VARIATIONS IN PHYSICAL AND TECHNICAL PERFORMANCE PARAMETERS OF PROFESSIONAL SOCCER PLAYERS ACCORDING TO MATCH OUTCOME, TEAM QUALITY, AND QUALITY OF OPPOSITION

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

KORAY BİBER

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
THE DEPARTMENT OF PHYSICAL EDUCATION AND SPORTS

MARCH 2022

Approval of the thesis:

VARIATIONS IN PHYSICAL AND TECHNICAL PERFORMANCE PARAMETERS OF PROFESSIONAL SOCCER PLAYERS ACCORDING TO MATCH OUTCOME, TEAM QUALITY, AND QUALITY OF OPPOSITION

submitted by **KORAY BİBER** in partial fulfillment of the requirements for the degree of **Master of Science in Physical Education and Sports, the Graduate School of Social Sciences of Middle East Technical University** by,

Prof. Dr. Yaşar KONDAKÇI
Dean
Graduate School of Social Sciences _____

Assoc. Prof. Dr. Sadettin KİRAZCI
Head of Department
Department of Physical Education and Sports _____

Assoc. Prof. Dr. Mustafa SÖĞÜT
Supervisor
Department of Physical Education and Sports _____

Examining Committee Members:

Prof. Dr. Ayşe KİN İŞLER (Head of the Examining Committee)
Hacettepe University
Department of Exercise and Sport Sciences _____

Assoc. Prof. Dr. Mustafa SÖĞÜT (Supervisor)
Middle East Technical University
Department of Physical Education and Sports _____

Assoc. Prof. Dr. Irmak HÜRMERİÇ ALTUNSÖZ
Middle East Technical University
Department of Physical Education and Sports _____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last Name: Koray BİBER

Signature:

ABSTRACT

VARIATIONS IN PHYSICAL AND TECHNICAL PERFORMANCE PARAMETERS OF PROFESSIONAL SOCCER PLAYERS ACCORDING TO MATCH OUTCOME, TEAM QUALITY, AND QUALITY OF OPPOSITION

Biber, Koray
M.S., The Department of Physical Education and Sports
Supervisor: Assoc. Prof. Dr. Mustafa Söğüt

March 2022, 88 pages

The purpose of this study was to analyze the variations in physical and technical performance parameters of professional soccer players according to match outcome (winning, drawing, and losing), team quality (according to their final ranking at the end of season: top-ranked, middle-ranked, and bottom-ranked), and quality of opposition (inferior and superior). The data was collected from 122 matches of the Turkish Super League during the 2019-2020 season using the semi-automatic multi-camera tracking system (Sentio Sports Analytics Company®). The results revealed that the winning teams performed greater high-intensity and high-speed activities, particularly when in possession, and the number of shots on target. The distance covered at high-intensity running, high-speed running and sprinting when in possession, and successful cross, shots on target, corner kicks, short pass rather than long pass, and the ball playing time were greater in top-ranked teams. The results also indicated that the percentage of ball possession, number of shots on target, and successful crosses were greater for both inferior and superior teams when they played

against the inferior team. While both groups played against superior, high-intensity running distance out of possession and high-speed distance out of possession were greater. Further, total distance in possession, high-intensity distance in possession, number of successful passes were greater for superior teams while playing against an inferior opponent. The coaches, performance analysts, and applied practitioners should consider performance parameters that are influenced by contextual variables before designing training programs and match evaluations.

Keywords: Turkish soccer, match analysis, performance parameters, contextual variables

ÖZ

MAÇ SONUCU, TAKIM KALİTESİ VE RAKİP KALİTESİNE GÖRE PROFESYONEL FUTBOLCULARIN FİZİKSEL VE TEKNİK PERFORMANS PARAMETRELERİNDEKİ DEĞİŞİMLER

BİBER, Koray

Yüksek Lisans, Beden Eğitimi ve Spor Bölümü

Tez Yöneticisi: Doç. Dr. Mustafa SÖĞÜT

Mart 2022, 88 sayfa

Bu çalışmanın amacı, maç sonucu (galibiyet, beraberlik, mağlubiyet), takım kalitesi (lig sonunda ilk altı sırada yer alan üst klasman, altı ve on ikinci sıra arasında yer alan orta klasman ve son altı sırada yer alan alt klasman) ve rakip kalitesine (lig sonunda ilk dokuz sırada yer alan üst ve son dokuz sırada yer alan alt klasman) göre profesyonel futbolcuların fiziksel ve teknik performans parametrelerindeki değişimleri incelemektedir. Veriler, Türkiye Süper Ligi 2019-2020 sezonunda oynanan 122 maçtan toplandı. Fiziksel ve teknik performans parametreleri, Sentio Sports Analytics tarafından kameralı izleme sistemiyle elde edilen maç sonu raporlarından alınmıştır. Araştırma bulguları Türkiye Süper Ligi'nde kazanan takımın futbolcularının, takım topa sahipken yüksek şiddetli ve yüksek hızdaki koşularda ve isabetli şut sayılarında

daha yüksek performans sergilediklerini göstermiştir. Elde edilen bulgulara göre, üst klasman takımlarda topa sahipken yapılan yüksek şiddetli koşu mesafesi, kısa koşu mesafesi ve yüksek hızlardaki mesafelerle birlikte isabetli şut ve orta sayıları, kazanılan köşe vuruş sayısı, kısa pas sayısı ve topla oynama süreleri daha yüksektir. Rakip alt klasmanken, üst klasman ve alt klasman takımlar topla oynama yüzdesi, isabetli şut ve ortalarda daha yüksek performans sergilemişlerdir. Her iki klasmanda da yer alan takımlar üst klasmana karşı oynarken, top rakipteyken kat edilen yüksek şiddetli ve yüksek hızlı koşu mesafesi daha yüksektir. Üst klasman takımlar alt klasman rakiple karşılaştığında ise, topa sahipken toplam kat edilen mesafe, topa sahipken yüksek şiddetle koşu mesafesi, isabetli pas sayısı daha yüksektir. Antrenörler, performans analistleri ve ilgili profesyoneller antrenman programlarını, maç stratejilerini ve maç analizlerini yaparken bu bulguları dikkate almalıdırlar.

Anahtar Kelimeler: Türk futbolu, maç analizi, maç sonucu, takım ve rakip kalitesi

To my family

ACKNOWLEDGMENTS

I would like to express my deepest appreciation to my supervisor, Assoc. Prof. Dr. Mustafa SÖĞÜT, for his unlimited patience and guidance throughout this research. His extensive knowledge, practical suggestions, enthusiasm, and invaluable expertise in methodology have deeply inspired me. I would also like to thank him for his friendship and sense of humor.

I would like to extend my sincere thanks to the rest of my thesis committee: Prof. Dr. Ayşe KİN İŞLER and Assoc. Prof. Dr. Irmak HÜRMERİÇ ALTUNSÖZ for their encouragement, insightful feedbacks, and hard questions.

I gratefully acknowledge the assistance of Dr. Ömür Serdal ALTUNSÖZ, athletic coach of Turkey National Football Team, for sharing his practical experience and providing valuable advice to shape my research questions.

I am also grateful to Sentio Sports Analytics Company to provide me the data used to carry out this research. I must also thank to the staff for their dedication to collect and organize the data during the 2019-2020 Süper Lig.

The completion of my thesis and whole education life would not have been possible without the support and nurturing of my mother. She was always there for me with her unconditional love. I would also like to extend my deepest gratitude to my sister for her constant support, trust, friendship, and love. I cannot leave my beloved nephew, Çağan, without mentioning who is a source of joy for me. His innocent love and cheer are very precious to me. Last but not least, the presence of my grandmother and grandfather has always been a blessing for me.

I am extremely grateful to have a friend and an opponent like Günay. I would like to thank him for his friendship, sense of humor, invaluable suggestions, and support whenever I need. He is surely one of the precious people in my life.

I have always had the utmost respect for my friend Mustafa as a person and as a champion. As my greatest rival over many years, I believe we pushed each other to become better tennis players. I would like to express my deepest appreciation for his friendship, sharing, generosity, unlimited support, and most of all his sense of humor.

Beyond shadow of a doubt, I cannot thank my “brur” Müren in words for his endless support he has shown me in all matters over the years, the invaluable suggestions he has given me with his extensive knowledge and patience. The presence of him is a gift for me and undoubtedly will be remain forever like that. I thank you for your brotherhood and being always there.

Above all, I would like to thank my supportive wife Duygu for her love, caring, and sacrifices for me. From my bottom of heart, I thank my wife for her patience that cannot be underestimated, constant support and ingenious suggestions. You will always have my love!

TABLE OF CONTENTS

PLAGIARISM iii

ABSTRACT iv

ÖZ vi

DEDICATION viii

ACKNOWLEDGMENTS ix

TABLE OF CONTENTS xi

LIST OF TABLES xiii

LIST OF ABBREVIATIONS xiv

CHAPTERS

1. INTRODUCTION 1

1.1. Purpose of the Study 4

1.2. Research Questions 5

1.3. Significance of the Study 5

1.4. Definition of Terms 6

2. LITERATURE REVIEW 9

2.1. Key Performance Indicators in Soccer 9

2.1.1. Physical Performance Parameters in Soccer 10

2.1.2. Technical Performance Parameters in Soccer 11

2.2. Contextual Variables 14

2.2.1. Match Outcome 14

2.2.2. Team Quality 16

2.2.3. Quality of Opposition 18

2.2.4. Match Location 21
2.2.5. Environmental Factors 25
3. METHODS 29
3.1. Data Resource 29
3.2. Sample and Procedures 30
3.3. Variables 31
3.3.1. Physical Performance Parameters 32
3.3.2. Technical Performance Parameters 33
3.3.3. Contextual Variables 34
3.4. Statistical Analysis 34
4. RESULTS 36
4.1. Match Outcome 36
4.2. Team Quality 39
4.3. Quality of Opposition 43
5. DISCUSSION AND CONCLUSION 48
5.1. Match Outcome 48
5.2. Team Quality 50
5.3. Quality of Opposition 52
5.4. Conclusion 53
5.5. Practical Implications 54
5.6. Limitations of the Study and Recommendations for Future Research 55
REFERENCES 56
APPENDICES
A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE 70
B. TURKISH SUMMARY / TÜRKÇE ÖZET 71
C. THESIS PERMISSION FORM / TEZ İZİN FORMU 88

LIST OF TABLES

Table 1 Summary of variables 31

Table 2 Physical performance parameters according to match outcome 36

Table 3 ANOVA results of physical performance parameters according to match outcome 37

Table 4 Technical performance parameters according to match outcome 38

Table 5 ANOVA results of technical performance parameters according to match outcome 39

Table 6 Physical performance parameters according to team quality 40

Table 7 ANOVA results of physical performance parameters according to team quality 41

Table 8 Technical performance parameters according to team quality 42

Table 9 ANOVA results of technical performance parameters according to team quality 42

Table 10 Physical performance parameters of superior teams according to quality of opposition 44

Table 11 Technical performance parameters of superior teams according to quality of opposition 45

Table 12 Physical performance parameters of inferior teams according to quality of opposition 46

Table 13 Technical performance parameters of inferior teams according to quality of opposition 47

LIST OF FIGURES

Figure 1 Sentio Sports Analytics multi-camera tracking system 30

LIST OF ABBREVIATIONS

AS	Average Speed
AVPL	Average Pass Length
BPT	Ball Play Time
COR	Corners
FC	Fouls Committed
HID	High Intensity Distance
HIDBOP	High-Intensity Distance Ball Out of Play
HIDOP	High-Intensity Distance Out of Possession
HIDP	High-Intensity Distance in Possession
HSD	High Speed Distance
HSDBOP	High-Speed Distance Ball Out of Play
HSDOP	High-Speed Distance Out of Possession
HSDP	High-Speed Distance in Possession
LP	Long Passes
NHIR	Number of High-Intensity Runs
NHSR	Number of High-Speed Runs
NS	Number of Sprints
OFF	Offsides
POS	Possession
PR	Pass Ratio
RC	Red Cards
SBOP	Sprint Ball Out of Play
SD	Sprint Distance
SHP	Short Passes
SOFT	Shots off Target
SOP	Sprint Out of Possession
SOT	Shots on Target

SP	Sprint in Possession
SUCC	Successful Crosses
SUCP	Successful Passes
TD	Total distance
TDBOP	Total Distance Ball Out of Play
TDOP	Total Distance Out of Possession
TDP	Total Distance in Possession
UNSUCC	Unsuccessful Crosses
UNSUCP	Unsuccessful Passes
YC	Yellow Cards

CHAPTER 1

INTRODUCTION

Soccer is the most popular sport worldwide across all ages and levels of play (Stølen et al., 2005). It is reported that 270 million individuals actively participate in soccer, including soccer players (male and female), referees, and officials (FIFA,2007). These numbers were % 10 higher than 2000 (FIFA, 2007). In the same period, 2006-2007, the number of registered soccer players has increased by approximately %23 and reached nearly 30 million. The later report of Fédération Internationale de Football Association (FIFA) published in 2019 stated more than 128 thousand soccer players worldwide (FIFA, 2019). Mexico has the biggest proportion of this amount, followed by Brazil, England, Argentina, and Turkey. When it comes to the total number of professional clubs, Mexico has the most registered clubs, while Brazil comes second, and Turkey takes third place proportionately (FIFA, 2019).

The growth in sports science has been noteworthy in recent years (Sporis et al., 2009). Sports science is widely utilized by coaches, players, and applied practitioners. The scientific approach is commonly used in soccer as a complementary element for several purposes, such as preventing injury (Brink et al., 2010; Verhagen et al., 2004), improving physical fitness components (Helgerud et al., 2001; Jovanovic et al., 2011), analyzing match performance (Fernandez-Navarro et al., 2018; Oliva-Lozano et al., 2021). The development of technological devices, e.g., photocell sensor, computerized isokinetic dynamometer, computerized multi-camera tracking systems, also involves the expansion of scientific literature in sports science (Randers et al., 2010; Svensson & Drust, 2005). As a result of the development of technology and scientific approach, players have higher physical fitness (Jovanovic et al., 2011) as well as less prone to injury (Croisier et al., 2008) and utilizing meaningful match performance analysis as

effective feedback to adjust their training programs, accordingly (Sarmento et al., 2014).

Performance analysis is preferred for players, coaches, and sports scientists as efficient feedback (Drust, 2010). To assess the performance of a team or individual several performance parameters can be used (Hughes et al., 2002). It is crucial for the coaches to select performance parameters to determine the performance (Bartlett, 2001; Hughes & Franks, 2008). The obtained data from performance analysis is essential to prescribe weekly training programs and design seasonal strategies (Carling et al., 2007). The primary purpose of the performance analysis is to diagnose the strengths that can be developed and weaknesses of a team to improve later. Further, a coach can use performance analysis to identify the strength and weaknesses of the opponent to counter that team efficiently (Castellano et al., 2012).

There are several methods to conduct performance analysis in soccer, such as manual notational analysis, semi-automated multi-camera tracking system, and global positioning system (GPS) (Carling et al., 2008; James, 2006). The manual notational analysis is often recommended to coaches as a low-cost approach to collect sports activities' physical and technical demands by quantifying the recorded player movement patterns. It is a subjective quantification method that collects data from either live observation or post-event video analysis by an observer to identify the frequency and timing of movements and then to relate their relative success (Barris & Button, 2008). Manual notational analysis has been widely used to examine the performance analysis in many sports, including soccer (Docherty & Neary, 1988; Grehaigne et al., 1997; Tavares & Gomes, 2003). Nevertheless, manual notational analysis is a low-cost, practical, and convenient tool; however, the validity and reliability of the procedure are dependent on several factors (i.e., number of observers, experience of the observer(s), and the quality of their angle of view) (Barris & Button, 2008).

GPS technology also involves the analysis of performance in soccer. To utilize GPS technology, the athlete must wear a receiver that draws on signals sent from satellites

to determine speed, covered distance, and pathway of the movements (Christopher Carling et al., 2008). The advantage of measuring the performance parameters in soccer through GPS is not only reliability and accuracy but also the portable devices to use during activity. As previously GPS devices were not allowed to be worn by the players during official matches, it has been widely used as a complementary element in training sessions (Mallo et al., 2015). However, it is reported by Randers et al. (2010) that the obtained data via different measurement methods such as video-based time-motion analysis, semi-automatic multiple camera system, and GPS should not be interchangeable.

The semi-automated multi-camera tracking system is prevalent among soccer match analysis studies (Bradley et al., 2013; Bush et al., 2017; Dellal et al., 2011; Di Salvo et al., 2007). This system is developed to accurately track players in real-time utilizing state-of-art computer vision and machine learning. A semi-automated multi-camera tracking system requires the installation of several cameras to the stadium to ensure tracking each player separately during the entire game (Carling et al., 2008). A semi-automated multi-camera tracking system is designed to model the playing surface two-dimensional and divide it into several cells, enabling player positions (x,y coordinates) to be calculated via camera sources (Carling et al., 2008). Through this technology, players are not required to carry or wear any material, strictly forbidden in official matches. However, the semi-automated multi-camera tracking system is a highly-cost measurement tool due to the requirement of many cameras installation, computer software, and a dedicated operator to organize the data collection procedures and conduct further analysis (Di Salvo et al., 2006).

There are numerous studies published in the literature by using the semi-automated multi-camera tracking system to examine physical performance parameters such as covered total distance, distance covered when in ball possession and out of possession, the distance covered in various speeds, number of different speed zone running in and out of possession, number of high-intensity activities either in possession or out of possession, and average speed in soccer (Barnes et al., 2014; Bradley et al., 2011; M. Bush et al., 2015; Gai et al., 2019; Martín-Fuentes et al., 2021). The large body of the

studies examined not only physical performance parameters but also technical performance parameters, including the number of short and long passes, shots on and off target, possession, successful and unsuccessful passes and crosses, offsides, corners, number of red and yellow cards, foul commitment (Barnes et al., 2014; Bradley et al., 2011, 2013; Dellal et al., 2011; Gai et al., 2019; Zhou et al., 2018). Numerous contextual factors influence physical and technical performance parameters of soccer players such as match location (home and away differences), match status (i.e., official, friendly, national league, international tournaments), match outcome (winning, losing, drawing), quality of opposition (better-ranked, similar-ranked, worst-ranked), team quality, player status (foreign or domestic), match halves (first and second half) (Castellano et al., 2011; Lago-Peñas & Lago-Ballesteros, 2011; T. Liu et al., 2019; Taylor et al., 2008).

The examination of physical and performance parameters according to several contextual variables has been broadly studied in a variety of leagues, including major leagues in Europe, e.g., the English Premier League (Bradley et al., 2011), Spanish La Liga (Oliva-Lozano et al., 2021), Italian Serie A (Ermanno Rampinini et al., 2009), German Bundesliga (Hoppe et al., 2015), French Ligue 1 (Christopher Carling, 2011), and international tournaments such as UEFA Champions League (Lago-Peñas et al., 2011), FIFA World Cup (Liu et al., 2016), The Africa Cup of Nations (AFCON) (Kubayi & Toriola, 2020), and many other national leagues in the world such as Chinese Super League (Liu et al., 2019), and Brazilian Campeonato Brasileiro Série A (Barros et al., 2007). However, to the best of the author's knowledge, there is limited evidence regarding physical and technical parameters variations according to contextual variables in the Turkish Super League.

1.1. Purpose of the Study

The purpose of this study was to examine the variations in physical and technical performance parameters according to match outcome (win, draw, lose), team quality

(top-ranked, middle-ranked, bottom-ranked), and quality of opposition (superior, inferior).

1.2. Research Questions

In this study, the investigated research questions are as follows:

1. Does match outcome influence selected physical and technical performance parameters?
2. Does team quality influence selected physical and technical performance parameters?
3. Does the quality of opposition influence selected physical and technical performance parameters?

1.3. Significance of the Study

Many studies were conducted to examine the impact of several contextual variables on physical and technical performance parameters in soccer players. The vast majority of the studies focused on either a higher level of national leagues in Europe such as the English Premier League (Bradley et al., 2011), Spanish La Liga (Oliva-Lozano et al., 2021), Italian Serie A (Ermanno Rampinini et al., 2009), German Bundesliga (Vogelbein et al., 2014), French Ligue 1 (Christopher Carling, 2011) or owning high reputation international tournaments such as UEFA Champions League (Lago-Peñas et al., 2011), and FIFA World Cup (Liu et al., 2015). However, lower-ranked leagues, e.g., the Turkish Super League, which is ranked 18th out of UEFA Country Coefficients (UEFA, 2021), were not studied according to the best of the author's knowledge. It is reported that team performance can vary according to the type of competition, both from between and within-team aspects (Gómez et al., 2013). Thus, this study aimed to investigate the variations of physical and performance parameters according to match outcome, team quality, and quality of opposition in elite soccer players competing in the Turkish Super League. The study purposed not only to contribute to the soccer match analysis literature but also the coaches, players, and

applied practitioners involved in the Turkish Super League to assist in conducting optimal performance assessment and developing appropriate training programs.

1.4. Definition of Terms

Total distance (TD): The sum of covered distance in meters by all the team players.

High-intensity distance (HID): The sum of covered distance in meters at speed between 20km/h and 24km/h by all the team players.

Sprint distance (SD): The sum of covered distance in meters at the speed over 24km/h by all the team players.

High-speed distance (HSD): The sum of the covered distance of high-intensity running and sprinting in meters (at the speed over 20km/h) by all the team players.

