What are the key performance indicators for a top position in the German Bundesliga?: 2022-2023 Bundesliga season example

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Abstract

The aim of the study is to compare the performance of the teams in the Bundesliga in the 2022/23 season according to the league ranking and to examine the relationship between these parameters and the points collected by the teams at the end of the season. The sample of the study consists of 612 matches played in the Bundesliga in the 2022/23 season. The data of the matches were collected from the Bundesliga official website; 8 technical, tactical, and 4 physical performance, 12 parameters in total were evaluated. Teams were group as top, middle and bottom according to their end-of-season rankings. MANOVA test was performed to reveal the difference between the teams and effect sizes were reported as partial eta squared (ηp^2). Pearson Correlation Test was applied to determine the relationships between the performance parameters of the teams and the points they collected. As a result of the analyses, it was determined that the top ranked teams had a statistically significant difference in the number of goals scored and conceded, number of shots and total points compared to the middle and bottom ranked teams. Significant positive relationships were found between total points and possession of the ball, accurate passing, goals scored, shots scored at very high and excellent level, and significant negative relationships were found with goals conceded and number of air balls won at high level. As a result, it can be said that the teams should passes the ball more, use the ball positively, utilise the opportunities positively, increase the number of goals and shots scored and decrease the number of goals conceded in order to take their place in the top ranks.

Keywords: Analysis, bundesliga, football, goal, running distance

Almanya Bundesliga'da üst sıralarda yer almak için hangi temel performans göstergelerine sahip olunmalı?: 2022-2023 sezonu Bundesliga örneği

Öz

Çalışmanın amacı, 2022/23 sezonunda Bundesliga'da yer alan takımların lig sıralamasına göre performans karşılaştırmasını yapmak ve takımların sezon sonunda topladıkları puan ile bu parametreler arasındaki ilişkiyi incelemektir. Araştırmanın örneklemini 2022/23 sezonunda Bundesliga'da oynanan 612 maç oluşturmaktadır. Müsabakalara ait veriler Bundesliga resmi internet sitesi üzerinden toplanmış; 8 teknik, taktik ve 4 fiziksel performans, toplamda 12 parametre değerlendirilmiştir. Takımlar sezon sonu sıralamalarına göre üst (1-6), orta (7-15) ve alt (16-18) sıralar olmak üzere gruplandırılmıştır. Takımlar arasındaki farkı ortaya koyabilmek için MANOVA testi yapılmış, etki büyüklükleri partial eta squared (ηp^2) olarak raporlanmıştır. Takımların performans parametreleri ile topladıkları puan arasındaki ilişkileri belirlemek için ise, Pearson Korelasyon Testi uygulanmıştır. Analizler sonucunda, üst sıralardaki takımların orta ve alt sıralardaki takımlara göre attığı ve yediği gol, şut sayısı ve toplam puanları istatistiksel olarak anlamlı bir farklılığa sahip olduğu belirlenmiştir. Toplanan puan ile topa sahip olma, isabetli pas, atılan gol, şut arasında çok yüksek ve mükemmel düzeyde pozitif; yenilen gol ve hava topu kazanma sayısı ile yüksek düzeyde negatif yönlü anlamlı ilişkiler ortaya koyulmuştur. Sonuç olarak, takımların üst sıralarda yerini alabilmeleri için topa daha fazla sahip olup topu olumlu kullanması, eline geçen fırsatları olumlu şekilde değerlendirmesi, attığı gol ve şut sayısını arttırması ve yediği gol sayısını azaltması gerektiği söylenebilir.

Anahtar Kelimeler: Analiz, bundesliga, futbol, gol, koşu mesafesi

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INTRODUCTION

Football is a highly complex sport involving the interaction between physical and technical factors (Bradley et al., 2013; Mota et al., 2016) and match performance is multifactorial. This performance is characterized by the interaction of technical, tactical, physical, physiological, and psychological components (Vergonis et al., 2019). In football, where the main goal is to defeat the opponent, it is necessary to initially determine and improve the level of physical conditioning in order to achieve this goal and compete successfully (Ertetik & Müniroğlu, 2021). In addition, a high level of technical skill and advanced tactical behavior parameters should also be present (Carling, 2013). At this point, one of the methods used to collect data is match analysis.

Match analysis is the basis of determining the match strategy and tactics, and with the development of technology, computer software allows easy analysis of technical, tactical, and physical performance components determined during the match (Arı & Deliceoğlu, 2020). Competition analysis (Lago-Penas et al., 2011), which is used to evaluate the characteristics that are of great importance for every coach in order to determine the strengths and weaknesses of both their own and the opposing team, also enables physiological, biological, technical, and tactical development (Safiq et al., 2013). In the analysis, the systems can provide useful information about the match-related statistics of various activities such as the number of fouls and shots taken by the players, ball control and passing variables, and the performances of the teams that won and lost the matches (Moura et al., 2014; Bilgin & Müniroğlu, 2022). Ball possession and pass success percentage can also be added to this list (Göral, 2015).

An increase in match physical and technical performance parameters has been reported in professional football over the last decade (Bush et al., 2015; Bradley et al., 2016; Reynolds et al., 2021). In another study in the literature, it was shown that there are different physical requirements between teams depending on various factors (Rampinini et al., 2007). In addition, it has been reported that physical performance may also play a supporting role in successful technical performance (Hoppe et al., 2015; Chmura et al., 2017; Andrzejewski et al., 2018; Yang et al., 2018). On the other hand, some existing studies on the subject have also shown that team success at the end of the season is related to technical performance (Lago-Ballesteros & Lago-Penas, 2010; Lago-Penas & Lago-Ballesteros, 2011; Kite & Nevill, 2017; Yang et al., 2018; Lepschy et al., 2020; Andrzejewski et al., 2022).

