

Poznan University of Physical Education

TRENDS in SPORT SCIENCES

(formerly Studies in Physical Culture and Tourism)



quarterly • number 3 • volume 30 • year 2023

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ISSN 2299-9590

Publisher

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Printed by

ESUS Tomasz Przybylak

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CONTENTS

REVIEW ARTICLE

- An integrative review of the game model in soccer: definition, misconceptions, and practical significance** 85
Spyridon Plakias

ORIGINAL ARTICLE

- Satisfaction rate of leisure time in adolescents of Slovakia** 93
Štefan Adamčák, Michal Marko, Lívia Nemcová, Rastislav Kollár, Stanislav Azor
- Sleep, energy, and stress in collegiate female volleyball athletes** 101
Emani Foster, Claire Schumann, Jennifer A. Bunn
- How to be praised in sports newspapers: a performance analysis from soccer matches** 109
Hugo Silva, Fábio Yuzo Nakamura, Vajiheh Javani, Rui Marcelino
- Match-related technical performance of qualified and eliminated teams in the group stage of Qatar 2022 World Cup** 119
Ibrahim Zakaria Kahlouche

- INSTRUCTIONS FOR AUTHORS 127

REVIEW ARTICLE

TRENDS in
Sport Sciences

2023; 30(3): 85-92

ISSN 2299-9590

DOI: 10.23829/TSS.2023.30.3-1

An integrative review of the game model in soccer: definition, misconceptions, and practical significance

SPYRIDON PLAKIAS

Abstract

Introduction. The complexity of football has led coaches to develop the game model (GM) to enhance the analysis and training of its various situations. Despite the great practical importance of the GM, this topic remains under-researched, while no relevant definition has been established in the scientific literature. **Aim of Study.** Therefore, the purpose of this study was to conduct an integrative review focusing on the components and practical applications of the GM. **Material and Methods.** Three search engines, namely Scopus, SportDiscus, and Google Scholar, were utilized. **Results.** After applying the exclusion criteria, a total of 17 documents were considered suitable. The review revealed a scarcity of research evidence despite the abundance of theoretical references to the GM. **Conclusions.** The synthesis of the findings demonstrated that the GM serves as a foundational framework for tactical periodization (TP), incorporating the coach's ideas while considering players' abilities, the club's culture, structure and objectives, and even national culture. In addition, its practical importance in performance analysis, training and competition at both team and individual levels was demonstrated. These findings highlight the value not only of the creation of a GM by coaches, but also of its correct application in practice.

KEYWORDS: football, tactical periodization, playing styles, coach's ideas, player's capabilities, strategies and tactics.

Received: 4 July 2023

Accepted: 16 August 2023

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Introduction

Football is a complex sport, in which chaotic situations arise [14]. To enable coaches to turn these situations into more controllable ones, they develop a game model (GM). It facilitates the breakdown of the game into manageable moments and sub-moments, allowing coaches to observe player positions and behaviors [37]. The GM has gained significant attention and recognition as a critical aspect of team performance. Coaches and researchers alike have recognized its potential to shape a team's playing style, tactical approach, and overall effectiveness on the field [37].

Despite its widespread use, the GM in soccer still lacks a clear and universally accepted definition. This lack of clarity often leads to its misuse, with one common misconception being its confusion with the term "playing style". Game styles (or playing styles) are also a prominent topic of study among soccer researchers [23], as their identification and quantification are crucial steps in effective performance analysis [20]. Playing styles have been extensively defined in the international literature, which describes them as distinctive patterns or behaviors consistently displayed by a team on the field [13, 15].

In the international literature there are examples of authors who do not correctly distinguish between the terms GM and game style. For instance, Jaime et al. [16] defined the GM as the characteristic playing pattern demonstrated by a team during matches. However, this definition aligns more closely with the concept of playing style rather than the GM itself. It is noteworthy that in their subsequent discussion, those authors also referred to the term

“playing style” as if it were synonymous with the GM. Considering this confusion, the practical significance of two concepts for coaches, and the absence of a literature review for components and practical applications of the GM (particularly in the English language), we have undertaken the present brief review.

Additionally, the analysis of performance in sports relies heavily on the development of operational definitions, which are essential in both academic and professional settings [38]. In this review article, we aim to provide a clear definition and a comprehensive analysis of the GM in soccer, exploring its conceptual foundations, practical applications, and impact on player and team performance. We will delve into the dynamic and evolving nature of the GM, considering factors that influence its development.

Aim of Study

By synthesizing current research and insights from leading experts in the field, this review article seeks to broaden our understanding of the GM in soccer and shed light on its practical implications for coaches, players, and researchers. Ultimately, we aim to provide a foundation for further exploration and development of the GM as a fundamental aspect of soccer practice, contributing to the continuous improvement of performance analysis.

Material and Methods

This review is based on documents published until June 15, 2023, with no restrictions on the year of publication. We utilized the search engines: Scopus, SportDiscus (from EBSCO), and Google Scholar, combining the terms “Game Model”, “soccer”, and “tactics” using the Boolean operator “AND”. We conducted a comprehensive

search across all document types, including review articles, qualitative and quantitative research articles, books, theses, and even unpublished articles that have not undergone peer review. However, we excluded documents written in languages other than English, documents that exclusively focused on developmental ages, women’s or robotic soccer, and documents, for which the full text was inaccessible.