The number of high-intensity runs (NHIR): Number of running in a match at a speed between 20km/h and 24km/h by all the team players.

Number of sprints (NS): Number of sprinting by all the team players.

Number of high-speed runs (NHSR): Number of high-speed runs by all the team players.

Average speed (AS): Average speed of running, walking, and jogging performed by all the team players.

Total distance in possession (TDP): The sum of covered distance in meters when in ball possession by all the team players.

Total distance out of possession (TDOP): The sum of covered distance in meters when out of ball possession by all the team players.

Total distance ball out of play (TDBOP): The sum of covered distance in meters when ball out of play by all the team players.

High-intensity distance in possession (HIDP): The sum of covered distance in meters when in ball possession at speed between 20km/h and 24km/h by all the team players.

High-intensity distance out of possession (HIDOP): The sum of covered distance in meters when out of ball possession at speed between 20km/h and 24km/h by all the team players.

High-intensity distance ball out of play (HIDBOP): The sum of covered distance in meters when the ball is out of play at speed between 20km/h and 24km/h by all the team players.

Sprint in possession (SP): The sum of covered distance in meters at the speed over 24km/h when in ball possession by all the team players.

Sprint out of possession (SOP): The sum of covered distance in meters at the speed over 24km/h when out of ball possession by all the team players.

Sprint ball out of play (SBOP): The sum of covered distance in meters at the speed over 24km/h when the ball is out of play by all the team players.

High-speed distance in possession (HSDP): The sum of the covered distance of high-intensity running and sprinting in meters (at the speed over 20km/h) when in ball possession by all the team players.

High-speed distance out of possession (HSDOP): The sum of covered distance in meters at the speed over 20km/h when out of ball possession by all the team players.

High-speed distance ball out of play (HSDBOP): The sum of covered distance in meters at the speed over 20km/h when the ball is out of play by all the team players.

Successful passes (SUCP): Number of the played ball between teammates without interruption.

Unsuccessful passes (UNSUCP): Number of failed attempts to play the ball between teammates.

Pass ratio (PR): The proportion of successful passes to the number of total passes.

Long passes (LP): Numbers of the played ball more than 30 meters in length between teammates without interruption.

Short passes (SHP): Numbers of played balls less than 30 meters in length between teammates without interruption.

Average pass length (AVPL): The mean length of successful passes.

Shots on target (SOT): An attempt to score a goal either goes into the net or saved, which would have gone into the net by the opponent player, who is the last man.

Shots off target (SOFT): An attempt to score a goal either go wide or over the goal or directly hits the goal frame.

Successful crosses (SUCC): Any ball sent from the wide position reaches the teammate in the opposition's area.

Unsuccessful crosses (UNSUCC): Any ball sent from the wide position targeting the teammate failed.

Corner (COR): When the ball left field over the goal line.

Fouls committed (FC): Penalized as foul by the referee due to infringing action.

Yellow cards (YC): It is shown by the referee to the players due to their dangerous foul commitment, time-wasting, played by hand, etc.

Red cards (RC): It is shown by the referee to remove a player from the game either directly or in consequence of a second yellow card.

Offside (OFF): Being caught in an offside position results in an indirect free-kick to the opposing team.

Possession (POS): The ball control duration of a team as a proportion of the total time when the ball is in play.

Ball playing time (BPT): The total duration of a team's possession.

CHAPTER 2

LITERATURE REVIEW

In the last decade, the research area of match performance analysis expanded with several studies. The analysis of match performance is essential feedback for the coaches and applied practitioners to design appropriate training programs to improve performance or fix the deficits of the performance parameters for further competitions (Bush et al., 2015). There are several studies conducted to study the influence of contextual variables on physical performance parameters (Andrzejewski et al., 2016; Carling, 2010; Castellano et al., 2011; Di Salvo et al., 2009; Di Salvo et al., 2010; Hoppe et al., 2015; Teixeira et al., 2021) or/and technical performance parameters (Almeida et al., 2014; Carling, 2011; Gai et al., 2019; Konefał et al., 2020; Kubayi & Toriola, 2020; Lago-Ballesteros & Lago-Peñas, 2010; Lago-Peñas & Lago-Ballesteros, 2011; Liu et al., 2015; Liu et al., 2019; Mao et al., 2016; Poulter, 2009; Rampinini et al., 2009; Zhou et al., 2018). This chapter covers the match performance analysis-related studies, particularly the physical and technical performance parameters variations according to various contextual variables.

2.1. Key Performance Indicators in Soccer

Match analysis methods are used to determine statistical variables that are the output of elite soccer competitions (Alves et al., 2019). The obtained data from match analysis contribute to determining key performance indicators, which is valuable for the coaches, athletes, scientists, and all applied practitioners to design optimal training schedule as these indicators demonstrated correlation with performance (Alves et al., 2019; Andrzejewski et al., 2016; Carling, 2011; Julen Castellano et al., 2012; García-

Rubio et al., 2015; Hoppe et al., 2015; Lago-Peñas & Lago-Ballesteros, 2011; Liu et al., 2019; Rampinini et al., 2009; Taylor et al., 2008; Zhou et al., 2018). The summary of several studies indicated that the key performance variables consist of physical performance parameters and technical performance parameters.

2.1.1. Physical Performance Parameters in Soccer

Previous studies have documented the role of physical performance parameters on the success of elite soccer. This section will scope the selected physical performance variables so far in the literature to determine the key to success in elite soccer.

For instance, Zhou et al. (2018) recruited the physical performance variables such as total distance, total distance in ball possession, total distance ball out of ball possession, sprinting distance, sprinting effort, sprinting distance in ball possession, sprinting distance out of ball possession, high-speed-running distance, high-speed-running effort, high-speed-running distance in ball possession, high-speed-running distance out of ball possession. It is reported that all variables related to sprinting were significant to discriminate match outcome. Furthermore, high-speed-running distance in ball possession and high-speed-running distance out of ball possession were also significantly different between winning, losing, and drawing.

In an earlier study conducted by Yang et al. (2019), the following physical performance variables were assessed to determine team quality: total distance covered, total distance covered at high-intensity (i.e., high-speed running and sprinting), total distance covered while sprinting, total distance covered at high speed. The statistical analyses of the sprinting distance covered and total distance without possession were significant.

In another sample, Bush et al. (2015) investigated the factors influencing physical performance variability in English Premier League. The selected physical performance parameters were as follows: standing (0–0.6 km/h), walking (0.7–7.1 km/h), jogging

(7.2–14.3 km/h), running (14.4–19.7 km/h), high- speed running (19.8–25.1 km/h), and sprinting (>25.1 km/h), total distance (as a sum of distances covered at all speeds), high-intensity running (distance in high speed and sprinting (>19.8 km/h) in the variation of with or without possession, and when the ball was out of play. The results indicated that high-intensity distances and sprinting performance were key indicators of success in elite soccer.

The effects of different playing styles on physical performance parameters in the 2018 FIFA World Cup were examined (Yi et al., 2019). The selected variables were again consisted of running performance variations. A total of eight physical variables were total distance covered, top speed, sprint distance, distance covered at five different speed zones (i.e., 0-7 km/h, 7-15 km/h, 15-20 km/h, 20-25 km/h, over 25 km/h). The analyses displayed that playing styles influenced physical variables such as total distance and total distance at various speed zones.

There are many other studies related to match performance analysis that adopted similar physical performance parameters (Alves et al., 2019; Andrzejewski et al., 2016; Aquino et al., 2017; Aughey et al., 2013; Chmura et al., 2018; Dellal et al., 2011; V. Di Salvo et al., 2007, 2009; Valter Di Salvo et al., 2010; Garvican et al., 2014; Hoppe et al., 2015; Konefał et al., 2020; Lago et al., 2010; Link & Weber, 2017; Yang et al., 2018). In brief, previous studies related the physical performance parameters with match running performance and classified regarding their intensities. The different intensity levels, from standing to sprinting, established many common physical performance indicators in the literature. Therefore, the physical performance parameters used in this study were selected in accordance with the earlier studies.

2.1.2. Technical Performance Parameters in Soccer

Earlier studies on match analysis in soccer have not only focused on physical performance parameters but also technical performance parameters to measure

success. This section intended to identify the selected technical performance parameters in previous studies.

Konefał et al. (2020), for example, selected number of shots, numbers of ball touches, numbers of passes, pass accuracy, total passes, number of crosses, number of one-on-one plays, number and percentage of one-on-one plays won as technical performance indicators to examine whether the variation of physical and technical performance variables and match location were associated with higher or lower odds of winning or losing close matches of the German Bundesliga during three consecutive seasons (from 2014-2015 to 2016-2017). The findings indicated that all selected technical variables significantly affected match outcome according to various playing positions and match location. Therefore, it is suggested that the selected variables related to technical performance parameters can be defined as key performance indicators to success in elite soccer.

Another example of using technical performance parameters was carried out by Rampinini et al. (2009). They investigated the technical and physical variables between the first and second half and the variations in performance parameters according to team quality during the Italian Serie A League. The technical performance parameters were: involvements with the ball, short passes, successful short passes, long passes, successful long passes, crosses, headers, tackles, dribbling, shots, shots on target. The analyses' outcome demonstrated that involvements with the ball, short passes, successful short passes, tackles, dribbling, shots, and shots on target were significantly higher in the more successful teams than in less successful teams. Thus, it can be useful to measure team success by choosing the technical performance parameters used in this study.

A previous study examined by Lago-Peñas & Lago-Ballesteros, (2011) aimed to identify the technical performance variables that best discriminate home and visiting teams according to the team quality in Spanish La Liga. The selected technical variables were divided into three main categories: goals scored related variables (i.e., goals scored, total shots; shots on goal), associated offense variables (i.e., attacking

moves, box moves, crosses, offsides committed, losses of possession, fouls received, assists, passes made, successful passes made, dribbles, successful dribbles, ball possession), and defense-related variables (i.e., gains of possession, fouls committed, yellow cards, red cards, clearances). The discriminant analysis of the technical performance parameters between home and away teams displayed that several variables were significantly different, including goals scored, crosses, losses of possession, passes made, successful passes, gains of possession, fouls committed, yellow cards. The study's conclusion indicated that many of the selected technical variables show differences except the number of rule violations such as fouls and offsides between home and away teams.

A similar study by Harrop & Nevill (2014) aimed to identify the performance indicators of an English League One soccer team that may discriminate between winning, losing, or drawing. A further purpose was to identify those variables that best predict success for the team. The recruited variables divided into three main categories: variables relating to the offense (total shots, shots on target, shots inside the penalty area, passes, successful passes (%), passes in the opposition half, fouls received, dribbles, crosses, corners, and offsides committed) defense (fouls committed, crosses against, corners against, yellow cards and, red cards). The following variables showed significant differences between winning, losing, and drawing: passes, successful passes, passes in the opposition half. As a result of the second aim, the technical variables that predict success for the team were passes, successful passes, shots, and dribbles. It can be concluded that technical performance variables affect match outcome and success.

Technical performance variables are often used as key performance indicators in soccer match analysis concerning the previous studies. It can be concluded from the earlier studies that the key technical performance variables are usually composed of the variety of passes, shots, and rule violations. This study's selected technical performance parameters are consistent with the documented literature.

2.2. Contextual Variables

2.2.1. Match Outcome

Zhou et al. (2018) examined the technical and physical variables and contextual variables (match location and quality of opposition) which discriminate the match outcome (winning, losing, drawing) in the Chinese Soccer Association Super League. A number of 1430 matches from 2012 to 2017 seasons in the Chinese Soccer Association League were sampled. The obtained data from AMISCO (Amisco, Nice France) were collected using a semi-automated multi-camera system. As shown red cards cause an imbalance of the games, the matches with at least one red card and unbalanced matches with a goal difference of more than two goals were excluded. Thus, the number of samples was reduced to 1056 matches. 16 technical and 11 physical performance variables were recruited as dependent variables. The contextual variables were match location and quality of opposition. The match outcome was assigned as the independent variable. The results of the analyses displayed that the following variables were significantly higher in winning teams than drawing and losing teams: shots, shots on target, 50-50 challenge won, offsides, sprinting distance, sprinting effort, sprinting distance in ball possession, and high-speed running distance in ball possession. Variables were also significantly higher for losing teams than drawing and winning teams, including passes, forward pass, sprinting distance out of ball possession, and high-speed running distance out of ball possession. The discriminant analysis results showed that the quality of opposition impacted the match outcome. However, the match location had no significant effect on the match outcome. The study concluded that the following indicators best separate the winning, losing, and drawing teams: shots on target, sprinting distance in ball possession, passes and forward passes, and quality of opposition.

Liu et al. (2015) studied the match performance analysis of the 2014 Brazil FIFA World Cup. The purpose of the study was to determine the influence of selected performance variables on match outcome (win, loss, draw). A total of 48 matches from

the group stage were included to conduct the analysis. The matches from the knockout phase were excluded as there were eight games with 30-minute extra time. The data provided by OPTA Sportsdata. Twenty-four performance variables were selected and classified into three groups: variables related to goal scoring, variables related to passing and organizing, and variables associated with defending. The results of the study indicated that shot, shot on target, shot from the counterattack, and shot from the inside area variables were significantly greater for the winning team. In contrast, shot blocked has a negative relationship with winning. Moreover, the following variables related to passing and organizing impacted winning: ball possession, short pass, average pass streak, and aerial advantage. However, cross and dribble had a negative impact on winning. The number of tackles was greater in winning teams, while the number of red cards was vice versa. The study concluded that the variables related to match outcome could be used to evaluate the performance and proactive strategies in matches.

A study conducted with elite soccer players from German Bundesliga played in the season of 2014-2015 by Andrzejewski et al. (2016). The study aimed to examine the influence of playing positions and match outcome (winning, losing, drawing) on total distance covered and distance covered at low-intensity and high-intensity activities. The playing positions were divided into five: central defender, full-back, central midfielder, wide midfielder, and forward. Goalkeepers and those who have not played the entire 90 minutes were excluded. The data was collected from all the 306 matches using a computerized vision-based tracking system for team sports called VIS.TRACK. Low-intensity performance parameters were defined as movements performed at ≤ 4 $m \cdot s^{-1}$ (standing, walking, jogging). High-intensity performance was classified as movements performed at ≥ 4 $m \cdot s^{-1}$ (running, high-speed running, sprinting). The analyses indicated that only forward players covered significantly longer distances in winning matches than drawing and losing matches. The distance covered at low- intensity was significantly longer in central defenders, full-backs, wide midfielders, and central midfielders at drawing matches than in losing matches. Further, the distance covered at high-intensity running analysis demonstrated that central defenders and full-backs covered significantly shorter distances in winning

matches than losing matches. Additionally, full-backs covered shorter distances at high-intensity running in winning matches than drawing and losing matches. Lastly, the covered distance at high-intensity was more significant for forward players in winning matches than losing and drawing matches. The study concluded that elite soccer players adjust their physical performance according to the match outcome for each game. Therefore, during physical performance assessment, match outcome and playing positions should be considered.

2.2.2. Team Quality

The study carried out by Lago-Peñas and Lago-Ballesteros (2011) aimed to examine the influence of game location and team quality on technical and tactical performances in elite soccer. All 380 matches played in the 2008-2009 season of the Spanish La Liga were analyzed. The data was obtained from Gecasport. The selected variables to analyze were separated into four groups in respect to their final ranking at the end of the season: Group 1 (ranks 1-5), Group 2 (ranks 6-10), Group 3 (11-15), and Group 4 (ranks 16-20). The results of the analyses indicated several significant differences. For instance, home teams had higher mean values for shots on goal, total shots, goals scored, attacking moves, box moves, crosses, offsides committed, assists, passes made, successful passes, dribbles, successful dribbles, ball possession, and gains of possession whereas visiting teams had higher mean scores for losses of possession and yellow cards compared to home teams. Regarding match location and team quality, the mean values of goal scored, total shots, shots on goal, attacking moves, box moves, crosses, assists, passes made, successful passes, successful dribbles, ball possession, and gains of possession were significantly higher for teams played at home from Group 1. Additionally, home teams from Group 2 had higher mean values for goals scored, total shots, shots on goal, box moves, crosses, assists, and ball possession. However, visiting teams from Group 2 had significantly higher mean values for losses of possession. Home teams from Group 3 showed significantly higher mean values on goals scored, total shots, shots on goal, attacking moves, crosses, assists, passes made, successful passes, ball possession, and gains of possession. Away teams from Group

3 had higher mean values in losses of possession. Lastly, home teams from Group 4 demonstrated significantly higher mean values on total shots, shots on goal, crosses, successful passes, and ball possession. To conclude the study, technical and tactical performances are influenced by game location and team quality. The home advantage is not experienced similarly by the superior and inferior teams.

The study aimed to examine the influence of team quality on physical and technical performance variables in the Italian Serie A League was conducted by Rampinini et al. (2009). The data were collected from the season of 2004-2005 of Serie A matches via a semi-automated computerized tracking system (SICS®). The players were divided into two subgroups according to their team's final rankings at the end of the season. The players from top-five ranked teams were assigned to a "more successful" group, while the players from the lowest-five ranked teams were assigned to a "less successful" group. The findings of the study demonstrated that the mean values of total distance covered, high-intensity running distance, and very high-intensity running distance were significantly higher in players from less successful teams. On the other hand, the total covered distance with the ball and the high-intensity running distance with the ball were higher in the more successful group than the less successful group. Involvements with the ball, short passes, successful short passes, tackles, dribbling, shots, and shots on target were the technical performance variables that had significantly higher scores in the more successful group compared to the less successful group. The study concluded that several match performance variables such as involvements with the ball, short passes, successful short passes, tackles, dribbling, shots, and shots on target might show the difference between players according to team quality playing in the same league.

Di salvo et al. (2009) investigated the high-intensity running activity of 563 soccer players from the English Premier League during three consecutive seasons of 2003-2004 (S1), 2004-2005 (S2), and 2005-2006 (S3). They included players that completed full matches (i.e., 90 min.) while excluding goalkeepers. A semi-automated multi-camera system (Prozone, Leeds, England) was used to collect data. Players were classified in respect of their playing positions as central defender, wide defender,

central midfielder, wide midfielder, and attacker to study the influence of playing positions on high-intensity activity. Furthermore, to examine the impact of team success, players were divided into three groups regarding their teams' final ranking of each season: top five (T), middle ten (M), and bottom five (B). A further purpose was to determine any seasonal variation in match performance parameters over three seasons S1, S2, S3. The selected high-intensity activities were: total high-intensity running distance (THIR), total sprint distance (TSD), and the number and type of sprints undertaken. Total high-intensity running distance in possession and out of possession was also examined. The results demonstrated that the M and B teams' players performed significantly higher total high-intensity running distance than T teams' players. Total high-intensity running distance was influenced by playing position with wide midfielders and central defenders completing the highest and lowest distance, respectively. The study concluded that high-intensity activity in elite soccer was influenced by playing positions and team success.

2.2.3. Quality of Opposition

Castellano et al. (2011) studied the contextual variables and time-motion analysis in soccer. The study aimed to investigate interactive effects of match location (home vs. away), match result (win, draw, and lose), opponent level (top, medium, bottom), and match half (first vs. second) on physical performance variables by observing a professional soccer team in official matches, analyzed in terms of effective playing time. The data to analyze in this study were collected through 434 entire match halves from Spanish La Liga during the 2005-2006 season via a semi-automated multi-camera tracking system (AMISCO Pro®, version 1.0.2., Nice, France). The results of analyses displayed that the difference of total time regarding the contextual variables halves, match location, match result was significant. Also, the difference in efficient time (subtracting the amount of time the ball is out of play) was significant regarding the contextual variable, opponent level. In terms of opponent level, standing intensity, low-intensity running, moderate-intensity running, high-intensity running, and very high-intensity running were the variables that showed significantly higher mean scores

playing against opponents from the top-level, medium-level, bottom-level, respectively. The value of sprinting scores was significantly higher when playing against medium level than top level and bottom level. All of the selected performance parameters were greater during the first halves. Regarding match location, sprinting, moderate-intensity running, low-intensity running, and standing intensity had significantly higher values for home teams. In contrast, very high-intensity running and high-intensity running scores were significantly higher for away teams. For the match outcome, losing teams had the highest score of sprinting, very high-intensity running, high-intensity running, and moderate-intensity running. While winning teams had the highest score of low-intensity running, the drawing teams performed the highest standing intensity. To conclude the study, selected physical performance variables were influenced by contextual variables, including match location, quality of opposition, halves, and match result.