In professional football, a season usually lasts 9-10 months and it is essential for teams to maintain a consistent performance at their best throughout the whole season in order to achieve an ideal ranking at the end of the season (Chmura et al., 2019). However, both physical and technical performances of football players can vary from match to match (Rampinini et al., 2007; Bush et al., 2015; Carling et al., 2016; Liu et al., 2016). Therefore, revealing the match performance of football teams in a season is important for coaches to adjust their training programs to maximize the physical and technical performance of their players and teams throughout the whole season (Chmura et al., 2019).

Nowadays, football has become a game played in faster and narrower spaces. Considering this situation, it is thought that research should be carried out to improve player and team performance. It is thought that it is important that the sample of these studies to be conducted consists of high-level leagues, tournaments, or organizations in order to reflect today's understanding of football. In addition, it seems necessary to investigate whether physical game parameters as well as technical and tactical components can make a distinction at the point of achieving success. To date, a limited number of studies have identified the relationship between physical performance and a team's final position in the rankings (Hughes & Churchill, 2005; Di Salvo et al., 2009; Lago-Penas, Rampinini et al., 2009; Lago-Penas et al., 2010; Lago-Ballesteros, & Rey, 2011; Safiq et al., 2013; Clemente et al., 2019; Brito-Souza et al., 2020). In this context, the number of studies on the correlation between team success, match technique and running performance in professional football should be increased. In addition, both match technique and running performance variables should be integrated into the same analysis for a better understanding of team success. In Germany, a football country, the Bundesliga, which is one of the best leagues in the world, combines different styles of play and therefore, the key performance indicators may be different from those determined in other national and European leagues. However, there is very little data on this topic, especially in the Bundesliga (Hoppe et al., 2015; Andrzejewski et al., 2018; Konefal et al., 2019a; Wasche, & Woll, 2020; Andrzejewski et al., 2022; Ergin et al., 2023; Lepschy et al., 2023).

On the other hand, it is thought that revealing the effect and relationship of the physical, technical and tactical performances of the teams in the top leagues on the end-of-league ranking is important for the development of today's football, and determining the parameters that are effective for the success of the teams at the end of the season will also be effective in terms of training planning, strategy and tactical understanding to be developed. In line with all these, the aim of the study is: 1) To determine the match technique and running performance required by

teams in a professional football league, 2) To compare the performance of the teams in the Bundesliga in the 2022/23 season, 3) To analyze the relationship between the success of the teams at the end of the season and the variables related to match technique, tactic and running performance, 4) To reveal the most important factors affecting the league ranking in the league.

METHOD

Study design

In this study, descriptive analysis and relational research model were used in accordance with the objectives. In this study, match technical, tactical, and running performance data collected by electronic performance and semi-automatic camera system (TRACAB, ChyronHego, New York, USA) during 612 matches in the 2022/23 season were analyzed. In addition, total points and league rankings were recorded at the end of the season to analyses the correlation between team success and variables related to match technical, tactical, and running performances. The teams were grouped in three different ways according to their end-of-season rankings: top (teams ranked between 1st-6th); middle (teams ranked between 7th-15th) and bottom (teams ranked between 16th-18th). Given that it was based on data collected in the context of professional football matches and allowed all clubs in the league to participate in the data analysis, restrictions apply to the availability of the data analyzed during the current study. Therefore, ethics committee approval and informed consent were not required.

Participants

A total of 612 matches played by the teams in the Bundesliga in the 2022/23 season constitute the sample of the study. However, the data of goalkeepers were not included in the study due to their different activity profiles (Match rules allow goalkeepers to use the ball within a certain area. Studies in the literature indicate that goalkeepers spend 98 per cent of the time during the match in low movement intensity. Their most decisive movements are their performances, which usually consist of explosive actions.) (White et al., 2018).

Data collection

The data of the matches were collected from the Bundesliga official website (Bundesliga, 2023), 8 technical, tactical (possession, percentage of accurate passes, number of goals scored and conceded, number of shots, number of duels won, number of air balls won and total points) and 4 physical performance (running distance per match, total running distance, high intensity running and number of sprints), 12 parameters in total were evaluated. In addition, the current performances of the teams in the league are associated with the points collected at the end of the season to determine which performance parameter is effective on the total points.

Statistical analysis

Data were analyzed in SPSS 25.0 package program. Mean and standard deviation values from descriptive statistics were used in the analysis. First, descriptive statistics of technical, tactical, and physical performance parameters were calculated according to the rankings at the end of the season. Shapiro-Wilks test was applied to determine the normality of the data distributions. MANOVA test with Bonferroni post-hoc test was performed to reveal the difference between the teams according to league ranking. Effect sizes were reported as partial eta squared (ηp^2). Pearson Correlation Test was used to determine the relationship between the technical, tactical, and physical performance parameters of the teams and their league rankings; Regression analysis was applied to determine which parameter was effective on the league ranking. Significance level was accepted as α=0.05. Magnitude-based reference intervals were used to describe the level of association between the data (r<0.09 insignificant; 0.1<r<0.29 small; 0.3<r<0.49 moderate; 0.5<r<0.69 high; 0.7<r<0.89 very high; r>9 excellent) (Hopkins et al., 2009).

RESULTS

At the end of the matches played in the Bundesliga in the 2022/23 season, the data revealing the differences between the technical, tactical, and physical performances of the teams in the leagues in the matches are given in Table 1.

