 2012/13, the physical demand showed increment. For example, high intensity running distance, high intensity actions number, sprint distances and number of sprints increased (from 890± 299m to 1151± 337m, from 118±36 to 176±46, from 232±114m to 350±139m, and from 31±14 to 57±20, respectively) (Barnes et al., 2014). Out weighting the physical evolution, Barnes et al., (2014), showed that the technical demand of the game achieved a significant evolution as for instance passing effectiveness reached 83% (season 2012/13) from 76% (season 2006/7), highlighting the distinguishing capability of technical performance between successful and unsuccessful teams. Bradley et al., (2013a) confirmed that technical rather than physical factors have been shown to better differentiate between competitive standards in elite soccer. There is, however, a lack of context specific research to map the development of the game and to quantify whether technical evolution is indeed a reality here. Moreover, soccer, called as a game of passing-and-receiving, need to be tested how the training load and recovery determines match performance in terms of passing and passing effectiveness. The examination of the association between load, recovery, NMF and match success first ought to be a research focus as an endeavor of performance understanding and enhancement in today`s soccer. Because if these variables are agreed to be success predictor, anything that can impact them can be studied.

The commonly observed action evident in all levels of soccer match is having crosses and corners towards the danger zone where attackers can have a better angle of shooting. Outside midfielders and as well fullbacks set balls into the area, designated as the danger zone for the defending team. However, having efficient crosses still matters the process of ensuring efficient attack more than having a mere frequent cross do. In the contemporary soccer the number of crosses, cross accuracy and corners are found to be one offensive-related performance indicator (Castellano et al., 2013). However, potential factors as TL, stress or recovery level and NMF condition affect them is not elucidated.

The ultimate of soccer is having shots that can yield goals. It is not the dominancy in possession, pass numbers, duels won, interceptions or tackles made, or crosses that we have, it is the shots that we made and scored that can matter the score line. All those related offensive-related indicators are the means to an end, which is shot or goal. Thus, the main performance indicator when we are in a position to evaluate our training or match performance, the criteria need to be goal-related indicators (Mitrotasios & Armatas, 2014; Shafizadeh et al., 2013).

2.14.1. Performance Consistency

Soccer teams which were found winner or better on a match out of accident cannot be champions. Champion teams are those who are more likely to be able to maintain their performance level over a number of matches or over a season to an expected level. Thus, consistency with performance parameters is an ideal factor to differentiate successful from unsuccessful soccer teams (Maleki et al., 2016). In this regard, Shafizadeh et al. (2013) analyzed the teams that qualified for the quarterfinal stage of EURO 2012 and proposed the use of time series analysis to identify the performance indicators (offensive and defensive). Here the authors witnessed that successful teams demonstrated a more consistent performance in terms of all indicators analyzed. However, it is important to believe that the performance indicators relating to the offensive phase are crucial to successful performance (Leite, 2013; Mitrotasios & Armatas, 2014; Sgro et al., 2016). Therefore, consistency of performance indicators during matches is established to be distinguishing characteristics of successful teams (Maleki et al., 2016). Thus, teams` success depends on the consistency and stability of high-level performance, rather than good performance in one or more individual games. For example, performance consistency was one distinguishing characteristics of Brazil, Netherlands, Argentina and Germany during the 2014 FIFA world cup (Maleki et al., 2016). Despite these findings and credence about the most reliable performance indicators, none of the studies accounted team success to that of physical vitality, TL, stress and recovery level. Hence this study will extend the literature in this field by identifying how these variables interrelate and determine match success.

Scholars propose numerous performance indicator to be used in today`s soccer (Mackenzie & Cushion, 2013), but utilization need to be used cautious as they can be influenced by situational variables (Sampaio & Leite, 2013), such as match status, match location and quality of opposition. It is also important to check that the studies using these indicators have taken account for the interactions among the teams and players used have accounted for the interactions among the teams and players (Tenga et al., 2010a; Tenga, Holme, Ronglan & Bahr, 2010b) and the complex nature of soccer. In a national domestic league, there may be a certain footballing culture and there may be a specific demand based on league level where identification of key performance indicators for success is too contributing for teams to realize promotion to a certain level. On the way it will provide a platform to evaluate our football against successful national teams and leagues. The ground breaking contribution of this endeavor is that existing literature will be benefited with regard to how TL and recovery strategy that we employ is training or draining the most important fitness segment (i.e., NMF) and how these interaction matters on the performance and success of players and clubs.

CHAPTER THREE: RESEARCH METHOD

Here in this chapter the methodological approaches, tools and technical procedures of the research project are outlined in details. The main topics presented in this chapter include the research design, the variables studied, the sources of data, the tools used, and most importantly the way the analysis are vividly portrayed.

3.1. Research Design

All the variables were measured and quantified in a quantitative way as the research conducted with a proactive or positivist perspective. In this research, a correlational study design was employed to examine the existing patterns of association between those variables including perceived weekly training load, recovery level, soccer specific neuromuscular fitness parameters and match success. For this, the relationship between load and stress or recovery level with those crucial neuromuscular fitness elements was also scrutinized.

Since the targate of training is to impose a load that can improve match performance, the study of the relationship of TL, recovery level, and neuromuscular fitness with match performance was quite interesting. Also, success prediction capacity of load, recovery level and neuromuscular fitness was examined. A greater number of high-intensity bouts characterize elite level soccer and it is fundamental to develop the ability to perform these bouts on-demand for an extended time (Iaia et al., 2009). Parallel to this evidence, for example, RSA is associated with match demands and indicated that RSA test score is a predictor of match-high intensity running performance (Barber-Alvarez, Pedro, & Nakamura, 2013). Therefore, the design enabled to find out how weekly load and recovery level alters NMF and how each of these variables relate with match success level as an individual factor and in interaction.

3.2. Research Setting and Participants

This research project was conducted in Amhara administrative region. The sampled clubs` in this research resided in Amhara regional state. These clubs were working in a yearlong program in the national league, which was the third highest level in the country with the ultimate goal of joining the super-league the next play season. As their historical records show, these clubs have never been part of the super-league ever before. The physical demand of soccer match increases as an inverse function of the league or players level. Here in Ethiopia, specifically to the third league level (national league), participation is practically more demanding than other league levels.

The national league is comprised of teams competing in six different groups. The number of teams in each group was 8-11. The grouping was based on the respected geographical zone. As such, the teams of Amhara region were having their competition in one group (group “C”). This group was comprised of 11 teams from different area of the regional state. The researcher as a resident and sport science professional in the area had conducted the study on this group (“C”) of the national league. From each club, all field players, (n = 88) players participated in the study. These were the players tested weekly for about five consecutive weeks. In addition to the weekly fitness test, they were asked to report their perceived internal load for each training session. With that of the RESTQ, the players reported their recovery level weekly 24 hour before each match.

3.3. Sampling Method and Sample Size

The researcher conducted the study with a specific group of teams competing at the national league level. This group was found in Amhara region and all the teams were from this region. Out of the total 11, teams only 5 teams were randomly selected. Simple random sampling method was employed because the teams were homogeneous, competing in the same of competition level and group. From these teams, 88 out of 97 volunteer field players participated in the study for about five weeks by filling the rating scale and participating in NMF field tests weekly. All filed players who were free from any injury taken from each sample team to participate. Players who got injuries were not included in the study (9 players).

3.4. Tools for Data Collection

The researcher collected the relevant data for each variable using various data collection tools. The researcher measured the independent variables such as perceived TL, recovery, stress, NMF and the dependent variable Match success (goals scored, goals conceded and points obtained from matches). Thus, each of these variables was measured using specific methods.

3.4.1. Neuromuscular Fitness

I. 40-m Dash Linear Sprinting Speed

40-meter dash was the distance and the protocol to measure the sprinting speed of the players. Three trials were given for each player with an adequate recovery time of 7-9 minutes between the trials. The best time among the trials has been taken as a score for analysis. This has been done for five consecutive weeks. The 40-m dash linear speed test is useful to provide information about independent speed quality and also it is a commonly used testing method to assess linear speed of trained soccer players (Buchheit, Simpson, Peltola & Mendez-Villanueva, 2012).

Test Procedure

Cones were set out at 40-m distance and two persons involved for testing. When one of the testers around the starting cone gives the command to sprint, the other person around the finishing cone start the time when the command go is heard. The tester around the finishing cone stops the time when the player reaches the finishing cone. Each player takes the second trail after the entire players take the first trial. The same way the third trials were conducted.

II. Repeated sprinting ability (RSA)

The researcher used 6*35m RSA testing method to measure players` ability to produce the best possible sprinting over consecutive sprints with only a brief recovery time between the sprints. The researcher used this specific RSA testing method following Bishop and colleagues (2011) and Bongers et al. (2015) recommendation. Here with this physical fitness quality, the aim was not only to measure how speedy were the players, but it was all about measuring the ability to produce the best possible sprint performance over a series of sprints over 35 m separated by short recovery periods of only 25-seconds. Therefore, the RAST (Running-based anaerobic sprint test), which involves 6*35m with 25 seconds recovery in between sprints was used. Because, it was such soccer specific RSA test (Zaggatto, Beck & Gabbatto, 2009).

Test Procedure

Cones have been set out at the end of a 35-meter running lane. Two testers were involved, as one person was required to time the 25 second recovery period. The player stands at one end of the 35m lane and starts a maximal sprint on the command “go”. Players were encouraged verbally to enable them produce maximum sprint through the distance. Then, after 25 seconds of recovery the next sprint starts from the opposite end of the 35 m lane. The sprint repeated the same way until 6 sprints were completed.

III. CODS

Concerning which agility tests are the most valid for the planned agility of soccer players, Sporis et al. (2010) found that, sprint 9-3-6-3-9 m with backward and forward running (SBF) is among the most valid and reliable tests (i.e., α=0.949). As a result, this test was used in this research to measure planned agility performance of the players. For this research, the "Sprint 9-3-6-3-9 m with backward and forward running (SBF)" was used despite the availability of numerous agility tests. The distance the player has to cover was 24m with forward sprinting and 6 m with backward running. Most sprints in soccer game are linear but the test that was used in this study better goes parallel with the point that the actions do not involve 90- or 180-degree sharp turn.

Test Procedure

Cones were sated out at the required distance to mark the starting place, how far to sprint forward, where to start and stop back sprint. The rest of the test procedure (i.e., the command to start, the number of trials and the recovery time between the trials) was similar with that of the 40-m dash linear speed test.

3.4.2. Perceived Training Load (TL)

As one of the main variables with this investigation, load was measured on a daily basis. The continuous and extended use of RPE for measuring internal load is so recommended (Aughey et al., 2016; Brink et al., 2010). Generally, RPE training load quantification is more effective than HR-based methods to predict changes in performance in soccer players (Figueirdo, Moreira, Goncalves & Dourado, 2019), because RPE load measurement acknowledges individual capacity (Rago, Brito, Figueredo, Krustrup & Rebelo, 2019). For this, the players were rating their perceived exertion (load) with the Borg`s scale (Borg CR10) on daily basis (for each training session). Thus, players used any number on the scale to rate their exertion (perceived load) within 20-30 minutes after the session as described by Foster et al., (2001). Then this number was multiplied by the duration of the session in minutes. Thus, the product of the session-RPE and the duration of the training session were defined as the training load (TL). A rating of zero on the scale was associated with no effort (rest) and a rating of 10 considered the maximal effort and associated with the most stressful session. This way as a procedure each player`s Session-RPE was collected about 20-30 minutes after each session to ensure that the perceived exertion is referring to the whole session rather than the most recent exercise intensity.

Before the beginning of data collection with this instrument, the players were oriented and familiarized with the scale. In the procedure, the players were shown the scale and asked "how hard was your workout?" and they gave a single number on the scale which best expresses their level of exertion (perceived load).

While TL assessment via heart rate (HR) measures is well accepted in endurance sports, this method is questionable in team sports since the overall TL often comprised of workouts that do not include a significant cardiorespiratory component (e.g. strength or speed training) (Borresen, & Lambert, 2009). For this reason, the use of rating of perceived exertion (RPE) based method has emerged as a practical and valid method of estimating TL in team sports (Figueirdedo et al., 2019; Impellizzeri, Rampinini, Coutts, Sassi & Marcora, 2004). Recent studies even use RPE with elite soccer players (Brito, Hertzog & Nassis, 2016; Rago et al., 2019). Generally, the reliability and internal consistency of RPE as indicator of intensity is good despite any possible influence of any contributing factor (Haddad et al., 2015; Weston et al., 2015).

3.4.3. Perceived Recovery

The levels of the players' physical and psychological recovery or preparedness for matches need to be estimated or quantified so as to have the data about recovery. This variable was measured with the "the short version of Recovery-Stress Questionnaire for sport (RESTQ-52-R-Sport)", which was primarily developed by Kellemann and Kallus (2001). This version is a questionnaire designed to identify players` perception of recovery-stress balance during training. This way it includes 7 general subscales concerning stress (i.e., general stress, social stress, emotional stress, conflict, lack of energy, physical compliant and fatigue), 5 general recovery subscales (i.e., success, social relaxation, somatic relaxation, general well-being, and sleep quality), 4 specific subscales for sport stress (i.e., disturbed breaks, burnout, emotional exhaustion and fitness/injury) and 3 subscales for specific sport recovery (i.e., fitness/being in shape, self-Regulation and self-efficacy). Thus, the questionnaire involves processes from physical, emotional, behavioral and social perspectives. The players are expected to respond to each statement by selecting the scales from 1 (never) to 7 (always). This has been done weekly within 24 hours before each match.

3.5. Pilot Test

The RESTQ-52 was translated into Amharic language by the researcher with an in expert in Amharic language (PhD holder in Amharic). Then the English and Amharic version has been submitted for the supervisors to comment on and to make subsequent corrections and modifications. The Amharic version then translated back in to the original (English) version with an expert in English language (a PhD holder in English) and the researcher. After checking and making the entire necessary modifications, pilot test was carried out with the Amharic version. Using the two teams who were not sample in the study, 37 questionnaires were found to calculate reliability. The Cronbach alpha value was ranged from 0.730-0.919, which indicated that the instrument used were all reliable. The overall Cronbach`s alpha value of each sub-scale is here under (table 1).

Table 3. The Cornbach`s alpha value of RESTQ-52 sub-scales

Sub-scales	Cronbach`s Alpha	Number of items
Fitness or Injury	.756	4
Being in shape	.832	4
Disturbed Breaks	.859	4
Burnout	.849	4
Emotional Exhaustion	.919	4
Self-Regulation	.849	4
Self-Efficacy	.770	4
Sleep Quality	.730	2
General Wellbeing	.829	2
Social Relaxation	.798	2
Somatic Relaxation	.826	2
Success	.788	2
General Stress	.826	2
Emotional Stress	.808	2
Social Stress	.767	2
Somatic Compliant	.858	2
Pressure or Conflict	.859	2
Lack of Energy	.816	2
Fatigue	.802	2

Match Success

Match success was quantified based on the number of goals the teams able to score. Goal-related success indicators are objective measures regardless of preferred footballing style and strategy. Total number of passes, passing effectiveness, corners, crosses and accuracy of crosses can be used as offensive performance indicators. But the ultimate of all these actions is to score goals and prevent opponents from scoring. Despite being good or better with these parameters', teams may not be able to score or to win. Therefore, examining success in terms of the number of goals scored and points obtained per match is comprehensive and the most objective measure of team success. As part of soccer performance analysis, defensive performance considered as tackles, tackles won, interceptions, clearances, duels won and aerial duels won. The ultimate of these actions is to prevent the opponent from scoring or to minimize the likelihood of conceding goals. To this end, the number of goals conceded was analyzed as a measure of success level. Generally, the number of goals scored, points obtained and goals conceded were the measures of success in the study.

3.6. The Data Analysis Methods

Statistical analysis of Pearson product moment correlation and regression analysis were computed using SPSS program of version 23. During the analysis, the critical value to determine statistical significance was set to be <0.05.

In this study, a number of variables such as load, neuromuscular fitness, recovery level, and match success were assessed. The relationship between the variables with each other and the relationship of one of these variables with two or more of the other variables was examined. Therefore, the relationship of load with neuromuscular fitness, stress and recovery level, neuromuscular fitness and with match success. The correlation of perceived stress and recovery level of the players with neuromuscular fitness of the players and with match success level was critically scrutinized using the Pearson product moment correlation (zero order co-efficient). In addition to a simple correlation test, partial correlation co-efficient was also used to examine the relationship by controlling the other moderating variables.

Pearson's product-moment correlation of zero order and partial correlation were employed in the study to examine relationships between TL and NMF, stress or recovery and NMF, TL and match success, stress or recovery and match success and also the relationship of NMF and match success. As a means to qualitatively interpret the magnitude of these associations a scale has been used. This way the correlation coefficients (r) has been interpreted in accordance with the following standard interpretations as suggested by Hopkins, Marshall, Batterham, and Hanin, (2009) ≤ 0.1, trivial; >0.1-0.3, small; >0.3-0.5, moderate; >0.5-0.7, large; >0.7-0.9, very large; and >0.9-1.0, almost perfect.