Bush et al. (2015) investigated the factors influencing physical and technical variability in the English Premier League (EPL). The purpose of the study was to examine the influence of contextual variables on the variation of physical and technical performance of EPL soccer players and match-to-match variation of performance parameters. The data was collected from 2005-2006 to 2012-2013 EPL seasons using a semi-automated multi-camera tracking system (Prozone 3, Prozone Sports Ltd, Leeds, UK). Players were classified into five groups according to their playing positions: central defender, fullback, central midfielder, wide midfielder, and attacker. The results of the study illustrated that the variation of high-intensity running distance with ball possession for central defenders was lower when playing against a stronger opponent compared to when playing a similar or weaker opponent, whereas high-intensity running showed minor variation against a weaker opponent. However, wide midfielders demonstrated lower variation when playing against a weaker opponent for all physical performance indicators. Central defenders, attackers, and wide midfielders showed greater variation in the number of passes received against weaker opposition. Additionally, the number of passes made was greater for fullbacks, attackers, and wide midfielders against weaker opponents. In terms of match outcome, the variation of the number of high-intensity and recovery times was greater for wide midfielders in the

winning matches compared to losing or drawing matches. Fullbacks demonstrated higher variation for the number of tackles in winning matches than in losing or drawing matches. Regarding the playing positions, the largest variation of total distance covered was observed in wide midfielders, while central midfielders showed the minor variation from match to match. The most variation from match to match for high-intensity running distance was found in central defenders compared to other positions. The variation of sprint distance was greater in central defenders than attackers, fullbacks, and wide midfielders. The high-intensity running distance without ball possession showed the greatest variation for attackers compared with central midfielders, central defenders, and fullbacks. Central defenders had the greatest variation for passes, passes received, and number of tackling per match among all positions. In opposition, attackers performed the greatest variation for tackles, possessions won, and interceptions per match compared to other positions. Fullbacks displayed the highest variation for the numbers of tackled per match compared to central midfielders, attackers, and wide midfielders. The variation for the number of interceptions and possession won was greater in wide midfielders than central defenders, central midfielders, and fullbacks. The difference observed for physical and technical performance indicators was insignificant according to match location. According to the study's conclusion, the contextual variables such as match location, match outcome, and quality of opposition had limited influence on match to match physical and technical performance variables. The effects of contextual variables previously documented in the literature may be occurred due to different match strategies instead of inherent variability between matches.

A study to analyze effects of match location (home and away), quality of opposition (high-ranking, i.e., ranks 1-5, medium-ranking, i.e., ranks 6-12, and low-ranking, i.e., ranks 13-18), and match outcome (win, lose, and draw) on match running performance in a Portuguese professional football team was conducted by Teixera et al., (2021). A total of 23 professional football players were involved in the study that played 18 matches (eight home and ten away) in the 2019-2020 season of the Portuguese Second League. The players were categorized into five groups (excluding goalkeepers) according to their playing position: central defenders, fullbacks, central midfielders,

wide midfielders, and forwards. The data were collected through a portable GPS during the entire match (STATSports Apex®, Newry, Northern Ireland). The results revealed that covered total distance was mainly influenced by the quality of opposition for wide midfielders compared to forwards. Match outcome had a very large effect on high-speed running distance for central defenders compared with fullbacks and wide midfielders. The number of decelerations was also influenced by the quality of opposition for central defenders compared to wide midfielders. The physical performance parameters (total distance covered, average speed, high-speed running, number of sprints, number of accelerations, number of decelerations) were influenced by playing positions without exception. Central midfielders and wide midfielders covered significantly higher total distances than other positions. The average speed for central midfielders was significantly higher than other positions, except wide midfielders. Wide midfielders performed the highest score of average speed among all positions. The values of sprinting performance were higher in fullbacks and forwards than wide midfielders. The accelerations were higher in wide midfielders than central midfielders and central defenders. In conclusion, match outcome and quality of opposition produced very large effects on total distance covered, number of high-intensity running, and deceleration with positional differences. Lastly, regarding match outcome, the high-intensity activity of forward players from winning teams and defenders from losing teams was greatly influenced.

2.2.4. Match Location

The advantage of playing at home in many sports competitions is well-documented previously (wining over %50 of the games under the circumstances of balanced home and away schedule) (Courneya & Carron, 1992). Liu and his colleagues (2019) studied the influence of match location (home and away) and quality of opposition on game-related variables in the Chinese Super League. The sample consisted of all matches (*n* = 720) played during three seasons from 2014 to 2016. Each team played 15 home and 15 away games in each season. Due to relegations, 12 teams played during three seasons, four teams played in two seasons, and four teams played one season. The data

was obtained from an online open-source whose data was derived from OPTA Sportdata. A number of 19 performance parameters were selected and grouped as goal scored, offensive, defensive, and physical variables. The results indicated that home advantage was quantified as nearly %60. The following parameters were not significantly different between home and away teams: aerial advantage, tackles, percentage of tackle success, and running distance. However, the values of the score, shot, shot on target, penalty, shot from the outside box, pass, possession, pass accuracy, offsides, and corner kick were significantly higher in teams played at home. Further, away teams have significantly higher free-kick, fouls committed, and yellow and red cards. The study also investigated the performance differences between top and lower-ranked teams in terms of match location. The results showed that both superior and inferior teams have significantly higher mean values in goals, shot, shot on target, shot off target, penalty, shot from the outside box, pass, possession, corner kick playing at home compared to away. Besides, superior and inferior teams showed significantly lower numbers in free kicks, foul committed, and yellow cards playing at home than away. However, pass accuracy was significantly higher only in superior teams, while the value of fewer red cards, offsides, and tackles was significantly higher in inferior teams. In regard to the quality of opposition and match location, the results of superiors vs. superior situation demonstrated that the following variables were significantly higher values for home teams: shot, shot off target, shot from the outside box, pass, possession, and corner kick, while away teams showed higher values of free-kick and yellow card. In superior vs. inferior condition, the goals scored, shot, shot on target, shot off target, penalty, shot from the outside box, pass, possession, pass accuracy, corner kick variables were significant for home teams. In inferior vs. superior situations, possession and corner kick values were significant for home teams, whereas free kick, goal against, and yellow card played at away teams. Lastly, under inferior vs. inferior conditions, shot, shot on target, penalty, and corner kick variables were significant for teams at home. In contrast, the number of free-kicks was higher in away teams. In conclusion, home advantage varied between superior and inferior teams. When superior teams play at home, they perform better in attacking variables such as goal scored and offensive.

The study conducted by Liu et al. (2016) across Spanish La Liga (2012-2013 season) examined the relationship between 16 match events and match location (home, away) with the match outcome. All matches (380) played in the 2012-2013 season were used to collect data via OPTA Sportsdata. 60 games excluded as they are described as unbalanced games (with a goal difference of more than two goals). 320 close matches were then analyzed to determine 16 match events variation according to match location and outcome. The quality of the opponent was also involved in further analysis. The strength was identified according to the final rankings of the season as high-level teams (ranks 1-6), medium-level teams (ranks 7-13), and low-level teams (ranks14-20). The results of 16 match statistics analysis displayed that 11 match events between-team influenced the probability of winning. Ball possession, pass, pass accuracy, and aerial advantage influenced positively; however, cross, lost ball, ball recovery, tackle, foul, yellow card, red card influenced negatively. The within-team effects were significant on the winning probability of all analyzed match variables. While shot, shot on target, offside, lost ball, ball recovery, tackle, foul, and game location had influenced positively ball possession, pass, pass accuracy, cross, and the red card had negative effects, and four remaining variables effects were not significant. Effects varied in the further analysis regarding the team quality and quality of opposition analysis. For high-level teams, shot on target was the only variable that showed positive within-team effects against all types of opponents (high-, medium-, low-level). Moreover, the impact of aerial advantage was negative when playing against a high-level opponent; shot, lost ball, ball recovery, tackle, foul, and game location influence positively when playing against medium-level teams, while ball possession and pass accuracy had negative effects; in matches against low-level opponents, pass, and shot were the variables that influence positively whereas, ball possession effects were negative. For medium levels, against all levels of opponents, shot on target and ball possession had positive within-team effects on winning; against high-level teams, shot, lost ball, foul, and game location influenced positively on the probability of winning; however, pass accuracy had a negative effect; against medium-level opponents, the tackle was the only variable had a within-team effect on winning; against low-level opponents, eight variable including shot, shot blocked, lost ball, ball recovery, tackle, foul and yellow card displayed positive effects whereas there was no variable showed a negative

impact. For low-level teams, when they play against medium-level teams, six of the variables (shot, shot on target, offside, foul, yellow card, and game location) demonstrated a positive effect on winning, and two variables (ball possession and red card) had a negative impact on winning. In the scenario of low-level team plays against the low-level team, shot on target, tackle, and game location had positive effects on winning while shot blocked and cross had negative effects on winning. In conclusion, match-related events vary according to team quality and quality of opposition, and game location. The applied practitioners are suggested to consider the variables that affect winning depending on situational variables while evaluating match performance or designing strategies of future events.

The study conducted by Aquino et al. (2017) aimed to examine the influence of independent and interactive effects of match location (home or away), quality of opponents (strong or weak), and match outcome (win, loss, draw) on physical performance in a professional Brazilian soccer team. The data were collected from the champion team of the Brazilian Championship fourth division of 2015 using the Global Positioning System (GPS). A total of eight matches were played at home, and eight matches were played away. Further, ten of sixteen matches were played against strong and six against weak teams. The quality of the opponent is determined according to the final standings of the teams. Total distance covered, maximum speed, average speed, and high-intensity activities were dependent variables of the study. Independent variables were divided into three situations: a) match location, b) quality of opposition, c) match outcome. The analysis results demonstrated that the mean scores of maximum speed, average speed, and high-intensity activities were significantly higher when the team played at home than away. In addition, total distance covered, maximum speed, and high-intensity activities showed significantly higher values when the team played against strong teams rather than weak teams. The analysis results were significant for the match outcome in all dependent variables. High-intensity activities were significantly higher in the winning teams compared with drawing teams. Maximum speed, average speed, and high-intensity activities were significantly higher in drawing teams compared to losing. The results of interaction effects analysis between match location and match outcome showed significant results

for the variables of maximum speed, and high-intensity activities. The other interaction analysis was not significant. It can be concluded from this study that match location, quality of opponent, and match outcome are essential for the assessment of movement patterns of Brazilian League soccer players.

2.2.5. Environmental Factors

Soccer is an altering sport played in various environmental situations; determining the effects of these factors is vital to optimize and improve player performance (Trewin et al., 2017). The association of environmental heat stress with performance in FIFA 2014 World Cup Brazil was investigated (Nassis et al., 2015). The purpose of the study was to examine the effects of environmental heat stress on performance and behavioral indicators during the 2014 FIFA World Cup Brazil. The performance data was collected from 64 matches during the tournament using the same tracking system as FIFA's official website. The goalkeepers were not included in the study. Temperatures were recorded at the middle of the pitch one hour before kick-off with a hand-held thermometer (WBGT-203A Heat Stroke Checker, Kyoto Electronics Manufacturing Co, Japan). The environmental conditions were characterized as low (%50 relative humidity, < 24 °C or %75 relative humidity, < 20 °C), moderate (%50 relative humidity, 24-28 °C or %75 relative humidity, 20-25 °C), and high (%50 relative humidity, 28-33°C or %75 relative humidity, 25-29 °C) environmental heat stress regarding temperature and humidity. The results of the study showed that the number of sprints was significantly lower under the high-stress category compared to under moderate or low-stress categories. The distance covered at high-intensity was significantly lower when the match was played under the high-stress category than the low-stress category. The number of passes showed no difference between different environmental stress categories (low, moderate, and high). Yet, the rate of successful passes showed significantly greater values under the high environmental stress category compared to the low environmental stress category. While the number of cards (total number of red cards and yellow cards) demonstrated trivial changes between all environmental stress categories, there was a higher prevalence of red cards

under high environmental stress than low environmental stress. In conclusion, the study displayed that the players reduced high-intensity activities and sprints under the high environmental heat stress. However, they maintained peak running speed and increased the successful pass ratio. The findings indicate that elite soccer players can regulate their activities to adapt to environmental factors such as heat and humidity to maintain match performance.

Another study conducted by Link & Weber (2017) aimed to investigate the relationship between air temperature and match running performance of professional soccer players from German Bundesliga 1 and German Bundesliga 2. The running performance was operationalized with the total distance covered in each game. The data was collected from most games during the 2011-2012 and 2012-2013 seasons of German Bundesliga 1 and German Bundesliga 2. The German soccer league records the ambient temperature before each match (10 min. before kickoff) through the data obtained from the German Weather Service. Temperature assigned to four groups: cold (≤ -5 °C), neutral (-4 to 13 °C), warm (14-27 °C), and hot (≥ 28 °C). The match running performance was measured via a semi-automated multi-camera tracking system (VisTrack; Impire Corp., Munich, Germany). The analyses displayed that running performance (total distance covered) was significantly lower in warm conditions than in cold or neutral conditions. The decreases in total distance covered in both leagues (Bundesliga 1 and Bundesliga 2) were evident. However, a greater decrease was observed in Bundesliga 1 than 2. In terms of league level, players in the first Bundesliga performed significantly higher running performance compared to the players in the second Bundesliga. It can be concluded from the study that running performance in the neutral environment is highly temperature independent. However, running activity is significantly influenced by hot ambient temperatures.

A study was carried out to analyze the effects of altitude on running performance reduction and magnitude of transient fatigue of elite youth soccer players and determine time course for preventing these expected decreases (Garvican et al., 2014). Twenty elite youth soccer players who played in the U-20 Australian team competed in the 2011 Youth World Cup (Colombia, South America) were recruited to conduct this study. Each player's activity was measured personally during either training or

"official friendly" matches by using commercially available GPS. The first of three friendly matches were played at sea level in Sydney, Australia. The remaining two matches were played on the fourth day (d4) and sixth day (d6) of arriving at the altitude (Denver, CO, USA, altitude ~1600 m). The first match consisted of standard two 45-minute halves with an official substitution system at sea level. The second and the third matches, at altitude, were played in three 25-minute periods and three 30-minute periods, respectively, with an interchangeable substitution system. Goalkeepers, players who did not play at sea level, and players were not present in consecutive games were excluded from collected data. Therefore, the sample of the data was limited to 12 players. The results of the analyses demonstrated that the total distance covered on d4 was lower than at sea level. Further, the value of total distance covered increased on d6 compared to d4. Low-velocity running showed a decrement on d4 compared with at sea level. Moreover, there was an increase observed on d6 compared to d4. High-velocity running also decreased from sea level to d4, and it is likely increased on d6 compared to d4. The frequency of acceleration on d4 was not influenced compared to sea level. However, at d6, it was higher than the sea level. The peak 5-minute period for distance was lower at d4 and d6 than at sea level. In similar, the peak 5-minute period for high velocity running decreased at both d4 and d6. Further, the peak 5-minute period for acceleration was also reduced at d4 and d6. To conclude the study, it is suggested that the match running performance of elite youth soccer players needs at least six days to adapt to the new altitude when they travel to a low altitude. While match running performance was decreased, the exacerbated fatigue was increased. Thus, it is recommended that elite soccer players need more than six days to acclimatize to matches at low altitudes.

Another study (Aughey et al., 2013) was conducted to examine the effects of high altitude in soccer match activity profile in elite youth soccer players by comparing high altitude and sea-level residents. A total of 20 elite youth soccer players from Australia (residents near sea level) and 19 elite youth soccer players from Bolivia (high altitude residents) participated in the study. The physical performance activities of participants were measured via commercially available GPS during matches during "official friendly" matches at both sea level and high altitude. Each participant played

five matches; two were held in Santa Cruz, Bolivia (430 m) over five days, and three matches were played in La Paz, Bolivia (3600 m) on days 1,6, and 13 arrived at high altitude. The players traveled directly by plane, so there was no longer time for adaptation to the new environmental conditions. The results of the study displayed that both teams showed a slight decrease in the variable of total distance per minute. However, the effects of altitude on total distance showed no difference between the two teams. While the low velocity running performance was higher in Australians than Bolivians in the second match (at near sea level), regarding with effects of altitude, there was no difference between the two teams for the low velocity running performance. Australians showed a moderately higher mean value for the high velocity running performance than Bolivians in the second match (at near sea level), whereas Bolivians produced a small magnitude higher mean value in games 3 and 5. Australians showed moderately lower high velocity running performance in game 3 and small magnitude lower in game 4 than pooled data from near sea level. However, Australians' decrements in high velocity running performance were smaller than Bolivians in games 3 and 4 at altitude. For maximal accelerations per minute in the first game at near sea level, Australians showed slightly higher scores than Bolivians.

CHAPTER 3

METHODS

3.1. Data Resource

Turkish Super League (Süper Lig) is the highest level of professional soccer in Turkey. The 2019-2020 season of the Turkish Super League, between August 2019 and July 2020, consisted of 18 teams, and each team played twice against their 17 opponents during the 34 match-day (a total of 306 matches completed) in home and away. However, only the data of 122 match performance were available that was provided by Sentio Sports Analytics Company®, which is specifically designed to accurately track players in real-time by utilizing state-of-the-art computer vision and machine learning algorithms. Shortly, it is a semi-automatic multi-camera tracking system which is widely used by several studies about soccer match analysis (Barris & Button, 2008; Bush et al., 2017; Carling, 2010; Castellano et al., 2014; Lago et al., 2010; Trewin et al., 2017). According to Sentio Sports Analytics Company procedures, two 4K cameras are installed closer to the midline of the pitch, as high as possible, and calibrated the field prior to the kick-off (Figure 1). The written consent was received from the Company to use their data to conduct the study.



Figure 1 *Sentio Sports Analytics multi-camera tracking system*

3.2. Sample and Procedures

Prior to the study, ethics committee (Human Subjects Ethics Committee) approval was received from the Middle East Technical University (approval number: 425-ODTU-2021). Performance parameters were classified into two main categories: physical performance and technical performance. The variations of performance parameters were studied according to three different contextual variables: match outcome, team quality, and quality of opposition. Out of 122 matches whose data were collected, 85 matches resulted as winners and losers, while 37 were concluded in a draw. Thus, in the context of performance parameters analysis according to the match outcome, teams with 85 winners, 85 losers and 74 draws formed the sample. As for the second contextual variable, team quality, the samples were set as the top (first six-ranked, n=80), middle (second six-ranked, n=89), and bottom (third six-ranked, n=75) according to their final ranking at the end of the season. The last contextual variable, quality of opposition, was classified as superior (first nine-ranked teams) and inferior (last-nine ranked) teams. Later, physical and technical performance parameters of superior teams were studied according to quality of opposition, either inferior or

superior and, then the same procedures were conducted for the performance parameters of inferior teams vice versa.

3.3. Variables

A total of 20 physical and 17 technical performance parameters were selected as dependent variables in accordance with previous studies (Alves et al., 2019; Gai et al., 2019; Harrop & Nevill, 2014; Konefał et al., 2020; Kubayi & Toriola, 2020; Lago-Peñas et al., 2010; Liu, Gómez, et al., 2016; Rampinini et al., 2007; Yang et al., 2018; Yi et al., 2019; Zhou et al., 2018). The independent variables were divided into three groups regarding the research problem: 1) match outcome (winning, losing, drawing), 2) team quality (top, middle, bottom), 3) quality of opposition (superior and inferior). All selected variables are shown in Table 1. Operational definitions of the variables are defined in the following sections (Stats Perform, 2021; Zhou et al., 2018).

Table 1 Summary of variables

Physical Summary	Tactical Summary	Contextual Summary
TD= Total distance	SUCP= Successful Passes	Match Outcome
HID= High-Intensity Distance	UNSUCP= Unsuccessful Passes	Team Quality
SD= Sprint Distance	PR= Pass Ratio	Quality of Opposition
HSD= High Speed Distance	LP= Long Passes (>30m)	
NHIR= Number of High Intensity Runs	SHP= Short Passes (<30m)	
NS= Number of Sprints	AVPL= Average Pass Length	
NHSR= Number of High-Speed Runs	SOT=Shots on Target	
AS= Average Speed	SOFT=Shots off Target	
TDP= Total Distance in Possession	SUCC=Successful Crosses	
TDOP= Total Distance Out of Possession	UNSUCC= Unsuccessful Crosses	
TDBOP= Total Distance Ball Out of Play	COR= Corners	
HIDP= High-Intensity Distance in Possession	FC= Fouls Committed	
HIDOP= High-Intensity Distance Out of Possession	YC= Yellow Cards	
HIDBOP= High Intensity Distance Ball Out of Play	RC= Red Cards	

Table 1 (continued)

SP= Sprint in Possession	OFF= Offsides
SOP= Sprint Out of Possession	POS= Possession
SBOP= Sprint Ball Out of Play	BPT= Ball Play Time
HSDP= High Speed Distance in Possession	
HSDOP= High Speed Distance Out of Possession	
HSDBOP= High Speed Distance Ball Out of Play	

3.3.1. Physical Performance Parameters

TD was the sum of covered distance in meter at all speeds by the players of a team. HID was defined as the sum of covered distance in meter at the speed between 20 km/h and 24 km/h by all the players of a team. SD was the sum of covered distance in meter at the speed over 24 km/h by all the players of a team. HSD was defined as the sum of covered SD and HID in meters (at the speed over 20km/h) by all the players of a team. NHIR were quantity of running in a match at the speed between 20km/h and 24km/h by all the players of a team. NS were quantity of sprinting by all the players of a team. NHSR were quantity of high-speed running by all the players of a team. AS was defined as the total distance covered by running, walking, and jogging in total time performed by all the players of a team. TDP was the sum of covered distance in meters when in ball possession by all the players of a team. TDOP was the sum of covered distance in km when out of ball possession by all the players of a team. TDBOP was the sum of covered distance in meters when ball out of play by all the players of a team. HIDP was the sum of covered distance in meters when in ball possession at the speed between 20km/h and 24km/h by all the players of a team. HIDOP was the sum of covered distance in meters when out of ball possession at the speed between 20km/h and 24km/h by all the players of a team. HIDBOP was the sum of covered distance in km when ball out of play at the speed between 20km/h and 24km/h by all the players of a team. SP was defined as the sum of covered distance in meters at the speed over 24km/h when in ball possession by all the players of a team. SOP was the sum of covered distance in meters at the speed over 24km/h when out of ball possession by all the players of a team. SBOP was the sum of covered distance in meters at the speed

over 24km/h when ball out of play by all the players of a team. HSDP was the sum of covered distance in meters at the speed over 20km/h when in ball possession by all the players of a team. HSDOP was the sum of covered distance in meters at the speed over 20km/h when out of ball possession by all the players of a team. Lastly, HSDBOP was defined as the sum of covered distance in meters at the speed over 20km/h when ball out of play by all the players of a team.