Table 1. Comparison of technical, tactical, and physical performances according to league ranking

Parameters	Top Ranking (Mean ± sd.)	Middle Ranking (Mean ± sd.)	Low Ranking (Mean ± sd.)	F	p	ηp^2
Ball Possession (%)	52.83 ± 5.845	48.11 ± 2.848	46.00 ± 3.606	3.447	0.059	0.315
Percentage of Accurate Pass (%)	83.55 ± 4.126	79.02 ± 4.201	78.07 ±4.359	2.637	0.104	0.260
Number of Goal	66.33 ± 17.317	50.11 ± 6.153	40.67 ± 5.132	6.397	**0.010*** **(1-2;1-3)**	0.460
Conceded Goal	42.33 ± 4.227	57.78 ± 7.311	65.67 ± 7.572	16.072	**0.000*** **(1-2;1-3)**	0.682
Number of Shot	489.17 ± 96.709	396.44 ± 22.886	418.33 ± 40.674	4.358	**0.032*** **(1-2;1-3)**	0.368
Number of Duels Won	3440.67 ± 224.567	3409.44 ± 163.651	3493.00 ± 68.235	0.254	0.779	0.033
Number of Aerial Duels Won	679.83 ± 162.840	758.67 ± 140.865	774.00 ± 87.607	0.681	0.521	0.083
Total Points	59.67 ± 12.028	42.44 ± 10.051	29.67 ± 1.155	9.947	**0.002*** **(1-2;1-3)**	0.570
Running Distance Per Match (km)	115.18 ± 1.749	115.48 ± 2.241	113.86 ± .045	0.805	0.465	0.097
Total Running Distance (km)	3916.05 ± 59.395	3926.23 ± 76.214	3871.23 ± 1.557	0.802	0.467	0.097
Number of HSR	23769.50 ± 756.169	24322.44 ± 1544.029	23523.33 ± 499.324	0.647	0.537	0.079
Number of Sprint	7728.67 ± 647.033	7775.00 ± 656.611	7785.33 ± 320.382	0.013	0.987	0.002
1: top ranking; **2:** middle ranking; **3:** low ranking						

*p<0.05

According to Table 1, when the difference between the technical, tactical, and physical parameters of the teams in the Bundesliga was analyzed, a statistically significant difference was found in the number of goals scored, number of goals conceded, number of shots and total points ($p < .05$). It was determined that all of these significant differences were in favor of the top ranked teams.

The data revealing the relationship between the technical, tactical, and physical performances of the teams in the Bundesliga in the 2022/23 season and the points they collected are given in Table 2.

Table 2. The relationship between the technical, tactical, and physical performances of the teams in the Bundesliga in the 2022/23 season and the points collected

Parameters	r	p
Ball Possession (%)	2.850**	0.000
Percentage of Accurate Pass (%)	2.921**	0.000
Number of Goal	2.859**	0.000
Conceded Goal	-2.640**	0.004
Number of Shot	2.719**	0.001
Number of Duels Won	2.104	0.681
Number of Aerial Duels Won	-2.656**	0.003
Running Distance Per Match (km)	-2.073	0.773
Number of HSR	2.010	0.968
Number of Sprint	2.205	0.414

*$p < 0.05$

As a result of the analyses, very high and excellent positive correlations were found between the collected score and possession ($r = 0.850$; $p < 0.01$), accurate pass percentage ($r = 0.921$; $p < 0.01$), number of goals scored ($r = 0.859$; $p < 0.01$), number of shots ($r = 0.719$; $p < 0.01$), and high negative correlations with the number of goals conceded ($r = -0.640$; $p < 0.01$) and number of air balls won ($r = -0.656$; $p < 0.01$). No significant correlation was found between the points scored and running parameters (Table 2).

The data revealing which parameter is more effective on the points collected by the teams in the leagues at the end of the matches played in the Bundesliga in the 2022/23 season are given in Table 3.

Table 3. Factors influencing the points collected in the Bundesliga

League		Parameters	R^2	ΔR^2	β	t	p	F
Bundesliga	Model 1	Ball Possession	0.834	0.743	0.047	0.095	0.926	0.192
		Percentage of Accurate Pass (%)			0.232	0.652	0.528	
		Number of Goal			0.834	-2.863	**0.015***	
		Conceded Goal			0.651	4.460	**0.001***	
		Number of Shot			0.267	0.834	0.422	
		Number of Aerial Duels Won			0.028	0.165	0.872	

*p<0.05

In Model 1, it was observed that there was a positive and negative interaction of all parameters on the points collected by the teams. All parameters were found to explain approximately 83% of the points collected. In addition, the number of goals scored and goals conceded were found to have significant effects on the points collected by the teams (Table 3).

DISCUSSION AND CONCLUSION

The aim of this study is to compare the performance of the teams in the Bundesliga in the 2022/23 season according to the league ranking, to reveal the factors affecting the league ranking and to analyze the relationship between these parameters and the points collected by the teams at the end of the season. According to the results of the analysis, a significant difference was found between the number of goals scored, number of goals conceded, number of shots and points collected by the top teams and the data of the teams in the middle and lower ranks. This significant difference could not be found in other variables. As another result, it was found that there was a significant correlation between the points collected by the teams in the Bundesliga at the end of the season and only the match technique parameters; in addition, when we look at the level of influence of the interacting relationships on the points collected, it was determined that the most influential factor was the number of goals scored and conceded.