Advanced regressions, general linear model (GLM) was used to reveal how perceived weekly TL, perceived stress and recovery level determine NMF. The same way, match success prediction capacity of perceived TL, stress level, recovery level and NMF of the players were examined using GLM.

3.7. The Conceptual Model of the Study

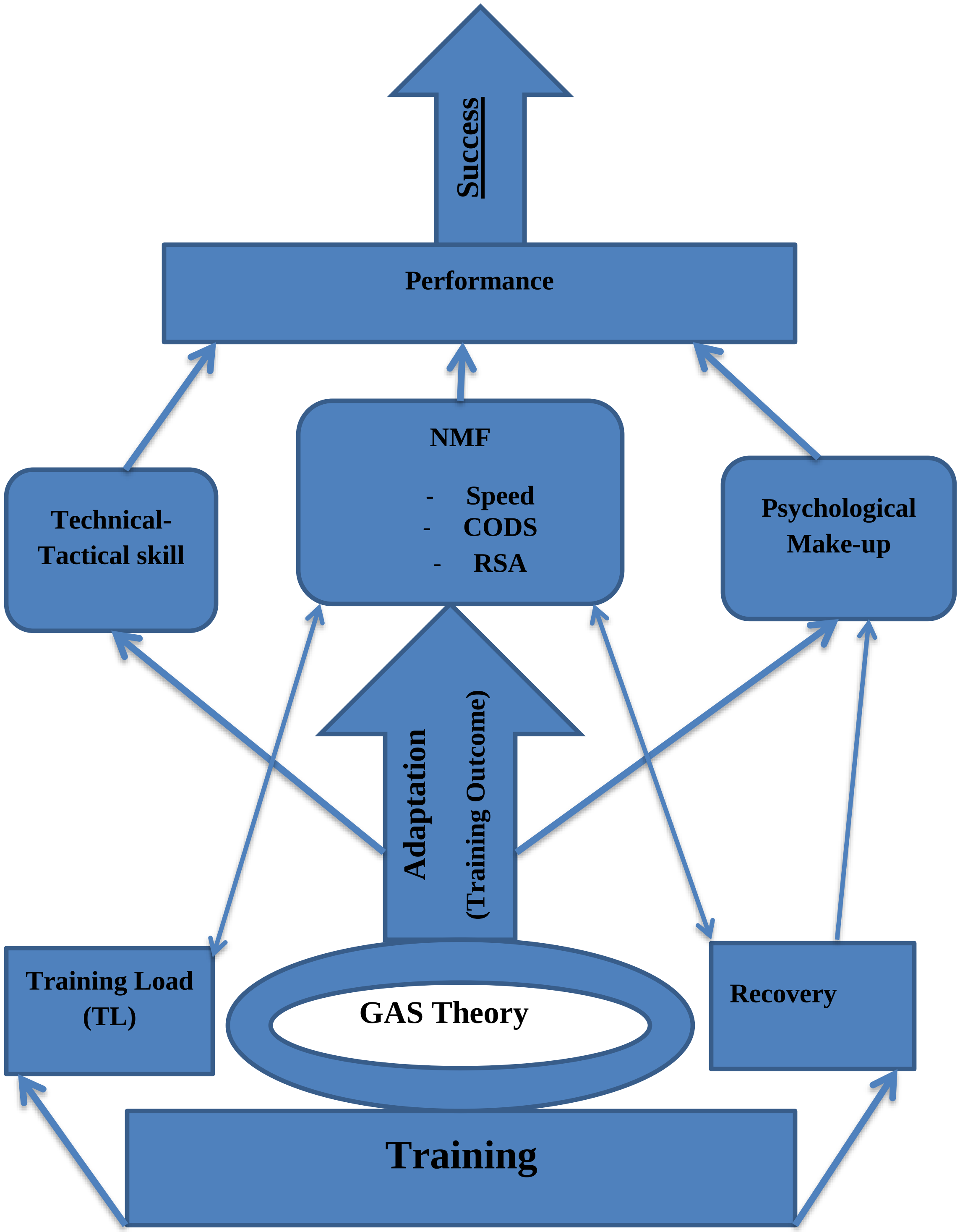

Figure 3. The conceptual model of the study connecting variables of the study

The conceptual model depicts how the variables such as TL, recovery and NMF interact or relates one another. It also displays how these factors relate or affect match success. The model acknowledges how GAS theory works for adaptation as a result of training (TL) and recovery. Moreover the model acknowledges how complicated is performance and success in soccer because of its multifaceted and interplaying factors.

CHAPTER FOUR: DATA ANALYSIS

4.0. Overview

This PhD research was conducted with competitive soccer players at the Ethiopian national league level, which is the third league in the nation next to the premier league and super league. In this PhD research, volunteered players (n=88) from 5 different teams participated. The data regarding perceived weekly training load (TL), neuromuscular fitness (NMF), stress and recovery status of the players were collected for five consecutive weeks. Soccer at competitive level mainly focuses on success (winning). Accordingly, this section presents the findings, regarding the relationships between these factors. More specifically, this section revealed how these factors relate directly or indirectly with the teams tendency of goal scoring ability and winning. Thus, it showed how physical qualities (speed, CODS, RSA), perceived TL, stress and recovery relate with success (i.e., goal scoring ability of teams and ability to obtain points from matches).

4.1. Demographic Characteristics

The demographic information includes chronological age, training age, weight and height of the players. The researcher collected these data by measuring the attributes (height and weight) and by asking the players via questionnaire to self-report the exact time of their birth and when they start participating in soccer training (age and training age). Regarding the players demographics, table 4 summarizes the descriptive results.

Table 4. Descriptive Summary of Players Demographic Characteristics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	88	18.00	30.00	22.250	2.260
Training Age	88	4.00	18.00	9.386	2.768
Weight	88	52.00	74.50	63.783	5.307
Height	88	150.00	185.00	172.909	6.258

As can be seen in Table 4, the mean of the players` chronological age was M = 22.250 ± (SD = 2.260) years with a corresponding mean training age of M = 9.386 ± (SD = 2.768) years. In terms of their weight and height, the players` had a mean weight of M = 63.783 ± (SD = 5.307kg) and a mean height of M = 172.909 ± (SD = 6.28cm). Compared to their age variability, the players` had higher weight and height variability that is SD of 5.307 and 6.258, respectively.

4.2. NMF (Speed, CODS and RSA) across the Studied Teams

In order to calculate the five neuromuscular test scores, the researcher took weekly measures for five weeks, and then averaged them to make comparison among the teams. Linear sprinting speed of the players was assessed to see how players across teams differ in their physical qualities. Moreover, teams compared against CODS and RSA performance of their players to examine differences. Table 5 displays the descriptive statistics of neuromuscular fitness mean time and SD in seconds.

Table 5. Descriptive Summary of Speed, CODS and RSA Time Score in seconds

	Team	Mean	SD	95% CI for Mean	
				Lower Bound	Upper Bound
Speed	1	5.871	0.124	5.810	5.938
	2	5.346	0.249	5.223	5.471
	3	5.387	0.299	5.247	5.527
	4	5.909	0.129	5.845	5.973
	5	5.955	0.175	5.862	6.049
CODS	1	10.639	0.321	10.468	10.811
	2	8.837	0.682	8.498	9.177
	3	9.083	0.879	8.672	9.495
	4	10.650	0.350	10.476	10.824
	5	10.784	0.312	10.618	10.950
RSA	1	5.356	0.151	5.276	5.437
	2	4.982	0.195	4.885	5.079
	3	4.868	0.211	4.770	4.967
	4	5.322	0.148	5.249	5.396
	5	5.168	0.109	5.334	5.451

ANOVA was used to test how significant is the difference in mean time score or performance of the teams in terms of the players linear sprinting speeds. The same way, mean time differences was tested among the teams using the players CODS and RSA mean time performance. Table 6 presents the summary of the NMF difference among the studied teams.

Table 6. Summary of Neuromuscular Fitness Test Performance among the Teams Studied

NMF		Sum of Squares	df	Mean Square	F
Speed	Between Groups	6.455	4	1.610	35.873***
	Within Groups	3.734	83	.045	
	Total	10.189	87		
CODS	Between Groups	64.849	4	16.210	48.595***
	Within Groups	27.690	83	.334	
	Total	92.540	87		
RSA	Between Groups	4.219	4	1.050	36.751***
	Within Groups	2.382	83	.029	
	Total	6.602	87		

*$p<.05$. **$p<.01$. ***$p<.001$

As shown in Table 6 linear sprinting speed (40m) was found significantly different among the teams F (4, 83) =35.873, p<.001. This way, the post-hoc result, Games-Howells, revealed that team 1, with a mean time of 5.87 seconds to cover the 40m distance was significantly different (slower than) team 2, which in average took 5.346 seconds and team 3, with 5.387 seconds. However, team 1 was not different from team 4, and team 5, who finished the 40m distance with 5.909 and 5.955 seconds respectively. Team 2 and 3 were not different, though they were different (better than) all the other teams. The same way, team 4 and 5 do not differ significantly.

When we compare the teams against CODS (9-3-6-3-9), there was a significant difference among the teams F (4, 83) = 48.595, p<.001 (table 6). Team 1 was significantly different (slower than) team 2 (M = 10.639, SD = 0.321 versus M = 8.837, SD = 0.682 seconds) and team 3 (M = 10.639, SD = 0.321 versus M = 9.083 SD = 0.879seconds) to cover the 9-3-6-3-9m CODS. As such team 2 and team 3 were significantly different from both team 4 (M = 10.650, SD = 0.350 seconds) and team 5 (M = 10.784, SD = 0.312 seconds), though they were not significantly different with each other. Team 1, 4 and 5 were not that different in their ability to cover the 9-3-6-3-9 CODS test.

In terms of repeated sprinting ability (RSA), the average time of the players, there was a statistically significant difference $F (4, 83) = 36.751$, $p<.001$ among the teams (table 6). RSA average time, which was measured with 6*35m, was statistically different between team 1 and team 2 (M = 5.356, SD = 0.151 versus M = 4.982, SD = 0.195 seconds). Still team 1 was different from team 3 which took 4.868 ± 0.211 seconds to cover the 6*35m RSA test. However, there was no statistically significant difference between team 1 and 4 (M = 5.356, SD = 0.151 versus M = 5.322, SD = 0.148 seconds), team 4 and 5 (M = 5.322, SD = 0.148 versus M = 5.168, SD = 0.109 seconds), team 2 and 3 (M = 4.982, SD = 0.195 versus M = 4.868, SD = 0.211). Team 2 and 3 were significantly different (better than) from the rest of the teams (i.e., from team 1, 4 and 5).

4.3. Success across the Teams

Comparison was made among the teams against success level. The studied teams were compared using the number of goals they scored and the goals they concede. Based on the points they were able to obtain from matches, the teams were also compared. Successful teams were those who scored more goals and obtained more points. Still the teams with the minimum number (least) in the goals conceded also considered as successful.

Table 7 shows the mean value of goals scored by the teams per game as performance indicator. The mean value of the goals conceded by the teams was also considered and used as success indicator. In addition, the ability of the teams to obtain points from matches is assessed and analyzed.

Table 7. Summary of the Descriptive Value of Success Parameters

	Teams	Mean	SD	95% CI for Mean	
				Lower Bound	Upper Bound
Goals Scored	1	0.400	0.000	0.400	0.400
	2	1.400	0.000	1.400	1.400
	3	1.600	0.000	1.600	1.600
	4	0.200	0.000	0.200	0.200
	5	0.200	0.000	0.200	0.200
Goals Conceded	1	1.200	0.000	1.200	1.200
	2	1.000	0.000	1.000	1.000
	3	0.600	0.000	0.600	0.600
	4	0.400	0.000	0.400	0.400
	5	1.000	0.000	1.000	1.000

Points Obtained	1	0.600	0.000	0.600	0.600
	2	2.000	0.000	2.000	2.000
	3	2.200	0.000	2.200	2.200
	4	0.800	0.000	0.800	0.800
	5	0.600	0.000	0.600	0.600

The descriptive statistics indicated that the teams` success level regarding their ability to score goals ranges from 1.600 goals per game (team 3) to 0.200 goals (team 4 and 5) per game. Team 1 and 2 has a gaol scoring ability of 0.400 and 1.400 per game respectively. As a defensive ability to prevent opponents from scoring, tendency of the teams to conced goals ranges from 0.400 (team 4) to 1.200 (team 1). Teams can get a maximum of 3 points per match if the win. Here with regard to the studied teams` ability to obtain points, the maximum is achieved by team 3 with an average of 2.200 goals per game. Still team team was able to obtain 2.00 goals per game. The next highest score in obtaining points from matches was 0.800 by team 4 and 0.600 by team 1 and 5. Those teams with low goal scoring ability were lower in obtaining points from matches.

After examining the mean value of each team against the parameters of success, ANOVA test was used to reveal how the mean difference was significant. The teams` success level was compared using the three parameters as number of goals scored per match, goals conceded and the points obtained from matches (table 8).

Table 8. Success across the studied Teams

Success		Sum of Squares	df	Mean Square	F
Goals Scored	Between Groups	34.080	4	8.520	5.621E+32***
	Within Groups	.000	83	.000	
	Total	34.080	87		
Goals Conceded	Between Groups	7.555	4	1.889	4.052E+32***
	Within Groups	.000	83	.000	
	Total	7.555	87		
Points	Between Groups	45.193	4	11.298	3.005E+32***
	Within Groups	.0003	83	.000	

	Total	45.19	87

*p<.05. **p<.01. ***p<.001

As a measure of success, goals teams scored per game was found significantly different across the teams F (4, 83) =5.621E+32, p<.001 (table 8). The level of success accomplished by teams can differ as a function of their chemistry as a team. The Games-Howell multiple comparison unveil that team 1 was significantly less successful (weaker) than team 2 (M = 0.400 versus M = 1.400 goals per game) and team 3 (M = 0.400 versus M = 1.600 goals per game) in scoring goals per game (p<0.001). But team 1 was more successful than team 4 (M = 0.400 versus M = 0.200 goals per game) and team 5 (M = 0.400 versus M = 0.200 points per game) p<0.001. Still team 2 was less successful than team 3 (1.400 versus 1.600 goals per game). Team 3 was highly successful than all the teams. Team 4 and 5 were perfectly the same with this success parameter (M = 0.200 versus M = 0.200 goals per game) goal per game.

The number of goals that teams conceded per game was significantly different F (4, 83) = 4.052E+32, p<.001 (table 8). Using Games-Howell post-hoc analysis, team 1 was the first to concede significantly more goals. Team 3 and 4 were the one to concede fewer goals with team 4 being the least.

The teams were found significantly different in their ability to obtain points from matches (match success) p<0.001 (table 8). From the post-hoc analysis, Games-Howell, it was found that team 1 was significantly less successful (weaker) than team 2 (M = 0.600 versus M = 2.000 points per game), team 3 (M = 0.600 versus M = 2.200) and team 4 (M = 0.600 versus M = 0.800) in earning points per game p<0.001. In this regard, team 1 was not different from team 5 (i.e., they were exactly the same). Team 2 was significantly lower (less successful) than team 3 (M = 2.000 versus M = 2.200 points per game) p<0.001, and more successful than team 4 (2.0 versus 0.800 points) p<0.001 and team 5 (M = 2.000 versus M = 0.600 points). Team 3 was significantly superior to team 1 (M = 2.200 versus M = 0.600), team 2 (M = 2.200 versus M = 2.000), team 4 (M = 2.200 versus M = 0.800) and team 5 (M = 2.200 versus M = 0.800 points per game). This way team 4 was significantly different or more successful than team 5 (M = 0.800 versus M = 0.600 points per game) p<0.001.

4.4. Playing Position and NMF of the Players

For different positions in soccer, there is a different physical qualities demand. With this assumption, the researcher considered the common playing positions such as center backs, full backs, holding midfielders, offensive midfielders, outside midfielders and strikers. These position players were compared against linear sprinting speed, CODS and RSA performance scores. The descriptive statistics is displayed to show the mean time taken to cover each test. The mean value in addition with the SD and 95% CI was considered for each position.