3.3.2. Technical Performance Parameters

SUCP referred the quantity of played ball between teammates without any interruption. UNSUCP was a definition of the number of failed attempting to play ball between teammates. PR stands for the proportion of successful passes to number of total passes. While the LP defined as numbers of played ball more than 30 meters length between teammates without any interruption and SHP have similar definition for under 30 meters length passes. AVPL was the mean length of successful passes. SOT were referred to an attempt to score a goal either goes into the net or saved by the opponent player who is the last-man which would have gone into the net. SOFT were an attempt to score a goal either goes wide or over the goal or directly hits the goal frame. SUCC were any ball sent from wide position that reaches the teammate in the opposition's area. UNSUCC were in opposition to SUCC that any ball sent from wide position targeting the teammate however, which is failed. COR were that when the ball left field over goal line. FC were that penalized as foul by referee in result of infringe action. YC were shown by the referee to the players due to their dangerous foul commitment, time wasting, played by hand etc. RC are shown by the referee to remove a player from the game either directly or in consequence of second yellow card. OFF is being caught in an offside position which results a free kick to the opposing team. POS was the ball control duration of a team as a proportion of total duration when the ball is in play. BPT referred to the total duration of a team's possession.

3.3.3. Contextual Variables

There were three contextual variables used in this study. First, match outcome was defined as winning, losing, or drawing at the end of the completed game duration. Second, team quality indicates that a team's quality according to the final standing of the season as top-ranked (i.e., first six-ranked), middle-ranked (i.e., second six-ranked), bottom-ranked (i.e., third six-ranked). Third, quality of opposition indicates that an opponent team's quality as superior or inferior regarding their final ranking of the season. The nine top-ranked teams were defined as superior teams, while the remaining nine were defined as inferior teams.

3.4. Statistical Analysis

A descriptive analysis of the data was computed separately according to each contextual variable, including match outcome, team quality, and quality of opposition. All values were then reported as means and standard deviations. Normality is an inherent assumption in parametric tests such as the one-way analysis of variance (ANOVA) (Gravetter & Wallnau, 2017). However, violation of this assumption does not result in biased estimations in cases with large sample sizes (Ghasemi & Zahediasl, 2012). Prior to parametric analysis, as each sample size includes enough observations (n>30) in this study, the violation of normality assumption should not cause a major problem as previously reported by Ghasemi and Zahediasl (2012). One-way ANOVA was used to examine the variations in physical and technical performance parameters in soccer players according to match outcome and team quality. Bonferroni Post Hoc Test was applied to identify pairwise differences. To measure the effect size, eta-squared (η^2) was computed ($\eta^2 = 0.01$: small effect size, $\eta^2 = 0.06$: medium effect size, $\eta^2 = 0.14$ or higher: large effect size) (Cohen, 1988). Independent samples t-test was conducted to analyze the differences in performance parameters of superior and inferior oppositions separately. Cohen's d was used to measure the effect size and interpreted as follows: <0.20 (trivial), 0.20–0.59 (small), 0.60–1.19 (moderate), 1.20–1.99 (large), 2.0–3.9 (very large), and >4.0 (extremely large) (Hopkins et al., 2009).

The significance level was set at $p < 0.05$. Each statistical analysis procedure in this study was performed using the IBM SPSS Statistic for Windows, Version 25.0 (SPSS Inc., Chicago IL).

CHAPTER 4

RESULTS

4.1. Match Outcome

Descriptive statistics of physical performance parameters according to match outcome and the results of ANOVA are represented in Table 2 and Table 3, respectively. The findings showed that winning and losing teams performed significantly greater NHIR $F(2, 241) = 4.558$, $p = 0.011$ and NHSR $F(2, 241) = 4.281$, $p = 0.015$ than the drawing teams. Furthermore, the value of AS was significantly higher in winning teams respectively to drawing and losing teams $F(2, 241) = 5.004$, $p = 0.007$. HIDP were significantly greater in winning teams than drawing teams $F(2, 241) = 5.684$, $p = 0.004$, losing teams covered greater value of HIDBOP than the drawing teams $F(2, 241) = 5.260$, $p = 0.006$. The results of ANOVA regarding covered HSDP and HSDOP were similar with SP and SOP. The winning teams showed better SP $F(2, 241) = 17.805$, $p = <0.001$ and covered more HSDP than drawing and losing teams $F(2, 241) = 11.361$, $p = <0.001$. However, losing teams showed greater SOP $F(2, 241) = 9.366$, $p = <0.001$ and HSDOP than wining and drawing teams $F(2, 241) = 6.642$, $p = 0.002$.

Table 2 Physical performance parameters according to match outcome

Variable	Winning (W) (n= 85)		Losing (L) (n= 85)		Drawing (D) (n= 74)	
	M	SD	M	SD	M	SD
TD (m)	108985.61	6922.11	107291.98	6756.19	108283.41	4213.27
HID (m)	4532.86	594.19	4492.2	584.76	4309.73	565.47
SD (m)	2551.48	499.13	2475.95	455.12	2458.43	506.82

Table 2 (continued)

HSD	7084.34	1003.12	6968.15	941.6	6768.16	973.37
NHIR	255.44	44.87	253.47	43.24	235.35	49.03
NS	100.52	28.12	98.38	27.28	90.42	29.42
NHSR	355.95	68.68	351.85	65.65	325.77	74.97
AS (km/h)	6.43	0.30	6.31	0.28	6.30	0.27
TDP (m)	37417.8	7087.04	35869.93	6920.13	35932.77	7404.49
TDOP (m)	37887.61	7385.26	38748.22	7188.16	37372.24	7906.8
TDBOP (m)	33679.24	5934.79	32672.71	6334.46	34977.43	6156.51
HIDP (m)	1839.08	411.87	1691.68	426.55	1622.99	408.86
HIDOP (m)	2058.14	529.54	2213.12	519.46	1946.91	513.34
HIDBOP (m)	441.13	356.82	403.64	373.22	497.68	417.26
SP (m)	1273.49	360.49	1006.72	239.64	1065.7	302.09
SOP (m)	1046.44	292.03	1248.94	343.61	1102.16	303.34
SBOP (m)	230.58	283.14	219.45	300.67	289.59	300.61
HSDP (m)	3178.18	700.64	2758.6	585.66	2771.45	646.62
HSDOP (m)	3190.13	755.54	3542.72	761.95	3154.73	749.88
HSDBOP (m)	715.72	727.64	666.28	777.95	841.5	787.65

*$p < .05$

Table 3 ANOVA results of physical performance parameters according to match outcome

Variable	*F*	*p*	η2	Post hoc
TD (m)	1.619	0.200	0.013	
HID (m)	3.23	0.041*	0.026	
SD (m)	0.845	0.431	0.007	
HSD (m)	2.117	0.123	0.017	
NHIR	4.558	0.011*	0.036	D<W, D<L
NS	2.758	0.065	0.022	
NHSR	4.281	0.015*	0.034	D<W, D<L
AS (km/h)	5.004	0.007*	0.04	L<W, D<W
TDP (m)	1.259	0.286	0.01	
TDOP (m)	0.693	0.501	0.006	
TDBOP (m)	2.787	0.064	0.023	
HIDP (m)	5.684	0.004*	0.045	D<W,
HIDOP (m)	5.26	0.006*	0.042	D<L
HIDBOP (m)	1.208	0.300	0.01	
SP (m)	17.805	<0.001*	0.129	L<W, D<W

Table 3 (continued)

SOP (m)	9.366	<0.001*	0.072	W<L, D<L
SBOP (m)	1.269	0.283	0.01	
HSDP (m)	11.361	<0.001*	0.086	L<W, D<W
HSDOP (m)	6.642	0.002*	0.052	W<L, D<L
HSDBOP (m)	1.09	0.338	0.009	

*$p < .05$

Table 4 presents descriptive statistics of technical performance parameters according to match outcome. The results of ANOVA demonstrated that significantly greater UNSUCP were observed in drawing teams, losing teams, and winning teams, respectively $F(2, 241) = 7.256$, $p = 0.001$ (Table 5). The findings showed that PR was higher in winning and losing teams than drawing teams $F(2, 241) = 5.971$, $p = 0.003$. The winning teams had significantly higher SOT than both losing and drawing teams $F(2, 241) = 25.905$, $p = <0.001$. Additionally, the value of UNSUCC was greater in losing teams than winning teams $F(2, 241) = 5.607$, $p = 0.004$. Finally, RC was also higher in losing teams than winning teams $F(2, 241) = 4.431$, $p = 0.013$.

Table 4 Technical performance parameters according to match outcome

Variable	Winning (W) (n= 85)		Losing (L) (n= 85)		Drawing (D) (n= 74)	
	M	SD	M	SD	M	SD
SUCP	352.07	105.43	342.73	87.84	326.3	107.86
UNSUCP	80.67	13.03	83.39	13.33	89.69	18.97
PR (%)	0.8	0.06	0.8	0.05	0.77	0.08
LP	61.06	15.11	62.81	16.5	64.15	16.11
SHP	375.21	104.83	363.31	89.35	351.84	102.2
AVPL	19.52	1.99	19.7	1.87	20.12	2.26
SOT	11.07	4.2	6.98	3.44	8.16	3.73
SOFT	5.76	2.74	5.35	2.74	5.65	3.16
SUCC	4.51	2.34	4.51	2.92	4.24	2.57
UNSUCC	12.14	5.82	15.54	6.78	13.84	7.26
COR	4.8	2.21	4.81	2.51	4.51	2.66
FC	13.08	3.83	12.27	3.64	13.43	3.79

Table 4 (continued)

YC	2.2	1.37	2.72	1.56	2.72	1.49
RC	0.06	0.24	0.26	0.60	0.15	0.39
OFF	1.89	1.65	1.92	1.39	1.89	1.71
POS (%)	0.51	0.08	0.49	0.08	0.5	0.09
BPT (min.)	27.39	5.00	26.18	5.38	26.76	5.28

*$p < .05$

Table 5 ANOVA results of technical performance parameters according to match outcome

Variable	*F*	*p*	η2	Post hoc
SUCP	1.322	0.269	0.011	
UNSUCP	7.256	0.001*	0.057	W<L<D
PR (%)	5.971	0.003*	0.047	D<W, D<L
LP	0.757	0.470	0.006	
SHP	1.108	0.332	0.009	
AVPL (m)	1.783	0.170	0.015	
SOT	25.905	<0.001*	0.177	L<W, D<W
SOFT	0.461	0.631	0.004	
SUCC	0.258	0.772	0.002	
UNSUCC	5.607	0.004*	0.044	W<L
COR	0.365	0.695	0.003	
FC	2.04	0.132	0.017	
YC	3.418	0.034*	0.028	
RC	4.431	0.013*	0.035	W<L
OFF	0.007	0.993	0.000	
POS (%)	0.494	0.610	0.004	
BPT (min.)	1.147	0.319	0.009	

*$p < .05$

4.2. Team Quality

Descriptive statistics of physical performance parameters according to team quality are shown in Table 6. According to ANOVA results, a total of five physical performance parameters had significantly different mean values between top-ranked

teams, middle-ranked teams, and bottom-ranked teams (Table7). The results of the analysis indicated that middle-ranked teams had significantly higher mean scores in the following physical performance parameters than bottom-ranked teams; HID $F(2, 241) = 4.424$, $p = 0.013$, HSD $F(2, 241) = 4.223$, $p = 0.016$, HIDP $F(2, 241) = 7.026$, $p = 0.001$, SP $F(2, 241) = 6.161$, $p = 0.002$, and HSDP $F(2, 241) = 8.319$, $p = <0.001$. Besides, top-ranked teams performed significantly higher mean scores in three similar performance parameters, including HIDP, SP, and HSDP. The remaining physical performance parameters had no significantly different mean values among three groups (top-ranked, middle-ranked, and bottom-ranked teams).

Table 6 Physical performance parameters according to team quality

Variable	Top (T) (n= 80)		Middle (M) (n= 89)		Bottom (B) (n= 75)	
	M	SD	M	SD	M	SD
TD (m)	108135.41	5354.53	108282.74	6628.73	108114.27	6519.1
HID (m)	4487.48	613.86	4553.48	582.67	4290.56	536.46
SD (m)	2514.96	516.85	2564.35	479.77	2397.76	449.47
HSD (m)	7002.44	1059.08	7117.83	979.71	6688.32	832.09
NHIR	250.2	44.47	253.42	45.99	241.37	48.22
NS	97.96	30.45	97.39	27.5	94.56	27.56
NHSR	348.16	70.89	350.81	69.81	335.93	71.11
AS (km/h)	6.31	0.26	6.36	0.26	6.37	0.34
TDP (m)	37718.51	6866.12	36429.58	7745.85	35050.24	6464.09
TDOP (m)	36849.15	7263.02	38078.43	7338.87	39235.73	7741.93
TDBOP (m)	33566.81	5898.7	33773.67	5524.73	33827.24	7230.42
HIDP (m)	1803.86	398.79	1773.43	440.68	1574.29	396.68
HIDOP (m)	2054.2	526.11	2154.89	510.6	2013.43	552.89
HIDBOP (m)	429.56	354.53	434.07	335.58	475.15	457.95
SP (m)	1180.33	333.06	1150.28	304.82	1011.72	318.81
SOP (m)	1096.01	305.97	1190.06	361.57	1107.61	291.8
SBOP (m)	237.68	287.46	223.11	249.83	277.48	348.72
HSDP (m)	3056.41	681.46	2988.79	655.42	2655.97	620.11
HSDOP (m)	3237.26	766.02	3431.99	797.36	3217.52	741.46
HSDBOP (m)	708.35	708.51	696.6	665.28	814.35	919.81

*$p < .05$

Table 7 ANOVA results of physical performance parameters according to team quality

Variable	*F*	*p*	η2	Post hoc
TD (m)	0.018	0.982	0.000	
HID (m)	4.424	0.013*	0.035	B<M
SD (m)	2.5	0.084	0.02	
HSD (m)	4.223	0.016*	0.034	B<M
NHIR	1.449	0.237	0.012	
NS	0.316	0.729	0.003	
NHSR	0.998	0.370	0.008	
AS (km/h)	0.877	0.417	0.007	
TDP (m)	2.745	0.066	0.022	
TDOP (m)	1.994	0.138	0.016	
TDBOP (m)	0.039	0.962	0.000	
HIDP (m)	7.026	0.001*	0.055	B<T, B<M
HIDOP (m)	1.58	0.208	0.013	
HIDBOP (m)	0.333	0.717	0.003	
SP (m)	6.161	0.002*	0.049	B<T, B<M
SOP (m)	2.139	0.120	0.017	
SBOP (m)	0.722	0.487	0.006	
HSDP (m)	8.319	<0.001*	0.065	B<T, B<M
HSDOP (m)	2.001	0.137	0.016	
HSDBOP (m)	0.563	0.570	0.050	

*$p < .05$

Descriptive statistics of technical performance parameters according to team quality are displayed in Table 8. The results indicated that top-ranked teams had significantly higher mean values than bottom-ranked teams in several technical performance parameters including SHP $F(2, 241) = 3.426$, $p = 0.034$, SOT $F(2, 241) = 6.487$, $p = 0.002$, SUCC $F(2, 241) = 9.065$, $p = <0.001$, COR $F(2, 241) = 6.128$, $p = 0.003$, and BPT $F(2, 241) = 3.268$, $p = 0.040$ (Table9). Furthermore, middle-ranked teams had significantly greater SUCC than bottom-ranked teams. However, there was no significant differences were found in other technical performance parameters.

Table 8 Technical performance parameters according to team quality

Variable	Top (T) (n= 80)		Middle (M) (n= 89)		Bottom (B) (n= 75)	
	M	SD	M	SD	M	SD
SUCP	364.26	103.8	331.64	105.28	327.29	87.46
UNSUCP	85.74	17.56	82.11	15.76	85.53	12.66
PR (%)	0.8	0.07	0.79	0.07	0.78	0.06
LP	62.99	15.42	60.75	16.55	64.4	15.55
SHP	387.01	96.68	356.37	107.23	348.43	87.14
AVPL (m)	19.44	1.83	19.68	1.97	20.2	2.27
SOT	9.99	4.24	8.61	4.06	7.64	3.95
SOFT	6.1	2.77	5.56	3.1	5.07	2.62
SUCC	5.24	2.8	4.47	2.5	3.51	2.25
UNSUCC	14.41	6.07	14.19	7.47	12.81	6.49
COR	5.35	2.67	4.75	2.39	4.00	2.11
FC	12.88	4.23	12.92	3.6	12.92	3.49
YC	2.45	1.45	2.58	1.43	2.57	1.60
RC	0.1	0.34	0.16	0.42	0.21	0.55
OFF	1.91	1.59	1.9	1.56	1.89	1.60
POS (%)	0.51	0.08	0.50	0.09	0.48	0.07
BPT (min.)	27.78	5.16	26.82	5.38	25.65	4.94

*$p < .05$

Table 9 ANOVA results of technical performance parameters according to team quality

Variable	*F*	*p*	η2	Post hoc
SUCP	3.283	0.039	0.027	
UNSUCP	1.462	0.234	0.012	
PR (%)	0.929	0.396	0.008	
LP	1.107	0.332	0.009	
SHP	3.426	0.034*	0.028	B<T
AVPL (m)	2.875	0.058	0.023	
SOT	6.487	0.002*	0.051	B<T
SOFT	2.549	0.080	0.021	
SUCC	9.065	<.0001*	0.070	B<T, B<M
UNSUCC	1.281	0.280	0.011	

Table 9 (continued)

COR	6.128	.003*	0.048	B<T
FC	0.004	0.996	0.000	
YC	0.203	0.816	0.002	
RC	1.26	0.286	0.010	
OFF	0.003	0.997	0.000	
POS (&)	2.732	0.067	0.022	
BPT (min.)	3.268	0.040*	0.026	B<T

*$p < .05$

4.3. Quality of Opposition

Table 10 shows the descriptive statistics and independent samples t-test results of physical performance parameters of superior teams according to quality of opposition. While superior teams playing against inferior teams, they performed significantly better mean scores than playing against superior teams in several physical performance parameters including HSD $t(128) = 2.883$, $p = 0.005$, $d = 0.51$, NHIR $t(128) = 2.394$, $p = 0.018$, $d = 0.42$, NS $t(128) = 2.843$, $p = 0.005$, $d = 0.50$, TDP $t(128) = 2.630$, $p = 0.010$, $d = 0.46$, HIDP $t(128) = 2.539$, $p = 0.012$, $d = 0.45$, and HSDP $t(128) = 2.292$, $p = 0.024$, $d = 0.41$. However, when they play against similar-ranked teams (superior vs. superior), the results indicated that a number of three physical performance parameters had significantly higher mean values; HIDOP $t(128) = 2.497$, $p = 0.014$, $d = 0.44$, SOP $t(128) = 2.257$, $p = 0.026$, $d = 0.40$, and HSDOP $t(128) = 2.292$, $p = 0.024$, $d = 0.40$, respectively. Last, HSDBOP $t(128) = 2.501$, $p = 0.014$, $d = 0.44$ was significantly higher when playing against inferior teams.

Table 10 Physical performance parameters of superior teams according to quality of opposition

Variable	Superior vs. Superior (n= 64)		Superior vs. Inferior (n= 66)		*t(128)*	*p*	*d*
	M	SD	M	SD			
TD (m)	108837.64	4359.97	108157.17	6951.23	0.666	0.506	-0.12
HID (m)	4478.06	612.27	4548.39	579.89	-0.673	0.502	-0.12
SD (m)	2546.44	543.19	2565.95	471.27	-0.219	0.827	-0.04
HSD (m)	7024.5	1082.84	7114.35	979.14	-0.497	0.620	-0.09
NHIR	238.59	41.57	260.70	45.68	-2.883	0.005*	-0.51
NS	90.67	28.67	102.80	29.08	-2.394	0.018*	-0.42
NHSR	329.27	66.44	363.50	70.71	-2.843	0.005*	-0.50
AS (km/h)	6.34	0.24	6.37	0.29	-0.65	0.517	-0.11
TDP (m)	36760.5	8189.57	39311.7	6614.31	-1.957	0.053	0.34
TDOP (m)	38591.23	8430.24	35255	5834.54	2.63	0.010*	-0.46
TDBOP (m)	33485	4265.33	33589.42	6568.22	-0.107	0.915	-0.02
HIDP (m)	1772.84	397.57	1854.09	434.79	-1.111	0.269	0.19
HIDOP (m)	2205.41	450.95	1987.06	525.56	2.539	0.012*	-0.45
HIDBOP (m)	347.42	140.76	482.17	408.81	-2.497	0.014*	-0.44
SP (m)	1189.72	330.89	1196.89	315.55	-0.127	0.899	0.02
SOP (m)	1183.94	312.55	1096.15	318.9	1.585	0.116	-0.28
SBOP (m)	171.81	123.53	271.98	333.58	-2.257	0.026*	-0.40
HSDP (m)	3015.98	659.22	3132.35	692.35	-0.981	0.329	0.17
HSDOP (m)	3471.61	710.28	3173.32	771.33	2.292	0.024*	-0.40
HSDBOP (m)	536.36	263.24	808.30	830.37	-2.501	0.014*	-0.44

*$p < .05$

SUCP $t(128) = 2.834$, $p = 0.005$, $d = 0.50$, PR $t(128) = 3.875$, $p = <0.001$, $d = 0.69$, SHP (<30m) $t(128) = 2.611$, $p = 0.010$, $d = 0.46$, SOT $t(128) = 3.877$, $p = <0.001$, $d = 0.69$, SUCC $t(128) = 2.354$, $p = 0.020$, $d = 0.42$, and POS $t(128) = 2.212$, $p = 0.029$, $d = 0.39$ were significantly higher when superior teams played against inferior teams compared to played against inferior teams (Table 11). On the contrary, when they play against superior teams, the following technical performance parameters showed significantly higher mean values: UNSUCP $t(128) = 2.601$, $p = 0.010$, $d = 0.46$, and BPT $t(128) = 2.6100$, $p = 0.010$, $d = 0.46$.