In our research, it was found that the teams covered an average distance of 113-115 km per match. This indicates that the players ran approximately 10-12 km during the match. These distances are similar to those reported in similar studies (Di Salvo et al., 2007; Rampinini et al., 2007).

As a result of our analysis, significant relationships were found between technical performance and total points in the Bundesliga. Previous studies in the literature have shown that technical performance is effective on team success at the end of the season (Lago-Ballesteros & Lago-Penas, 2010; Lago-Penas & Lago-Ballesteros, 2011; Kite & Nevill, 2017; Yang et al., 2018; Konefal et al., 2019b; Lepschy et al., 2020; Andrzejewski et al., 2022). Moreover, some studies have shown that technical performance may be more important than

physical performance for success in football (Liu et al., 2016; Konefal et al., 2019a). For example, a recent study in the German Bundesliga reported a trend that variables related to accuracy (e.g., shots on goal or goal efficiency, successful passes) are critical (Konefal et al., 2019b; Lepschy et al., 2020; Ergin et al., 2023). Ergin et al. (2023) aimed to investigate the effects of the goal parameters of the football teams ranked in the first four and last three places in the German Bundesliga league in the 2020-2021 season on the league table. According to the results of the study, considering the league positions of the teams included in the study, they reported that the number of goal attempts, shots, shots on goal, successful passes and key passes affected the ranking. A similar conclusion can be made according to the results of the studies conducted to determine which parameters are more effective to leave the matches victorious (Zhou et al., 2018; Coşkuner et al., 2020; Gürkan et al., 2020; Bilgin & Müniroğlu, 2022; Gürkan, 2023; Praça et al., 2023). Researchers have reported that shooting and accurate shooting averages are effective in the teams' victories. Gürkan (2023) also stated in his study that teams should also have superiority in technical parameters such as ball possession and number of accurate passes in order to rank high. As a result of their research, Parça et al. (2023) revealed that winning teams showed more ball possession, passing, successful passing and shooting performance than losing teams. In addition, researchers have shown that increased number of shots, close pressing movements, possession rates and successful passes predict winning. The results of all these studies are similar to the findings of our study.

On the other hand, according to some studies in the literature, physical performance can play an auxiliary role in successful technical performance (Hoppe et al., 2015; Chmura et al., 2017; Andrzejewski et al., 2018; Yang et al., 2018). For example, in one of these studies, it was concluded that match running performance alone did not have a significant relationship with team success, but there were positive-significant correlations between ball possession and running performance (Hoppe et al., 2015). In other studies, it has been reported that some running performance parameters have a significant relationship with the points collected by the teams at the end of the season (Lago-Ballesteros & Lago-Penas, 2010; Lago-Penas & Lago-Ballesteros, 2011; Yang et al., 2018; Brito Souza et al., 2020; Lepschy et al., 2020; Andrzejewski et al., 2022). According to a study conducted in the Spanish La Liga, football is evolving towards a more intense game where players increase the total sprint and high-intensity distances travelled in a match (Pons et al., 2021). However, there are variables related to match running performance, such as players' maximum running speed, and according to a recent study, these variables have a weak correlation with team success (Del Coso et al., 2020). The findings

of this study and the results of our study are parallel in terms of interpretation. According to the results we obtained, no relationship was found between team success and running performances. These differences with the results of some studies in the literature may be due to the fact that in our study, especially high intensity running and sprinting performances were presented in numbers rather than distance, evaluations were made over distance in studies that found a relationship, and league differences. When interpreting the results, it is thought that it would be better to make conclusion sentences by taking into consideration that different leagues have different understanding of the game.

We are aware that there are many factors that may have influenced the results of the analyses presented in this study. For example, one of the limitations of this study is that physical performance variables such as high intensity running distance, sprint distance, total acceleration or deceleration could not be reported on the site where the data were obtained. Another limitation is that this type of research should also be written considering the influence of different contextual variables such as playing position, fitness level, etc. (Oliva-Lozano et al., 2021). Furthermore, the current study focused on the 2022/23 season of the Bundesliga league. Therefore, future research could be designed to take these limitations into account for a better understanding of both physical and technical performance in professional soccer. Furthermore, running performance in the whole game sample should be analyzed for a better understanding of how running parameters affect the game.

Since significant interactions were observed between the points collected by the teams and technical performance, coaches can consider the results of this study to develop appropriate training strategies. In order for teams to be more successful at the end of the season, they need to learn to possess the ball, shoot and use the ball positively, make positive use of the opportunities they have, and especially increase the number of goals scored and decrease the number of goals conceded. On the other hand, although we did not find a relationship between running performance and team success, considering that the running activities of the teams in the top leagues are almost equal, this means that running performance should not fall below the current level in terms of establishing superiority or competing with the opponent, but rather it should be maintained or improved. Therefore, these results may have practical implications for the direction in which professional teams can improve their game.

Recommendations

Although this study analysed the matches played in one of the most important leagues in the world, it has some limitations. Firstly, the study did not include all parameters as technical and tactical performance. Secondly, in terms of physical performance evaluation, only the parameters of total running and running distances per match, high intensity running, and number of sprints were used, and parameters such as sprint distance, time spent in different speed zones were not analysed. This may lead to a generalization of the current elite level football mentality that may determine the success of the teams. On the other hand, some of the results mentioned and discussed above may be surprising, especially for coaches and scientific experts working at the professional level. However, at this point, one of the most fundamental aspects of football, the game with the ball, may be overlooked in the analyses of match performance, especially when using the GPS system. Based on this information, it can be suggested that researchers who want to conduct studies on this and similar topics should make analyses without ignoring the play with and without the ball in terms of physical performance.