After removing duplicates, the application of the criteria was carried out in two stages. During the first stage (screening) all records that were not in English, lacked full-text accessibility, or did not pertain to adult men’s football, were excluded. In the second stage (eligibility) records were eliminated if the mention of the GM was minimal (e.g., only in one sentence) or if it was solely present in the bibliographic references section. To record the gathered data, we employed a Microsoft Excel spreadsheet. For each retrieved paper we recorded the title, author’s/authors’ name, publication year, and document type.

Results

As depicted in the flow diagram of Figure 1, a total of 690 records were obtained from the initial search across the three databases. After eliminating duplicates and applying two-stage exclusion criteria (screening, eligibility), 17 articles were ultimately considered appropriate for inclusion in the review.

Table 1 presents the details (title, author(s), year, and document type) of the 17 records included in the study. The table reveals that 2 books, 2 dissertations, 4 review articles, 3 unpublished articles, 3 qualitative research articles, 2 quantitative research articles, and 1 research article utilizing a mixed method (qualitative and quantitative).

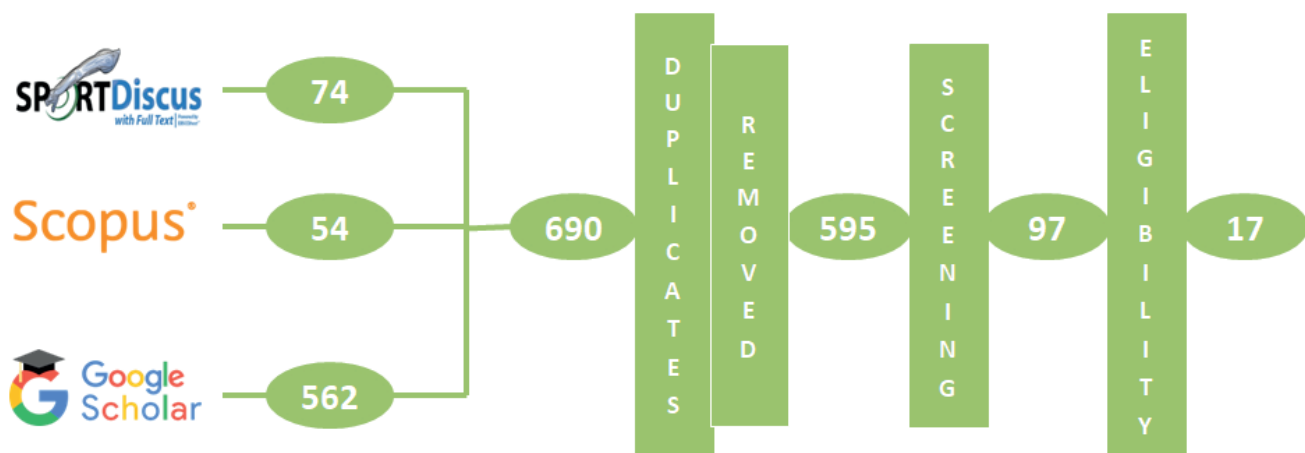


Figure 1. Flowchart illustrating the methodology and results of the search

Table 1. Title, author(s), year, and document type of the 17 records included in the study

TITLE	YEAR	AUTHOR	TYPE OF DOCUMENT
Tactical Periodization: Mourinho's Best-kept secret?	2012	Delgado-Bordonau & Mendez-Villanueva	Unpublished article
Holistic soccer profile by position: a theoretical framework.	2021	Mota et al.	Review article
Network-based centrality measures and physical demands in football regarding player position: Is there a connection? A preliminary study.	2019	Castellano & Echeazarra	Quantitative research article
The Analysis, Support and Development of Coaches' Tactical Knowledge in Practice.	2021	Walsh	Dissertation
Comparative Analysis of The Offensive Game Between Real Madrid 10/11 and 09/10 Inter Milan.	2011	Barbosa et al.	Unpublished article
Exploiting bi-directional self-organizing tendencies in team sports: the role of the game model and tactical principles of play.	2019	Ribeiro et al.	Review article
Coaching through Principles of Play. A Conceptualisation of the Coaches' Process of Knowledge.	2018	Kerr-Cumbo	Dissertation
Tactical periodization: A proven successful training model.	2018	Delgado-Bordonau & Mendez-Villanueva	Book
A systematic review of research on tactical periodization: absence of empirical data, burden of proof, and benefit of doubt.	2020	Afonso et al.	Review article
How and why do soccer coaches use small-sided games in the training process?	2017	Alves et al.	Qualitative research article
Adapting the High Chaos phase of the 'control-chaos continuum': a bridge to team training	2020	Taberner et al.	Unpublished article
Patterns of Play in the Counterattack of Elite Football Teams - A Mixed Method Approach	2017	Sarmento et al.	Quantitative and Qualitative research article
The coaching process in football—A qualitative perspective.	2014	Sarmento et al.	Qualitative research article
Soccer match analysis. A qualitative study with Portuguese First League coaches.	2013	Sarmento et al.	Qualitative research article
Tactical Principles of Soccer: concepts and application	2009	da Costa et al.	Review article
Coaching Positional Play: "expansive Football" Attacking Tactics and Practices.	2015	Basile	Book
Comparison of tactical principles efficiency among soccer players from different game positions.	2017	Rechenchosky et al.	Quantitative research article