Table 11 Technical performance parameters of superior teams according to quality of opposition

Variable	Superior vs. Superior (n= 64)		Superior vs. Inferior (n= 66)		*t*(128)	*p*	*d*
	M	SD	M	SD			
SUCP	335.27	122.27	388.55	90.11	-2.834	0.005*	-0.50
UNSUCP	88.31	19.82	80.52	13.95	2.601	0.010*	0.46
PR (%)	0.77	0.08	0.82	0.05	-3.875	<.0001*	-0.69
LP	60.39	13.16	62.82	16.45	-0.928	0.355	-0.16
SHP	363.19	115.87	410.79	90.86	-2.611	0.010*	-0.46
AVPL (m)	19.58	1.72	19.22	2.06	1.098	0.274	0.19
SOT	8.28	3.78	11.02	4.24	-3.877	<.0001*	-0.69
SOFT	5.78	3.08	6.42	2.78	-1.249	0.214	-0.22
SUCC	4.34	2.73	5.44	2.58	-2.354	0.020*	-0.42
UNSUCC	13.47	6.47	14.92	6.70	-1.259	0.210	-0.22
COR	5.14	2.70	5.36	2.45	-0.493	0.623	-0.09
FC	13.67	3.95	12.77	3.83	1.318	0.190	0.23
YC	2.5	1.31	2.32	1.54	0.724	0.470	0.13
RC	0.16	0.44	0.11	0.31	0.749	0.455	0.13
OFF	2.05	1.57	1.74	1.43	1.158	0.249	0.20
POS (%)	0.5	0.11	0.53	0.07	-2.212	0.029*	-0.39
BPT (min.)	26.62	6.02	29.06	4.56	-2.61	0.010*	-0.46

*$p < .05$

Comparison of physical performance parameters of inferior teams according to quality of opposition is presented in Table 12. There were three parameters that inferior teams had significantly higher mean values when they were playing against superior teams than playing against similar-ranked teams (inferior vs. inferior) including TDOP $t(112) = 2.807$, $p = 0.006$, $d = 0.53$, HIDOP $t(112) = 2.243$, $p = 0.027$, $d = 0.42$, HSDOP $t(112) = 2.322$, $p = 0.022$, $d = 0.44$.

Table 12 Physical performance parameters of inferior teams according to quality of opposition

Variable	Inferior vs. Inferior (n = 48)		Inferior vs. Superior (n = 66)		*t(112)*	*p*	*d*
	M	SD	M	SD			
TD (m)	107528.5	5155.51	108048.74	7484.58	-0.415	0.679	-0.08
HID (m)	4268.96	603.24	4459.85	541.6	-1.771	0.079	-0.33
SD (m)	2403.56	424.23	2447.88	479.51	-0.511	0.61	-0.1
HSD (m)	6672.52	887.27	6907.73	903.28	-1.383	0.169	-0.26
NHIR	238.67	54.77	253.65	41.63	-1.66	0.100	-0.31
NS	94.29	27.7	98.23	27.31	-0.755	0.452	-0.14
NHSR	332.96	78.6	351.88	64.21	-1.413	0.161	-0.27
AS (km/h)	6.32	0.33	6.36	0.30	-0.723	0.471	-0.14
TDP (m)	35851.67	6970.40	33641.79	5456.15	1.898	0.060	0.36
TDOP (m)	37115.08	7139.42	40930.29	7182.96	-2.807	0.006*	-0.53
TDBOP (m)	34560.58	7087.89	33475.68	6739.49	0.83	0.408	0.16
HIDP (m)	1621.08	460.93	1614.73	370.22	0.082	0.935	0.02
HIDOP (m)	1923.5	600.70	2159.21	517.75	-2.243	0.027*	-0.42
HIDBOP (m)	504.04	477.50	460.32	425.1	0.515	0.608	0.1
SP (m)	1063.08	325.96	1007.8	295.14	0.945	0.347	0.18
SOP (m)	1071.58	338.21	1168.38	327.90	-1.536	0.127	-0.29
SBOP (m)	267.9	336.42	270.85	332.17	-0.047	0.963	-0.01
HSDP (m)	2751.6	676.78	2695.12	578.51	0.479	0.633	0.09
HSDOP (m)	3082.13	839.52	3426.94	738.98	-2.322	0.022*	-0.44
HSDBOP (m)	838.38	930.60	785.21	863.16	0.314	0.754	0.06

*$p < .05$

Technical performance parameters of inferior teams according to quality of opposition is given in Table 13. A significant difference observed between inferior vs. inferior and inferior vs. superior groups in the following variables: SOT $t(112) = 2.877$, $p = 0.005$, $d = 0.54$, SUCC $t(112) = 2.028$, $p = 0.045$, $d = 0.38$, POS $t(112) = 2.799$, $p = 0.006$, $d = 0.53$, and BPT $t(112) = 2.053$, $p = 0.042$, $d = 0.39$. The mean scores of these variables were significantly higher when inferior teams playing against similar-ranked teams (inferior vs. inferior) compared to better-ranked teams (inferior vs. superior).

Table 13 Technical performance parameters of inferior teams according to quality of opposition

Variable	Inferior vs. Inferior (n= 48)		Inferior vs. Superior (n= 66)		*t(112)*	*p*	*d*
	M	SD	M	SD			
SUCP	330.88	92.74	306.38	73.23	1.575	0.118	0.3
UNSUCP	82.83	11.62	85.45	14.08	-1.054	0.294	-0.2
PR (%)	0.79	0.06	0.77	0.05	1.397	0.165	0.26
LP	62.81	17.61	64.39	16.54	-0.49	0.625	-0.09
SHP	350.90	92.82	327.44	73.33	1.507	0.135	0.28
AVPL (m)	20.08	2.37	20.24	1.93	-0.398	0.691	-0.08
SOT	8.92	4.22	6.86	3.39	2.877	0.005*	0.54
SOFT	5.56	2.84	4.58	2.49	1.971	0.051	0.37
SUCC	4.42	2.7	3.5	2.13	2.028	0.045*	0.38
UNSUCC	14.77	8.05	12.44	5.80	1.798	0.075	0.34
COR	4.13	2.35	4.09	2.04	0.083	0.934	0.02
FC	12.67	3.92	12.47	3.38	0.287	0.774	0.05
YC	2.65	1.52	2.71	1.57	-0.226	0.822	-0.04
RC	0.10	0.37	0.24	0.58	-1.442	0.152	-0.27
OFF	1.75	1.49	2.03	1.78	-0.887	0.377	-0.17
POS (%)	0.50	0.06	0.47	0.07	2.799	0.006*	0.53
BPT (min.)	26.58	4.13	24.78	4.94	2.053	0.042*	0.39

*$p < .05$

CHAPTER 5

DISCUSSION AND CONCLUSION

This study aimed to determine the variations of physical and technical performance variables according to match outcome, team quality, and quality of opposition in elite soccer players from the Turkish Super League. The main findings of the study were three-fold. First, the results revealed nine physical performance parameters and five technical performance parameters that discriminate between winning, losing, and drawing. Second, a total of five physical and five technical performance parameters determined team quality, ranks at the end of the season, according to the results of this study. Third, nine physical performance parameters and eight technical performance parameters showed significant variation in superior teams according to their quality of opposition. Further, the inferior teams also displayed significant variations in their physical (number of three) and technical (number of four) performance parameters.

5.1. Match Outcome

This study confirmed that elite soccer players' physical and technical performance parameters in the Turkish Super League were varied according to match outcome. The earlier studies often reported that the high-level of match running performance is essential for success in elite soccer teams from German Bundesliga (Hoppe et al., 2015). Also, a former study indicated that the match outcome is influenced by high-intensity activities in Brazilian League players (Aquino et al., 2017). This study demonstrates that NHIR and NHSR are related to winning and losing compared to the drawing. However, the AS was significantly higher only in winning teams compared to drawing and losing teams.

Although the POS did not differ the winning, losing, and drawing teams, the distances covered when in ball possession at various speeds discriminated the match outcome. For winning teams, HIDP, SP, and HSDP were higher. In opposition, the winning teams and drawing teams covered less SOP and HSDOP compared to losing teams. These results were in accordance with a previous study conducted by Zhou et al. (2018) in the Chinese Soccer Association Super League. Further, the high-intensity distance out of possession was significantly lower in drawing teams than losing teams. In brief, the present study's findings indicated that high-intensity activities, particularly when in possession, increase the probability of winning or at least drawing in the Turkish Super League.

The present study found that SOT was significantly higher in winning teams than both losing and drawing teams. Similar findings were also reported by Lago-Peñas et al. (2010) in the Spanish La Liga, Castellano et al. (2012) in three consecutive FIFA World Cup (2002, 2006, 2010) and Zhou et al. (2018) in the Chinese Soccer Association Super League. As previously reported, the quality of shots is more important than the quantity of the shots for success in the German Bundesliga (Yue et al., 2014), and it is also confirmed for the Turkish Super League according to the results of the present study. Thus, the importance of shots quality should be well considered while developing training programs.

The findings of this study indicated that the variables associated with passes such as UNSUCP, PR, and UNSUCC were significantly different between winning, losing, and drawing teams. As was expected, the winning teams performed less UNSUCP than the losing and drawing teams. Surprisingly, losing teams performed less UNSUCP than drawing teams. In line with these results, the PR was lower for drawing teams compared to winning and losing teams. Similar results for PR were reported in a study that examined the 2018 FIFA World Cup (Alves et al., 2019). Furthermore, the influence of pass success for winning in the UEFA Champions League (Lago-Peñas et al., 2011) and Spanish La Liga (Lago-Peñas et al., 2010) were documented. According to the results of the present study, UNSUCC was seen less in winning teams

than in losing teams. This result was in agreement with a previous study conducted in the Chinese Soccer Association League (Zhou et al., 2018). It is probably because winning teams have better organizational skills compared to losing teams.

The variables related to rule breach were only significant for RC between winning and losing teams. The number of red cards received was lower for winning teams in this study. Previous studies also reported a significant relationship between the number of red cards and winning, losing, and drawing teams in UEFA Champions League and Spanish La Liga (Lago-Peñas et al., 2010, 2011). However, in opposition to Lago-Peñas et al. (2011), the number of yellow cards received by the teams was not significantly varied between match outcomes.

The percentage of ball possession was significantly lower in winning teams than in losing teams in AFCON 2017 (Kubayi & Toriola, 2020). In counter to this finding, Lago-Peñas et al. (2010) found that winning teams had a higher percentage of ball possession. However, this study neither contradicted one of the aforementioned studies nor in accordance with. The value of POS was not significantly different according to the match outcome in the present study. Therefore, the percentage of ball possession variable can be overlooked during determining match strategies in Turkish Super League.

5.2. Team Quality

The results revealed that the following variables were significant between teams regarding their quality: HID, HIDP, HSD, HSDP, SP. Unsurprisingly, the variables mentioned above were significantly lower in bottom-ranked teams than middle-ranked teams without exception. However, the significant difference between top-ranked and bottom-ranked teams was seen when in possession such as HIDP, HSDP, and SP. These findings suggest that high-intensity activities are crucial to success in the Turkish Super League, particularly when in possession. In accordance with the results of this study, Rampinini et al. (2009) documented that value of high-speed running distance in possession were varied between lower-ranked and higher-ranked teams in

Italian Serie A League, and Hoppe et.al. (2015) found that match running performance when in ball possession was greater in higher-ranked teams compared to lower-ranked teams in German Bundesliga. In opposition to the present study, Rampinini et.al. (2009) also reported that the value of total distance covered was varied between different team qualities. In addition, Di Salvo et al. (2009) found that total high-intensity running distance and high-intensity running distance without possession were significantly greater in bottom-ranked and middle-ranked teams than top-ranked teams in English Premier League. These findings contradict the present study as high-intensity activities without possession showed no significant difference between top-ranked, middle-ranked, and bottom-ranked teams.

According to team quality, the technical performance parameters were significant in several variables, including SHP, SOT, SUCC, COR, and BPT. The post-hoc analysis revealed that the top-ranked teams have greater values of all aforementioned variables than bottom-ranked teams, whereas the SUCC was also greater in middle-ranked teams than bottom-ranked teams. The findings for SHP and SOT variables from the present study are in agreement with the study of Rampinini et al. (2009) who examined Italian Serie A. In both studies, the values of SHP and SOT were greater in better-ranked teams than in worst-ranked teams. In addition, the results of the study conducted in Spanish La Liga by Liu et al. (2016) were parallel with the results of the present study in terms of BPT and SOT performances. BPT was also greater in top-ranked teams in the present study. Further, COR and SUCC were greater in top-ranked teams compared to bottom-ranked teams. It is probably because corner kicks and crosses can be described as an attacking related variable.

Lastly, the present study indicates that SUCC was significantly greater in top-ranked and middle-ranked teams compared to bottom-ranked teams. The earlier studies reported number of crosses was higher in less successful teams (Liu, Gómez, Gonçalves, et al., 2016; Liu, Hopkins, & Gómez, 2016). Thus, the findings of the present study emphasize the quality of the crosses rather than quantity of crosses.

5.3. Quality of Opposition

Prior to statistical analyses to determine the influence of quality of opposition on performance parameters, the teams were divided into two groups according to end-of-season rankings: Superior (top nine teams) and inferior (bottom nine teams). First, superior teams were analyzed according to the quality of their opponent (superior vs. superior and superior vs. inferior). Second, performance parameters of inferior teams were analyzed according to the quality of their opponent (inferior vs. inferior and inferior vs. superior). The analyses demonstrated that superior teams showed greater NHIR, NHSR, NS, and HIDBOP, SBOP, and HSDBOP against inferior opponents compared to superior opposition. However, superior teams showed higher TDOP, HIDOP, and HSDOP when playing against superior teams than inferior teams. Moreover, inferior teams covered greater TDOP, HIDOP, and HSDOP when playing against inferior teams than superior opposition. The previous studies reported that as the opponent level decreases, the total distance covered by the reference team decreases (Mohr et al., 2003; Rampinini et al., 2009). However, the present study contradicts previous finding as the difference in total distance covered was trivial according to the quality of opposition.

The present study suggests that when playing against a higher-ranked team, the reference team cover a greater distance out of possession at various speed and intensities. The rationale for these findings is probably that better quality opponents can cover the greater high-speed running distance in possession and high-intensity running distance in possession, as reported in the present study. It is also confirmed with another study conducted in Spanish La Liga (Castellano et al., 2011) that when the opponent has higher quality, the reference team performs greater distances at all intensities, including high-intensity.

The results indicated that seven technical performance parameters (i.e., SUCP, PR, SHP, SOT, SUCC, POS, and BPT) were significantly greater in superior teams when playing against inferior teams compared to a superior opponent. The following variables were higher when inferior teams played against inferior teams: SOT, SUCC,

POS, and BPT. Only one variable, UNSUCP, was greater in superior teams when playing against superior teams compared to inferior opponents. Lago-Peñas et al. (2010, 2011) conducted two studies in Spanish La Liga and UEFA Champion League and reported similar results with the present study. They found that higher-ranked teams were performed greater pass performance than their opponents.

Moreover, earlier studies documented that playing with a strong opponent was in relation with a decrease of ball possession in Spanish La Liga (Lago, 2009), UEFA Champions League (Lago-Peñas et al., 2011), and in English Premier League (Fernandez-Navarro et al., 2018).

Lastly, of the attacking related variables, SOT and SUCC were greater when facing a lower-ranked opponent in the results of this study unsurprisingly. It is most likely because the reference team can organize more attacks against weaker opponents relative to stronger opponents. Therefore, the number of SOT and SUCC is greater against weaker opponents.

5.4. Conclusion

This study examined the variations in physical and technical performance parameters of elite soccer players according to match outcome, team quality, and quality of opposition during the 2019-2020 season of the Turkish Super League. The findings of the present study indicated that several physical and technical performance variables were influenced by selected contextual factors (i.e., match outcome, team quality, and quality of opposition). This study is original in the sense that it provides an insight into a better understanding of soccer match analysis in the Turkish Super League for the first time to the best of the author's knowledge. It can be concluded that the winning teams have greater high-intensity and high-speed activities, especially when in possession. Also, winning teams can be identified with a high number of shots on target. The distance covered when in possession at high-intensity, high-speed and sprinting are characteristics of top-level teams in the Turkish Super League. Additionally, top-ranked teams perform more SUCC, SOT, COR, SHP rather than LP,

and BPT compared to lower-ranked teams. The quality of opposition influenced the physical and technical performance parameters of soccer players in the Turkish Super League. When they play against higher-ranked teams, several match running variables out of possession, such as TDOP, HIDOP, and HSDOP are greater. In contrast, numerous performance variables are greater when the opponent is lower-ranked, including NHIR, NS, NHSR, and match running performance variables when the ball is out of play (i.e., HIDBOP, HSDBOP, and SBOP). Furthermore, playing against lower-ranked teams enables a greater number of SUCP, SHP, SOT and dominating the game by POS.

5.5. Practical Implications

This study reported several key performance indicators for success in the Turkish Super League. Firstly, the findings demonstrated that high-speed and high-intensity running in possession is higher in winning teams. Therefore, coaches, performance analysts, and applied practitioners can consider organizing training programs that enable the players to successfully perform high-intensity activities in possession and develop speed in their players. Moreover, the number of shots on target was also significantly greater in winning teams. Thus, the training methods that will improve the quality of shots rather than the quantity of shots should be implemented. These findings should also be considered when evaluating match performance and planning the match strategies for further competitions.

Second, the present study results indicated that top-ranked teams are better at covering the distance at high-intensity, high-speed, and sprinting in possession. Therefore, sprinting exercises should also be integrated into training strategies to enhance team quality. In addition, the number of successful crosses, shots on target, corner kicks, short passes, and ball play time were greater in top-ranked teams. Improving the quality of crosses and selecting the playing strategies that require more short passes than long passes while increasing ball play time can be beneficial to improve team quality in the Turkish Super League.

Lastly, playing against superior teams varied physical performance parameters, including high-intensity running distance out of possession, total distance covered out of possession, high-speed running distance out of possession. When playing against inferior teams, high-intensity running distance ball play out, sprinting distance ball play out, high-speed running distance ball play out are greater. Moreover, the number of successful passes, short passes, shots on target, and possession was greater when playing against lower-ranked teams. Thus, coaches, performance analysts, and applied practitioners should consider these findings during pre-match evaluations and post-match analyses to conclude appropriate results.

5.6. Limitations of the Study and Recommendations for Future Research

This study has several limitations. First, the data collected from the 2019-2020 season of the Turkish Super League. Collecting the data from a single season instead of several more consecutive seasons reduced the power of generalization. Hence, future studies should establish large sample sizes from several seasons. Second, previous research documented that environmental factors also influence the performance variables of elite soccer players (Trewin et al., 2017). However, the data analyses were carried out without considering environmental factors such as heat stress and altitude. The environmental factors are essential variables for future research. Last, the 2019-2020 season of the Turkish Super League was interrupted due to COVID-19 pandemic. The matches held in the post-pandemic period were played without an audience that may have influenced soccer players' performance parameters. Therefore, the data collected from the uninterrupted season(s) would strengthen future studies.