Table 9. Descriptive Summary of Neuromuscular Fitness Performance of Different position players

Fitness	Position	Mean	SD	95% CI	
				Lower Bound	Upper Bound
Speed	Center Backs	5.689	0.342	5.537	5.841
	Fullbacks	5.599	0.434	5.143	6.055
	Holding Mid	5.842	0.180	5.738	5.946
	Attacking Mid	5.768	0.304	5.617	5.919
	Wingers	5.442	0.422	5.225	5.657
	Striker	5.700	0.209	5.556	5.841
CODS	Center Backs	9.897	1.133	9.395	10.399
	Fullbacks	9.902	1.167	8.678	11.127
	Holding Mid	10.414	0.678	10.022	10.805
	Attacking Mid	10.276	0.884	9.836	10.716
	Wingers	9.253	1.207	8.633	9.873
	Striker	9.000	0.544	9.634	10.365
RSA	Center Backs	5.220	0.260	5.104	5.335
	Fullbacks	5.127	0.350	4.759	5.495
	Holding Mid	5.305	0.183	5.200	5.411
	Attacking Mid	5.224	0.247	5.102	5.347
	Wingers	4.930	0.311	4.770	5.090
	Striker	5.191	0.142	5.096	5.286

After the mean value description, group comparison was made to reveal how the different position players differ in their sprinting speed and CODS performance. The groups were also compared against RSA score. As such, Table 10 presents the group comparison results.

Table 10 Fitness Level among the Different Position Players

NMF		Sum of Squares	df	Mean Square	F	Sig.
Speed	Between Groups	1.516	5	.303	2.867	.020
	Within Groups	8.673	82	.106		
	Total	10.189	87			
CODS	Between Groups	13.285	5	2.657	2.749	.024
	Within Groups	79.255	82	.967		
	Total	92.540	87			
RSA	Between Groups	1.356	5	.271	4.240	.002
	Within Groups	5.246	82	.064		
	Total	6.602	87			

$^{*}p<.05$. $^{**}p<.01$. $^{***}p<.001$

NMF as defined with linear sprinting speed over 40m, CODS with 9-3-6-3-9 and RSA average time with 6*35m test protocol, was significantly different among the common playing position players (i.e., fullbacks, center backs, holding midfielders, offensive midfielders, outside midfielders/wingers, and strikers) (table 10).

Linear sprinting speed performance of players was found significantly different among different position players F (5, 82), 2.867, p = 0.02 (table 10). Games-Howell test of multiple comparison revealed that center backs do not differ from other position players. The same thing was true with fullbacks that they do not differ from any of other position players. However, holding midfielders were significantly different (slower) than wing players (p=0.019), though they were not different from other position players. All position players were not different, but only wing players (outside midfielders) were significantly superior to holding midfielders (M = 5.442, SD = 0.422 versus M = 5.842, SD = 0.180 seconds to cover the 40m distance).

As part of NMF parameters, CODS was found position dependent F (5, 82) = 2.749, p=0.024 (table 4.7). The multiple comparisons, Games-Howell showed that, fullbacks differ from center backs, holding midfielders, offensive midfielders, wing players and from strikers. Even center backs do not have a statistically significant difference from holding midfielders, offensive midfielders, wing players, and strikers. The same way, holding midfielders and offensive midfielders do not have a significant difference in CODS performance level. The difference in CODS performance between holding midfielders and strikers was not significant enough. However, there was such a significant difference between outside midfielders and holding midfielders (M = 9.253, SD = 1.200 versus M = 10.414, SD = 0.678 seconds to cover the 9-3-6-3-9 CODS test), p=0.025.

RSA was significantly different among the different position players F (5, 82), p= .002 (table 7). RSA average time was not significantly differed when we compare center backs with fullbacks, holding midfielders, offensive mid fielders and with strikers (table 7). However, center backs were significantly different (sluggish than) outside midfielders (M = 5.220, SD = 0.260 versus M = 4.930, SD = 0.311 seconds) p=0.044. Full backs do not differ from any of other position players as holding midfielders, offensive midfielders, wingers and strikers. The same way holding midfielders do not differ from offensive midfielders and strikers. However, holding midfielders significantly differ (slower than) wing players (M = 5.305, SD = 0.183 versus M = 4.930, SD, 0.311 seconds) p=0.004. Outside midfielders do not differ from full backs and strikers, though they significantly differ (faster than) from offensive midfielders (M = 4.930, SD = 0.311 versus M = 5.224, SD = 0.247 seconds of average time in the 6*35m RSA test protocol) p=0.044 (table 10).

4.5. The Relationship of NMF with Stress level, Recovery level and TL

NMF was considered as the performance scores of the players in the 40-m linear sprinting, 9-3-6-3-9 CODS and 6*35m RSA performance. The perceived recovery and stress level of the players were measure as GS, SSS, GR and SSR. The analysis to show how these variables relate was carried out using zero-order correlation and partial correlation. The zero-order correlation was used to examine how NMF relate with stress, recovery and TL without considering how other factors moderate or affect the relationship. But the partial correlation was done with a due consideration of the effect that other variables have on each relationship.

Table 11. The relationship of Speed with GS, SSS, GR, SSR and TL

		GS	SSS	GR	SSR	TL
Speed	Correlation	.677	.670	-.571	-.790	-.293
	Significance(2-tailed)	.000	.000	.000	.000	.006
	df	86	86	86	86	86
Controlled	Correlation	.000	.037	-.043	.003	-.004
Variables:6	Significance(2-tailed)	.999	.742	.700	981	.973
	df	80	80	80	80	80

Though the zero-order correlation between speed and general stress (GS) was significant r (86) =0.677, p<0.001, the partial correlation after controlling CODS, RSA, general recovery (GR), sport specific stress (SSS), sport specific recovery (SSR) and perceived weekly training load (TL) was not significant (table 11). After controlling these variables there was no relationship between linear sprinting speeds over 40m distance and GS level of the players. The same way, sport specific stress (SSS) do not correlate with speed after controlling CODS, GS, GR, SSR and TL, though they do possess a significant zero-order correlation r (86) =0.670, p<0.001, meaning that the relationship of linear sprinting speed with either GS or SSS was highly dependent on the existence of those covariates as CODS, RSA, GR, SSR and TL conditions.

With zero-order correlation, speed was found to correlate with GR level of the players r (86) =0.571, p<0.001 (table 11). The zero-order correlation indicated that players who reported a higher GR level were found to perform better in linear sprinting speed. However, the partial correlation of speed and GR after controlling CODS, RSA, GS, SSS, SSR and TL was found to be non-significant. The other recovery dimension, SSR, was found strongly correlating with sprinting speed performance r (86) = 0.790, p<0.001 with the zero-order correlation. But after controlling GS, SSS, GR and TL, there was no statistically significant relationship at all between speed and SSR.

A small significant relationship between speed and perceived weekly training load (TL) was found with the zero-order correlation coefficient r (86) = -0.293, p = 0.006 (table 11). But the relationship between speed and TL after controlling RSA, CODS, GS, GR, SSS and SSR was not that significant.

Table 12. The relationship of CODS with GS, SSS, GR, SSR and TL

		GS	SSS	GR	SSR	TL
CODS	Correlation	.703	.708	-.655	-.837	-.274
	Significance(2-tailed)	.000	.000	.000	.000	.010
	df	86	86	86	86	86
Controlled Variables: 6	Correlation	-.220	.052	.331	-.305	.177
	Significance(2-tailed)	.047	.641	.002	.005	.111
	df	80	80	80	80	80

The zero-order correlation between CODS and GS was significant r (86) = 0.70, p<0.001 (table 12). This zero-order correlation coefficient is greater than the partial correlation of CODS and GS r (80) = -0.220, p=0.047, which is negative when speed, RSA, GR, SSS, SSR and TL were controlled. The effect of these variables on the nature of the relationship between CODS performance of players with the general level of stress was substantially impactful. Players who reported lower on the GS level tend to perform better in the 9-3-6-3-9 fitness test score. Even CODS was found to have a higher positive zero-order correlation with SSS r (86) =0.708, p<0.001, although the nature of this relationship was altered to be non-existent when speed, RSA, SSR, GS, GR and TL were controlled. Thus, the relationship between these variables was highly affected by the controlled variables.

The association between CODS performance and general recovery level of the players was statistically significant and inverse r (86) =-0.655, p<0.001 (table 12). However, when the other variables (factors) are controlled, the strength of the relationship becomes lower as the partial correlation coefficient becomes r (80) =-0.331, p=0.002. This indicates that speed, RSA, SSS, SSR, GS and TL can affect the relationship of CODS with general recovery level. Regardless of the difference, both the zero-order and partial correlation result indicated that players with higher GR level tend to perform better in CODS.

The zero-order correlation coefficient between CODS and SSR was inversely significant r (86) =-0.837, p<0.001, indicating a strong relationship. This relationship becomes lower as the partial correlation coefficient was r (80) =-0.305, p=0.005 (table 12). The effect of the other factors on the relationship between CODS and SSR was higher as the correlation coefficient drops from -0.837 to -0.305. Anyways, it was evident that players who rated a higher SSR level perform better in CODS.

Perceived weekly training load (TL) had a satisfactory significant relationship with CODS performance r (86) =-0.274, p=0.01 (table 12). But the partial correlation coefficient indicated that there is no a significant level of correlation between CODS performance and perceived weekly TL when the moderating variables are controlled.

Table 13. The Relationship of RSA with GS, SSS, GR, SSR and TL

		GS	SSS	GR	SSR	TL
RSA	Correlation	.671	.646	-.487	-.779	-.319
	Significance(2-tailed)	.000	.000	.000	.000	.002
	df	86	86	86	86	86
Partial correlation	Correlation	.128	-.037	.353	-.093	-.144
	Significance(2-tailed)	.253	.745	.000	.407	.198
	df	80	80	80	80	80

RSA average time as a performance parameter was found to have a significant zero-order correlation r (86) =0.671, p<0.001 with GS (table 13). When the relationship was examined by controlling the other confounding variables, there was no that practically significant relationship between RSA and GS level of the players. The same thing was true about the relationship between RSA and SSS r (86) = 0.646, p<.001, meaning that though there was a significant zero-order relationship between RSA and SSS, the partial correlation after controlling the confounding variables showed that there is no significant relationship.

The zero-order correlation between RSA and GR was significantly inverse r (86) = -0.487, p<0.001 (table 13). Even this relationship was statistically significant when the other confounding variables were controlled, as the partial correlation was r (80) = 0.35, p<0.001. RSA performance does not relate with SSR when speed, CODS, GS, GR, SSS and TL were controlled. But the relationship between RSA performance and SSR was highly affected by these confounding variables as the zero-order correlation was significant with a coefficient of r (86) = -0.799, p<0.001. There was a significant moderate level of correlation between RSA performance and TL r (86) =-0.319, p=0.002. But this relationship was not significant when other factors were controlled, indicating that the relationship was affected by other variables.

4.6. The Interdependence among Speed, CODS and RSA Performance

These fitness qualities are generally believed to have a relationship as they all mainly rely on the anaerobic energy pathway and they involve explosive movements for a brief time. However, the exact relationship that they have with each other is not clear and consistent. The test protocols even are different enough. Here these fitness qualities are examined to reveal how they relate each other and how significant and strong is their relationship.

Table 14. The correlation of Speed with CODS and RSA

		CODS	RSA
Speed	Correlation	.904	.901
	Significance(2-tailed)	.000	.000
	df	86	86
Controlled Variables: 6	Correlation	.433	.505
	Significance(2-tailed)	.000	.000
	df	80	80

The bivariate relationship between linear sprinting speed and CODS was significantly very strong r (86) =0.904, p<0.001 (table 14). After controlling GS, GR, SSS, SSR and TL, the relationship decreases substantially r (80) =0.433, p<0.001. The effect of the other variables on the relationship between speed and CODS was significant. The same way, the effect of other variables on the relationship between speed and RSA was significant as the partial correlation is lower than the zero-order correlation between speed and RSA (r (86) =0.901, p<0.001 versus r (80) =0.505, p<0.001) (table 14).

Table 15. The relationship between CODS and RSA

		RSA
CODS	Correlation	.872
	Significance(2-tailed)	.000
	df	86
Controlled Variables: 6	Correlation	.325
	Significance(2-tailed)	.003
	df	80

The relationship between CODS and RSA was highly significant r (86) = .872, p<.001 (table 15). Players who were good in CODS perform better in RSA test. However, this relationship was highly mediated by the other variables as stress level, recovery level and TL. As a result, the partial correlation was too smaller than the zero-order correlation r (80) = .325, p=.003. But in both cases CODS and RSA as a soccer specific fitness quality showed a statistically significant relationship.

4.7. NMF and Perceived Stress level, Recovery Level and TL

As a highly related performance parameter (table 14 and 15), speed, CODS and RSA performance has been considered (computed) as a single behavior (variable) to examine its relationship with perceived TL, stress and recovery level of the players.

Table 16. The correlation of NMF with Stress, Recovery and TL

		GS	SSS	GR	SSR	TL
NMF	Correlation	.713	.711	-.628	-.843	-.294
	Significance(2-tailed)	.000	.000	.000	.000	.005
	df	86	86	86	86	86
Controlled	Correlation	-.58	.083	-.087	-.578	.066
Variables:	Significance(2-tailed)	.151	.454	.432	.000	.549
4	df	82	82	82	82	82

NMF (speed, CODS and RSA) had a significant zero-order correlation coefficient of r (86) =0.713, 0.711, -0.628 and -0.843, p<0.001 with GS, SSS, GR, and SSR respectively (table 16). There was also such a significant relationship with TL r (86) = -.294, p=.005. However, the magnitude of the relationship found to be highly affected by the confounding variables. The partial correlation results revealed that NMF do not exhibit that significant relationship with GS, SSS, GR and TL. But NMF and SSR significantly correlated though the effect of the other variables was substantially greater. However, the zero-order correlation was higher than the partial correlation coefficient (r (86) = -0.843, p<0.001 versus r (82) = -0.578, p<0.001). Players who scored higher in the SSR measures tend to have a better NMF.

4.8. How Perceived TL Relate with Perceived Stress and Recovery Level

Perceived load is presumed to be affected by different conditions in addition to the training. The sport specific and non-sport specific burdens (psychology stressors) as a stimulus are believed to impact the negative and positive consequences of training. Having this, the relationship of stress and recovery level with TL was examined using zero-order and partial correlation.

Table 17. The Relationship of Perceived TL with Stress and Recovery Level

		GS	SSS	GR	SSR
TL	Correlation	-.384	-.261	.358	.397
	Significance(2-tailed)	.000	.014	.001	.000
	df	86	86	86	86
Control Variables	Correlation	-.096	.160	.100	.156
	Significance(2-tailed)	.380	.143	.361	.153
	df	83	83	83	83

Perceived weekly TL had a significant inverse relationship with GS r (86) = -0.384, p<0.001 and SSS r (86) =-0.261, p=0.014 (table 17). Players who reported lower levels of general and sport specific stress reported lower TL. It`s relationship with GR and SSR level was found positive with a coefficient of r (86) = 0.358, p=0.001 and r (86) =0.397, p<0.001 respectively. Players who exhibited better perceived recovery were able to have higher weekly TL. But the partial correlation revealed that TL does not have a statistically significant correlation with GS, SSS, GR or SSR when the effect of the other variables is controlled. The moderating effect of the variables with each other on the nature of the relationship was higher.

4.9. Team Success in Relation with the Players NMF, TL, Stress and Recovery

Success level has been considered using the parameters as the points obtained from matches, the number of goals teams able to score and the number of goals that teams concede. The team who won can earn 3 points per match and 1 point when they end the match with a draw result. When they lose, they cannot earn any point. As success also depends on team's ability to prevent an opponent from scoring, the number of goals teams concede has been examined as success parameter. Thus, these parameters were examined about how they relate with the players perceived TL, stress and recovery level.

Table 18. The Relationship of Success with TL, Stress and Recovery

Success		TL	GS	SSS	GR	SSR	Speed	CODS	RSA
Goals Scored	Correlation	.454	-.905	-.827	.727	.973	-.785	-.817	-.789
	Significance(2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000
	df	86	86	86	86	86	86	86	86
Controlled Variables: 9	Correlation	.320	.096	.138	-.321	.004	.102	.132	-.196
	Significance(2-tailed)	.004	.402	.000	.004	.970	.371	.245	.084
	df	77	77	77	77	77	77	77	77
Points obtained	Correlation	.452	-.890	-.836	.728	.970	-.781	-.819	-.796
	Significance(2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000
	df	86	86	86	86	86	86	86	86
Controlled Variables: 9	Correlation	-.196	-.259	-.549	.399	.356	-.097	-.095	.088
	Significance(2-tailed)	.084	.021	.000	.000	.001	.397	.406	.443
	df	77	77	77	77	77	77	77	77

The level of success in terms of points obtained from games and the number of goals that the teams scored were found to inversely correlate with linear sprinting, CODS and RSA performance scores of the players. Sprinting speed over 40m distance, CODS performance in 9-3-6-39 and RSA as measured with 6*35m strongly correlated with points obtained as the zero-order coefficient was significant r (86) =-0.781, $p<0.001$, -0.819, $p<0.001$ and -0.796, $p<0.001$ respectively (table 18). This result alone indicated that teams with less time score to cover the NMF test found to be more successful than those teams who took longer time to cover the tests. However, this relationship, which is found with the zero-order correlation test, was not there when the relationship was examined by controlling the mediating variables of stress or recovery level and TL. Thus, the relationship of points obtained (success level) from games with speed, CODS or RSA was affected by one or more of other factors. The relationship of goal scoring ability of teams with speed, CODS and RSA was significantly larger $p<0.001$ with a correlation coefficient of r (86) =-0.785, -0.817 and -0.789 respectively (table 18).