GENİŞLETİLMİŞ ÖZET

GİRİŞ

Futbol, fiziksel ve teknik faktörler arasındaki etkileşimi içeren oldukça karmaşık bir spordur (Bradley ve ark., 2013; Mota ve ark., 2016) ve maç performansı çok faktörlüdür. Bu performans teknik, taktik, fiziksel, fizyolojik ve psikolojik bileşenlerin etkileşimi ile karakterize edilir (Vergonis ve ark., 2019). Ana hedefin rakibi yenmek olduğu futbolda, bu hedefe ulaşmak ve başarılı bir şekilde mücadele edebilmek için öncelikle fizik kondisyon düzeyinin belirlenmesi ve geliştirilmesi (Ertetik & Müniroğlu, 2021) ve yüksek düzeyde teknik beceri ve gelişmiş taktiksel davranış parametrelerinin de bir arada olması gerekir (Carling, 2013). Bu noktada veri toplamak amacı ile kullanılan metotlardan biri müsabaka analizidir. Müsabaka analizi, maç stratejisi ve taktiğini belirleme aşamasının temelini oluşturur ve teknolojinin gelişmesi ile bilgisayar yazılımları maç içerisinde belirlenen teknik, taktik ve fiziksel performans bileşenlerinin kolayca analiz edilmesine olanak sağlar (Arı & Deliceoğlu, 2020).

Literatürde yer alan bir çalışmada, çeşitli faktörlere bağlı olarak takımlar arasında farklı fiziksel gereksinimlerin olduğu tespit edilmiştir (Rampinini ve ark., 2007). Ayrıca, fiziksel performansın da başarılı teknik performansı destekleyici bir rol oynayabileceği bildirilmiştir (Chmura ve ark., 2017; Andrzejewski ve ark., 2018; Yang ve ark., 2018). Öte yandan, konuyla ilgili mevcut bazı çalışmalar da sezon sonundaki takım başarısının teknik performansla ilişkili olduğunu ortaya koymuştur (Yang ve ark., 2018; Lepschy et al., 2020; Andrzejewski ve ark., 2022).

Futbolun günümüzde daha hızlı ve daha küçük alanlarda oynanan bir oyun haline geldiği düşünüldüğünde, oyuncu ve takım performansını geliştirmeye yönelik araştırmaların yapılması

gerektiği düşünülmektedir. Takım başarısının daha iyi anlaşılması için hem maç tekniği hem de koşu performansı değişkenleri aynı analize entegre edilmelidir. Bir futbol ülkesi olan Almanya'da, dünyanın en iyi liglerinden biri olan Bundesliga, farklı oyun tarzlarını bir araya getirmektedir ve bu nedenle, temel performans göstergeleri diğer ulusal ve Avrupa liglerinde belirlenenlerden farklı olabilir. Ancak, özellikle Bundesliga'da bu konuda çok az veri bulunmaktadır (Andrzejewski ve ark., 2018; Konefal ve ark., 2019a; Wasche ve Woll, 2020; Andrzejewski ve ark., 2022; Ergin ve ark., 2023; Praça ve ark., 2023). Tüm bunlar doğrultusunda çalışmanın amacı: 1) Profesyonel bir futbol ligindeki takımların ihtiyaç duyduğu maç tekniği ve koşu performansını belirlemek, 2) Bundesliga'daki takımların 2022/23 sezonundaki performanslarını karşılaştırmak, 3) Takımların sezon sonundaki başarıları ile maç tekniği ve koşu performansına ilişkin değişkenler arasındaki ilişkiyi analiz etmek, 4) Ligdeki sıralamayı etkileyen ana faktörleri ortaya koymaktır.

YÖNTEM

Bundesliga 2022/23 sezonunda oynanan toplam 612 maç çalışmanın örneklemini oluşturmaktadır. Ayrıca, toplanan puan ile maç teknik, taktik ve koşu performanslarına ilişkin değişkenler arasındaki korelasyonu analiz etmek için sezon sonunda toplam puanlar ve lig sıralamaları kaydedilmiştir. Takımlar sezon sonu sıralamalarına göre üst (1-6. sıra); orta (7-15. sıra) ve alt (16-18. sıra) olmak üzere üç farklı şekilde gruplandırılmıştır. Maçlara ait erişime açık veriler Bundesliga resmi internet sitesinden toplanmış; 8 teknik, taktik (topa sahip olma, isabetli pas yüzdesi, atılan ve yenilen gol sayısı, şut sayısı, kazanılan ikili mücadele sayısı, kazanılan hava topu sayısı ve toplam puan) ve 4 fiziksel performans (maç başına koşu mesafesi, toplam koşu mesafesi, yüksek yoğunluklu koşu ve sprint sayısı) olmak üzere toplam 12 parametre değerlendirilmiştir. Veri dağılımlarının normalliğini belirlemek için Shapiro-Wilks testi; lig sıralamasına göre takımlar arasındaki farkı ortaya koymak için Bonferroni post-hoc testi ile MANOVA testi yapılmıştır. Etki büyüklükleri kısmi eta kare (ηp^2) olarak raporlanmıştır. Takımların teknik, taktik ve fiziksel performans parametreleri ile lig sıralamaları arasındaki ilişkiyi belirlemek için Pearson Korelasyon Testi; hangi parametrenin lig sıralaması üzerinde etkili olduğunu belirlemek için Regresyon analizi uygulanmıştır.