Discussion

Components of the game model

The creation of a GM involves considering various factors, primarily including the coach's ideas, players' capabilities, the club's culture, structure, and objectives, as well as the country's culture. These factors have been extensively discussed in international literature, as evidenced by scientific articles, books and dissertations. Obviously, the coach's ideas (philosophy) are the most crucial factor in creating a GM. These encompass the principles of play [12, 19], the desired style of play for the team [8, 24, 37], systems (or formations or structural organization) [3, 12], and strategies and tactics to be

implemented [26, 37]. All of these aspects are adapted to the key moments of the game [17, 37]. There are five key moments (or phases) in football: attack, defensive transition, defense, attacking transition, and set-pieces [15, 21]. With the distinction of set-pieces into defensive and offensive, it becomes six [6]. Furthermore, the attack phase can be divided into three sub-phases (or sub-moments): the build-up phase, the progressive or creativity phase, and the finishing phase. Depending on the zone the team defends, we distinguish three additional sub-phases: high-press or high-block, mid-block, and low-block [20].

Delgado-Bordonau and Mendez-Villanueva [11] clearly defined the role of game principles as a crucial factor in

constructing a GM. In fact, they categorized principles into the main, sub, and sub-sub categories based on their complexity. Principles enable a team to execute specific motor actions and patterns. The main principles of play pertain to collective actions, sub-principles pertain to sectorial and intersectorial actions, while sub-sub-principles of play pertain to individual actions. All these elements are interconnected, forming a functional organization that showcases the team's identity. Another crucial factor in creating a GM is the team's formation, which refers to how the players are positioned on the field and is commonly referred to as the system of play. The formation is typically denoted by three numbers representing the number of defenders, midfielders, and forwards, with the addition of number 1 for the goalkeeper [10]. For example, when a team adopts a 1-4-3-3 formation, it indicates that they have one goalkeeper, four defenders, three midfielders, and three forwards. While the formation represents a static spatial arrangement, it can significantly influence and facilitate the desired behaviors of the team [12]. According to Walsh [37], the coach's ideas that determine the GM also include playing styles, strategies and tactics. In fact, other authors have argued that one of the key aspects in a coach's philosophy is the playing styles they want their teams to adopt [18, 30, 31, 39]. Playing styles refer to the patterns and behaviors that teams adopt during matches [13, 15]. Additionally, Luxbacher [18], Walker and Hawkins [36] and Zainuddin et al. [39] argued that the coach's philosophy determines the strategies and tactics they want their team to implement. The term tactics refers

to specific actions carried out by football players within the context of the team's broader strategy [7]. However, in addition to their personal ideas coaches should take into account other factors when creating a successful GM. First and foremost, the coach should consider whether the characteristics of his players align with the GM he wants to create [11, 12, 17, 37]. Therefore, he must assess the abilities of his players in five areas: technical, tactical, psychological, physiological, and sociological skills [22, 37]. Secondly, the team's structure, objectives, and culture are another crucial factor. Hence, the manager needs to take into account the number of players and coaching staff members, whether the team aims to win the championship or avoid relegation, and also consider the team's culture [11]. Lastly, the overall culture of the country, to which the team belongs, can influence the development of its GM. A prime example is the contrasting styles between Brazilian and Italian, or Norwegian teams [4, 34]. Figure 2 summarizes the factors that contribute to the creation of a GM. The four main components of the GM, namely the coach's ideas, players' capabilities, club culture, structure and objectives, and even the country's culture, can be observed in the corridor. Following that, there is an extensive analysis of the coach's ideas, including principles, formations, strategies, tactics, and playing styles, which must be adapted to the key moments of the game.

Practical applications in the training process

The most widespread application of the GM is the TP. According to Delgado-Bordonau and Mendez-