The zero-order correlation of points obtained with stress-recovery level was highly significant. Success level significantly and inversely correlated with GS and SSS with a coefficient of r (86) =-0.890, $p<0.001$ and -0.836, $p<0.001$ respectively (table 18). Here the partial correlation coefficient was significant r (77) =-0.259, $p=0.021$ and -0.549, $p<0.001$ with GS and SSS respectively, indicating that the relationship is highly affected by the controlled variables. There was also a significant positive correlation between success and GR and between success and SSR level. The zero-order correlation of success with GR was r (86) = 0.728, p<0.001. This was true with that of SSR as the zero-order correlation was very large r (86) = 0.970, p<0.001. The relationship between success and GR or SSR was also significant when the association was examined with partial correlation, though it was smaller than the zero-order correlation r (86) =0.728 versus r (77) = 0.399 and r (86) = 0.970 versus r (77) = 0.356.

The association between success level and perceived training load was significant r (86) =0.452, p<0.001. But the partial correlation was non-significant, indicating that the relationship between success and TL was highly mediated by stress level and recovery level.

Goal Scoring and Stress-Recovery Level

Goal scoring ability of teams, which is one success parameter, highly correlates with both GS and SSS as the zero-order correlation coefficient was found to be significant r (86) =-0.905, p<0.001 and -0.827, p<0.001 respectively (table 18). Both GR and SSR has a significant positive relationship with goal scoring ability of the teams with a coefficient of r (86) =0.727 and 0.973, p<0.001 respectively. However, these relationships were not that bigger or significant when some of the variables were controlled and examined with partial correlation. For example, GS and SSR do not show statistically significant relationship with goal scoring ability, though they were significant with the zero-order correlation. Still, SSS and GR show a significant relationship with goal scoring ability when the effect of the other variables was controlled. The partial correlation coefficient of SSS with goal scoring ability was r (77) =0.438, p<0.001 and that of GR had a correlation coefficient of r (77) =-0.31, p=0.004 with goal scoring ability of the teams. Here the strength of the partial correlation is smaller than the zero-order correlation (-0.827 versus 0.438 and 0.727 versus -0.321) (table 18).

Perceived weekly TL had a statistically significant relationship with goal scoring ability of teams r (86) =0.454, p<0.001 (table 18). This relationship also existed when GS, SSS, GR and SSR were controlled. The partial correlation coefficient r (77) =0.320, p=0.004 was significant enough though it was lower than the zero-order correlation level. The teams with higher perceived weekly TL were significantly better in goal scoring than those teams with the lower perceived weekly TL. GS, SSS, GR, SSR and TL were found to be affected by one another when they are assessed about how they relate with goal scoring ability of teams. This was evident when comparison is made between zero-order correlation coefficient and partial correlation coefficient of each variable with goal scoring tendency of teams.

4.10. The Relationship of Goals Conceded by Teams with Stress, Recovery, TL and NMF

The teams with the smallest or least in conceding goals were considered as successful. For this, it was analyzed to reveal how it relates with TL, stress and recovery level of the players. The teams which were capable to deny space and time can minimize the likelihood of conceding. Thus, this analysis shows how the teams were good enough in doing so.

Table 19. The Correlation of Goals Conceded by Teams with Stress, Recovery Level, NMF and TL

Success		TL	GS	SSS	GR	SSR	Speed	CODS	RSA
Goals Conceded	Correlation	-.239	-.018	-.005	.050	-.089	.050	.057	.189
	Significance(2-tailed)	.025	.870	.960	.642	.410	.646	.598	.077
	df	86	86	86	86	86	86	86	86
Control Variables	Correlation	-.273	-.301	-.509	.376	.255	-.168	-.121	.207
	Significance(2-tailed)	.015	.007	.000	.000	.0023	.138	.286	.067
	df	77	77	77	77	77	77	77	77

There was no relationship between the players GS level and the number of goals conceded by the teams. The same way, SSS level of the players does not correlate with goal conceding tendency of the teams. The relationship of GR and SSR level of players with goals conceded by their team also was not significant. Regardless of all this, the association of GS, SSS, GR and SSR levels of players with their team's condition of conceding goals was significant when the effect of confounding variables was controlled. As such GS and SSS level of players had a significant negative correlation coefficient of r (77) =-0.301, p=0.007 and -0.509, p<0.001 respectively with the number of goals conceded by teams (table 19). The same way GR and SSR level had a partial correlation coefficient of r (77) =0.376, p=0.001 and 0.255, p=0.0023 respectively.

Perceived weekly TL of the players had a significant inverse correlation with goals conceded by teams even when the other variables were controlled or their effect was not in due consideration. TL had a zero-order correlation coefficient of r (86) =-0.239, p=0.025 and a partial correlation coefficient of r (77) =-0.273, p=0.015 with that of goals conceded by teams. The higher the players perceived weekly TL, the lesser the goals conceded by their respective teams. NMF in general or specifically linear sprinting speed, CODS and RSA do not have a significant relationship with goals conceded by teams.

4.11. Predicting NMF performance from TL, Stress and Recovery level

Perceived TL, stress level and recovery level scores examined to identify how these predictor variables predict NMF. For this, A multiple regression analysis using GLM has been done to examine how TL, GS, GR, SSS and SSR predicts (explain) neuromuscular fitness (NMF) as measured with 40m linear sprinting speed, 9-3-6-3-9 CODS and 6*35m RSA. NMF was considered in different ways. First it was taken as a single behavior by combining speed, CODS and RSA as a single behavior (performance). Then after, speed, CODS and RSA were analyzed separately.

Table 20. Determinants of NMF Performance

Source	df	F	B	Sig.	Partial Eta Squared
Corrected Model	5	120.496		.000	.581
Intercept	1	486.152	7.763	.000	.528
GS	1	5.122	.162	.024	.012
GR	1	.213	-.014	.644	.000
SSS	1	2.280	.081	.132	.005
SSR	1	133.859	-.371	.000	.236
TL	1	1.229	-7.089E-5	.268	.003
Error	434				
Total	440				
Corrected Total	439				

a. R Squared = .581 (Adjusted R Squared = .576)
b. Dependent Variable: NMF
c. Model: (Intercept), TL, GS, GR, SSS, SSR

Using the analysis, the overall regression model was significant F (5,434) =120.496, p<0.001, adjusted R^2 = 0.576 (table 20). Among the predictor variables used in the analysis, only GS and SSR were found to be significant predictors of performance (NMF) with a significance value of p=0.024 and p<0.001 respectively. These values represent low and strong effects, respectively (Lenhard & Lenhard, 2016). The interaction effect of each variable with the other predictors was not significant. As per the partial eta squared values, the effect of SSR is much stronger than the effect of GS (ηp2= 0.012 or Cohen`s d = 0.220 versus ηp2 = 0.236 or Cohen`s d = 1.111). The response variable, NMF, is highly explained by those predictors as GS and SSR. Thus, 57.6% of the variance in NMF can be explained by GS and SSR level of the players. Generally, the model or equation was significant with the following intercept and coefficients.

NMF=7.763+0.162(GS) -0.371(SSR) or $Y = 7.63 + 0.162X1 - 0.371X2$

Speed

The players perceived level of stress, recovery and TL were examined to unveil how these factors as a predictor determine the players sprinting speed over 40-m dash.

Table 21. Determinants of Sprinting Performance

Source	df	F	B	Sig.	Partial Eta Squared
Corrected Model	5	73.134		.000	.457
Intercept	1	483.469	5.938	.000	.527
GS	1	3.599	.104	.058	.008
GR	1	.164	-.009	.686	.000
SSS	1	3.280	.074	.071	.008
SSR	1	79.704	-.220	.000	.155
TL	1	.040	-9.822E-006	.841	.000
Error	434				
Total	440				
Corrected Total	439				

a. R Squared = .457 (Adjusted R Squared = .451)
b. Dependent Variable: Speed
c. Model: (Intercept), TL, GS, GR, SSS, SSR

How TL, GS, GR, SSS and SSR as a predictor variable determine sprinting speed performance over 40m distance was tested using GLM. Among these predictors, only SSR level of the players was a significant predictor of sprinting speed performance. With this predictor, the overall regression model was significant F (5,434) =483.469, p<0.001, adjusted R^2=0.451 (table 21). The effect of SSR on linear speed performance of the players is large (Partial η2 = 0.155 = Cohens d= 0.857). The interaction of the predictors was not statistically significant. When we think how the predictor determines the response variable, it was found that 45.1% of the variance in speed performance can be explained by the players' level of SSR. The equation for speed from the predictor is: Speed=5.938-0.220 (SSR) or ($Y = 5.938 - 0.220X$).

CODS

The perceived weekly TL, perceived stress and recovery level of the players were analyzed to identify to what extent these factors can explain the players performance score in the 9-3-6-3-9 CODS fitness test.

Table 22. Determinants of CODS

Source	df	B	F	Sig.	Partial Eta Squared
Corrected Model	5		103.662	.000	.544
Intercept	1	11.890	263.197	.000	.378
GS	1	.316	4.528	.034	.010
GR	1	-.075	1.385	.240	.003
SSS	1	.125	1.260	.262	.003
SSR	1	-.705	111.553	.000	.204
TL	1	.000	1.998	.158	.005
Error	434				
Total	440				
Corrected Total	439				

a. R Squared = .544 (Adjusted R Squared = .539)
b. Dependent Variable: CODS
c. Model: (Intercept), TL, GS, GR, SSS, SSR

Those predictors as TL, GS, GR, SSS and SSR were used to predict 9-3-6-3-9 CODS performance. The GLM analysis indicated that the general regression model was significant F (5,434) =263.197, p<0.001, adjusted R^2=0.539 (table 22). In this model, both GS and SSR were significant predictors of CODS performance p<0.001. The effect of GS and SSR were medium and large respectively. However, the interaction of the predictors with one-another was not significant. From the analysis, it was found that 53.9% of the variance in CODS performance can be explained by the level of SSR. The regression (equation) from the GLM analysis looks like the following.

CODS=11.890-0.705 (SSR) or ($Y = 11..890 - 0.705X1$).

RSA

Repeated sprinting ability performance was considered about how different conditions of the players determine it. Perceived stress (GS & SS), perceived recovery (GR & SSR) and perceived weekly TL were examined to show how they predict RSA performance of the players.

Table 23. Determinants of RSA

Source	df	B	F	Sig.	Partial Eta Squared
Corrected Model	5		93.814	.000	.519
Intercept	1	5.463	826.132	.000	.656
GS	1	.065	2.812	.094	.006
GR	1	.023	1.948	.163	.004
SSS	1	.045	2.219	.137	.005
SSR	1	-.189	118.588	.000	.215
TL	1	-1.820E-5	.182	.670	.000
Error	434				
Total	440				
Corrected Total	439				

a. R Squared = .519 (Adjusted R Squared = .514)
b. Dependent Variable: RSA
c. Model: (Intercept), TL, GS, GR, SSS, SSR

GLM has been employed to test how strongly TL, GS, GR, SSS and SSR determine RSA performance. From the analysis, the general regression model was significant F (5,434) =826.132, p<0.001, adjusted R^2=0.514 (table 23). From the predictors used in the analysis, only SSR was a statistically significant p<0.001 predictor. The effect of SSR on RSA performance is large. When SSR level increases by 1 unit, RSA time decreases by 0.189 seconds. Thus, 51.4% of the variance in RSA can be explained by SSR level of the players. The regression model or equation for RSA is RSA= 5.463-0.189 (SSR) or ($Y = 5.463 - 0.189X1$)

4.12. Determinants of Success

Team success level of teams was considered using the points teams able to obtain, number of goals teams scored and the number of goals they concede. This way, the ability of the teams to get points from matches (success level) was assessed about how it can be determined from perceived TL, GS, SSS, GR, SSR and NMF.

Table 24. Match Success as a function of Perceived TL, Stress, Recovery and NMF

Source	B	df	F	Sig.	Partial Eta Squared
Corrected Model		21	31.535	.000	.613
Intercept	28.022	1	2.461	.117	.006
TL	-.007	1	3.528	.061	.008
GS	-4.256	1	1.416	.235	.003
GR	5.955	1	4.511	.034	.011
SSS	-8.210	1	7.484	.006	.018
SSR	-3.170	1	4.253	.040	.010
NMF	-2.905	1	2.030	.155	.005
TL * GS	.000	1	.398	.528	.001
TL * GR	.000	1	1.487	.223	.004
TL * SSS	.001	1	2.324	.128	.006
TL * SSR	.001	1	28.512	.000	.064
TL * NMF	.001	1	3.844	.051	.009
GS * GR	-.468	1	1.248	.265	.003
GS * SSS	.820	1	4.839	.028	.011
GS * SSR	.156	1	.473	.492	.001
GS * NMF	.500	1	1.991	.159	.005
GR * SSS	-.128	1	.183	.669	.000
GR * SSR	-.284	1	2.006	.157	.005
GR * NMF	-.346	1	1.622	.203	.004
SSS * SSR	.529	1	8.003	.005	.019
SSS * NMF	.499	1	3.060	.081	.007
SSR * NMF	.040	1	.084	.772	.000
Error		418			
Total		440			
Corrected Total		439			

R Squared .613 (Adjusted R Squared=.594)

Dependent Variable: Points obtained

Model: (Intercept), TL, GS, GR, SSS, SSR, NMF, TL * GS, TL * GR, TL * SSS, TL * SSR, TL * NMF, GS * GR, GS * SSS, GS * SSR, GS * NMF, GR * SSS, GR * SSR, GR * NMF, SSS * SSR, SSS * NMF, SSR * NMF

Using GLM analysis, the overall regression model was significant F (21,418) =2.461, p<0.001, adjusted R^2=0.594 (table 24). Among the potential predictors, perceived weekly TL (p=0.016), GR (p=0.013), SSS (p=0.008) and SSR (p=0.043) were statistically significant determinants (predictors) of team success level in terms of points obtained from matches. Moreover, the interaction effect of some of these variables was significant enough. This way, the interaction of perceived weekly TL with SSR had significant prediction effect on the level of success (p<0.001). Moreover, the interaction of GS and SSS as well as the interaction of SSS and SSR significantly impacted the success level of teams. When all of these predictors have a small effect, the interaction efect of TL with SSR is moderate. Generally, 59.4% of the variance in the ability of teams to obtain points has been explained by those factors as perceived weekly GR, SSS, SSR and the interaction of TL with SSR, GS with SSS and the interaction of SSS with SSR level of the players. The equation or model for points obtained is:

5.955(GR)-8.21(SSS)-3.17(SSR) +0.001(TL*NMF) + 0.82(GS*SSS) +0.529(SSS*SSR)

Goal Scoring

The ultimate of soccer teams is to score goals. Mainly soccer teams` success heavily relies on their players' ability to score. Believing that numerous factors can be accounted for, the teams` ability to score goals was assessed using TL, GS. GR, SSS, SSR and NMF level of the players to identify how they predict it. Table 25 presents the studied teams` goal scoring ability predction from the variables in consideration.

Table 25. Determinants of the Teams` Goal Scoring Ability

Source	df	B	F	Sig.	Partial Eta Squared
Corrected Model	6		67.127	.000	.482
Intercept	1	.790	.724	.395	.002
GS	1	-.165	1.607	.206	.004
GR	1	.043	.602	.438	.001
SSS	1	-.059	.368	.544	.001
SSR	1	.271	16.702	.000	.037
NMF	1	-.309	12.618	.000	.028
TL	1	.001	58.117	.000	.118
Error	433				
Total	440				
Corrected Total	439				

a. R Squared = .482 (Adjusted R Squared = .475)
b. Dependent Variable: Goals Scored
c. Model: (Intercept), TL, GS, GR, SSS, SSR, NMF

As shown in table 25, the analysis using GLM showed that the overall regression model was significant F (6,433) = 67.127, $p<0.001$, adjusted $R^2=0.475$ (table 25). Perceived weekly TL, and SSR level were among those significant predictors ($p<0.001$). NMF level of the players was also a significant predictor of team`s ability to score goals ($p<0.001$). SSR and NMF of the players had a small effect size on the teams scoring ability. But, NMF had a moderate effect size the teams goal scoring ability. These predictor variables had explained 47.5% of the variance in the teams` ability to score goals. For example, a unit change (increment) in SSR can cause 0.37 increments in the team's ability to score goals. Still perceived TL and NMF increment (change) significantly positively relate with the teams' ability of goal scoring. The overall regression model or equation is; Goal Scoring ability= 0.790 + 0.001 (TL) + 0.271 (SSR) - 0.309 (NMF).