REFERENCES

Almeida, C. H., Ferreira, A. P., & Volossovitch, A. (2014). Effects of match location, match status and quality of opposition on regaining possession in UEFA champions league. *Journal of Human Kinetics*, *41*(1), 203–214. https://doi.org/10.2478/hukin-2014-0048

Alves, D. L., Osiecki, R., Palumbo, D. P., Moiano-Junior, J. V. M., Oneda, G., & Cruz, R. (2019). What variables can differentiate winning and losing teams in the group and final stages of the 2018 FIFA World Cup? *International Journal of Performance Analysis in Sport*, *19*(2), 248–257. https://doi.org/10.1080/24748668.2019.1593096

Andrzejewski, M., Konefał, M., Chmura, P., Kowalczuk, E., & Chmura, J. (2016). Match outcome and distances covered at various speeds in match play by elite German soccer players. *International Journal of Performance Analysis in Sport*, *16*(3), 817–828. https://doi.org/10.1080/24748668.2016.11868930

Aquino, R., Munhoz Martins, G. H., Palucci Vieira, L. H., & Menezes, R. P. (2017). Influence of Match Location, Quality of Opponents, and Match Status on Movement Patterns in Brazilian Professional Football Players. *Journal of Strength and Conditioning Research*, *31*(8), 2155–2161. https://doi.org/10.1519/JSC.0000000000001674

Aughey, R. J., Hammond, K., Varley, M. C., Schmidt, W. F., Bourdon, P. C., Buchheit, M., Simpson, B., Garvican-Lewis, L. A., Kley, M., Soria, R., Sargent, C., Roach, G. D., Jimenez Claros, J. C., Wachsmuth, N., & Gore, C. J. (2013). Soccer activity profile of altitude versus sea-level natives during acclimatisation to 3600 m (ISA3600). *British Journal of Sports Medicine*, *47*(SUPPL. 1), 1–7. https://doi.org/10.1136/bjsports-2013-092776

Barnes, C., Archer, D., Hogg, B., Bush, M., & Bradley, P. (2014). The Evolution of Physical and Technical Performance Parameters in the English Premier League. *International Journal of Sports Medicine*, *35*(13), 1095–1100. https://doi.org/10.1055/s-0034-1375695

Barris, S., & Button, C. (2008). A review of vision-based motion analysis in sport. *Sports Medicine*, *38*(12), 1025–1043. https://doi.org/10.2165/00007256-200838120-00006

Barros, R. M. L., Misuta, M. S., Menezes, R. P., Figueroa, P. J., Moura, F. A., Cunha, S. A., Anido, R., & Leite, N. J. (2007). Analysis of the distances covered by first division Brazilian soccer players obtained with an automatic tracking method. *Journal of Sports Science and Medicine*, *6*(2), 233–242.

Bartlett, R. (2001). Performance analysis : can bringing together biomechanics and notational analysis benefit coaches ? *International Journal of Performance Analysis in Sport*, *1*(1), 122–126. https://doi.org/10.1080/24748668.2001.11868254

Bradley, P. S., Carling, C., Archer, D., Roberts, J., Dodds, A., di Mascio, M., Paul, D., Diaz, A. G., Peart, D., & Krustrup, P. (2011). The effect of playing formation on high-intensity running and technical profiles in English FA premier League soccer matches. *Journal of Sports Sciences*, *29*(8), 821–830. https://doi.org/10.1080/02640414.2011.561868

Bradley, P. S., Carling, C., Gomez Diaz, A., Hood, P., Barnes, C., Ade, J., Boddy, M., Krustrup, P., & Mohr, M. (2013). Match performance and physical capacity of players in the top three competitive standards of English professional soccer. *Human Movement Science*, *32*(4), 808–821. https://doi.org/10.1016/j.humov.2013.06.002

Brink, M. S., Visscher, C., Arends, S., Zwerver, J., Post, W. J., & Lemmink, K. A. P. M. (2010). Monitoring stress and recovery: New insights for the prevention of injuries and illnesses in elite youth soccer players. *British Journal of Sports Medicine*, *44*(11), 809–815. https://doi.org/10.1136/bjsm.2009.069476

Bush, M., Archer, D. T., Barnes, C., Hogg, B., & Bradley, P. S. (2017). Longitudinal match performance characteristics of UK and non-UK players in the English Premier League. *Science and Medicine in Football*, *1*(1), 2–9. https://doi.org/10.1080/02640414.2016.1233347

Bush, M., Barnes, C., Archer, D. T., Hogg, B., & Bradley, P. S. (2015). Evolution of match performance parameters for various playing positions in the English Premier League. *Human Movement Science*, *39*, 1–11. https://doi.org/10.1016/j.humov.2014.10.003

Bush, M. D., Archer, D. T., Hogg, R., & Bradley, P. S. (2015). Factors influencing physical and technical variability in the english premier league. *International Journal of Sports Physiology and Performance*, *10*(7), 865–872. https://doi.org/10.1123/ijspp.2014-0484

Carling, Chris. (2010). Analysis of physical activity profiles when running with the ball in a professional soccer team. In *Journal of Sports Sciences* (Vol. 28, Issue 3, pp. 319–326). https://doi.org/10.1080/02640410903473851

Carling, Christopher. (2011). Influence of opposition team formation on physical and skill-related performance in a professional soccer team. In *European Journal of Sport Science* (Vol. 11, Issue 3, pp. 155–164). https://doi.org/10.1080/17461391.2010.499972

Carling, Christopher, Bloomfield, J., Nelsen, L., & Reilly, T. (2008). The Role of Motion Analysis in Elite Soccer Work Rate Data. *Sports Medicine*, *38*(10), 839–862.

Carling, Christopher, Williams, A. M., & Reilly, T. (2007). Handbook of Soccer Match Analysis. In *Handbook of Soccer Match Analysis*. Routledge. https://doi.org/10.4324/9780203448625

Castellano, J., Blanco-Villaseñor, A., & Álvarez, D. (2011). Contextual variables and time-motion analysis in soccer. *International Journal of Sports Medicine*, *32*(6), 415–421. https://doi.org/10.1055/s-0031-1271771

Castellano, Julen, Alvarez-Pastor, D., & Bradley, P. S. (2014). Evaluation of research using computerised tracking systems (amisco® and prozone®) to analyse physical performance in elite soccer: A systematic review. *Sports Medicine*, *44*(5), 701–712. https://doi.org/10.1007/s40279-014-0144-3

Castellano, Julen, Casamichana, D., & Lago, C. (2012). The use of match statistics that discriminate between successful and unsuccessful soccer teams. *Journal of Human Kinetics*, *31*(1), 139–147. https://doi.org/10.2478/v10078-012-0015-7

Chmura, P., Konefał, M., Chmura, J., Kowalczuk, E., Zajac, T., Rokita, A., & Andrzejewski, M. (2018). Match outcome and running performance in different

intensity ranges among elite soccer players. *Biology of Sport*, *35*(2), 197–203. https://doi.org/10.5114/biolsport.2018.74196

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Lawrence Erlbaum Associates.

Courneya, K. S., & Carron, A. V. (1992). The Home Advantage In Sport Competitions: A Literature Review. *Journal of Sport and Exercise Psychology*, *14*(1), 13–27. https://doi.org/10.1123/jsep.14.1.13

Croisier, J. L., Ganteaume, S., Binet, J., Genty, M., & Ferret, J. M. (2008). Strength imbalances and prevention of hamstring injury in professional soccer players: A prospective study. *American Journal of Sports Medicine*, *36*(8), 1469–1475. https://doi.org/10.1177/0363546508316764

Dellal, A., Chamari, K., Wong, D. P., Ahmaidi, S., Keller, D., Barros, R., Bisciotti, G. N., & Carling, C. (2011). Comparison of physical and technical performance in European soccer match-play: Fa Premier League and La Liga. *European Journal of Sport Science*, *11*(1), 51–59. https://doi.org/10.1080/17461391.2010.481334

Di Salvo, V., Baron, R., Tschan, H., Calderon Montero, F. J., Bachl, N., & Pigozzi, F. (2007). Performance characteristics according to playing position in elite soccer. *International Journal of Sports Medicine*, *28*(3), 222–227. https://doi.org/10.1055/s-2006-924294

Di Salvo, V., Gregson, W., Atkinson, G., Tordoff, P., & Drust, B. (2009). Analysis of high intensity activity in premier league soccer. *International Journal of Sports Medicine*, *30*(3), 205–212. https://doi.org/10.1055/s-0028-1105950

Di Salvo, Valter, Baron, R., González-Haro, C., Gormasz, C., Pigozzi, F., & Bachl, N. (2010). Sprinting analysis of elite soccer players during European Champions League and UEFA Cup matches. *Journal of Sports Sciences*, *28*(14), 1489–1494.

https://doi.org/10.1080/02640414.2010.521166

Docherty, D., & Neary, P. (1988). Time-motion analysis related to the physiological demands of rugby. *Journal of Human Movement Studies*, *14*(6), 269–277.

Drust, B. (2010). Performance analysis research : Meeting the challenge. *Journal of Sports Sciences*, *28*(9), 921–922. https://doi.org/10.1080/02640411003740769

Fernandez-Navarro, J., Fradua, L., Zubillaga, A., & McRobert, A. P. (2018). Influence of contextual variables on styles of play in soccer. *International Journal of Performance Analysis in Sport*, *18*(3), 423–436. https://doi.org/10.1080/24748668.2018.1479925

FIFA. (2007). *FIFA Big Count 2006 : 270 million people active in football Big Count : Comparison 2006 – 2000*.

FIFA. (2019). *Professional Football Report 2019*.

Gai, Y., Leicht, A. S., Lago, C., & Gómez, M. Á. (2019). Physical and technical differences between domestic and foreign soccer players according to playing positions in the China Super League. *Research in Sports Medicine*, *27*(3), 314–325. https://doi.org/10.1080/15438627.2018.1540005

García-Rubio, J., Gómez, M. Á., Lago-Peñas, C., & Ibáñez Godoy, S. J. (2015). Effect of match venue, scoring first and quality of opposition on match outcome in the UEFA champions league. *International Journal of Performance Analysis in Sport*, *15*(2), 527–539. https://doi.org/10.1080/24748668.2015.11868811

Garvican, L. A., Hammond, K., Varley, M. C., Gore, C. J., Billaut, F., & Aughey, R. J. (2014). Lower running performance and exacerbated fatigue in soccer played at 1600 m. *International Journal of Sports Physiology and Performance*, *9*(3), 397–404. https://doi.org/10.1123/IJSPP.2012-0375

Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: A guide for non-statisticians. *International Journal of Endocrinology and Metabolism*, *10*(2), 486–489. https://doi.org/10.5812/ijem.3505

Gómez, M.-Á., Lago-Peñas, C., & Pollard, R. (2013). Situational Variables. In *Routledge Handbook of Sports Performance Analysis Routledge.* https://doi.org/10.4324/9780203806913.ch21

Gravetter, F. J., & Wallnau, L. B. (2017). Statistics for the behavioral science 10th. In *Statistic for The Behavioral Science*.

Grehaigne, J., Bouthier, D., David, B., Bouthier, D., & Dynamic-, B. D. (1997). Dynamic-system analysis of opponent relationships in collective actions in soccer. *Journal of Sports Sciences*, *15*(2), 137–149. https://doi.org/: 10.1080/026404197367416

Harrop, K., & Nevill, A. (2014). Performance indicators that predict success in an English Professional League One Soccer Team. *International Journal of Performance Analysis in Sport*, *14*(3), 907–920. https://doi.org/10.1080/24748668.2014.11868767

Helgerud, J., Engen, L. C., Wisløff, U., & Hoff, J. (2001). Aerobic endurance training improves soccer performance. *Medicine and Science in Sports and Exercise*, *33*(11), 1925–1931. https://doi.org/10.1097/00005768-200111000-00019

Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hanin, J. (2009). Progressive statistics for studies in sports medicine and exercise science. *Medicine and Science in Sports and Exercise*, *41*(1), 3–12. https://doi.org/10.1249/MSS.0b013e31818cb278

Hoppe, M. W., Slomka, M., Baumgart, C., Weber, H., & Freiwald, J. (2015). Match running performance and success across a season in German Bundesliga soccer teams. *International Journal of Sports Medicine*, *36*(7), 563–566.

https://doi.org/10.1055/s-0034-1398578

Hughes, M. D., Bartlett, R. M., Hughes, M. D., & Bartlett, R. M. (2002). The use of performance indicators in performance analysis. *Journal of Sports Sciences*, *20*(10), 739–754. https://doi.org/10.1080/026404102320675602

Hughes, M., & Franks, lan M. (2008). *The essentials of performance analysis – An introduction*. E. & FN Spon.

James, N. (2006). Notational analysis in soccer: past, present and future. *International Journal of Performance Analysis in Sport*, *6*(2), 67–81. https://doi.org/10.1080/24748668.2006.11868373

Jovanovic, M., Sporis, G., Omrcen, D., & Fiorentini, F. (2011). Effects of Speed, Agility, Quickness Training Method on Power Performance in Elite Soccer Players. *Journal of Strength and Conditioning Research*, *25*(5), 1285–1292. https://doi.org/10.1519/JSC.0b013e3181d67c65

Konefał, M., Chmura, P., Tessitore, A., Melcer, T., Kowalczuk, E., Chmura, J., & Andrzejewski, M. (2020). The Impact of Match Location and Players' Physical and Technical Activities on Winning in the German Bundesliga. *Frontiers in Psychology*, *11*(July), 1–9. https://doi.org/10.3389/fpsyg.2020.01748

Kubayi, A., & Toriola, A. (2020). Match Performance Indicators that Discriminated between Winning, Drawing and Losing Teams in the 2017 AFCON Soccer Championship. *Journal of Human Kinetics*, *72*(1), 215–221. https://doi.org/10.2478/hukin-2019-0108

Lago-Ballesteros, J., & Lago-Peñas, C. (2010). Performance in team sports: Identifying the keys to success in soccer. *Journal of Human Kinetics*, *25*(1), 85–91. https://doi.org/10.2478/v10078-010-0035-0

Lago-Peñas, C., & Lago-Ballesteros, J. (2011). Game location and team quality effects on performance profiles in professional soccer. *Journal of Sports Science & Medicine*, *10*(3), 465–471. http://www.ncbi.nlm.nih.gov/pubmed/24150619

Lago-Peñas, C., Lago-Ballesteros, J., Dellal, A., & Gómez, M. (2010). Game-related statistics that discriminated winning, drawing and losing teams from the Spanish soccer league. *Journal of Sports Science and Medicine*, *9*(2), 288–293.

Lago-Peñas, C., Lago-Ballesteros, J., & Rey, E. (2011). Differences in performance indicators between winning and losing teams in the UEFA Champions League. *Journal of Human Kinetics*, *27*(2011), 135–146. https://doi.org/10.2478/v10078-011-0011-3

Lago, C. (2009). The influence of match location, quality of opposition, and match status on possession strategies in professional association football. In *Journal of Sports Sciences* (Vol. 27, Issue 13, pp. 1463–1469). https://doi.org/10.1080/02640410903131681

Lago, C., Casais, L., Dominguez, E., & Sampaio, J. (2010). The effects of situational variables on distance covered at various speeds in elite soccer. *European Journal of Sport Science*, *10*(2), 103–109. https://doi.org/10.1080/17461390903273994

Link, D., & Weber, H. (2017). Effect of Ambient Temperature on Pacing in Soccer Depends on Skill Level. *Journal of Strength and Conditioning Research*, *31*(7), 1766–1770. https://doi.org/10.1519/JSC.0000000000001013

Liu, H., Gómez, M. A., Gonçalves, B., & Sampaio, J. (2016). Technical performance and match-to-match variation in elite football teams. *Journal of Sports Sciences*, *34*(6), 509–518. https://doi.org/10.1080/02640414.2015.1117121

Liu, H., Gomez, M. Á., Lago-Peñas, C., & Sampaio, J. (2015). Match statistics related to winning in the group stage of 2014 Brazil FIFA World Cup. *Journal of Sports*

Sciences, *33*(12), 1205–1213. https://doi.org/10.1080/02640414.2015.1022578

Liu, H., Hopkins, W. G., & Gómez, M. A. (2016). Modelling relationships between match events and match outcome in elite football. *European Journal of Sport Science*, *16*(5), 516–525. https://doi.org/10.1080/17461391.2015.1042527

Liu, H., Hopkins, W. G., Gómez, M. A., Molinuevo, J. S., Gomez, M. Á., Lago-Peñas, C., & Sampaio, J. (2016). Match statistics related to winning in the group stage of 2014 Brazil FIFA World Cup. *Journal of Sports Sciences*, *33*(3), 1205–1213. https://doi.org/10.1080/02640414.2015.1022578

Liu, T., García-De-Alcaraz, A., Zhang, L., & Zhang, Y. (2019). Exploring home advantage and quality of opposition interactions in the Chinese Football Super League. *International Journal of Performance Analysis in Sport*, *19*(3), 289–301. https://doi.org/10.1080/24748668.2019.1600907

Mallo, J., Mena, E., Nevado, F., & Paredes, V. (2015). Physical Demands of Top-Class Soccer Friendly Matches in Relation to a Playing Position Using Global Positioning System Technology. *Journal of Human Kinetics*, *47*(1), 179–188. https://doi.org/10.1515/hukin-2015-0073

Mao, L., Peng, Z., Liu, H., & Gómez, M. (2016). Identifying keys to win in the Chinese professional soccer league. *International Journal of Performance Analysis in Sport*, *16*(3), 935–947. https://doi.org/10.1080/24748668.2016.11868940

Martín-Fuentes, I., Oliva-Lozano, J. M., Fortes, V., & Muyor, J. M. (2021). Effect of playing position, passage duration and starting status on the most demanding passages of match play in professional football. *Research in Sports Medicine*, *29*(5), 417–426. https://doi.org/10.1080/15438627.2021.1937163

Mohr, M., Krustrup, P., & Bangsbo, J. (2003). Match performance of high-standard soccer players with special reference to development of fatigue. *Journal of Sports*

Sciences, *21*(7), 519–528. https://doi.org/10.1080/0264041031000071182

Nassis, G. P., Brito, J., Dvorak, J., Chalabi, H., & Racinais, S. (2015). The association of environmental heat stress with performance: Analysis of the 2014 FIFA World Cup Brazil. *British Journal of Sports Medicine*, *49*(9), 609–613. https://doi.org/10.1136/bjsports-2014-094449

Oliva-Lozano, J. M., Rojas-Valverde, D., Gómez-Carmona, C. D., Fortes, V., & Pino-Ortega, J. (2021). Impact of contextual variables on the representative external load profile of Spanish professional soccer match-play: A full season study. *European Journal of SportScience*, *21*(4), 497–506. https://doi.org/10.1080/17461391.2020.1751305

Poulter, D. R. (2009). Home advantage and player nationality in international club football. *Journal of Sports Sciences*, *27*(8), 797–805. https://doi.org/10.1080/02640410902893364

Rampinini, E., Coutts, A. J., Castagna, C., Sassi, R., & Impellizzeri, F. M. (2007). Variation in top level soccer match performance. *International Journal of Sports Medicine*, *28*(12), 1018–1024. https://doi.org/10.1055/s-2007-965158

Rampinini, Ermanno, Impellizzeri, F. M., Castagna, C., Coutts, A. J., & Wisløff, U. (2009). Technical performance during soccer matches of the Italian Serie A league: Effect of fatigue and competitive level. *Journal of Science and Medicine in Sport*, *12*(1), 227–233. https://doi.org/10.1016/j.jsams.2007.10.002

Randers, M. B., Mujika, I., Hewitt, A., Santisteban, J., Bischoff, R., Solano, R., Zubillaga, A., Peltola, E., Krustrup, P., & Mohr, M. (2010). Application of four different football match analysis systems: A comparative study. *Journal of Sports Sciences*, *28*(2), 171–182. https://doi.org/10.1080/02640410903428525

Salvo, D., Prof, V., Adam, C., Barry, M., & Marco, C. (2006). Validation of Prozone ® : A new video-based performance analysis system. *International Journal of Performance Analysis in Sport*, *6*(1), 108–119. https://doi.org/10.1080/24748668.2006.11868359

Sarmento, H., Marcelino, R., Anguera, M. T., CampaniÇo, J., Matos, N., & LeitÃo, J. C. (2014). Match analysis in football: a systematic review. *Journal of Sports Sciences*, *32*(20), 1831–1843. https://doi.org/10.1080/02640414.2014.898852

Sporis, G., Jukic, I., Ostojic, S. M., & Milanovic, D. (2009). Fitness Profiling in Soccer: Physical and Physiologic Characteristics of Elite Players. *Journal of Strength and Conditioning Research*, *23*(7), 1947–1953. https://doi.org/10.1519/JSC.0b013e3181b3e141

Stats Perform. (2021). *Opta Event Definitions*. Statsperform.Com. https://www.statsperform.com/opta-event-definitions/#:~:text=A situation where a player,are always considered big chances.

Stølen, T., Chamari, K., Castagna, C., & Wisløff, U. (2005). *Physiology of Soccer*. *35*(6), 501–536.