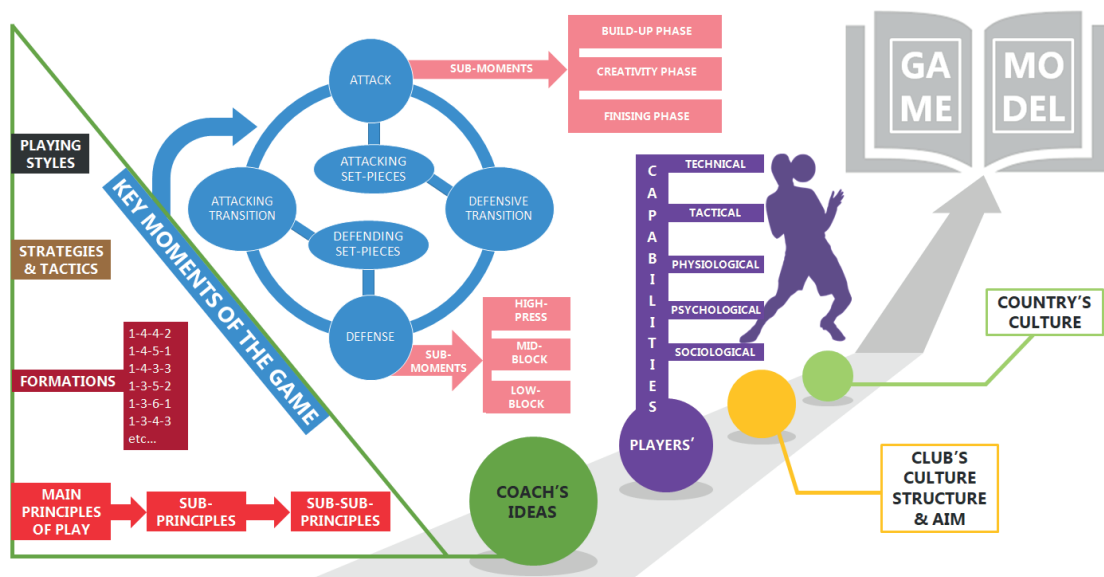


Figure 2. Factors that contribute to the creation of a GM

Villanueva [12], TP is a training approach in football that prioritizes the tactical dimension as the driving force for all aspects of the game. It revolves around the GM, which guides the training process. By aligning training sessions with the GM, TP ensures a close relationship between all dimensions of the game, including physical, mental, and technical elements.

In more detail, Delgado-Bordonau and Mendez-Villanueva [11] argued that TP emphasizes specificity, with practices designed to directly transfer the principles of play to competitive matches. It also incorporates systematic repetition to develop habits related to performance in real matches. Additionally, complex progression prioritizes the most important principles of the GM and increases the complexity of training practices as players become more integrated. The approach places significant importance on the coordination of decisions within a common tactical language, promoting collective thinking and optimal actions on the field. Successful coaches such as José Mourinho, Leonardo Jardim, Brendan Rodgers, Marco Silva and Pep Guardiola have utilized principles of TP to prepare their teams, emphasizing the construction of a specific style of play based on well-defined ideas.

According to TP, the training is structured around the microcycle, which corresponds to the training week, and aims to prepare the team for the next challenge [1, 11]. Designing practices and training sessions based on the team's style of play and GM is crucial. The coach breaks down the principles of play, creates complex actions, and fosters desired relationships and habits among the players. Weekly training patterns are designed through continuous interactions between the GM, the team's performance, and the characteristics of the upcoming opponent. However, despite its popularity TP lacks scientific evidence and research to support its effectiveness [1].

However, in addition to Tactical Periodization, there are other practical training aspects related to the GM. Alves et al. [2] found that Small-Sided Games (SSGs) play a crucial role in the evolution of the team's GM. SSGs provide dynamic and intense gameplay that enables corrections, targeted training, and the development of players' abilities and the desired GM. Furthermore, as stated by Taberner et al. [33], it is crucial for practitioners to have a comprehensive understanding of the physical and neurocognitive demands of team training and the coach's GM before implementing high chaos training phases as part of the RTS (return to sport) process. This knowledge allows for a careful and progressive reintegration of the returning player into team training,

ensuring their readiness and suitability for the dynamic and unpredictable nature of the game.

Practical applications in match preparation

The performance analysis process involves observing and diagnosing strengths and weaknesses, followed by intervention to improve performance. Coaches ensure congruence between their GM and what they observe regarding their teams [28]. Understanding their own team is crucial in evaluating opposing teams [29]. The preparation phase is characterized by rigor and systematization. The observed aspects are then evaluated based on each coach's specific GM, which informs on their intervention and planning [29].

Practical applications in competition

The GM and its associated principles play a crucial role in team organization and functioning. They guide cooperative interactions and behaviors of players as they seek tactical solutions during competitions [26]. For instance, the principle of an offensive or defensive unity emphasizes the importance of understanding the game and the team's adopted GM in relation to offensive or defensive strategies, respectively [9]. Creating a clear GM enables coaches to operationalize their team's style and systems of play, improving tactical cohesion [37]. The relationship between the GM and tactical principles of play is bidirectional, as they continually influence each other at different levels of team organization [26]. The operational strategy, influenced by the opponent's weaknesses and strengths, guides the training content to maximize the team's advantage [5].

Furthermore, the GM also impacts the individual development of players. It helps players understand their roles and responsibilities, leading to improved team performance [37]. Understanding the GM can inform the development of specialized player development programs and provide theoretical and practical frameworks for training and performance periodization in different sub-phases of play [26]. The GM reduces player uncertainty and impulsive decision-making [5]. However, this does not mean that a GM should be rigid and inflexible. On the contrary, it should be flexible, allowing players to explore a wide variety of performance solutions within the prescribed principles of play [26]. Players have individual autonomy and diversity within a team, and this tendency persists even if the coach imposes a predefined GM. While actions within a team usually align, the specific shape the game takes depends on problem-solving reasoning in response to game situations and the quality of individual tactical