CHAPTER FIVE: DISCUSSION

5.0. Overview

The study was carried out aiming to examine the relationship of soccer performance and team success with varied and interplaying factors. As such, perceived weekly training load (TL), perceived stress, and perceived recovery were examined against soccer specific neuromuscular fitness (NMF) parameters such as linear sprinting speed over 40-m, change-of-direction-speed (CODS) and repeated sprinting ability (RSA). To this end, NMF as a performance parameter was predicted from these variables. As the ultimate of the study and soccer teams, team success has been examined as how it relates with TL, stress level, recovery level and NMF. Eventually, success prediction capacity of these factors was tested. The interpretation of results was made using the standard suggested by Hopkins et al. (2009): ≤ 0.1, trivial; >0.1-0.3, small; >0.3-0.5, moderate; >0.5-0.7, large; >0.7-0.9, very large; and >0.9-1.0, almost perfect.

6.1. NMF and Success Level across the Studied Teams

Fitness is one big performance factor underlying success in different level of individual and team sporting. The effect of fitness on success in individual sports like athletics is well established and it is too significant. In most team sports however, specifically in soccer, the effect of fitness on success is not that clear (Hoffman et al., 2014). The generic concept of fitness can better viewed as aerobic and anaerobic fitness. Each of this fitness can have a different level of effect on sport specific performance in addition to their interdependence (Lockie et al., 2013). Some argue that only a certain level of fitness is necessary and the rest relies on other factors, mostly on technical-tactical skills (Kempe et al., 2014). Still others claim that successful teams (teams on the top of Danish leagues) achieve higher physical work or 30-40% more high-speed running distance than middle or bottom teams (Ingebrington et al., 2012; 14). This basically goes in parallel with the finding here that NMF has found to be associated with success. Mohr et al., (2003), on the other side showed that international top-class players perform 28% more high intensity running (2.43 versus 1.90km) and 58% more sprinting (650 versus 410m) than professional players at a lower level team. The studied teams had a significant ($p<.001$) difference in their NMF test scores of speed, CODS and RSA (table 6). In addition, the teams significantly differ in their success level of goal scoring, obtaining points and goals conceded ($p<.001$) (table 8). Here in Ethiopia the level of football is not that satisfying and the level may still be lower when it comes to the third level of the league (National League). Thus, the positive association of NMF with success (goals scoring ability and points obtained) is convincing (table 18). This implies that any factors that can affect NMF can potential affect success as well. Therefore, the level of stress and TL imposed on the players and recovery achieved need to be scrutinized against success parameters.

Di Salvo et al. (2013) observed that championship players did more high-speed running and sprinting than players in the Premier League. Along the same lines, a study found that players in the second (Championship) and third (League 1) categories performed more high-speed running (>19km/h) than those in the premier league (803, 881, and 681m, respectively), which was also the case for sprinting (308, 360, and 248m, respectively) (Bradley et al., 2013a). These findings indicated that players' fitness (sprinting or RSA) becomes too significant with lower league levels. In addition, a group of players (n=20) changing teams and moving from Premier League to the Championship League covered more distance with high-intensity running (1103 versus 995m), whereas no difference was observed for players moving up from Championship to Premier League (945 versus 1021m).

Moreover, it was found that successful Italian teams appear to cover less (4-12%) high-intensity running distance compared to unsuccessful teams, but more distance while in possession of the ball (Rampinini et al., 2009a). In addition, players cover more distance with high-intensity running when playing against higher quality compared to lower quality opponents (Castellano, blanco-Villasenor & Alvarez, 2011; Di Salvo et al., 2013). Playing against strong opponents has been found to be associated with lower ball possession (Lago, 2009), and it is possible that lower-standard players have to cover greater distances in an attempt to close in players and regain possession. Generally, considering the level of our football and the league level of the study participants, the zero-order correlation of NMF with success was persuasive (r= -0.785-0.817, p<.001) (table 18). However as success in soccer is the result of optimal blend of different performance factors, the relationship of NMF with success is greatly moderated by other factors as TL, stress and recovery levels. To this end, the partial correlation was non-significant (table 18)

Although the total distance covered by each player has remained relatively constant over the last few years, the demand of physical efforts has increased due to greater high-intensity running and longer sprinting distance covered during matches (Barnes et al., 2014). Anaerobic fitness is considered the main ingredient of soccer performance in competitive level (Mohr et al., 2003). Among the fitness segments labeled as anaerobic, speed is the most critical. Going in parallel with this fact, speed and speed related factors (CODS and RSA) were the determinant factors of success here in the case of this study. Goal scoring ability of teams and the points teams obtained were highly dependent on the players' level of speed qualities. The same way, Fernandes-Da-Silva et al. (2019) showed that players with faster RSA mean time were able to perform more distance with sprinting during matches (606±204-m) when compared with their slower counterparts (457±229). However, it has been showed that players in a lower league level (success level) can cover more high-intensity running distance. Also it is indicated that the lower the level of football the higher the anaerobic fitness demand. Thus, with higher level of competition the difference can be instead accounted to technical-tactical differences. Moreover, it should be noted that the physical demand of different leagues or tournaments is not the same. As a result, the importance of this study can be magnified when we consider its significance to have evidence driven training. Here in this study linear sprinting speed, CODS and RSA were significantly related with success. Thus, the relationship of soccer specific NMF with success is undeniable as a team or as a player.

Among physical fitness parameterss, speed matters the most. However, the researcher mainly focused on speed of movement, though all speed elements (i.e., speed of perception, speed of decision and speed of movement) matters a lot in modern competitive soccer. Consider world class-players all over the world; Mesi, Ronaldo, Hazard, Neymar, Mahrez, Sterling, or Mabpe, and compare them with Lukaku. Here the quality Lukaku lacks is not linear speed, but he may not be as good as Hazard or sterling in COD. Messi out performs most of these players and one of his exceptional physical quality which is believed to be the reason is that he can reach his maximum speed within two seconds. For this, Husian Bolt, the fastest man on the planet, said that Mesi can win me over 30-m linear sprinting. Thus, the physical quality that Messi possess is his acceleration and deceleration quality. All these can witness how speed matters soccer performance and success.

For their importance, there has to be a method of improving and maintaining these qualities. The typical soccer training may not be enough to develop these qualities to the required level. In this regard, a number of recent findings recommended additional training regimens (Beato et al., 2018; Negra et al., 2018). For example, short term protocols of both complex (COD plus plyometric) training protocol and isolated COD protocol are important to have meaningful improvements in speed parameters of soccer players. However, the complex protocol (COD plus plyometric) protocol showed larger effect on power and speed (Beato et al., 2018). Therefore, the inclusion of power training, strength training and plyometric training in addition/combined with soccer specific training can better improve CODS, speed and RSA performance than soccer specific training alone can do (Negra et al., 2018). However, this approach can potentially expose our players for overtraining, if the players' life style is not helpful to withstand this and other soccer specific trainings. Thus, the effect of training on these performance parameters ought to be considered against other factors as recovery, sport related and non-sport related stresses and overall perceived TL.

6.2. Age and NMF

Maturation (age) and physical fitness are presumed to be related. When maturation comes, quality differentiation and physical fitness increments are highly expected. What this study came across is that teams with the higher mean age tend to perform better when fitness is examined. Taking RSA alone, it was shown to increase with age in youth soccer players (Di Mascio, Ade, Musham, Girard, & Bradley, 2017). RSA performance showed to increase progressively from U12 to U16 players (De Macio et al., 2017). Strengthening the above findings those anaerobic finesses as speed and CODS are most likely better in more mature players (Emmonds, Scantlbury, Murray, Turner, Robsinon & Jones, 2018). This way, it was found that U23 players were significantly faster than U16 players were in 20-m linear sprinting speed (2.09 versus 2.98 seconds, $p=0.02$; ES=0.94) (Bishop, Brashil, Abbot, Read, Lake & Turner, 2019). Still other recent finding witnessed that repeated-sprint sets (RSS) improve with maturation in young soccer players (Selmi, Sassi, Yahmed, Giannin, Perron & Elloumi, 2017). Generally, the finding in this study goes in parallel with these recent findings. Moreover strengthening the finding, it revealed that perceived weekly TL (RPE) increases with age (U14, 2524±128AU; U16, 2919±136AU; U18, 3948±222AU) (Wrigley, Drust, Strattan, Scot & Gregson, 2012).

6.3. Perceived Training Load (TL) and Neuromuscular Fitness

The relationship between TL and sprinting speed was significantly positive, meaning that higher TL was associated with a better 40-m sprinting speed. Those players who reported a higher perceived weekly TL tend to perform better in 40-m sprinting speed performance (smaller time to cover the 40-m dash). The ability to produce high speeds is considered an important quality for match performance since soccer players are shown to achieve 85-94% of maximal velocity during match play (Haddad et al., 2015). That is why well-developed high-speed running ability and maximal velocity are required of players during competition in order to beat opposition players to possession and gain an advantage in attacking and defensive situation (Johnston, 2014). As such, there is a noted increase in the volume of high-speed running performed during competitive soccer match-play (Barnes et al., 2014). This role of speed in soccer reminds us to think the effects of different factors on speed and speed related performance of players. Thus, higher TL is one factor to be monitored to cultivate important physical qualities in soccer players.

In the pursuit of preparing players for maximal velocity and high-speed elements of match play, exposure to periods of high-speed running during training is most commonly used (Gabbett, 2016). This is because adequate workloads are required to improve player`s performance or fitness (Malone et al., 2017; Malone et al., 2018). However, there is a balance to be considered between improving fitness and preventing overtraining. Regarding negative consequences and speed related training, evidences suggest that lower limb injuries are associated with excessive high-speed running exposure (Elliott, Zarins, Powell & Kenyon, 2011; Gabbett & Ullah, 2012). Still well-developed lower-body strength, RSA and speed are associated with better tolerance to higher workloads and reduced risk of injury in team-sport athletes (Malone, Hughes, Doran, Collins & Gabbett, 2019), meaning that the effect of speed related training load is dependent on player`s specific fitness quality. Therefore, positive relationship between load and speed is logically sound. This is because that when the players are fit they can endure higher TL which is inherent to soccer specific trainings and additional speed workouts and resist the negative results (injury) (Malone et al., 2019). With that of futsal, players with a better sprinting ability were likely to report higher perceived TL (Nakamura et al., 2016). Moreover, logically higher TL can induce higher homeostatic disruption and higher neuromuscular adaptation.

As that of sprinting speed, both CODS and RSA were highly related with TL to an extent (i.e., r (86) = -0.274 and -0.319). It is a well-known fact that fitness does not solely depend on TL, meaning that a lot of factors can interplay and moderate the relationship. Going in parallel with the above idea, the partial correlation was not that significant. The evolving nature of team-based sports has resulted in an increased interest in monitoring player activities quantitatively on a daily and weekly basis (Bourdon et al., 2017). As such, the prescription of appropriate TL require careful consideration by all stakeholders to best maximize performance levels while minimizing the negative effects of the prescribed load (Bourdon et al., 2017). Here in this study the positive relationship implies that higher weekly TL can positively relate with a better performance in the 9-3-6-3-9 CODS and 6*35m RSA tests. Those players who were experiencing a higher perceived weekly TL were taking smaller time to cover both the CODS and RSA test.

In soccer, TL has been reported as a modifiable risk factor in relation with injury (Malone et al., 2017a). In competitive soccer the frequency of matches is high and players are frequently required to play consecutive matches with 3-days recovery (Nedelec et al., 2015), which can elevate the weekly perceived TL. Therefore, soccer players can inherently have high TL due to poor recovery periods between games and subsequent training sessions. Generally, contemporary soccer players are often exposed to year-long training and high match frequencies, with periods of a congested competition, which increases injury risk (Malone et al., 2017a). However, in our case, teams were not obliged to play even 2 matches per week (i.e., a maximum of 1 game per week). Even there was no any additional competition or tournament other than the regular league. Thus, these players suspected to play fewer games than they were expected to play at their age level. This means that the likelihood of exposure for overtraining in this situation is too minimal. For these reasons, the positive correlation of TL with speed, CODS and RSA performance is right on the spot.

The focus here ought to be ensuring the highest optimal TL to realize fitness goals and to an extent the success level of players and teams. This is because that both positive and negative adaptations can be controlled by total workloads as well as changes in load (e.g. the acute: chronic workload ratio) (Windt & Gabbett, 2016). The common soccer season involves higher number of training days and matches that cause injury which has been shown to be detrimental to team success (De Hoyo et al., 2015). For example, high-sustained exposure and s-RPE were evident for the 3 weeks prior to injury (Lu, Howle, Waterson, Duncan & Duffield, 2017). Consequently, specific load prescription and monitoring can provide coaches with information about the intensity of output that can be expected from individual players during a training session (Gallo, Cormack, Gabbett & Lorenzen, 2015; Lu et al., 2017). Greater fatigue potential, muscle soreness, stresses and internal TL was more apparent within a 2-game microcycle. As a result, care should be taken when planning the lead into and out of a 2-game fixture microcycle highlighting key specific recovery strategies to damped the increased stress effect (Clemente, Mendes, Nikolaidis, Calvete, Carriço & Owen, 2017).

Pre-season period of training induces significantly more strenuous exhausting demands on professional soccer players compared with the in-season period at the elite level (Fessi, Nouira, Dellor, Owen, Elloumi & Moalla, 2016). However, this study has been done only paying attention on the relationship of TL, recovery and stress level with NMF and match success during the first 5 weeks of the in-season. Thus, the season-based relationship and effect of TL, stress level and recovery level with/on NMF and match performance is an issue which is worthy of further scientific investigation. This is because that now a day's coaches and practitioners perceive that (highly convinced that) TL monitoring is worthwhile (Weston, 2018), though there is no vivid guideline.

As the scientific evidence witnessed, high-performance team-sport athletes endure numerous physiological, psychological, and neuromuscular stressors during training and competition (Nédélec, McCall, Carling, Legall, Berhtoin, & Dupont, 2012). These stressors can potentially have an adverse effect on performance capacity of the players. This compels there to be a sound and vivid understanding on the matter and most importantly strategies and modalities to counter the negative effect of the stressors. As a result, the process of planning appropriate workloads is a cross-discipline effort involving management, strength and conditioning and medical staff to realize a holistic process (Gabbett & Whiteley, 2017).

Though adequate workload is prerequisites for fitness and performance qualities improvement (Malone et al., 2017a), there has to be a striking balance between improved fitness and minimum fatigue (GAS). This is the main reason why contemporary soccer has resulted in an increased interest in monitoring player activities and conditions quantitatively on a daily and weekly basis

(Bourdon et al., 2017). This is because that, significant relationship ($p<0.001$) is evident between TL and perceived fatigue, perceived sleep, stress and muscle soreness (Moalla, Fessi, Farhat,, Nouira, Wong & Dupont, 2016). Even in professional soccer players, perceived sleep, stress, fatigue and muscle soreness are moderately related to the daily TL (Moalla et al., 2016). The other way, match outcomes moderately to largely affect RPE (perceived TL), perceived feeling, sleep quality, stress and fatigue (Fessi & Moalla, 2018).

6.4. The Interplay of TL, Stress, Recovery, NMF and Team Success

When players perceive higher TL, they reported a significantly lower level of stress. This is partly because that higher TL can yield the highest possible fitness gain (adaptation). It is a fact that imbalance between oxidative stress (OS) and the body`s own antioxidant systems can cause exercise fatigue, loss of function with aging, and several disease process (Clarkson & Thompson, 2000; Lambert & Yang, 2003). However, aerobic and anaerobic training regimens can significantly improve antioxidant capacity AOC and redox balance against potential risk factors of excessive reactive oxygen species (ROS) (Park & Kwak, 2016). Anaerobic exercises specifically sprinting and resistant training improves AOC (Bloomer, Goldfarb, Wideman, McKenzie & Consitt, 2005). Since aerobic and anaerobic exercise are common and inevitable in soccer training and match conditions, higher TL can be better associated with better stress resistance. It was in part due to that players can benefit from difficulties or higher TL, which can challenge their physiology (Howells, Sarkar & Fletcher, 2017). These suggest that improved fitness can have a protective function for perceived stress level. Thus, when improved fitness is associated with higher TL, improved resistance to stress is associated with improved fitness.

In another way, high level of fitness as a performance capacity can lower the stresses which came out of less success (defeat) (Fessi & Moalla, 2018; Broodryk et al., 2019). In relation with recovery capability of the players, players with higher weekly TL have a better recovery level. Higher level of physical fitness can aid recovery ability of the body. Moreover, a finding manifested that progressive increase in workload can develop the players physical tolerance to higher loads and resilience to injury (Bowen, Gross, Gimpel & Li, 2016). Therefore, higher TL is something that can positively impact fitness, tolerance to increased load and the ability to cope up with stresses. Supporting the negative relationship of TL with stress as measured with the level of cortisol is $r = -0.34$, $p=.003$ (Broodryk, Pienaar, Edwards & Sparks, 2017).