Svensson, M., & Drust, B. (2005). Testing soccer players. *Journal of Sports Sciences*, *23*(6), 601–618. https://doi.org/10.1080/02640410400021294

Tavares, F., & Gomes, N. (2003). The offensive process in basketball – a study in high performance junior teams. *International Journal of Performance Analysis in Sport*, *3*(1), 34–39. https://doi.org/:10.1080/24748668.2003.11868272

Taylor, J., Mellalieu, S., James, N., & Shearer, D. (2008). The influence of match location, quality of opposition, and match status on technical performance in professional association football. *Journal of Sports Sciences*, *26*(9), 885–895. https://doi.org/10.1080/02640410701836887

Teixeira, J. E., Leal, M., Ferraz, R., Ribeiro, J., Cachada, J. M., Barbosa, T. M., Monteiro, A. M., & Forte, P. (2021). Effects of Match Location, Quality of Opposition and Match Outcome on Match Running Performance in a Portuguese Professional Football Team. *Entropy*, *23*(8), 973. https://doi.org/10.3390/e23080973

Trewin, J., Meylan, C., Varley, M. C., & Cronin, J. (2017). The influence of situational and environmental factors on match-running in soccer: a systematic review. *Science and Medicine in Football*, *1*(2), 183–194. https://doi.org/10.1080/24733938.2017.1329589

UEFA (2021) *Country coefficients* UEFA https://www.uefa.com/nationalassociations/uefarankings/country/#/yr/2022

Verhagen, E., Van Der Beek, A., Twisk, J., Bouter, L., Bahr, R., & Van Mechelen, W. (2004). The effect of a proprioceptive balance board training program for the prevention of ankle sprains: A prospective controlled trial. *American Journal of Sports Medicine*, *32*(6), 1385–1393. https://doi.org/10.1177/0363546503262177

Vogelbein, M., Nopp, S., & Hökelmann, A. (2014). Defensive transition in soccer - are prompt possession regains a measure of success? A quantitative analysis of German Fußball-Bundesliga 2010/2011. *Journal of Sports Sciences*, *32*(11), 1076–1083. https://doi.org/10.1080/02640414.2013.879671

Yang, G., Leicht, A. S., Lago, C., & Gómez, M. Á. (2018). Key team physical and technical performance indicators indicative of team quality in the soccer Chinese super league. *Research in Sports Medicine*, *26*(2), 158–167. https://doi.org/10.1080/15438627.2018.1431539

Yi, Q., Gómez, M. A., Wang, L., Huang, G., Zhang, H., & Liu, H. (2019). Technical and physical match performance of teams in the 2018 FIFA World Cup: Effects of two different playing styles. *Journal of Sports Sciences*, *37*(22), 2569–2577.

https://doi.org/10.1080/02640414.2019.164812

Yue, Z., Broich, H., & Mester, J. (2014). Statistical analysis for the soccer matches of the first bundesliga. *International Journal of Sports Science and Coaching*, *9*(3), 553–560. https://doi.org/10.1260/1747-9541.9.3.553

Zhou, C., Zhang, S., Lorenzo Calvo, A., & Cui, Y. (2018). Chinese soccer association super league, 2012–2017: key performance indicators in balance games. *International Journal of Performance Analysis in Sport*, *18*(4), 645–656. https://doi.org/10.1080/24748668.2018.1509254

APPENDICES

A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

DUMLUPINAR BULVARI 06800
ÇANKAYA ANKARA/TURKEY
T: +90 312 210 22 91
F: +90 312 210 79 59
ueam@metu.edu.tr
www.ueam.metu.edu.tr

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

Sayı: 28620816 /

27 EKİM 2021

Konu : Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi : İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Doç.Dr. Mustafa SÖĞÜT

Danışmanlığını yürüttüğünüz Koray BİBER'in "Variations in physical and technical performance parameters of professional soccer players according to match outcome and quality of opposition" başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **425-ODTU-2021** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

Prof. Dr. Mine MISIRLISOY
İAEK Başkanı

B. TURKISH SUMMARY / TÜRKÇE ÖZET

GİRİŞ

Futbol, tüm yaş, cinsiyet ve seviyelerde dünyadaki en popüler spor olarak belirtilmektedir (Stølen et al., 2005). 2007 yılında FIFA tarafından yayınlanan rapora göre futbolcular, hakemler ve diğer yetkililerle birlikte toplam 270 milyon birey aktif olarak futbol camiasında görev almaktadır. 2019 yılında FIFA tarafından yayınlanan başka bir rapora göre ise dünya üzerinde 128 bine yakın lisanslı futbolcu bulunmaktadır. Bu futbolcuların en çoğu Meksika'da yer alırken Türkiye lisanslı futbolcu sıralamasında 5. sırada yer almaktadır. Kulüp sayılarında da Meksika 1. sırada yer alırken Türkiye 3. sırada yer bulmaktadır.

Spor bilimleri, son yıllarda gözle görülür bir ivme ile gelişme göstermiştir (Sporis et al., 2009). Spor bilimleri antrenörler, atletler ve spor insanları için sakatlık önleyici antrenmanlar düzenlemede (Brink et al., 2010; Verhagen et al., 2004), fiziksel performans gelişiminde (Helgerud et al., 2001; Jovanovic et al., 2011), maç performans analizi (Fernandez-Navarro et al., 2018; Oliva-Lozano et al., 2021) gibi alanlarda yararlanılan önemli bir yardımcı kaynaktır. Fotosel sensörler, bilgisayarlı izokinetik dinamometreler ve bilgisayarlı ve görüntülü maç analizi yapan teknolojik gelişmeler de spor endüstrisine önemli katkılar sağlamaktadır (Randers et al., 2010; Svensson & Drust, 2005). Bu gelişmeler ışığında, futbolcular günümüzde sakatlığa daha az yatkın olmakla birlikte (Croisier et al., 2008) daha iyi fiziksel performanslara ulaşmakta (Jovanovic et al., 2011) ve önemli bir geri bildirim yöntemi olarak etkili maç performans analizlerinden yararlanmaktadırlar (Sarmento et al., 2014).

Performans analizi antrenörler, oyuncular ve spor bilimcileri tarafından sıklıkla tercih edilen etkili bir geri bildirim yöntemidir (Drust, 2010). Performans analizinin esas

amacı bir takımını zayıf ve güçlü yanlarını ortaya koymaktır (Castellano et al., 2012). Performans analizinde seçilecek parametreler antrenörlerin optimum sonuçlar alabilmesi için büyük önem arz etmektedir (Bartlett, 2001; Hughes & Franks, 2008).

Performans analizinde kullanılan birçok yöntem bulunmaktadır. Bunları örnekleyecek olursak, elle yapılan notasyonel sistem, GPS ve bilgisayarlı yarı otomatik kameralı izleme sistemleri olarak sıralanabilir (Carling et al., 2008; James, 2006). Notasyonel sistemde, oyuncuların fiziksel ve teknik performans göstergeleri canlı gözlem anında veya oyuncuların daha önceden kaydedilmiş hareket görüntüler kullanılarak sayısal verilere çevrilir. Bu yöntem, ucuz, pratik ve gelenekseldir fakat sübjektif bir metot olması sebebiyle güvenilirliği ve geçerliliği açısından zayıf bir yöntemdir (Barris & Button, 2008).

GPS teknolojisi, atletlerin hızlarını, kat ettikleri mesafe ve hareket ettikleri yönleri üzerlerine giydikleri alıcılar sayesinde uydudan aldığı sinyaller ile sayısal verilere dönüştürür (Christopher Carling et al., 2008). GPS yöntemi oldukça isabetli ve güvenilir ölçümler yapmasının yanı sıra atletler için kullanılması hareket kısıtlılığı yaratmadığı için oldukça kullanışlı bir araçtır.

Yarı otomatik bilgisayarlı kamera izleme sistemler futbolda maç performans analizinde oldukça yaygın kullanılan bir yöntemdir (Bradley et al., 2013; Bush et al., 2017; Dellal et al., 2011; Di Salvo et al., 2007). Bu sistem, oyuncaları gerçek zamanlı izlerken yapay zekâ öğreniminden faydalanarak isabetli ölçümler sağlamaktadır. Bu teknoloji kullanılırken oyuncular herhangi bir ekstra materyal taşımak veya giymek zorunda olmadıkları için oldukça konforlu ve pratiktir. Ancak, bu sistem kamera, bilgisayar programı, organize etmek için bir operatör, verileri analiz edecek bir analist gibi gereksinimleri sebebiyle oldukça maliyetli bir yöntemdir (Di Salvo et al., 2006).

Yarı otomatik bilgisayarlı kamera izleme sistemler kullanılarak yapılan birçok performans analizi çalışması bulunmaktadır. Hem fiziksel performans (top rakipteyken veya takımdayken kat edilen toplam mesafe, yüksek hızda kat edilen mesafe, yüksek şiddetli koşularda kat edilen mesafe, kısa koşu ile kat edilen mesafe

vb.) (Tablo 14) hem de teknik performans (topla oynama yüzdesi, toplam pas sayısı, isabetli pas sayısı, toplam şut sayısı, isabetli şut sayısı, ofsayt, kırmızı kart, sarı kart, köşe vuruşu sayısı vb.) (Tablo 15) parametrelerindeki değişimler farklı bağlamsal durumlarda (maç sonucu, rakip ve takım kalitesi, maçın oynandığı yer, çevresel etmenler, maç statüsü vb.) incelenmiştir (Tablo 16) (Castellano et al., 2011; Lago-Peñas & Lago-Ballesteros, 2011; T. Liu et al., 2019; Taylor et al., 2008). Bu alanda bugüne kadar yapılmış olan çalışmaların önemli bir çoğunluğu üst düzey Avrupa ligleri olan İngiltere Premier Ligi (Bradley et al., 2011), Fransa Ligi (Christopher Carling, 2011), Almanya Ligi (Hoppe et al., 2015), İspanya Ligi (Oliva-Lozano et al., 2021), İtalya Ligi (Rampinini et al., 2009) ve üst düzey uluslararası turnuvalardan (UEFA Şampiyonlar Ligi, FIFA Dünya Kupası, Avrupa Uluslar Kupası) (Lago-Peñas et al., 2011; Liu et al., 2016; Kubayi & Toriola, 2020) alınan örneklemlerle yapılmıştır. Daha alt seviye liglerde yapılan çalışmalar sınırlı olmakla birlikte, güncel verilere göre Türkiye Süper Ligi'nde bu alanda hiç çalışma yapılmadığı görülmüştür.

Tablo 13 Fiziksel performans parametrelerini inceleyen çalışmalar

Çalışma	Örneklem	Fiziksel Performans Parametreleri	Veri Toplama Yöntemi
Barros et.al., (2007)	Brezilya Liginden 55 futbolcu	Durma, yürüme, hafif tempo kuşu, orta ve yüksek hızda koşu, sprintler.	Bilgisayarlı video analizi
Di Salvo et.al., (2007)	İspanya Liginden 300 futbolcu	Durma, yürüme, hafif tempo kuşu, orta ve yüksek hızda koşu, sprintler.	Bilgisayarlı video analizi
Rampinin et.al., (2007)	Avrupa'nın majör liglerinden 20 futbolcu	Durma, yürüme, hafif tempo kuşu, orta ve yüksek hızda koşu, sprintler.	Bilgisayarlı video analizi
Zhou et.al., (2018)	Çin Liginden 1056 maç gözlemi	Kat edilen toplam mesafe, yüksek hızdaki koşu mesafesi, sprint ile kat edilen mesafe.	Bilgisayarlı video analizi

Tablo 13 (devamı)

Bush et.al., (2015)	İngiltere Premier Liginden 7 sezonda 14700 maç gözlemi	Durma, yürüme, hafif tempo kuşu, orta ve yüksek hızda koşu, kat edilen toplam mesafe, sprint ile kat edilen mesafe.	Bilgisayarlı video analizi
Yi et al., (2019)	2018 FIFA Dünya Kupası	Durma, yürüme, hafif tempo kuşu, orta ve yüksek hızda koşu, kat edilen toplam mesafe, sprint ile kat edilen mesafe.	Bilgisayarlı video analizi

Tablo 14 *Teknik performans parametrelerini inceleyen çalışmalar*

Çalışma	Örneklem	Teknik Performans Parametreleri	Veri Toplama Yöntemi
Konefał et al., (2020)	3 sezonda oynanan Almanya Ligi maçlarının gözlemi	Kaleyi bulan şut, topla buluşma, toplam pas, isabetli pas, toplam orta, toplam ikili mücadele, kazanılan ikili mücadele sayıları	Bilgisayarlı video analizi
Rampinini et al., (2009)	İtalya Liginde oynana maçların gözlemi	Topla buluşma, kısa pas, isabetli kısa pas, uzun pas, isabetli uzun pas, orta, kafa vuruşu, top çalma, şut, isabetli şut sayıları	Bilgisayarlı video analizi
Lago-Peñas & Lago-Ballesteros, (2011)	İspanya Liginde oynanan maçların gözlemi	Toplam gol, şut, isabetli şut, ceza sahasında topla buluşma, orta, ofsayt, kazanılan faul, asist, pas, isabetli pas, dribling sayıları, sarı kart, kırmızı kart sayıları ve topla oynama yüzdesi,	Bilgisayarlı video analizi
Harrop & Nevill, (2014)	İngiltere 1. Ligi maçlarının gözlemi	Şut, isabetli şut, ceza sahası içinden çekilen şutlar, pas, isabetli pas, rakip sahada yapılan pas, orta, köşe vuruşu ve ofsayt sayıları	Bilgisayarlı video analizi

Tablo 15 *Farklı bağlamlara göre performans parametreleri*

Çalışma	Örneklem	Bağlamsal Değişken	Etkilenen Performans Değişkeni
Zhou et.al., (2018)	Çin Liginden 1056 maç gözlemi	Maç sonucu ve rakip kalitesi	Şut, kaleyi bulan şut, ikili mücadele, topa sahipken ve top rakipteyken kat edilen sprint ve yüksek hızdaki koşu mesafesi
Liu et.al., (2015)	2014 FIFA Dünya Kupası	Maç Sonucu	Şut, kaleyi bulan şut, kontratakta çekilen şut, ceza sahası içinden çekilen şut, orta, kısa pas, dripling, hava topu mücadelesi sayıları ve topla oynama yüzdesi
Andrzejewski et.al., (2016)	2014-2015 sezonu Almanya Ligi	Maç sonucu ve oyuncuların mevkileri	Yüksek ve düşük şiddette yapılan koşu mesafeleri
Lago-Peñas and Lago-Ballesteros (2011)	2008-2009 sezonu İspanya Ligi	Maçın oynandığı yer ve takım kalitesi	Şut, kaleyi bulan şut, orta, ceza sahasında topla buluşma, ofsayt, isabetli pas, dripling sayıları ve topla oynama yüzdesi
Rampinini et.al., (2009)	2004-2005 sezonu İtalya Ligi	Takım kalitesi	Kat edilen toplam mesafe, yüksek şiddetli koşularda kat edilen mesafe, topa sahipken yüksek şiddetli koşularda kat edilen mesafe, topla buluşma, kısa pas, top çalma, dripling, şut ve kaleyi bulan şu sayıları
Di salvo et.al., (2009)	2003-2004, 2004-2005, 2005-2006 İngiltere Premier Ligi sezonları	Takım kalitesi ve oyuncuların mevkileri	Yüksek şiddetli koşularda kat edilen mesafe
Castellano et.al., (2011)	İspanya Ligi 2005-2006 sezonu	Maçın oynandığı yer, takım kalitesi, rakip kalitesi ve maç devreleri	Yüksek, düşük ve orta şiddetli koşularda kat edilen mesafeler.

Tablo 15 (devamı)

Bush et.al., (2015)	İngiltere Premier Ligi 2005-2006 ile 2012-2013 arası sezonlar	Rakip kalitesi ve oyuncu mevkileri	Yüksek şiddetli koşularda kat edilen mesafe, topa sahipken yapılan yüksek şiddetli koşularda kat edilen mesafe, top çalma, pas sayıları ve topla oynama yüzdesi

Çalışmanın amacı

Bu çalışmanın amacı, maç sonucu (galibiyet, beraberlik, mağlubiyet), takım kalitesi (lig sonunda ilk altı sırada yer alan üst klasman, altı ve on ikinci sıra arasında yer alan orta klasman ve son altı sırada yer alan alt klasman) ve rakip kalitesine (lig sonunda ilk dokuz sırada yer alan üst ve son dokuz sırada yer alan alt klasman) göre profesyonel futbolcuların fiziksel ve teknik performans parametrelerindeki değişimleri incelemektedir.

Araştırma soruları

Bu çalışma aşağıdaki sorulara cevap aramaktadır:

1. Fiziksel ve teknik performans parametrelerinde maç sonucuna göre farklılık oluşuyor mu?
2. Fiziksel ve teknik performans parametrelerinde takım kalitesine göre farklılık oluşuyor mu?
3. Fiziksel ve teknik performans parametrelerinde rakip kalitesine göre farklılık oluşuyor mu?

Çalışmanın önemi

Literatürde daha önce yapılan fiziksel ve teknik performans parametrelerinin çeşitli bağlamlara göre (maç sonucu, takım kalitesi, rakip kalitesi, maç statüsü, çevresel etmenler, maçın yapıldığı yer vb.) gösterdiği varyasyonları inceleyen çalışmalar üst düzey Avrupa ligleri ve uluslararası turnuvaları örneklem olarak alırken görece daha alt seviyede yer alan Türkiye Süper Ligi (UEFA sıralamasına göre 18. sırada yer almaktadır) bu alanda çalışma olmadığı tespit edilmiştir. Daha önce yapılan bir çalışmaya göre (Gomez et.al., 2013) takım performansı farklı lig veya turnuvalara göre hem takımlar arası hem takım içi değişiklikler gösterebilir. Bu sebeple, Türkiye Süper Liginde yapılan bu çalışma ile maç sonucu (galibiyet, beraberlik, mağlubiyet), takım kalitesi (lig sonunda ilk altı sırada yer alan üst klasman, altı ve on ikinci sıra arasında yer alan orta klasman ve son altı sırada yer alan alt klasman) ve rakip kalitesine (lig sonunda ilk dokuz sırada yer alan üst ve son dokuz sırada yer alan alt klasman) göre profesyonel futbolcuların fiziksel ve teknik performans parametrelerindeki değişimlerin saptanması amaçlanmıştır. Bu çalışma maç performans analiz literatürüne katkı sağlayacağı kadar Türkiye Süper Liginde çalışan antrenör ekibi, oyuncu ve ilgili performans ekibine de daha etkili antrenman programı hazırlamaları ve maç performansı analizi hususunda yardımcı olabilecek bir kaynak olacaktır.

YÖNTEM

Veri Kaynağı

Türkiye Süper Ligi 2019-2020 sezonu Ağustos 2019 ve Temmuz 2020 tarihleri arasında oynanmıştır. 18 takımdan oluşan lig iki devre usulü her takım kalan 17 takımla iç saha ve dış sahada birer maç oynamıştır. 34 hafta süren ligde toplam 306 maç oynanmış olup bu çalışmada Sports Analytics Company® tarafından sağlanabilen 122 maçın gözleminden elde edilen veriler analiz edilmiştir. Sentio Analytics, yarı otomatik bilgisayarlı kamera izleme sistemiyle maçlarda anlık olarak verileri

toplamaktadır. İki adet 4K kamera santra çizgisine olabildiğince yakın bir bölgeye konumlandırılarak maç başlamasından önce gerekli optimizasyon ayarları yapılarak santra vuruşundan itibaren anlık verileri bilgisayar ortamına aktarır. Verilerin kullanımı için firmanın yazılı izni alınmıştır.

Örneklem

Bu çalışmanın yürütülmesi, Orta Doğu Teknik Üniversitesi İnsan Araştırmaları Etik Kurulu tarafından "425-ODTU-2021" protokol numarası ile uygun bulmuştur. Performans parametreleri üç farklı bağlama (maç sonucu, takım kalitesi ve rakip kalitesi) göre analiz edildiği için üç farklı örneklem yöntemi izlenmiştir. Birinci bağlam için (maç sonucu), incelenen 122 maçın 85'i bir tarafın galibiyeti ile sonuçlandığı için 85 galip gelen ve 85 mağlup olan takım oluşurken 37 maç beraberlikle sonuçlandığı için 74 adet berabere kalan takım olarak sınıflandırılmıştır. İkinci bağlam için (takım kalitesi), ligi 1-6. sırada bitiren takımlar üst klasman, 7-12. Sırada bitiren takımlar orta klasman ve 13-18. Sırada bitirenler ise alt klasman olarak sınıflandırıldı. Son bağlam olan rakip kalitesi için ise ligi ilk dokuz sırada bitiren takım üst klasman ve son dokuz sırada bitiren takım ise alt klasman olarak sınıflandırılmıştır.

Veri Analizi

Bu çalışmada verilerin analizinde maç sonucu ve takım kalitesine göre performans parametrelerinin değişimlerinde gruplar arasındaki anlamlı değişimleri saptamak için tek yönlü varyans analizi (ANOVA) kullanılmış ve anlamlı çıkan değişkenler için Bonferroni Post Hoc testi uygulanmıştır. Rakip kalitesine göre olan anlamlı değişimleri saptamak için bağımsız örneklem t-test kullanılmıştır. Bu çalışmada anlamlılık seviyesi $p < 0.05$ olarak belirlenmiştir. Tüm istatistiksel analizler IBM SPSS programında yürütülmüştür.

BULGULAR

Maç Sonucu

Bulgulara göre kazanan ve kaybeden takımlar beraberlik alan takımlardan anlamlı bir şekilde daha fazla sayıda yüksek şiddetli koşu $F(2, 241) = 4.558$, $p = 0.011$ yüksek hızda koşu performansı $F(2, 241) = 4.281$, $p = 0.015$ göstermiştir. Bunun yanı sıra kazanan takımın ortalama hızı kaybeden ve beraberlik alan takımlardan anlamlı bir şekilde yüksekti $F(2, 241) = 5.004$, $p = 0.007$. Topa sahipken yüksek şiddetli koşularda kat edilen mesafe kazanan takımlarda berabere kalan takımlara göre daha yüksekken $F(2, 241) = 5.684$, $p = 0.004$, top oyun dışındayken yüksek şiddetli koşularda kat edilen mesafe kaybeden takımlarda berabere kalan takımlara göre daha yüksektir $F(2, 241) = 5.260$, $p = 0.006$. Kazanan takım topa sahipken, kısa koşu ile kat dilen mesafede $F(2, 241) = 17.805$, $p = <0.001$ ve yüksek hızda kat edilen mesafede beraberlik alan ve kaybeden takımlardan daha yüksek performans sergilemiştir. $F(2, 241) = 11.361$, $p = <0.001$. Ancak top rakipteyken, kaybeden takım kısa koşu ile kat edilen mesafede SOP $F(2, 241) = 9.366$, $p = <0.001$ ve yüksek hızlı koşular ile kat edilen kazanan ve beraberlik alan takımlardan daha yüksek performans göstermiştir $F(2, 241) = 6.642$, $p = 0.002$.