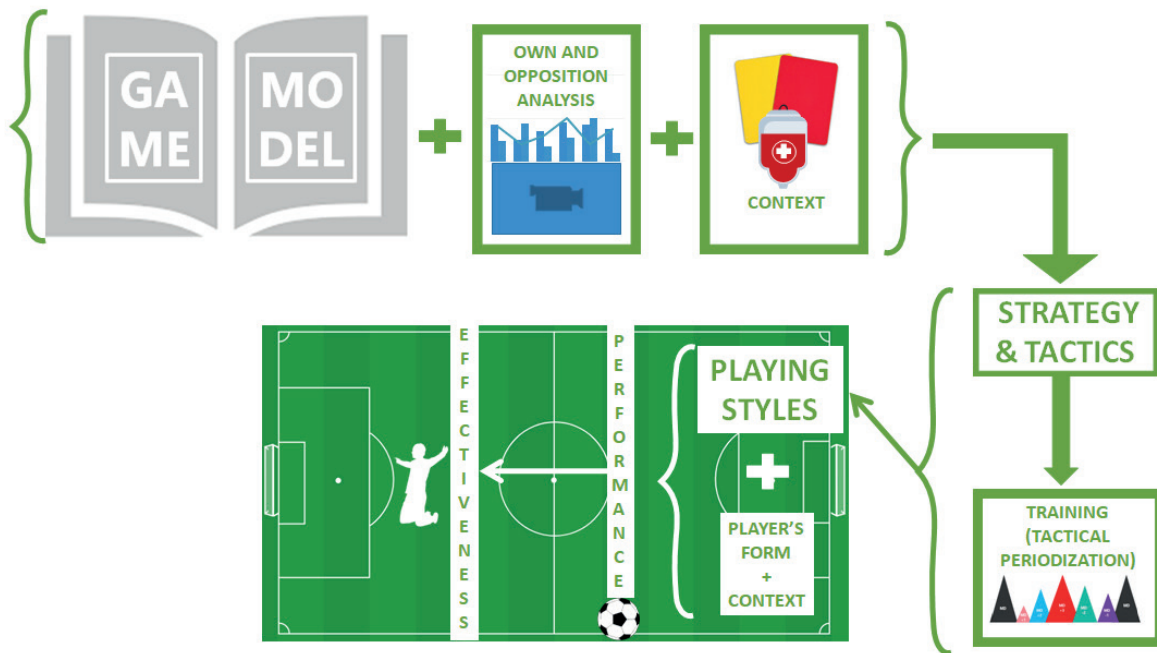


Figure 3. Practical applications derived from the GM

execution [25]. Coaches attribute the success of such teams as Barcelona to their GM, which enables effective decision-making and utilization of players' abilities [27]. The goal is to develop "intelligent performers", who are autonomous problem solvers and can regulate their actions using information [25].

Figure 3 provides a summary of the practical applications that emerge from the Game Model (GM). The coach, based on the GM, takes into account the context for the next match, such as the presence of suspended or injured players and the venue of the match. Additionally, the coach analyzes the team's performance in the previous match and assesses the upcoming opponent. This analysis guides the coach in determining the strategy and tactics to employ during the match, which are then refined during the week's training sessions. As a result, the team demonstrates specific styles of play on the field. These styles, in conjunction with the players' form and the match context (e.g., player form, opponent quality, match conditions), ultimately determine the team's performance and overall effectiveness.

Definition

Considering all the points discussed above, we present the following revised definition: "The Game Model is a framework encompassing the coach's ideas, players' capabilities, club's culture, structure and objectives, and even the country's culture. It serves as the basis for team organization, training, and individual player

development, while constitutes the core of Tactical Periodization".

Conclusions

An important limitation of the present review is its reliance solely on English language records. Consequently, documents in other languages, such as Portuguese, which serves as the foundation for TP [1, 11], were not included. Furthermore, the review was not conducted in a systematic way. Despite these limitations, our review provides valuable information regarding the GM. We developed two new theoretical frameworks, which serve as the focal point of this integrative review [32, 35]. Specifically, we initially identified the factors necessary for the establishment of the GM, followed by an analysis of its practical applications in training, performance analysis, and within the game context at both team and individual levels. Additionally, a definition was extracted, which could provide a common language among football researchers. The current study could serve as a foundation for a future systematic review on the GM in soccer. Furthermore, this review revealed that most knowledge is derived from theoretical concepts (qualitative research, books, review articles, theoretical frameworks). This underscores the necessity for scientists to conduct further research on the practical applications of the GM. The two theoretical frameworks we have developed (illustrated in Figures 2 and 3) can serve as valuable tools for future researchers conducting studies on the GM.

Conflict of Interest

The author declares no conflict of interest.