In elite and competitive soccer, success is the ultimate goal of teams or clubs. In the pursuit of success, coaches, players and other close personnel do hard day and night. For this, manipulation of training, the main modifiable factor, to ensure positive outcome and prevent negative outcomes like injury and performance declines is common. Here it was evident that higher perceived TL was associated with greater success. This is all because of the relation of TL with adaptation or supercompensation, and resistance to injury and stressors. However, a study in soccer have indicated the relationship between load and fitness to be inverse (Cross et al., 2016), although Brink et al. (2010) associated more training with improved performance.

In Futsal, TL resulted decreased sprinting performance (Morreira et al., 2013) and in Rugby TL and injury are found to be strongly correlated (r = .82) (Gabbett & Jenkins, 2011). Standing against Gabbett and Jenkins result, higher TL coupled with more HSR distance is associated with reduced injury and less TL coupled with the same HSR distance associated with higher injury rate (Malone et al., 2017b). In Australian football, weekly TL and training stress balance for strain shown to be the best predictors of match success (internal load for winning than loses) (Aughey et al., 2016). Here if higher TL was examined with players having congested schedule the result would be negative (i.e., performance decrement or injury) and if it was with lower number of matches it is too likely to be positive. Recently, Lee and Mukherjee (2019) showed that TL and RSA do not have a significant correlation in soccer players. However, TL was measured using Lucia TRIMP (TRIMPL). This is because that RPE is more effective than HR-based methods to predict performance change for TL (Figuerdo, et al., 2019). Therefore, the positive association of TL and fitness or success in our case is convincing to be positive.

The teams with high TL were able to achieve greater success. This positive relationship between TL and success was manifested in the teams` ability to score goals, and their ability to not to concede goals and the ability to obtain points from matches. The higher the TL imposed, the less likely to concede goals which helps teams to be successful. The same recent study also showed that higher TL is associated more with success or winning (Aughey et al., 2016). It is a fact that training and competition load stimulate a series homeostatic responses and accompanying adaptation of the human body`s system (Hawley, Hargreaves, Joyner & Zierath, 2014), which help to perform better. Generally, the observed positive association between TL and success (scoring more goals, obtaining more points and conceding fewer goals) can be explained that imposing high TL can cause increased fitness, and better recovering ability. As a matter of the observed fact and scientific evidence, teams with better fitness level are too likely to succeed. Moreover, it is evident that speed and agility are key qualities to be able to create space and time, as well as to deny your opponent space and time. These physical qualities can be cultivated and maintained with a kind of training that can impose high level of stimulus. Thus, TL can positively relate with success as it can improve fitness (Hawley et al., 2014) and improve recovery ability or sometimes injury resistance (Melano et al., 2017b). For this reason, elite and developing players are advised to push their training volume and intensity to the limits to maximize their performance improvement.

Success level, measured with goal scoring ability and points obtained from games highly relates with NMF, though in some cases fitness is not the distinguishing characteristics of successful teams (Kempe et al., 2014). However, in this study those specific fitness parameters as speed, CODS and RSA were highly associated with success level of the teams to score goals and obtain points. Bradley et al. (2013a) showed that in the Championship, teams with greater NMF score were the most successful teams than the teams with lower NMF performance level. In addition players with better RSA mean time were found to have a better match physical performance (Fernandes-Da-Silva et al., 2019). This suggests that in lower level soccer the contribution of physical fitness for success is higher. Thus, the association of NMF with success with the study is in agreement with other findings. Still the partial correlation analysis affirmed that the relationship of success with speed, CODS and RSA was highly mediated by their interdependency and interaction of the factors. As sport performance is a complex and dynamic interaction of multidimensional variables, such a difference between the zero-order and partial correlation was convincing.

6.5. Success with Stress and Recovery Level

Match success, measured with specific parameters, is highly related with the players' level of recovery. GR and most importantly SSR are highly related (positively) factors with match success level. As the recovery level of the players is higher, the greater the points that the teams obtain from matches. As such, GR and SSR level of the players were highly associated with the number of goals scored by teams`. This is because that both goal scoring and assisting actions in modern soccer highly depend on aggressive and explosive movements as sprinting (Faude et al., 2012). This means that high-speed and sprinting running ability are helpful to gain an advantage in attacking and defensive situations (Jhonston et al., 2014). For example, sprint-type activities which depend on aggressive movements are crucial elements of competitive soccer (Bradley et al., 2013a; Gabbett, 2016; Haddad et al., 2015; Nedelec et al., 2015). For a player to execute these actions with the required level of execution, it demands there to be both physical and psychological vitality and assertiveness. The level of physical and psychological vitality, or perceived recovery level is among the significant determinants of soccer performance. Thus, high level of perceived recovery is a prerequisite for a player to be this fit.

The interaction between sleep and physiological recovery in team-sport athletes is not well-understood (Fullagar et al., 2015). Even the potential role sleep can play in post-exercise recovery is not that clear (Fullagar et al., 2015). However, team-sport players are at high risk of poor sleeping during and after competition (Fullagar et al., 2015). Worsening the complication, matches and high intensity training before bed are likely causes of poor sleep or recovery ability (Nedelec, Dawson & Dupont, 2019). This study came across with the fact that recovery in part sleep-quality is one serious success factor. Still the factors of sleep disturbance and the methods of ensuring sleep are less vivid with modern soccer players, though competitive soccer players are prone to various situations and conditions that can interfere with sleep. Preforming activities demanding high levels of concentration close to bedtime, use of products containing caffeine or alcohol in the period preceding bedtime, regular daytime napping throughout the week, variable wake-up times or bedtime can adversely affect sleep (Nedelec et al., 2019). With all these challenges to ensure proper sleep time and quality, it is indicated that recovery is positively related with success. All these suggest that success in soccer is a matter of the ability to recover and recovery is a matter of life style.

Many of the world’s greatest athletes eat, sleep, breathe, and live for their sport. In addition to physical conditioning and conscious eating, sleep plays a major role in performance and competitive results. Sleep in particular provides energy to both the brain and body. For this effect, it has been shown that poor sleep results declines in split-second decision making (Wickens, Hutchins, Laux & Sebok, 2015). It is suggested that sleep deprivation increases levels of stress hormone, cortisol (Hirotus, Tufik & Andersen, 2015). Sleep deprivation has also been seen to decrease production of glycogen and carbohydrates that are stored for energy use during high intensity actions (Wicken et al., 2015). These suggest that poor recovery increases the possibility of fatigue, low energy, and poor focus at game time, which all can cost winning performance. Poor glycogen storage is a matter of having the relevant fuel for sprint type actions in soccer. The positive association thus with this study was scientifically convincing. Recovery in soccer can help you on the road to good fitness, health and success.

Stress was one factor associated with success. Both GS and SSS were conditions (perceived conditions) which were associated with lower level of success. Higher level of GS and SSS may be factors which can potentially impact physical and psychological readiness of the players. This is mainly because stress can cause our body to produce stress hormones (Hirotus et al., 2015). These hormones combined with poor psychological readiness can impair performance of the players and success level of teams. The ultimate of teams (coaches) and trainers should be to induce a significant level of TL, which can cause positive adaptation. Fitness, the result of higher TL can help players to withstand (cope) stresses from different sources (Park & Kwak, 2016), which are inherent to soccer players. Better fitness can even aid players to recover from training related stresses. Therefore, the focus ought to be taking into account alternative measures to insure higher TL, greater recovery and the minimum possible level of perceived stress.

6.6. TL with Stress and Recovery

Being in a stressful condition as measured with GS and SSS can significantly impact our perception of weekly TL. It is straight forward to think that the lower the level of stress, the higher our readiness and our tendency to perceive a specific TL lower. When our body and mind is feeling energetic or recovered, its readiness and ability to tolerate training or TL can be elevated. Moreover, being in a condition which is not energetic or a condition which is causing the production of stress hormones can substantially reduce its ability to tolerate TL (Broodryk et al., 2017). This means that a simple (low) TL can be felt higher or above threshold level. But here it is found that TL and stress level inversely correlate, meaning that high level of stress (GS and SSS) can result a lower perceived weekly TL. The underlying reason here is that, when our body is feeling greater level of stress, its vitality or readiness becomes poor. A player with low level of readiness will not be that aggressive during training exercises. This implies that higher GS and SSS level can shade away the players’ level of motivation to work aggressively that can affect the entire weekly TL to be low or small. Still this relationship can greatly be moderated by some other factors.

Players' level of recovery (GR and SSR) positively correlated with perceived TL. What is found here can be explained that well recovered (conditioned) body is believed to be good enough in terms of vitality and readiness. A well recovered body is the one to be aggressive enough during training sessions. Generally, a well-recovered player is the one to work aggressively and practically to report higher workload (weekly TL) as a result. That was the possible underlying reasons for players with good recovery level to have higher weekly TL.

6.7. NMF as a Function of TL, Stress and Recovery Level

NMF, aggregating speed, CODS and RSA, was highly dependent on potential conditions as TL, stress and recovery level. Although all these specific factors as TL, GS, SSS, GR and SSR were related with NMF to an extent, only GS and SSR were significant predictors of NMF. This can be considered as both stress and recovery levels are important predictors of NMF performance of soccer players. These significant factors explained it to a greater level of 57.6%. This result and the partial correlation among the factors imply that the effect of stress and recovery balance is still the key performance factor of soccer players. Thus, confounding factors including inadequate nutrition, illness, psychological stressors (work, team, coach, and family) and sleep disorders can impact NMF that in most instances overlooked. Research has not been able to discern the relative importance of these confounding variables and they are likely different for each individual and play a critical role both in the development of overtraining and the recovery from this condition (Winsley & Matos, 2010).

Speed as a manifestation of greater performance level, it was highly determined by SSR only. It explained 54.4% of speed, implying that the nature of the relationship between TL, GS, SSS, GR and SSR was a big factor. The higher the level of the players' perceived recovery, the better their sprinting performance. They can be energetic and aggressive enough in running the 40-m dash, if they achieved higher perceived recovery. As a result, greater recovery level can be equated with a decrease in the time to be taken to cover the 40-m distance. However, it is believed that 40-m sprinting speed cannot be significantly determined by recovery level, as it does not need too much energy or time. But it is too persuasive that quality movement production can be affected by our body and psychological condition. For that, 40-m linear sprinting has been explained by recovery level to that extent. Though it was in hockey, decreased sleep quality (recovery) and increased muscle soreness (stress) are associated with decreased high speed running (McGuiness et al., 2019).

Using the factors such as TL, GS, SSS, GR and SSR, CODS was highly predicted by the level of players SSR. The level of recovery can basically be the product of varied factors, like lifestyle, fitness level, weekly TL and recovery strategies employed (Hirotus et al., 2015; Kellman et al., 2018; Park & Kwark, 2016; Wicken et al., 2015). The nature of the relationship among the variables even witnesses the multidimensional nature of recovery ability. When players are well-recovered or when they accomplish a good SSR level, they perform better in the 9-3-6-3-9 test score. The time players took to accomplish the test gets significantly lower when they have a good deal of SSR. Ensuring SSR which is the result of varied and complicated moderators is ideal to ensure physical vitality and to realize ideal level of performance.

The ability of the players to produce the best sprinting performance over a number of consecutive sprints has been explained by the level of perceived recovery, specifically SSR. However, the point was that recovery (SSR) was really the manifestation of different conditions and abilities of the players. Here in this regard the nature of the relationship among the factor variables (i.e., the zero-order and partial correlation) was highly moderated by the other variables (they moderate one another). Generally, SSR is a major predictor of players RSA performance as it helps them to be aggressive and explosive enough during sprints and most importantly it helps them to recover during the short recovery time sprints and to produce a better sprint performance in the subsequent sprints. Perceived recovery can partly be the result of increased glycogen, ATP or CPr which all are important conditions for perceived recovery and RSA performance. Thus, physiologically players with good condition in this regard are highly expected to report a higher SSR level. The bottom line is that players who reported a higher SSR level can have smaller average time to cover RSA test.

The basic tenet of recovery in sport is normalization of physiological functions, return of homeostasis, restoration of energy stores, replenishment of cellular energy enzymes and the associated perceptual feelings. Recovery is regarded as a multifaceted (i.e., physiological, psychological) restorative process relative to time (Kellmann et al., 2018). Thus, it is the ability to meet or exceed performance or performance capacities. For this, players need to be educated on the matter (recovery) because they lack the basic insight and attitude (Crowther, Sealey, Crowe, Edwards, & Halson, 2017). As recovery is a relatively new area of scientific research, soccer players are encouraged to experiment with various recovery techniques to identify useful individualized recovery strategies (Halson, 2013). As a result, specific roles have been developed within the team sports physician core in order to improve recovery protocols (Calleja-González et al., 2018). Generally, performance in soccer can be viewed as the expression of complex, dynamic, interactive, and multidimensional processes as TL and stress interact with recovery to impact performance or performance capacity. It is now well-established that optimum recovery is a key factor and can predict performance and success in soccer. Recent publications even strengthen this point (Calleja-González et al., 2018). Therefore, player and coach recovery education is recommended (Crowther et al., 2017), which still to be too serious in the area where there is no qualified coaching staff, the case with the studied teams.

6.8. Success Predictors

The level of success with soccer teams or even a player is the product of myriads of factors and a complex interaction of these factors. Acknowledging this fact, it was examined how TL, stress level, recovery level and NMF determine team's success level. Doing so, the team's ability of obtaining points per game is mainly the function of these factors and their inherent complex interaction. This is due to that higher TL can result a greater degree of adaptation (fitness gain and greater ball contact). In turn greater fitness level can potentially enable a player (teams) to be capable of tolerating even higher TL and this significantly impact their ability to tolerate sport related stress. Higher fitness still is associated with a greater ability to recover between sessions and came up the next session with a good readiness to accomplish the workouts aggressively or with the expected level of quality (intensified exertion) which in turn cause greater neuromuscular adaptation. To sum up, higher weekly TL and fitness can guarantee a greater performance level which is the key for success. As a matter of fact, good fitness can give an advantage of the ability to recover for competitive edges. In addition to TL, GR and SSR have had a significant prediction capacity of the team's ability to obtain points. TL is one of the main stimuli that we can have in sport to realize performance (competitive edge). With scientific evidence, the amount of load players experience is one major success determinant factor.

In terms of recovery, a player is as good as his ability to recover; meaning that to cope up all the stressors as TL, match, other SSS and non-sport specific stress (GS) and coming up with the required level of readiness is such a determining factor. Success in soccer is highly dependent on team (collective) quality. Thus, a soccer team is as good as its ability to recover from the impact of all the stressors. The point is that this magnitude of prediction of the teams` ability to obtain points from TL, GR, SSR and the interaction of TL and SSR, TL and NMF, and SSS and SSR is too persuasive. The negative relationship of stress and success is also witnessed by recent findings. As such, matches lost caused higher total-mood disturbance index compared with matches won ($p<.001$, $d=1.4$) (Broodryk, Pienaar, Edwards & Sparks, 2019). What worsens the situation is that cortisol positively correlates with total-mood disturbance (Broodryk et al., 2019). Thus, stress hormones and the resulting psychological responses relate with match outcome and stressed players cannot be well-recovered.

Generally, as can be seen in this study results (table 24 and 25) the individual factors, though their interdependence is still invaluable, TL, NMF, GS, SSS, GR and SSR were good determinants of team success. Success can be accounted for different performance parameters. No matter the parameters are defensive or offensive performance indicators. The prevailing fact is that recovery level is one determinant factor of team success to an extent (table 4.15 and 4.16). When greater fitness level is associated with success in some league levels and types, in some other leagues' fitness is not a distinguishing factor of successful teams from non-successful teams. But these studies do not consider the association of fitness with recovery ability of players or teams. They simply compare successful teams with unsuccessful teams against fitness or the physical exertion level during matches. They overlook how fitness (NMF) translated to other success factors as recovery level, which is too critical to make instant decisions. Using zero-order correlation, partial correlation and advanced regression analysis, the effect of NMF on success level was highly moderated by stress level, recovery level or TL, which is too convincing. Since instant decision and fast actions are inherent to soccer, higher NMF and decision, which rely heavily on recovery level, are too convincing to determine success.

6.9. Goal Scoring Ability of the Teams

Goal scoring is the ultimate of any soccer team during matches. It is the difference between winning or losing or the difference between being successful or unsuccessful. Being the key performance parameter, it relies on a lot of factors and qualities from a team and as well from players. As such goal scoring ability of teams was examined using TL, stress or recovery level and NMF as a predictor variable. As a result, the estimated explanation or prediction capacity of TL, GS and SSR to a level of 47.5% (table 25) was practically convincing. For example, Aughey et al. (2016), in Australian football found that higher TL load was associated with win and low TL with loss.