BULGULAR

Çalışmanın ana bulguları şöyledir: 1) Takımların attıkları ve yedikleri gol sayıları, şut sayıları ve toplam puanları arasında istatistiksel olarak üst sıralardaki takımlar lehine anlamlı farklar bulunmuştur; 2) Toplanan puan ile topa sahip olma, isabetli pas yüzdesi, atılan gol sayısı, şut sayısı arasında çok yüksek ve mükemmel düzeyde pozitif yönlü, yenilen gol sayısı ve kazanılan hava topu sayısı arasında ise, yüksek düzeyde negatif yönlü korelasyonlar bulunmuştur; 3) Topa sahip olma yüzdesi, isabetli pas yüzdesi, atılan ve yenilen gol sayısı, şut sayısı ve hava topu kazanma sayısı parametrelerinin takımların topladığı puanlar üzerinde pozitif ve negatif bir etkileşime sahip olduğu ve bu parametrelerin toplanan puanların yaklaşık %83'ünü açıkladığı görülmektedir. Buna ek olarak, atılan gol sayısı ve yenilen gol sayısının takımların topladığı puanlar üzerinde önemli etkileri olduğu tespit edilmiştir.

TARTIŞMA VE SONUÇ

Bu çalışmanın amacı, 2022/23 sezonunda Bundesliga'da yer alan takımların performanslarını lig sıralamasına göre karşılaştırmak, lig sıralamasını etkileyen faktörleri ortaya koymak ve bu parametreler ile takımların sezon sonunda topladıkları puanlar arasındaki ilişkiyi analiz etmektir.

Analizimiz sonucunda, Bundesliga'da teknik performans ile toplam puan arasında anlamlı ilişkiler bulunmuştur. Literatürdeki önceki çalışmalar teknik performansın sezon sonunda takım başarısı üzerinde etkili olduğunu göstermiştir (Kite ve Nevill, 2017; Yang ve ark., 2018; Konefal ve ark., 2019b; Lepschy ve ark., 2020; Andrzejewski ve ark., 2022). Dahası, bazı çalışmalar futbolda başarı için teknik performansın fiziksel performanstan daha önemli olabileceğini göstermiştir (Liu ve ark., 2016; Konefal ve ark., 2019a). Örneğin, Almanya Bundesliga'da yakın zamanda yapılan bir çalışma, isabetlilikle ilgili değişkenlerin (örneğin kaleye şutlar veya gol verimliliği, başarılı pas) kritik olduğu yönünde bir eğilim bildirmiştir (Konefal ve ark., 2019b; Lepschy ve ark., 2020; Ergin ve ark., 2023). Ergin ve arkadaşları (2023), 2020/21 sezonunda Bundesliga'da ilk dört ve son üç sırada yer alan takımların gol parametrelerinin lig tablosuna etkilerini araştırmış, çalışmanın sonuçlarına göre, gol girişimi, şut, kaleye şut, başarılı pas ve kilit pas sayılarının sıralamayı etkilediğini bildirmişlerdir. Benzer sonuçlar, maçlardan galip ayrılmak için hangi parametrelerin daha etkili olduğunu belirlemek amacıyla yapılan çalışmalardan da elde edilmiştir (Zhou ve ark., 2018; Coşkuner ve ark., 2020; Gürkan ve ark., 2020; Bilgin & Müniroğlu, 2022; Gürkan, 2023; Praça ve ark., 2023). Araştırmacılar, şut ve isabetli şut ortalamalarının takımların galibiyetlerinde etkili olduğunu bildirmişlerdir. Tüm bu çalışmaların sonuçları bizim çalışmamızın bulgularıyla benzerlik göstermektedir.

Öte yandan, literatürdeki bazı çalışmalara göre, fiziksel performans, başarılı teknik performansta yardımcı bir rol oynayabilmektedir (Hoppe ve ark., 2015; Chmura ve ark., 2017; Andrzejewski ve ark., 2018; Yang ve ark., 2018). Örneğin bu çalışmalardan birinde, maç koşu performansının tek başına takım başarısı ile anlamlı bir ilişkisi olmadığı, ancak topa sahip olma ile koşu performansı arasında pozitif-anlamlı korelasyonlar olduğu sonucuna varılmıştır (Hoppe ve ark., 2015).

Yapılan analizler sonunda elde edilen bulguları etkilemiş olabilecek sınırlılıklar bulunmaktadır. Örneğin, bu çalışmanın kısıtlamalarından biri, yüksek yoğunluklu koşu mesafesi, sprint mesafesi, toplam hızlanma veya yavaşlama gibi fiziksel performans değişkenlerinin rapor edilememiş olmasıdır. Bir diğer sınırlama ise, bu tür araştırmaların oyun pozisyonu, kondisyon seviyesi gibi farklı bağlamsal değişkenlerin etkisi de dikkate alınarak yazılması gerektiğidir (Oliva-Lozano ve ark., 2021). Ayrıca, mevcut çalışmada, 2022/23 futbol sezonunda Almanya Bundesliga'da oynanan maçlar üzerine odaklanılmıştır. Bu nedenle, gelecekteki araştırmalar, profesyonel futbolda hem fiziksel hem de teknik performansın daha iyi anlaşılması için bu sınırlamaları dikkate alacak şekilde tasarlanabilir. Ayrıca, koşu parametrelerinin oyunu nasıl etkilediğinin daha iyi anlaşılması için tüm oyun örneklemindeki koşu performansı analiz edilmelidir.