References

- Afonso J, Bessa C, Nikolaidis PT, Teoldo I, Clemente F. A systematic review of research on tactical periodization: absence of empirical data, burden of proof, and benefit of doubt. *Hum Mov.* 2020;21(4):37-43.
- Alves G, Clemente FM, Sousa PM, Pinheiro V, dos Santos FJL. How and why do soccer coaches use small-sided games in the training process? *Hum Mov Special Issues.* 2017;2017(5):117-124.
- Barbosa AA, Sarmiento HM, Anzano AP, Campaniço JM. Comparative Analysis of the Offensive Game Between Real Madrid 10/11 and 09/10 Inter Milan. 2011.
- Basevitch I, Yang Y, Tenenbaum G. Is the best defense a good offense? Comparing the Brazilian and Italian soccer styles. *Kinesiology.* 2013;45(2):213-221.
- Basile PC. Coaching positional play: "expansive football" attacking tactics and practices. SoccerTutor.com; 2015.
- Bauer P. Automated detection of complex tactical patterns in football: Using machine learning techniques to identify tactical behavior [dissertation]. University of Tübingen; 2021.
- Carling C, Williams AM, Reilly T. Handbook of soccer match analysis: A systematic approach to improving performance. London: Routledge; 2007.
- Castellano J, Echezazra I. Network-based centrality measures and physical demands in football regarding player position: Is there a connection? A preliminary study. *J Sport Sci.* 2019;37(23):2631-2638.
- da Costa IT, da Silva JMG, Greco PJ, Mesquita I. Tactical principles of soccer: concepts and application. *Revista Motriz.* 2009;15(3):657-668.
- Deb S, Das S. Optimal selection of the starting lineup for a football team. arXiv:2303.12385.
- Delgado-Bordonau JL, Mendez-Villanueva JA. Tactical periodization: A proven successful training model. SoccerTutor.com; 2018.
- Delgado-Bordonau JL, Mendez-Villanueva JA. Tactical Periodization: Mourinho's best-kept secret? *Soccer NSCAA Journal.* 2012;29-34.
13. Fernandez-Navarro J, Fradua L, Zubillaga A, Ford PR, McRobert AP. Attacking and defensive styles of play in soccer: analysis of Spanish and English elite teams. *J Sport Sci.* 2016;34(24):2195-2204.
- Ferrarini A. Order out of chaos: emergent patterns in soccer matches. *Selforganizology.* 2016;3(2):51-58.
- Hewitt A, Greenham G, Norton K. Game style in soccer: what is it and can we quantify it? In *J Perf Anal Sport.* 2016;16(1):355-372.
- Jaime MdO, Kim I, Menegassi VM, Rechenchosky L, Magossi M, Kravchychyn C, et al. Examining offensive tactical actions performed by youth soccer players with different competitive contexts. *J Phys Educ.* 2020;31.
- Kerr-Cumbo R. Coaching through principles of play. A conceptualisation of the coaches' process of knowledge generation [dissertation]: University of Sheffield; 2018.
- Luxbacher J. Attacking soccer. Champaign: Human Kinetics; 1999.
- Mota T, Silva R, Clemente FM. Holistic soccer profile by position: A theoretical framework. *Hum Mov.* 2021;24(1).
- Plakias S, Kokkotis C, Moustakidis S, Tsatalas T, Papalexi M, Kasioura C, et al. Identifying playing styles of European soccer teams during the key moments of the game. *J Phys Educ Sport.* 2023;23(4):878-890.
- Plakias S, Kokkotis C, Tsaopoulos D, Moustakidis S, Papalexi M, Giakas G, et al. The effectiveness of direct corners in high level soccer depending on the type and the zone of delivery. *J Phys Educ Sport.* 2023;23(2):449-456.
- Plakias S, Mandroukas A, Kokkotis C, Michailidis Y, Mavromatis G, Metaxas T. The correlation of the penetrative pass on offensive third with the possession of the ball in high level soccer. *Gazzetta Medica Italiana-Archivio per le Scienze Mediche.* 2022;181(9):633-638.
- Plakias S, Moustakidis S, Kokkotis C, Tsatalas T, Papalexi M, Plakias D, et al. Identifying soccer teams' styles of play: a scoping and critical review. *J Funct Morphol Kinesiol.* 2023;8(2):39.
- Plakias S, Moustakidis S, Mitrotasios M, Kokkotis C, Tsatalas T, Papalexi M, et al. Analysis of playing styles in European football: insights from a visual mapping approach. *J Phys Educ Sport.* 2023;23(6):1385-1393.
- Rechenchosky L, Borges PH, Menegassi VM, Jaime MdO, Guilherme J, Teoldo I, et al. Comparison of tactical principles efficiency among soccer players from different game positions. *Hum Mov Special Issues.* 2017;2017(5): 31-38.
- Ribeiro J, Davids K, Araújo D, Guilherme J, Silva P, Garganta J. Exploiting bi-directional self-organizing tendencies in team sports: the role of the game model and tactical principles of play. *Front Psychol.* 2019;10:2213.
- Sarmiento H, Anguera MT, Pereira A, Marques A, Campaniço J, Leitão J. Patterns of play in the counterattack of elite football teams – A mixed method approach. In *J Perf Anal Sport.* 2014;14(2):411-427.
- Sarmiento H, Pereira A, Anguera MT, Campaniço J, Leitão J. The coaching process in football: A qualitative perspective. *Montenegrin J Sports Sci Med.* 2014;3(1):9-16.
- Sarmiento H, Pereira A, Campaniço J, Anguera MT, Leitão J. Soccer match analysis: A qualitative study