The ability of creating space is an important essence of attacking or goal scoring. Space creation or time is not that easy during soccer games as the opponent is working hard to deny space and time. Therefore, the players mind as well his muscle need to be speedy enough to create space or time. A player ought to outperform his opponent with speed of perception, decision and movement to create space or time. The player`s ability to exploit the available space even after creating is another issue for scoring. Linear sprinting speed, CODS and RSA as a result are important prerequisite qualities. Generally, being good in NMF measures and recovery level is a real prerequisite to be this aggressive and explosive in movement executions. In addition, findings so far witnessed that both assisting and scoring actions involve all out efforts (sprint actions) (Faude et al., 2012). A side this, attacking actions as assisting and finishing or scoring demand players to take initiatives and creativity which both are dependent on our physical and mental condition of readiness (Hirotus et al., 2015). Specific fitness like sprinting speed, CODS and RSA are thus without doubt fundamental qualities for player involving in goal scoring or attacking roles (table 23, 24 and 25). Still fitness was the product of TL and recovery to an extent (table 19-22). The bottom line is that the explanation of goal scoring ability from perceived weekly TL, GS and SSR was practical and logical. Recent findings also confirmed that decreased perceived wellness, sleep quality and increased somatic compliant (muscle soreness) are associated with decreased high-speed running (McGuinness et al., 2019).

CHAPTER SIX: CONCLUSIONS, RECOMMENDATIONS AND SUMMARY

6.1. Conclusions

When we think of success or performance improvement in soccer, we typically think of training targeting performance factors that can be directly influenced by training or exercise. Simply stated, an optimal level of TL is enough by considering under-load and overload as detrimental. However, in the contemporary soccer we need to move away from the thought that there is a golden rule regarding the effect of TL level on performance capacity and well-being. How we experience, perceive and feel about interventions can be affected by our genetic make-up, experience, life style and specific condition on the spot. A glass or perspective should be there when understanding, estimation and evaluation of the effect of intervention is the concern. It was the common question that how day-in and-day-out and week-in and-week-out trainings are all positively affecting performance? If so how the performance difference among teams or players, and in larger-level among nations accounted to training?

Player monitoring is now a common practice in high-performance or competitive soccer. Fundamentally, player monitoring involves a lot including quantification of players training load and their responses to training. This can help a lot by providing information to refine training, increase performance readiness and wellbeing. To this end, this PhD research investigated the relationship of NMF with TL, recovery, stress and particularly how these factors relate with success. For this, TL, perceived recovery or stress, NMF and match success were considered, and quantitative data generated from sample players for about five weeks.

As per the findings of this PhD research, higher training load significantly positively relates with a higher performance in linear speed of soccer players, CODS and RSA. In addition, the findings highlight that higher training loads is a negative correlate of perceived stress (both GS and SSS) and a positive correlate of recovery levels (GR and SSR). Beyond this, it was clear from the finding that higher recovery is related with a higher performance, while stress is associated with decreased performance in speed, CODS and RSA of the players. Generally, NMF, which is an aggregate of speed, CODS and RSA is positively correlated with TL and recovery and negatively correlated with stress.

The common assumption is that simply TL can result a positive result (i.e., adaptation) or negative (i.e., overtraining). It is only the optimum level of TL, which is highly thought to produce positive results (increased performance capacities). However with my professional and personal experience, I always contemplate about the intricacies of TL with some other factors as perceived recovery and stress during training and out of training time can potentially alter how TL impacts performance and success. To this end I examined how TL in relation with recovery and stress level correlate with NMF. This way, NMF found to be correlated positively with recovery level and negatively with stress level.

The partial correlation of NMF with TL, stress and recovery however was not that significant, meaning that they moderate each other highly. For this reason, the interdependence or interrelationship among TL, stress and recovery was one ultimate with the study. Perceived weekly TL significantly relates with the level of the players perceived stress and recovery level. When TL relates positively with perceived recovery level, its relationship with perceived stress level is significantly inverse. There is also a significant partial correlation between TL and stress or recovery of the players.

NMF was considered as an aggregate performance of linear speed, CODS and RSA performance. Considering the relationship, the extent to which the factors can predict NMF was studied. Though all the factors are related with NMF, only GS (stress) and SSR (recovery) reached a level of significant relationship with NMF. Thus, it is concluded that both perceived stress and recovery levels of the players can determine (predict) NMF performance of the players (lower level of stress and higher level of recovery can help to produce the highest possible NMF performance). When speed, CODS and RSA considered as a separate performance parameter, SSR (perceived recovery) predicts speed and RSA performance. However, CODS performance was significantly positively influenced by GS and SSR.

Success in competitive soccer is highly connected with winning or other related factors. Success level therefore, was considered by evaluating teams against points obtained, goals scored and goals conceded. With the curiosity of understanding success factors considering its multifaceted nature, TL, Stress, recovery and NMF were examined to test how they relate/associate with success. This way TL moderately and positively correlated with the teams` ability to score goals and obtain points. Higher TL is associated with greater success. Stress (negatively) and recovery (positively) very largely correlates with the teams' ability to score goals and obtain points. As a specific fitness for soccer, speed, CODS and RSA were very largely correlated with goal scoring ability the ability to obtain points. Thus, lower stress, higher recovery and a better NMF is associated with more success or the reverse is true. Goals conceded as a performance factor do not correlate with stress or recovery level of the players and NMF (speed, CODS and RSA) directly. The number of goals that teams conceded indirectly relates with TL, stress and recovery level. However, it has no relationship with speed, CODS or RSA at all.

Eventually the focus of the research was to come up with how much does TL, stress, recovery and NMF of the players determine success level of the teams. As such TL, recovery or stress and NMF of the players can potentially predict teams' success as independent and interdependent factors. Specifically the soccer teams' ability of goal scoring or to obtain points is a function of the players perceived stress, recovery, TL and NMF levels. Generally, success level of soccer teams is a function of the TL imposed on the players, perceived recovery level and NMF of the players. A soccer team success relies on these individual conditions of the players and the complex interaction of these factors.

To sum up a soccer player is as successful as his ability to withstand higher TL and his ability to recover. Similarly, a soccer team is as successful as its ability to ensure the highest possible TL and recovery.

6.2. Recommendation

Practical Recommendations

Among the soccer players at the National League Level, it is critical to pay attention to the differences in NMF and individual performances among the players between different playing positions, as well as, the differences in NMF and success among teams. In this sense, coaches and trainers who work with soccer players at the National League Level should give differential treatment in approaching players and teams depending on their playing positions and the team compositions, respectively.

From the practical perspective, soccer coaches and trainers used to target, for the most part, the development of a winning team, so that their players and teams shortly become champions, without paying attention to the training load and the entire processes. In this regard, soccer coaches and trainers must shift the focus towards building NMF and team success based on a well-organized and systematic training load adaptation. As far as this study finding is concerned, proper training load, as well as, building NMF components are possible resources for soccer players' better performances and team successes. Thus, when NMF is the main concern, soccer coaches and trainers should target not only the simple monitoring of training, but also the level of recovery that the players achieved and the prevention of stress. From the practical perspective, they need to appreciate how recovery helps the players to have frequent training and have higher TL, which still helps them to achieve even greater adaptation. Therefore, it is important to move away from the perspective that justifies NMF improvement in terms of the training alone. Specifically, when coaches are in a position to improve NMF, the interplay of TL and recovery should be considered. Thus, it is recommended for coaches and trainers to devise (insure) a level of TL, which is high enough to the extent that can highly alter (disrupt) homeostasis for maximal adaptation and helping players to have less sport specific and non-sport specific stress. They should also acknowledge the vital contribution of recovery on performance enhancement. Higher TL, lower stress and higher recovery ought to be the specific and main targets of interventions in the soccer performance enhancement trajectory.

The effect of TL should be considered on the bases of the individual condition of the players. It is not only the level of TL that produces the desired result, instead it is also how the players respond to that stimulus strength that matters the adaptation which will follow. How the players respond to a TL depends on their perceived condition of mood and physiology. The maturity level of the players is also related to how they perceive and respond to TL. Thus, coaches or trainers should take into account the players' psychophysiological condition and maturity level when imposing a specific level of TL. The evaluation of the effect of training needs also to be considered in terms of who the players based their perceived condition and maturity level.

Continuous quantification and monitoring of TL against performance capacities and perceived psychophysiological conditions should be part of the players monitoring program. The players ought to get the maximum TL load for a better adaptation or performance, resistance (tolerance) to stress and recovery ability. This is mainly because the players with higher NMF experience higher TL, recover easily and resist stress. For this, it is recommended for the coaches and players to have basic education on TL monitoring and recovery strategies.

In-school and out-of-school youth soccer coaches and trainers shall to be educated, informed and monitored about realizing the highest possible training load and implementation of different recovery modalities. Thus, youth soccer program coaches should be supervised with trained personnel to monitor load and expose the players with the required level of load to achieve the highest possible adaptation. As part of soccer development program, curriculum and competency matrix developers should consider the contribution of higher training load and recovery.

Recommendations for Future Research

The soccer players at the National League Level as well as others face many challenges because they are constantly at risk for injuries, peer pressure, team failure, among others. Conferred in their policy statements, soccer clubs at the National and Super League Levels are meant for safeguarding the players and the team from such risks. Thus, Training load, consisting of both the stress and recovery level as well as the corresponding NMF deserves special attention for its role as a proxy for performance, as a process indicator of quality soccer coaching, and ultimately as a predictor of team success.

Findings of this PhD research have implications for assisting the soccer players at the National and other league levels, through the development of strategies, for example, optimizing the training, stress and recovery and the identification of parameters of NMF that could facilitate the promotion of players performance as well as team success in the National League Soccer

Clubs/teams. However, the inclusion of five teams only from one Regional State of the country limits the generalizability of the findings. To counter these limitations and contribute for the development of soccer at the National League Level, future research should employ larger and more randomized samples across different regions of the country to help improve the generalizability as well as decrease bias in the design of the research.

Paying considerable attention towards including large numbers of soccer coaches and trainers into future research designs would also contribute more positively to the overall scope of the findings, and allow for further comparative analysis between soccer players, and coaches and trainers, and for the examination of any interaction effects that may exist.

Further research on how the relationship of TL and adaptation is moderated by age or maturity level of the players is also necessary. The other way, the moderating effect of previous or baseline fitness on the effect of TL on adaptation potential is worthy of investigation. For a better understanding of the effect of TL on performance and well-being, a longitudinal investigation, studying players and teams for a relatively sustained period of time should be considered as the effect of TL can potentially vary at different phases or cycles of the season. For example, a specific TL can have different effects at different cycles of the competition season. Somewhere it may be positive and somewhere it may be negative. Thus, a longitudinal research with a more data collection is too worthwhile to determine the pattern of relationships across time.

6.3. Summary

The demand of contemporary soccer is multifaceted and complex. Acknowdgning this demand of soccer the study was conducted to unveil how those factors how perceived TL, stress and recovery relate and determine soccer specific fitnesses of linear sprinting speed, CODS and RSA. As the final sought goal of any soccer team or club, success was examined agaist these variables about how they relate and determine success level. As such it was questioned that how perceived TL, etress and recovery level relate and most importantly determine performance scores in linear sprinting speed overn 40m, CODS in 9-3-6-3-9m FB and RSA in 6*35m test protocols. Finally the relationship tht success has with perceived TL, stress, recovery level and NMF was examined. In addition success prediction capacity of all these variables was considered.

The study was conducted on competitive soccer players at the national league level. However, only one group which is those teams in the Amhara regional state. Out of the 11 teams in region which were participating in the national league competition, 5 teams were selected randomly for the study. All outfield players from the 5 teams participated in the study. Thus, a total of 88 injury free players completed the study protocol and the data was collected from these players. The data was gathered for five consecutive weeks. This way each variable or behavior was measured 5 times. Thus a total of 440 observations were made for the variables in due consideration.

Perceived TL was measured using RPE scale and weekle TL was calculated adding the entire sessions through each week. For the measurement of perceived stress and recovery level, RESTQ-52 was used. The questionnaire was filled by the players 24 hours before each match for five weeks. The issue regarding the measurement of NMF, 3 days before each match the players' performance level was measured using 40m dash, 9-3-6-3-9m and 6*35m test protocols for linear speed, CODS and RSA respectively. The level of team success was considered using the points obtain from matches, the number of goals they scored and goals conceded. Generally, all of these variables were measured for five consecutive weeks.

The difference in NMF and success level among the studied teams was evaluated using ANOVA with Games-Howell post hoc test. The level of correlation coefficient among perceived TL, stress, recovery, NMF and success was examined using bivariate correlation and partial correlation. Success prediction capacity of TL, stress, recovery and NMF was tested using GLM. Also using GLM, the prediction of NMF from perceived TL, stress and recovery was examined.

The result revealed that teams were significantly different interms of the success level as it was measured using those parameters as their ability to score goals and obtain points from matches. Interms of soccer specific fitness, the teams were significantly different in their player NMF performance level. As a result it was questioned that can we account the teams' success difference to their NMF performance score? Using bivariate correlation, perceived TL, stress and recovery had a statistically significant relationship with NMF performance score. Still success level as measured with goals scored, goals conceded and points obtained significantly correlate with perceived TL, stress, recovery level and most importantly with NMF. However, the partial correlation was not as significant and larger as the bivariate correlation coefficient. Thus, it was evident that the variables highly moderate each other. With the GLM analysis, NMF performance score can be predicted from stress and recovery level. Still success level can be predicted from perceived stress, recovery level and perceived TL.

From the study, it was concluded that teams at the national league level are different in their NMF performance level and as a function of their NMF they are different enough in their success level. Still NMF is a positive correlate of perceived TL and recovery level. However, NMF is a negetaive correlate of the players perceived stress level. Team success in soccer is a positive correlate of NMF, perceived recovery and TL and it is a negative correlate of perceived stress level. Generally, a soccer team is as successful as its ability to tolerate higher TL and its ability to recover or resist stress.

The search for success in soccer should focus on building NMF with highly monitored TL provision to ensure the level of stimulus for maximum adaptation. The process and modalities of recovery should also be part of the adaptation process. As such, youth soccer programs should give a due emphasis for the realization of the maximum possible TL with appropriate recovery approach. However, the matter needs a season based longitudinal research with larger sample sizes so that there will be more elucidation and strong conclusions.

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Appendix A: RESTQ-52 English Version
BAHIR DAR UNIVERSITY

SPORT ACADEMY

SPORT SCIENCE PROGRAM

Questionnaire for National League Soccer Players

General Information:-

Dear participant, my name is ***Belayneh Chekle*** and I am a graduate student at ***Bahir Dar University***. For my dissertation, I am examining how training load, stress and recovery level relates with performance. Because you are a soccer player at a national league level, I am inviting you to participate in this research study by completing the attached questionnaire.

The questionnaire will require approximately 40 minutes to complete. There is no any known risk for responding. In order to ensure that all information will remain confidential, please do not include your name (write your code number on the given space). Responses will not be identified by individual player or clubs name. All responses will be compiled together and analyzed as a group. Please answer all the questions as honestly as possible and return the completed questionnaires. There are no right and wrong answers that I am interested in how you feel or doing. Your participation in this study is voluntary and you are free to withdraw your participation from the study at any time.

Thank you very much for helping me with this important study. The data which will be collected will provide useful information regarding the relationship of training load, stress and recovery level with performance. Thus, the finding will help players, coaches and sport science professionals in monitoring load, stress and recovery level in the pursuit of performance. If you require additional information or in case you have any questions regarding the questionnaire, please contact me, Belayneh Chekle or My supervisors, Dr. Tefera Tadesse and Dr. Zerihun Birhanu at the number or address listed below.

Belayneh Chekle: Cell phone= 09 75 16 17 42, email: admbelaya@gmail.com

Dr. Tefera Tadesse: Cell phone= 0917801007

Dr. Zerihun Birhanu: Cell phone= 0961014088

The Recovery-Stress Questionnaire RESTQ Sport (52 items)

This questionnaire consists of a series of statements. These statements possibly describe your psychic or physical well-being or your activities during the past few days and nights. Please select the answer that most accurately reflects your thoughts and activities. Indicate how often each statement was right in your case in the past 7 days/nights. The statements related to performance should refer to performance during competition as well as during practice. For each statement there are seven possible answers.

Please make your selection by marking the number corresponding to the appropriate answer.