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Takımların topladıkları puanlar ile teknik performansları arasında anlamlı etkileşimler gözlendiğinden, antrenörler uygun antrenman stratejileri geliştirmek için bu çalışmanın sonuçlarını dikkate alabilirler. Takımların sezon sonunda daha başarılı olabilmeleri için topa sahip olmayı, şut atmayı ve topu olumlu kullanmayı öğrenmeleri, yakaladıkları fırsatları olumlu değerlendirmeleri ve özellikle attıkları gol sayısını artırıp yedikleri gol sayısını azaltmaları gerekmektedir. Öte yandan, koşu performansı ile takım başarısı arasında bir ilişki bulunamamış olsa da üst liglerdeki takımların koşu aktivitelerinin neredeyse eşit olduğu düşünüldüğünde, bu durum koşu performansının üstünlük kurma ya da rakiple rekabet etme açısından mevcut seviyenin altına düşmemesi, aksine korunması ya da geliştirilmesi gerektiği anlamına gelmektedir. Dolayısıyla bu sonuçlar, profesyonel takımların oyunlarını hangi yönde geliştirebilecekleri konusunda pratik çıkarımlara sahip olabilir.

REFERENCES

Andrzejewski, M., Chmura, P., Konefal, M., Kowalczuk, E., & Chmura, J. (2018). Match outcome and sprinting activities in match play by elite German soccer players. *The Journal of Sports Medicine and Physical Fitness, 58*(6), 785-792.

Andrzejewski, M., Oliva-Lozano, J. M., Chmura, P., Chmura, J., Czarniecki, S., Kowalczuk, E., … et al. (2022). Analysis of team success based on match technical and running performance in a professional soccer league. *BMC Sport Science, Medicine and Rehabilitation*, (14), 82.

Arı, E., & Deliceoğlu, G. (2020). Türkiye Süper Ligi 2018-2019 futbol sezonunda gol zamanı- lig performansı ilişkisi. *Turkish Studies Social Sciences, 15*(6), 2833-2849.

Bilgin, S., & Müniroğlu, R. S. (2022). 2018 dünya kupası maçlarının teknik, taktik ve hareket zaman ilişkisinin istatistiksel analizi. *Spormetre The Journal of Physical Education and Sport Sciences*, 20(2), 105-116.

Bradley P. S., Archer D. T., Hogg B., Schuth, G., Bush, M., Carling C., … et al. (2016). Tier-specific evolution of match performance characteristics in the English Premier League: It's getting tougher at the top League. *Journal of Sports Sciences, 34*(10), 980–987.

Bradley, P. S., Lago-P. C., Rey, E., & Gomez D. A. (2013). The effect of high and low percentage ball possession on physical and technical profiles in English FA Premier League soccer matches. *Journal of Sports Sciences, 31*(12), 1261–1270.

Brito Souza, D., Lopez-Del Campo, R,., Blanco-Pita, H., Resta, R., & Del Coso, J. (2020). Association of match running performance with and without ball possession to football performance. *International Journal of Performance Analysis in Sport*, 1-12.

Bundesliga. (2023, Ağustos 15). *Bundesliga stats 2022-2023*. https://www.bundesliga.com/en/bundesliga

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), 865–872.

Carling, C. (2013). Interpreting physical performance in Professional soccer match-play: Should we be more pragmatic in our approach? *Sports Medicine, 43*(8), 655-663.

Carling, C., Bradley, P., McCall, A., & Dupont, G. (2016). Match-to-match variability in high-speed running activity in a professional soccer team. *Journal of Sports Sciences, 34*(24), 2215-2223.

Chmura, P., Andrzejewski, M., Konefał, M., Mroczek, D., Rokita, A., & Chmura J. (2017). Analysis of motor activities of professional soccer players during the 2014 World Cup in Brazil. *Journal of Human Kinetics*, 56(1), 187-195.

Chmura, P., Konefal, M., Wong, D. P., Figueiredo, A. J., Kowalczuk, E., Rokita, A., … et al. (2019). Players' physical performance decreased after two-thirds of the season: results of 3 consecutive seasons in the German first Bundesliga. *International Journal of Environmental Research and Public Health,* (16), 2044.

Clemente, J. A. A., Requena, B., Jukic, I., Nayler, J., Hernandez, A. S., & Carling, C. (2019). Is physical performance a differentiating element between more or less successful football teams? *Sports,* (7), 216.

Coşkuner, Z., Büyükçelebi, H., & Kurak, K. (2020). Türkiye Süper Ligi'ndeki oyun içi değişkenlerin analizi. *Germenica Beden Eğitimi ve Spor Bilimleri Dergisi*, *1*(1), 47-54.

Del Coso, J., Brito de Souza, D., Moreno-Perez, V., Buldu, J. M., Nevado, F., Resta, R., … et al. (2020). Influence of players' maximum running speed on the team's ranking position at the end of the Spanish LaLiga. *International Journal of Environmental Research and Public Health*, *17*(23), 1–11.

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), 222-227.

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), 205-212.

Ergin, E., Kartal, R., Kartal, A., & Gürkan, O. (2023). Effects of the goal parameters of the football teams coming in the first four and last three places in the Bundesliga 2020-2021 season on the league ranking. *International Journal of Sport Culture and Science, 11*(1), 25-33.

Ertetik, G., & Müniroğlu, R. S. (2021). Avrupa kupalarına katılan Türk futbol takımlarının maçlarının teknik ve taktik açıdan analizi. *Spormetre, 19*(1), 156-163.

Göral, K. (2015). Passing success percentages and ball possession rates of successful teams in 2014 Fifa world cup. *International Journal of Science Culture and Sports, 3*(1), 86-95.