- with Portuguese First League coaches. In: Peters D, O'Donoghue P, editors. *Performance analysis of sport IX*. London: Routledge; 2013. pp. 36-42.
30. Sarmiento H, Pereira A, Matos N, Campaniço J, Anguera TM, Leitão J. English premier league, spain's la liga and italy's serie a-What's different? In *J Perf Anal Sport*. 2013; 13(3):773-789.
 31. Sarmiento H, Teresa Anguera M, Campaniço J, Resende R, Leitão J. Manchester United, Internazionale Milano and FC Barcelona: What's different. *Sport Mont*. 2014;12:40-41.
 32. Snyder H. Literature review as a research methodology: An overview and guidelines. *J Bus Res*. 2019;104:333-339.
 33. Taberner M, Allen T, Cohen DD. Adapting the high chaos phase of the 'control-chaos continuum': A bridge to team training. *Sports Performance and Scientific Reports*. 2020;109:1-6.
 34. Tenga A, Larsen Ø. Testing the validity of match analysis to describe playing styles in football. In *J Perf Anal Sport*. 2003;3(2):90-102.
 35. Torraco RJ. Writing integrative literature reviews: Guidelines and examples. *Hum Resour Dev Rev*. 2005; 4(3):356-367.
 36. Walker GJ, Hawkins R. Structuring a program in elite professional soccer. *Strength Cond J*. 2018;40(3):72-82.
 37. Walsh MP. *The Analysis, Support and Development of Coaches' Tactical Knowledge in Practice [dissertation]*. Liverpool John Moores University; 2021.
 38. Williams JJ. Operational definitions in performance Analysis and the need for consensus. In *J Perf Anal Sport*. 2012;12(1):52-63.
 39. Zainuddin ZH, Adnan MA, Mohamed MN, Annur MSS. Association between the pattern of play and the outcome of matches during the 2015 Asian Football Confederation (AFC) according to ball possession. *J Phys Educ Sport*. 2022;22(9):1999-2004.

Satisfaction rate of leisure time in adolescents of Slovakia

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Abstract

Introduction. Leisure time is an important part of adolescents' lives, impacting the quality of lives. Engaging in leisure activity promotes health, well-being, social development, individual growth, and life satisfaction. **Aim of Study.** The aim of study was to examine the satisfaction rate (life) of leisure time in adolescents (n = 1204) of Slovakia. **Material and Methods.** Survey instrument (satisfaction rate of leisure time) was carried out 6 weeks (May 1 – June 10, 2023) as a way of examining (e.g., analyze, compare) satisfaction rate of leisure time in adolescent boys (n = 542, 45.02%) and girls (n = 662, 54.98%) of Slovakia. Examining the satisfaction rate of leisure time was by means of Assumption of Homogeneity of Variance and Independent Samples, 2-Sample T-Test, and Anova, of which the significance level was 0.01 and 0.05 (Ibm Spss Modeler). **Results.** Statistical difference (0.01, 0.05) between adolescent boys and girls was in: (i) active leisure (± 0.32); (ii) passive leisure (± 0.25); (iii) leisure education (± 0.20); (iv) leisure caring (± 0.10); (v) social leisure (± 0.12). No difference (0.01, 0.05), between adolescent boys and girls was in satisfaction rate (± 0.08). Within the adolescent boys, 0.01 and 0.05 difference of variance (Anova) was in: (i) active leisure (8.88E-06); (ii) passive leisure (4.24E-08); (iii) leisure caring (0.030); (iv) social leisure (0.008). Within the adolescent girls, 0.05 difference of variance was in: (i) leisure caring (0.020). **Conclusions.** Engaging in leisure activity provides adolescents with chances for individual growth, stress reduction, and social connection; therefore, it is important to encourage them to make most of their leisure time, which contributes to holistic development, happiness, and life satisfaction.

KEYWORDS: adolescents, leisure time, satisfaction rate, secondary schools, quality of life.

Received: 10 July 2023

Accepted: 4 August 2023

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Introduction

Adolescence is an important stage (transformative Aperiod) in an individual's life, characterized by numerous changes (e.g., physical cognitive, social). When navigating the demands (challenges) of this developmental stage, leisure time is an important aspect of adolescents' lives [11]. Adolescents experience a new sense of autonomy and independence, translating into increased leisure time. Participating in leisure activity provides adolescents with chances (opportunities) for individual growth, stress reduction, and social connection. Leisure time provides adolescents with breaks from the demands of academic life, enabling them to relax, revitalize, and explore individual interests and passions [4].

Physical activity (i.e., active leisure) is an important choice in adolescents during their leisure time, because sports and games contribute to health and well-being, while also fostering discipline, teamwork, and perseverance. Participating in active leisure enhances

self-esteem, improves body image, and reduces stress, as a consequence promoting well-being [9]. Passive leisure maintains an important place in leisure time of adolescents, offering chances for individual enrichment (e.g., relaxation, entertainment). Passive leisure (e.g., watching television, playing video games, reading books) provides adolescents with breaks from the demands of life, allowing mental escapes and a sense of calm. Entertainment allows adolescents to enjoy and indulge in moments of pure enjoyment and leisure. Watching television, playing video games, and reading books provides temporary escapes from reality; however, it is important to note that while passive leisure has its merits, a balanced approach to leisure is important. Adolescents should attempt a mix of both leisure types (active and passive), ensuring participation in physical activity, social interaction, and individual growth alongside experiences of passive leisure [3, 6, 10, 22].

Leisure education in adolescents refers to intentional (structured) attempts aimed at promoting the development of knowledge (skills) and attitudes necessary for meaningful leisure experiences. It seeks to enhance adolescents' understanding of leisure value, assists in making choices concerning leisure activity, and cultivates the ability to engage in leisure pursuits, contributing to individual growth and well-being [25]. Leisure education empowers adolescents to make informed choices, engage in a meaningful leisure activity, and cultivate habits, enhancing the quality of life [5, 12, 16].