ANOVA sonuçlarına göre başarısız pas sayısı beraberlik alan takımlarda en yüksekken onu kaybeden ve kazanan takımlar takip etmiş. $F(2, 241) = 7.256$, $p = 0.001$. Bulgulara göre, isabetli pas yüzdesi kazanan ve kaybeden takımlarda beraberlik alan takımlara göre anlamlı bir şekilde daha yüksektir $F(2, 241) = 5.971$, $p = 0.003$. Kazanan takımlar açık bir şekilde kaybeden ve beraberlik alan takımlardan daha fazla sayıda kaleyi bulan şut performansı sergilemişlerdir $F(2, 241) = 25.905$, $p = <0.001$. Bunların yanı sıra, isabetsiz orta sayıları kaybeden takımlarda kazanan takımlara nazaran anlamlı bir şekilde daha yüksektir $F(2, 241) = 5.607$, $p = 0.004$. Son olarak, kırmızı kart sayıları

kaybeden takımlarda kazanan takımlara göre daha yüksek olarak saptanmıştır $F(2, 241) = 4.431$, $p = 0.013$.

Takım Kalitesi

Çalışmada elde edilen bulgularına göre orta klasman takımlar, yüksek şiddetli koşularda kat ettikleri mesafede, $F(2, 241) = 4.424$, $p = 0.013$, yüksek hızda kat ettikleri mesafede, $F(2, 241) = 4.223$, $p = 0.016$, topa sahipken yüksek şiddetli koşularda kat ettikleri mesafede $F(2, 241) = 7.026$, $p = 0.001$, topa sahipken kısa koşularda kat ettikleri mesafede $F(2, 241) = 6.161$, $p = 0.002$ ve top sahipken yüksek hızdaki koşularında kat ettikleri mesafeleri $F(2, 241) = 8.319$, $p = <0.001$ alt klasman takımlara göre anlamlı bir şekilde daha yüksektir. Ayrıca, üst klasman takımlar topa sahipken yüksek şiddetli koşu mesafesi, kısa koşularda ve yüksek hızdaki koşularda daha yüksek performans sergilemişlerdir.

Analiz sonuçlarına göre, üst klasman takımlar alt klasman takımlara göre anlamlı olarak daha fazla sayıda kısa pas $F(2, 241) = 3.426$, $p = 0.034$, isabetli şut $F(2, 241) = 6.487$, $p = 0.002$, isabetli orta $F(2, 241) = 9.065$, $p = <0.001$, köşe vuruşu $F(2, 241) = 6.128$, $p = 0.003$ ve topla oynama süresi $F(2, 241) = 3.268$, $p = 0.040$ sergilemiştir. Dahası, orta klasman takımların da isabetli orta sayısı anlamlı bir şekilde alt klasman takımlardan yüksek bulunmuştur.

Rakip Kalitesi

Üst klasman takımların rakibi alt klasman takımlarken üst klasman rakipleriyle oynadıklarına göre daha fazla yüksek hızda koşu mesafesi $t(128) = 2.883$, $p = 0.005$, $d = 0.51$, daha fazla sayıda yüksek şiddetli koşu $t(128) = 2.394$, $p = 0.018$, $d = 0.42$, daha fazla sayıda kısa koşu $t(128) = 2.843$, $p = 0.005$, $d = 0.50$, topa sahipken daha fazla mesafe $t(128) = 2.630$, $p = 0.010$, $d = 0.46$, topa sahipken daha fazla yüksek şiddetli koşu mesafesi $t(128) = 2.539$, $p = 0.012$, $d = 0.45$ ve topa sahipken daha fazla yüksek hızda koşu mesafesi performansı sergilemiştir $t(128) = 2.292$, $p = 0.024$, $d = 0.41$. Ancak, üst klasman takımlar yine üst klasman takımlarla rakip olduklarında top

rakipteyken yüksek şiddetli koşu mesafesi t(128) = 2.497, p = 0.014, d = 0.44, top rakipteyken kısa koşu mesafesi t(128) = 2.257, p = 0.026, d = 0.40 ve top rakipteyken yüksek hızdaki koşu mesafesi t(128) = 2.292, p = 0.024, d = 0.40, daha yüksek olarak bulunmuştur. Son olarak, oyunun durduğu zamanlarda da yüksek hızdaki koşu mesafeleri daha yüksek olarak saptanmıştır t(128) = 2.501, p = 0.014, d = 0.44.

Başarılı pas sayısı $t(128) = 2.834$, $p = 0.005$, $d = 0.50$, isabetli pas yüzdesi $t(128) = 3.875$, $p = <0.001$, $d = 0.69$, kısa pas sayısı (<30m) $t(128) = 2.611$, $p = 0.010$, $d = 0.46$, kaleyi bulan şut sayısı $t(128) = 3.877$, $p = <0.001$, $d = 0.69$, isabetli orta sayısı $t(128) = 2.354$, $p = 0.020$, $d = 0.42$ ve topla oynama yüzdesi $t(128) = 2.212$, $p = 0.029$, $d = 0.39$ anlamlı olarak üst klasman takımlarda rakipleri alt klasmanken rakiplerinin üst klasman olmasına göre daha yüksek olarak bulunmuştur. Ancak, rakipleri de üst klasman takımlarken isabetsiz pas sayısı $t(128) = 2.601$, $p = 0.010$, $d = 0.46$, ve topla oynama süreleri daha yüksek olarak saptanmıştır $t(128) = 2.6100$, $p = 0.010$, $d = 0.46$.

Alt klasman takımlar üst klasman rakipleriyle karşılaşırken alt klasman rakiplerle olan mücadelelere göre daha fazla mesafe kat ettikleri parametreler şu şekilde bulunmuştur: top rakipteyken kat edilen toplam mesafe $t(112) = 2.807$, $p = 0.006$, $d = 0.53$, top rakipteyken yüksek şiddetli koşularla kat edilen mesafe $t(112) = 2.243$, $p = 0.027$, $d = 0.42$ ve top rakipteyken yüksek hızda koşularda kat edilen mesafe $t(112) = 2.322$, $p = 0.022$, $d = 0.44$.

Alt klasman takımlarda rakipleri de alt klasmanken, isabetli şut sayısı $t(112) = 2.877$, $p = 0.005$, $d = 0.54$, isabetli orta sayısı $t(112) = 2.028$, $p = 0.045$, $d = 0.38$, topla oynama yüzdesi $t(112) = 2.799$, $p = 0.006$, $d = 0.53$ ve topla oynama süresi $t(112) = 2.053$, $p = 0.042$, $d = 0.39$ üst klasman rakiplerle oynadıkları maçlara göre daha yüksek olarak saptanmıştır.

TARTIŞMA VE SONUÇ

Maç Sonucu

Elde edilen bulgulara göre, yüksek seviyede koşu performansı galibiyet için önemli bir belirleyici etken. Daha önce Almanya Liginde yapılan bir çalışmada da bu bulgu desteklenmektedir (Hoppe et al., 2015). Brezilya Liginde yapılan bir çalışmaya göre de yüksek şiddetli aktiviteler maç sonucuyla yakından ilişkili olarak belirtilmiştir (Aquino et al., 2017). Bu çalışmada, topa sahip olma oranları gruplar arasında anlamlı bir farklılık göstermese de topa sahipken yapılan yüksek şiddetli aktiviteler de gruplar arasında anlamlı şekilde farklılıklar göstermiştir. Zhou ve arkadaşları (2018) tarafından yürütülen bir çalışmada da bu çalışmayı destekler nitelikte sonuçlar elde edilmiştir. Kısacası, profesyonel futbolda, özellikle Türkiye Süper Liginde, topa sahipken yapılan yüksek şiddetli ve hızlı aktiviteler maç sonucunda belirleyici bir unsurdur.

Bu çalışma daha önceki çalışmalarda olduğu gibi (Lago-Peñas et al., 2010; Castellano et al., 2012; Zhou et al., 2018) isabetli şut sayısının maç sonucuna göre anlamlı değişiklik gösterdiğini saptamıştır. Daha önce Yue ve arkadaşları (2014) tarafından vurgulandığı gibi şut sayısından ziyade şutun kalitesi maç kazanmada daha belirleyici bir etmendir.

Kazanan takımların beraberlik alan ve kaybeden takımlardan daha az isabetsiz pas yaptığı gözlemlenmiştir. Çarpıcı bir şekilde kaybeden takımlar beraberlik alan takımlara göre daha az isabetsiz pas yapmışlardır. Pas yüzdesinde benzer sonuçlar Alves ve arkadaşları (2019) tarafından da 2018 FIFA Dünya Kupasında yapılan bir çalışmada rapor edilmiştir. Dahası, UEFA Şampiyonlar Ligi (Lago-Peñas et al., 2011) ve İspanya Liginde (Lago-Peñas et al., 2010) yapılan çalışmalar da kazanan takımlarda isabetli pasların fazlalığını raporlamıştır. Bunun yanı sıra, Çin Liginde olduğu gibi

(Zhou et.al., 2018) bu çalışmada da isabetsiz ortalar kazanan takımlarda anlamlı bir şekilde daha az gözlemlenmiştir.

Kural ihlali ile ilgili değişkenlerden sadece kırmızı kart sayılarında gruplar arasında anlamlı değişiklik bulunmuştur. Kırmızı kart sayısı kazanan takımlarda kaybeden takımlara göre anlamlı bir şekilde daha az görülmüştür. Bu bulgular UEFA Şampiyonlar Ligi (Lago-Peñas et al., 2011) ve İspanya Liginde (Lago-Peñas et al., 2010) yapılan çalışmalarda çıkan sonuçlarla paralellik göstermektedir.

Topla oynama yüzdesi Afrika Uluslar Kupası 2017'de yapılan bir çalışmada (Kubayi & Toriola, 2020) kazanan takımlarda daha düşük çıkarken başka bir çalışmada (Lago-Peñas et al., 2010) bunun tam tersine kazanan takımların topla oynama yüzdesi daha yüksek bulunmuştur. İki çalışmanın aksine, bu çalışmada topla oynama yüzdesi değişkeninde gruplar arasında anlamlı bir farklılık saptanmamıştır.

Takım Kalitesi

Topa sahipken yüksek hızda, yüksek şiddette ve kısa koşularda kat edilen toplam mesafe ve yüksek şiddetli koşularda kat edilen mesafe ve yüksek hızda kat edilen toplam mesafe üst klasman takımlarda daha yüksek olarak bulunmuştur. Bu çalışmaya paralel olarak İtalya Liginde (Rampinini et al., 2009) ve Almanya Liginde (Hoppe et.al., 2015) yapılan çalışmalarda da benzer bulgular elde edilmiştir.

Üst klasman takımlar alt klasman takımlara göre daha fazla sayıda kısa pas, isabetli şut, isabetli orta, köşe vuruşu ve topla oynama süresi sergilemişlerdir. Rampinini ve arkadaşları (2009) İtalya Liginde yaptıkları çalışmada kısa pas ve isabetli şut sayılarında benzer sonuçları raporlamışlardır. İspanya Liginde yapılan başka bir çalışmada da (Liu et.al., 2016) topla oynama süreleri ve isabetli şut sayıları parametreleri bu çalışmadaki bulguları desteklemektedir.

Son olarak bu çalışmadaki bulgular isabetli orta sayısının üst klasman takımlarda daha yüksek olduğunu ortaya koymuştur. Daha önce yapılmış bazı çalışmaların sonuçları

da daha az başarılı takımların daha fazla isabetsiz orta yaptığını saptamıştır (Liu, Gómez, Gonçalves, et al., 2016; Liu, Hopkins, & Gómez, 2016).

Rakip Kalitesi

Elde edilen bulgulara göre üst klasmanda yer alan takımlar alt klasman takımlarla maç yaparken daha fazla sayıda yüksek şiddette koşu, kısa koşu ve yüksek hızda koşular yaparken top oyun dışındayken de daha fazla mesafeyi yüksek şiddette koşu, kısa koşu ve yüksek hızda koşular kat etmişlerdir. Önceki çalışmalarda (Mohr et al., 2003; Rampinini et al., 2009), rakip kalitesi düştükçe kat edilen toplam mesafede düştüğüne dair bulgular elde edilmiştir. Bunun aksine ise mevcut çalışmada kat edilen toplam mesafe ile ilgili anlamlı bir değişiklik saptanmamış, sadece yüksek şiddet ve hızlardaki aktivitelerde farklılıklar gözlemlenmiştir.

Üst klasman takımlar yine üst klasman takımlarla oynarlarken ise top rakipteyken kat ettikleri toplam mesafe, top rakipteyken kat ettikleri yüksek şiddetli koşulardaki mesafeleri ve top rakipteyken yüksek hızdaki mesafeleri daha yüksek olarak saptanmıştır. Bu durum mevcut çalışmada gözlemlendiği üzere daha iyi rakiplerin top kendilerindeyken daha çok yüksek şiddet ve hızlarda mesafe kat etmelerinden kaynaklanıyor olabilir. Daha önce yürütülmüş başka bir çalışma (Castellano et al., 2011) sonuçlarına göre rakip kalitesi arttıkça yüksek hız ve şiddetlerde kat edilen mesafeler artıyor sonucu da bu bulguyu destekler niteliktedir.

Hem üst klasman takımlar hem de alt klasman takımlar rakip olarak alt klasman takımlarla karşılaşırken isabetli şut sayıları, isabetli orta sayıları, topla oynama yüzdeleri ve süreleri daha yüksek olarak bulunmuştur. Buna ek olarak üst klasman takımlarda isabetli pas ve kısa pas sayıları da anlamlı bir şekilde yüksektir. Bu bulgulara destek olarak Lago-Peñas ve arkadaşları İspanya Ligi ve UEFA Şampiyonlar Liginde yürüttükleri iki çalışma ile (2010, 2011) üst düzey takımların daha alt düzey rakipleri karşısında daha iyi pas performansı sergilediklerini raporlamışlardır. Dahası, daha güçlü rakiplerle oynanan maçlarda takımların daha düşük topla oynama yüzdeleri

de birçok çalışmada benzer bulgularla raporlanmıştır (Lago, 2009; Lago-Peñas et al., 2011; Fernandez-Navarro et al., 2018).

Sonuç

Bu çalışmada 2019-2020 Türkiye Süper Liginde oynayan futbolcuların fiziksel ve teknik performanslarındaki değişimler farklı bağlamsal etmenlere (maç sonucu, takım kalitesi ve rakip kalitesi) göre incelemiştir. Günümüzdeki verilere göre literatürde daha önce Türkiye Süper Liginde maç performans analizi konusunda çalışma ya hiç yapılmadığı ya da sınırlı bir şekilde çalışıldığı için bu çalışma Türkiye Süper Liginde görev alan antrenör ve performans ekibi için önemli bir kaynak olabilir. Bu çalışmadan çıkarılacak sonuçlardan bir tanesi kazanan takımların topa sahipken sergilemiş oldukları yüksek şiddet ve yüksek hız koşu aktiviteleri diğer takımlara göre yüksek olmuştur. Ayrıca, kazanan takımların isabetli şut sayıları da anlamlı bir şekilde diğer takımlardan ayrışmaktadır. Takım kalitesine göre incelendiğinde ise üst klasman takımların topa sahipken yüksek hız, yüksek şiddet ve kısa koşulardaki üstün performansı ile diğer gruplardan farklılaştığı gözlemlenmiştir. Buna ilave olarak üst klasman takımlar, isabetli orta, isabetli şut, köşe vuruşu, kısa pas ve topla oynama süresi performanslarıyla da öne çıkmaktadır. Türkiye Süper liginde rakip daha üst seviyedeyse top rakipteyken kat edilen yüksek hızda ve yüksek şiddetteki koşu mesafeleri anlamlı bir artış göstermektedir. Rakip kalitesi görece daha düşük olduğunda ise, kısa koşu sayıları, yapılan yüksek hızlı koşu sayıları artmaktadır. Buna ilaveten, rakip seviyesi düştükçe topun oyun dışında olduğu anlarda kat edilen yüksek hız ve yüksek şiddetli koşu mesafeleri de artış göstermektedir. Son olarak, alt seviyedeki rakiplere karşı takımlar daha fazla isabetli pas, isabetli şut, kısa pas yapmakta ve topa daha çok sahip olmaktadırlar.

Çalışmanın Etkileri

Türkiye Süper Liginde görev alan antrenör ekipleri topa sahipken yapılacak yüksek şiddet ve yüksek hızdaki aktiviteleri geliştirecek antrenman yöntemlerine odaklanmanın yanı sıra oyuncularında hız bileşenini de bireysel olarak geliştirmeyi

hedeflemelidirler. İsabetli şut sayısının sonuçları göstermiştir ki şutların niceliğinden çok niteliği çok daha etkili olmaktadır. Bu yüzden şut kalitesini arttırıcı çalışmalar antrenman programlarına eklenmelidir. Bu bulgular, maç stratejisi belirlenirken de takım kalitesi ve rakip kalitesine göre hangi parametrelerin öne çıkacağının ön görüsü için kullanılmalıdır.

İkinci olarak, bu çalışma üst klasmanda ligi bitiren takımlarda yüksek hız, yüksek şiddet ve kısa koşu mesafelerinin topa sahipken yüksek olduğu göz önüne alınarak kısa koşu antrenmanları da yukarı da belirtilen önerilere eklenebilir. İlave olarak, orta kalitesini arttıracak çalışmalar ve uzun pastansa kısa pas tercihlerini arttırarak yüksek oranda topa sahip olunan oyun stratejilerinin seçilmesi başarı oranını arttırabilir.

Üst seviye takımlarla karşılaşırken, top rakipteyken yüksek şiddetli koşu, yüksek hızda koşu ve toplam koşu mesafelerinin artacağı ön görüsünde bulundurularak maç sonu performans değerlendirmeleri veya maç öncesi stratejileri bu minvalde değerlendirilmeye alınmalıdır. Alt seviye takımlara karşı ise topun durduğu anlarda yüksek hız ve yüksek şiddetteki koşu mesafelerinde artma olacağı göz ardı edilmeyerek maç sonu veya maç öncesi değerlendirmeleri yapılmalıdır. Son olarak, daha alt seviye rakiplere karşı takımların isabetli pas, isabetli şut, kısa pas ve topla oynama yüzdesini arttırdığı verisi performans ve maç stratejisi analizlerinde değerlendirmeye katılmalıdır.

Araştırmanın Sınırlılıkları ve Gelecek Araştırmalar İçin Öneriler

1- Çalışmayı yürütmek için kullanılan veriler tek bir sezondan toplandığı için sonuçların genellemesi istatistiksel olarak çalışmayı zayıflatmıştır. Gelecekteki çalışmalar daha fazla sezondan toplayacakları daha fazla örneklem ile daha güçlü genellemelere varabilir.

2- Bu çalışmanın analizine çevresel etmenler katılmamıştır. Çevresel etmenlerin performans üzerindeki etkileri geçmiş araştırmalar tarafından vurgulanmıştır (Trewin

et al., 2017). Bu nedenle ilerideki çalışmalarda sıcaklık, yükseklik ve nem gibi çevresel faktörlerin göz önünde bulundurulması faydalı olabilir.

3- Verilerin toplandığı 2019-2020 sezonu COVID-19 pandemisi sebebiyle yarıda kesilmiş, pandemi sonrası dönemdeki maçlar seyircisiz olarak oynanmıştır. Gelecek çalışmalar analizlerini yürütürken seyirci açısından maçların homojenliğini gözetmesi daha isabetli bulgular elde edilmesinde yarar sağlayabilir.

C. THESIS PERMISSION FORM / TEZ İZİN FORMU

(Please fill out this form on computer. Double click on the boxes to fill them)

ENSTİTÜ / INSTITUTE

Fen Bilimleri Enstitüsü / Graduate School of Natural and Applied Sciences ☐

Sosyal Bilimler Enstitüsü / Graduate School of Social Sciences ☒

Uygulamalı Matematik Enstitüsü / Graduate School of Applied Mathematics ☐

Enformatik Enstitüsü / Graduate School of Informatics ☐

Deniz Bilimleri Enstitüsü / Graduate School of Marine Sciences ☐

YAZARIN / AUTHOR

Soyadı / Surname : Biber
Adı / Name : Koray
Bölümü / Department : Beden Eğitimi ve Spor / Physical Education and Sports

TEZİN ADI / TITLE OF THE THESIS (**İngilizce** / English):

TEZİN TÜRÜ / DEGREE: **Yüksek Lisans** / Master ☒ **Doktora** / PhD ☐

1. **Tezin tamamı dünya çapında erişime açılacaktır. /** Release the entire work immediately for access worldwide. ☒
2. **Tez iki yıl süreyle erişime kapalı olacaktır.** / Secure the entire work for patent and/or proprietary purposes for a period of **two years. *** ☐
3. **Tez altı ay süreyle erişime kapalı olacaktır.** / Secure the entire work for period of **six months**. ***** ☐

***** *Enstitü Yönetim Kurulu kararının basılı kopyası tezle birlikte kütüphaneye teslim edilecektir. / A copy of the decision of the Institute Administrative Committee will be delivered to the library together with the printed thesis.*

Yazarın imzası / Signature ..... **Tarih** / Date .....
(Kütüphaneye teslim ettiğiniz tarih. Elle doldurulacaktır.)
(Library submission date. Please fill out by hand.)

Tezin son sayfasıdır. / This is the last page of the thesis/dissertation.