Gürkan, O. (2023). Futbolda bazı teknik parametrelerin maç konumu, maç sonucu ve lig sıralamasına göre incelenmesi (2021/2022 Sezonu Türkiye Futbol Süper Ligi Örneği). *Akdeniz Spor Bilimleri Dergisi*, *6*(1), 326-340.

Gürkan, O., Yüksel, Y., & Ertetik, G. (2020). UEFA şampiyonlar liginde galibiyet, mağlubiyet ve beraberlikle sonuçlanan müsabakaların bazı parametreler açısından karşılaştırmalı analizi. *International Journal of Contemporary Educational Studies (IntJCES), 6*(2), 669-680.

Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hanin, J. (2009). Progressive statistics for studies in sports medicine and exercise science. *Medicine & Science in Sports & Exercise*, (41), 3–12

Hoppe, M., 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.

Hughes, M., & Churchill, S. (2005). *Attacking profiles of successful and unsuccessful team in Copa America 2001*. Science and Football V, Routledge.

Kite, C. S., & Nevill, A. (2017). The predictors and determinants of inter-seasonal success in a professional soccer team. *Journal of Human Kinetics*, *58*(1), 157–167.

Konefal, M., Chmura, P., Kowalczuk, E., Figueiredo, A. J., Sarmento, H., Rokita, A., et al. (2019a). Modeling of relationships between physical and technical activities and match outcome in elite German soccer players. *The Journal of Sports Medicine and Physical Fitness*, *59*(5), 752–759.

Konefal, M., Chmura, P., Rybka, K., Chmura, J., Huzarski, M., & Andrzejewski, M. (2019b). What frequency of technical activity is needed to improve results? New approach to analysis of match status in professional soccer. *International Journal of Environmental Research and Public Health*, *16*(12), 2233.

Lago-Ballesteros, J., & Lago-Penas, C. (2010). Performance in team sports: Identifying the keys to success in soccer. *Journal of Human Kinetics, 25*(1), 85–91.

Lago-Penas, C., & Lago-Ballesteros, J. (2011). Game location and team quality effects on performance profiles in professional soccer. *Journal of Sports Science and Medicine*, *10*(3), 465-471.

Lago-Penas, C., Lago-Ballesteros, J., Dellal, A., & Gomez, 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-Penas, 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), 135–146.

Lepschy, H., Wasche, H., & Woll, A. (2020). Success factors in football: an analysis of the German Bundesliga. *International Journal of Performance Analysis in Sport*, *20*(2), 150–164.

Liu, H. Y., Gomez, M. A., Goncalves, B., & Sampaio, J. (2016). Technical performance and match-to-match variation in elite football teams. *Journal of Sports Science,* (34), 509-518.

Liu, H., Hopkins, W. G., & Gomez, M. A. (2016). Modelling relationships between match events and match outcome in elite football. *European Journal of Sport Science, 16*(5), 516–525.

Mota, G. R., Thiengo, C. R., Gimenes, S. V., & Bradley, P. S. (2016). The effects of ball possession status on physical and technical indicators during the 2014 FIFA World Cup Finals. *Journal of Sports Sciences, 34(*6), 493-500.

Moura, F. A., Martins, L. E. B., & Cunha, S. A. (2014). Analysis of football game-related statistics using multivariate techniques. *Journal of Sports Sciences, 32*(20), 1881-1887.

Oliva-Lozano, J. M., Rago, V., Fortes, V., & Muyor, J. M. (2021). Impact of match-related contextual variables on weekly training load in a professional soccer team: A full season study. *Biology of Sport., 39*(1), 125-134.

Pons, E., Ponce-Bordon, J. C., Diaz-Garcia, J., Lopez del Campo, R., Resta, R., Peirau, X., … et al. (2021). A longitudinal exploration of match running performance during a football match in the Spanish La Liga: A four-season study. *International Journal of Environmental Research and Public Health*, *18*(3), 1133.

Praça, G. M., Jacinto, A. L. B., Sousa Pinheiro, G., Oliveira Abreu, C., & Costa, V. T. (2023). What are the key performance indicators related to winning matches in the German Bundesliga?. *International Journal of Performance Analysis in Sport, 23*(4), 284-295.

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), 1018–1024.

Rampinini, E., Impellizzeri, F. M., Castagna, C., Coutts, A. J., & Wisloff, 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), 227–233.

Reynolds, J., Connor, M., Jamil, M., & Beato, M. (2021). Quantifying and comparing the match demands of U18, U23 ve 1st team English professional soccer players. *Frontiers in Physiology,* (12), 706451.

Safiq, M., Sulaiman, N., & Rahmat, A. (2013). Differences in goal scoring and passing sequences between winning and losing team in Uefa-Euro Championship 2012. *International Journal of Social, Behavioral, Educational, Economic and Management Engineering, 7*(2), 224-229.

Vergonis, A., Michailidis, Y., Mikikis, D., Semaltianou, E., Mavrommatis, G., Christoulas, K., … et al. (2019). Technical and tactical analysis of goal scoring patterns in the 2018 Fifa world cup in Russia. *Facta Universitas, 17*(2), 181-193.

White, A., Hills, S. P., Cooke, C. B., Batten, T., Kilduff, L. P., Cook, C. J., … et al. (2018). Match-play and performancetest responses of soccer goalkeepers: A review of current literature. *Sports Medicine*, *48*(11), 2497–2516.

Yang, G., Leicht, A. S., Lago, C., & Gomez, M. A. (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.

Zhou, C., Zhang, S., Calvo, L. A., & Cui, Y. (2018). Chinese soccer association superleague, 2012–2017: key performance indicators in balance games. *International Journal of Performance Analysis in Sport*, *18*(4), 645 656.

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