Example

In the past 7 days/night

… I read a news paper	1	2	3	4	5	**6**	7
	Never	Seldom	Sometimes	Often	More often	**Very often**	Always

In the past 7 days

Use this scale	1	2	3	4	5	6	7
	Never	Seldom	Sometimes	Often	More often	Very often	Always

1) I watched TV	1	2	3	4	5	6	7
2) I laughed	1	2	3	4	5	6	7
3) I was in a bad mood	1	2	3	4	5	6	7
4) I felt physically relaxed	1	2	3	4	5	6	7
5) I was in good spirits	1	2	3	4	5	6	7
6) I had difficulties in concentrating	1	2	3	4	5	6	7
7) I worried about unresolved problems	1	2	3	4	5	6	7
8) I had a good time with my friends	1	2	3	4	5	6	7
9) I had a headache	1	2	3	4	5	6	7
10) I was dead tired after work	1	2	3	4	5	6	7
11) I was successful in what I did	1	2	3	4	5	6	7
12) I felt uncomfortable	1	2	3	4	5	6	7
13) I was annoyed by others	1	2	3	4	5	6	7
14) I felt down	1	2	3	4	5	6	7
15) I had a satisfying sleep	1	2	3	4	5	6	7
16) I was fed up with everything	1	2	3	4	5	6	7
17) I was in a good mood	1	2	3	4	5	6	7
18) I was overtired	1	2	3	4	5	6	7
19) I slept restlessly	1	2	3	4	5	6	7
20) I was annoyed	1	2	3	4	5	6	7
21) I felt as if I could get everything done	1	2	3	4	5	6	7

In the past 7 days

Use this scale	1	2	3	4	5	6	7
	Never	Seldom	Sometimes	Often	More often	Very often	Always

22) I was upset	1	2	3	4	5	6	7
23) I put off making decisions	1	2	3	4	5	6	7
24) I made important decisions	1	2	3	4	5	6	7
25) I felt under pressure	1	2	3	4	5	6	7
26) Parts of my body were aching	1	2	3	4	5	6	7
27) I could not get rest during the breaks	1	2	3	4	5	6	7
28) I was convinced I could achieve my set goals during performance	1	2	3	4	5	6	7
29) I recovered well physically	1	2	3	4	5	6	7
30) I felt burned out by my sport	1	2	3	4	5	6	7
31) I accomplished many worthwhile things in my sport	1	2	3	4	5	6	7
32) I prepared myself mentally for performance	1	2	3	4	5	6	7
33) My muscles felt stiff or tense during performance	1	2	3	4	5	6	7
34) I had the impression there were too few breaks	1	2	3	4	5	6	7
35) I was convinced that I could achieve my performance at any time	1	2	3	4	5	6	7
36) I dealt very effectively with my teammates` problems	1	2	3	4	5	6	7
37) I was in a good condition physically	1	2	3	4	5	6	7
38) I pushed myself during performance	1	2	3	4	5	6	7

In the past 7 days

Use this scale	1	2	3	4	5	6	7
	Never	Seldom	Sometimes	Often	More often	Very often	Always
39) I felt emotionally drained from performance	1	2	3	4	5	6	7
40) I had muscle pain after performance	1	2	3	4	5	6	7
41) I was convinced that I performed well	1	2	3	4	5	6	7
42) Too much was demanded of me during the breaks	1	2	3	4	5	6	7
43) I psyched myself up before performance	1	2	3	4	5	6	7
44) I felt that I wanted to quit sport	1	2	3	4	5	6	7
45) I felt very energetic	1	2	3	4	5	6	7
46) I easily understood how my teammates felt about things	1	2	3	4	5	6	7
47) I was convinced that I had trained well	1	2	3	4	5	6	7
48) The breaks were not at the right times	1	2	3	4	5	6	7
49) I felt vulnerable to injuries	1	2	3	4	5	6	7
50) I set definite goals for myself during performance	1	2	3	4	5	6	7
51) My body felt strong	1	2	3	4	5	6	7
52) I felt frustrated by my sport	1	2	3	4	5	6	7
53) I dealt with emotional problems in my sport very calmly	1	2	3	4	5	6	7

Appendix B: RESTQ-52 Amharic Version

ባህር ዳር ዩኒቨርሲቲ

ስፖረተ አካዳሚ

ስፖርት ሳይንስ ፐሮገራም

አጠቃላይ መረጃ

ወድ ተሳታፊዎች እኔ በላይነህ ጨቅሌ በባህረዳር ዩኒቨርስቲ የድህረ-ምረቃ ፕሮግራም ተማሪ ስሆን የመመረቂያ ጥናቴን በስልጠና ጫና፤ የማገገም አቅም እና አጠቃላይ የእለተ ተዕለት ጫናዎች ከብቃት ጋር ያላቸውን ዝምድና በማጥናት ላይ እገኛለሁ። እርሰዎም በቢሄራዊ ሊግ ደረጃ የእግር ኳስ ተጫዋች ስለሆኑ ይህን መጠይቅ በመሙላት የጥናቱ ተሳታፊ እንዲሆኑ እጠይቀዎታለሁ።

ይህን መጠይቅ ሞልቶ ለመጨረስ 30 ደቂቃ አካባቢ የሚዎስድ ሲሆን ምንም አይነት ተጓዳኝ ችግር ሊያደርስበዎ እንማይችል ላረጋግጥለዎት እወዳለሁ። የሚሰጡትን መረጃ ሚስጥራዊነት ለመጠበቅ ይረዳ ዘንድ በመጠይቁ ላይ ስም ሳይሆን ተመራማሪው የሰጠወትን ኮድ ቁጥር ብቻ ቦታው ላይ ያስቀምጡ። የትኛውም አይነት መረጃ በእርስዎ ወይንም በክለበዎ ስም አይጠቀስም። ሁሉም መልሶች (መረጃዎች) በቡድን ከተደራጁ በኃላ ትንተናው በጥቅል ይሰራል። ስለዚህ እርሰዎም ሁሉንም ጥያቄዎች እዉነተኛ ስሜተዎን መሰረት አድርገው እንዲመልሱ አጠይቀዎታለሁ።ለየትኛውም ጥያቄ ትክክል ወይንም ስህተት የሚባል መልስ ባይኖርም እኔ (ምርምሩ) የሚፈልገው ትክክለኛ የሆነ ስሜትዎን (ሁኔታ) ማወቅ ነው። በዚህ ወቅት ተሳትፎዎት በፈቃደኝነት ላይ የተመሰረተ ሆኖ በማንኛውም ሰአት ማቆም ከፈለጉ አይገደዱም።

ይህን መጠይቅ በመሙላት የዚህ ጥናት ተሳታፊ በመሆነዎ እጅግ በጣም አመሰግናለሁ። እርሰዎ የሚሰጡት መረጃ ከላይ የተነሱት ተለዋዋጮች የአንድን ተጫዋች ብቃት በምን መልኩ እንደሚወስኑት ለማወቅ የሚረዳ ሲሆን ይህ ደግሞ ለእግር ኳስ ተጫዋቾች፤ አሰልጣኞች እንዲሁም ለስፖርት ሳይንስ ባለሙያወች ጠቀሜታው ከፍ ያለ ነው። በማንናውም ጊዜ ተጨማሪ ማብራሪያ ካስፈለገዎት ወይንም ደግሞ ከመጠይቁ ጋር በተገናኘ ጥያቄ ካለዎት ተመራማሪውን ከዚህ በታች በተገለፀው አድራሻ ማግኘት ይችላሉ።በላይነህ ጨቅሌ (ተመራማሪ)፡ 0975161742፣ ኢሜል፡ admbelaya@gmail.com

Recovery Stress Questionnaire (RESTQ-52)

ይህ መጠይቅ ተከታታይነት ያላቸው ሀሳቦች የቀረቡበት ነው፡፡የሚነሱት ሀሳቦች ባለፉት ቀኖችና ሌሊቶች እርሰዎ የነበረወትን አእምሮአዊ ወይም አካላዊ ደህንነት አለያም የእንቅስቃሴ ሁኔታ ሊገልፁ እንደሚችሉ ይታመናል፡፡ ከተሰጡት አማራጭ መልሶች የእርሰዎን አስተሳሰብ (ስሜት)፤ ሁኔታ እና እንቅስቃሴ በተሻለ መጠን ይገልፅልኛል የሚሉትን ይምረጡ፡፡ በዚህም መሠረት ለአያንዳንዱ ጥያቄ እርስዎ ላለፉት 7 ቀናት የነበሩበትን ሁኔታ ምን ያህል እንደሚገልፅ ያመልክቱ፡፡ ከብቃት ጋር ተያይዘዉ የቀረቡት ሀሳቦች የሚዛመዱት በጨዋታ እና በልምምድ ወቅት ከነበረ ሁኔታ ጋር ነዉ፡፡ ለእያንዳንዱ ሀሳብ ሰባት አማራጮች ቀርበዋል፡፡ እርሰዎም ተገቢውን ምላሽ ለመስጠት የእርሰዎን ስሜት እና ሁኔታ የሚገልፅለዎትን ቁጥር በማክበብ ያመልክቱ፡፡

ለምሳሌ፡

ላለፉት 7 ቀናት (ሌሊት)

ጋዜጣ አንብቢያለሁ	በፍፁም	ከስነት አንዴ	አልፎ አልፎ	ብዙ ጊዜ	በጣም ብዙ ጊዜ	እጅግበጣም ብዙ ጊዜ	ሁልጊዜ
	1	2	3	4	5	6	7
1. ቴሌቪዥን አይቻለሁ	1	2	3	4	5	6	7
2. እስቅ ነበር	1	2	3	4	5	6	7
3. ጥሩ ያልሆነ ስሜት ውስጥ ነበርኩ	1	2	3	4	5	6	7
4. ሰውነቴ ዘና የማለት ስሜት ነበረው	1	2	3	4	5	6	7
5. ጥሩ የሆነ መንፈስ ነበረኝ	1	2	3	4	5	6	7
6. ትኩረቴን ለመሰብሰብ እቸገር ነበር	1	2	3	4	5	6	7
7. ሰላልተፈቱ (መፍትሄ ስላጠሁላቸው) ችግሮች እጨነቅ ነበር	1	2	3	4	5	6	7
8. ከጓደኞቸ ጋር ጥሩ ጊዜ አሳልፍ ነበር	1	2	3	4	5	6	7
9. ራስ ምታታ ያመኝ ነበር	1	2	3	4	5	6	7
10. ከስራ (እንቅስቃሴ) በኋላ በጣም ይደክመኝ ነበር	1	2	3	4	5	6	7
11. በሰራሁት ስራ ስኬታማ ነበርኩ	1	2	3	4	5	6	7
12. ምቾት አይሰማኝም ነበር	1	2	3	4	5	6	7
13. በሰዎች እበሳጭ ነበር	1	2	3	4	5	6	7
14. የመውደቅ (መሸነፍ) ስሜት ተሰምቶኛል	1	2	3	4	5	6	7
15. በቂ እንቅልፍ ነበረኝ	1	2	3	4	5	6	7
16. ሁሉም ነገር ስልችት ይለኛል	1	2	3	4	5	6	7
17. ጥሩ ስሜት (ሙድ) ነበረኝ	1	2	3	4	5	6	7
18. በጣም ይደክመኝ ነበር	1	2	3	4	5	6	7
19. ሰላማዊ እነቅልፍ አልነበረኝም	1	2	3	4	5	6	7
20. እበሳጭ ነበር	1	2	3	4	5	6	7
21. ሁሉንም ስራ ሰርቼ መጨረስ እንደምችል ይሰማኝ ነበር	1	2	3	4	5	6	7
22. ተረብሸ ነበር	1	2	3	4	5	6	7
23. ለመወሰን እዘገይ ነበር	1	2	3	4	5	6	7
24. ጠቃሚ ውሳኔዎችን እወስን ነበር	1	2	3	4	5	6	7
25. ጫና ውስጥ እንዳለሁ ይሰማኛል	1	2	3	4	5	6	7
26. በተወሰነው የሰዉነት ክፍሌ ህመም ነበረብኝ	1	2	3	4	5	6	7

27. በእረፍት ሰዓት ሰላም የለኝም ነበር	1	2	3	4	5	6	7
28. ያቀድሁትን (ያለምኩትን) ብቃት ማሳካት እንደምችል አምን ነበር	1	2	3	4	5	6	7
29. ሰውነቴ በደንብ ያገግም ነበር	1	2	3	4	5	6	7
30. በምሰራው ስፖርት እጅግ የመድከም እና የመዛል ስሜት ይሰማኛል	1	2	3	4	5	6	7
31. በዚህ ስፖርት (እግር ኳስ) ብዙ የሚጠቅሙ ነገሮችን አሳክቻለሁ	1	2	3	4	5	6	7
32. ለሚጠብቀኝ የብቃት ደረጃ በአእምሮ (በስነ ልቦና) እራሴን አዘጋጅ ነበር	1	2	3	4	5	6	7
33. እንቅስቃሴ በማደረግ ጊዜ ጡንቻዬ ላይ የመድረቅ ስሜት ይሰማኛል	1	2	3	4	5	6	7
34. የሚሰጠው የእረፍት ግዜ በጣም ያነሰ እንደነበር ይሰማኛል	1	2	3	4	5	6	7
35. በማንኛውም ሰዓት የሚጠበቅብኝን የብቃት ደረጃ ማሳካት እንደምችል አምናለሁ	1	2	3	4	5	6	7
36. የጓደኞቸን ችግር ውጤታማ በሆነ መንገድ ፈትቻለሁ (ቀርፊያለሁ)	1	2	3	4	5	6	7
37. በጥሩ አካላዊ ሁኔታ ላይ ነበርኩ	1	2	3	4	5	6	7
38. በስራ (በእንቅስቃሴ) ወቅት እራሴን አጀግናለሁ	1	2	3	4	5	6	7
39. ከስራ በኋላ ወኔ (ተነሳሽነት) የማጣት ስሜት ይሰማኛል	1	2	3	4	5	6	7
40. ከስራ (እንቅስቃሴ) በኋላ የጡንቻ ህመም ይሰማኝ ነበር	1	2	3	4	5	6	7
41. አመርቂ እንቅስቃሴ እንደነበረኝ ይሰማኛል	1	2	3	4	5	6	7
42. በእረፍት ሰዓት ብዙ ነገር ይጠበቅብኝ ነበር	1	2	3	4	5	6	7
43. ከእንቅስቃሴ በፊት በቂ ስነልቦናዊ ዝግጅት አደርጋለሁ	1	2	3	4	5	6	7
44. ስፖርቱን (እግር ኳስን) ማቆም እንደፈልግ ይሰማኝ ነበር	1	2	3	4	5	6	7
45. ሀይል (ጉልበት) እንዳለኝ ይሰማኝ ነበር	1	2	3	4	5	6	7
46. ጓደኞቸ (የቡድን አጋሮቸ) ስለነገሮች ምን እንደሚሰማቸው በቀላሉ እረዳ ነበር	1	2	3	4	5	6	7
47. በቂ ስልጠና (ልምምድ) እንደሰራሁ አምን ነበር	1	2	3	4	5	6	7
48. እረፍት የሚሰጠው ትክክለኛ ጊዜ ላይ አልነበረም	1	2	3	4	5	6	7
49. ለጉዳት ተጋላጭ እንደሆንኩ ይሰማኝ ነበር	1	2	3	4	5	6	7
50. ለብቃት ግልፅ መድረሻ ግብ አስቀምጣለሁ	1	2	3	4	5	6	7
51. አካላዊ ጥንካሬ ይሰማኛል	1	2	3	4	5	6	7
52. በዚህ ስፖርት ተስፋ እቆርጣለሁ	1	2	3	4	5	6	7
53. ስሜት የሚጎዱ ጉዳዮች በእግር ኳስ ምክንያት ሲከሰት ተረጋግቼ እፈታለሁ	1	2	3	4	5	6	7

የኮድ ቁጥር ________

Appendix C: RPE English and Amharic Version

Rate of perceived exertion (RPE)

Rate your perceived exertion on the CR-10 scale by choosing any number on the scale to rate your overall effort during the training session. A rating of 0 is to be associated with no effort (rest) and a rating of 10 with maximal effort (the most stressful exercise performed).

How hard was the training for you?

Rating	Descriptor		
0	Rest		
1	Very, very easy		
2	Easy		
3	Moderate		
4	Somewhat hard		
5	Hard		
6			
7	Very hard		
8			
9			
10	Maximal		

የተሰማንን የጫና መጠን ማመልከት (መግለፅ) (RPE)

የዚህ መለኪያ አላማ የተሰማንን የጫና መጠን እንድንገልፅ ነው፡፡ በዚህ መሠረት ከዚህ በታች ባለው የጫና መጠን መለኪያ ደረጃ (Scale) በዛሬው ስልጠና የተሰማወትን የጫና መጠን ከጐን በተቀመጠው ቁጥር √ በማድረግ እንዲያመለክቱ ነው፡፡ 0 ምንም አይነት ጫና (ክብደት) እንዳልተሰማዎት (ከእረፍት የተለየ አለመሆኑን) የሚገልፅ ሲሆን ፤ 10 ደግሞ እጅግ በጣም ከባድ ጫና እንደተሰማዎት ይገልፃል (ያመለክታል)፡፡

የዛሬው ስልጠና ምን ያክል ከባድ ነበር?

መጠን	ገላጭ
0	**እረፍት**
1	**በጣም በጣም ቀላል**
2	**ቀላል**
3	**መጠነኛ**
4	**በተወሰነ መጠን ከባድ**
5	**ከባድ**
6	
7	**በጣም ከባድ**
8	
9	
10	**እጅግ በጣም ከባድ**

የኮድ ቁጥር_______________