At present adolescents are spending more time using screen time and social media [4] (e.g., Meta-Facebook, Instagram), with the number of hours spent online having risen during the Covid-19 pandemic. Excessive screen time causes problems; however, responsible use of technology offers chances for learning, individual growth, and social connections; therefore, adolescents should attempt to reach a mix of both online and offline activities, ensuring both education and recreation by means of technology [4]. Relationships between social leisure and screen time in adolescents are important, because screen time provides chances for social interaction and leisure activity; however, it is important to monitor (manage) screen time to avoid its excessive use and negative impacts. This can be done by maintaining a balance between screen time and social interaction (offline), promoting a mindful screen use, and setting limits all contribute to a positive social leisure experience. Social leisure provides adolescents with chances to socialize with their peers, fostering the

development of important social skills, in particular empathy, cooperation, and conflict resolution [19]. In the case of organized groups, when hanging out with peers (friends) and participating in clubs (organizations), adolescents learn to navigate social dynamics, build relationships, and cultivate the sense of belonging [7]. Social leisure and leisure caring are similar concepts sharing common elements and they sometimes overlap in practice; however, leisure caring emphasizes acts of kindness (caring for others), while social leisure involves a diverse range of social interactions [1, 22].

Aim of Study

Because many research gaps remain in literature in terms of satisfaction rate of leisure time and Slovak scale (the best of authors' knowledge), the aim of study was to examine the satisfaction rate of leisure time in adolescents ($n = 1204$) of Slovakia.

Material and Methods

Procedure sample and participant selection

In terms of the study aim, the survey group ($n = 1204$) (i.e., target population) consisted of 1204 adolescent boys (45.02%, $n = 542$) (18.88 ± 0.38 years) and girls (54.98%, $n = 662$) (18.92 ± 0.32 years) from Slovakia, attending grammar (40.04, $n = 482$) and vocational (59.96%, $n = 722$) secondary schools, and living in Žilina (46.68%, $n = 562$) and Banská Bystrica (53.32%, $n = 642$) (Table 1). Adolescent boys (45.02%, $n = 542$) and girls (54.98%, $n = 662$) (i.e., the survey group)

Table 1. Demographic data of the survey group ($n = 1204$)

Age (2)	
Boys	542; 45.02%
Girls	662; 54.98%
Gender (2)	
Boys	18.88 ± 0.38
Girls	18.92 ± 0.32
Region (2)	
Žilina	562; 46.68%
Banská Bystrica	642; 53.32%
School (2)	
Grammar	482; 40.04%
Vocational	722; 59.96%

consisted of a convenience sample, recruited through the EduPage (complete school system) and teachers of physical education [13]. Recruitment (i.e., the selection process) of the survey group ($n = 1\,204$) was carried out for 6 weeks (May 1 – June 10, 2023), in intervals of $2 \times$ (Mon, Thu)/ week, aiming for intentional (selective) sampling; in particular, age, gender, region, and school. Undertaking recruitment for surveys in schools (e.g., secondary schools, in our case) is an effective way in terms of recruiting adolescents to participate in surveys. Examining the satisfaction rate of leisure time in adolescent boys (45.02%, $n = 542$) and girls (54.98%, $n = 662$) from Slovakia was carried out in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments and/or comparable ethical standards. All subjects (i.e., the survey group) provided their written informed consent [14].

Assessments, measures and procedures

The survey instrument (the satisfaction rate of leisure time) was carried out for 6 weeks (May 1 – June 10, 2023) as a way of examining (e.g., analyzing, comparing) the satisfaction rate of leisure time in adolescent boys (45.02%, $n = 542$) and girls (54.98%, $n = 662$) from Slovakia. Adopting the survey instrument (satisfaction rate of leisure time) [16] made it easier to examine the available data, consisting of two sections: (i) demographic data; (ii) satisfaction rate of leisure time (4 survey items) with a 5-point Likert scale (mutual saturation; assessing the attitudes): (ii-i) very unsatisfied (1); (ii-ii) unsatisfied (2); (ii-iii) neutral (3); (ii-iv) satisfied (4); (ii-v) very satisfied (5) (Figure 1). Determining the satisfaction rate (e.g., frequency) of leisure time in the survey group ($n = 1\,204$) was by means of 20 survey items with a 5-point Likert scale: (i) never (1); (ii) rarely (2); (iii) sometimes (3); (iv) often (4); and (v) always (5). Because of the varimax rotation, Kaiser–Meyer–Olkin Test of Sampling Adequacy, Bartlett’s Test of Sphericity, and exploratory factor analysis, a 20-item survey confirmed the presence of five sections: (i) active leisure (e.g., walking, cycling, swimming); (ii) passive leisure (e.g., watching television, playing video games, reading books); (iii) leisure education (e.g., knowledge of leisure, self-awareness); (iv) leisure caring (e.g., volunteering, caring of others); and (v) social leisure (e.g., going out, board games) [16].

A 6-week period (May 1 – June 10, 2023) of the survey instrument (unlimited time) did not indicate any problems; in particular, the comparative design (technical) and language (e.g., grammar, vocabulary). Forms (debriefing) of the survey instrument did not

detect individual data (except for demographic data, Table 1) of the survey group ($n = 1\,204$). Incentives were not given for participation (it was voluntary); however, the survey group ($n = 1\,204$) received the report of their individual data (results) afterwards. The survey instrument (online version) was selected because of its cost effectiveness, time saving, and easy accessibility (Microsoft Forms, Office 365, Microsoft Corp., Redmond, WA, USA) [3].

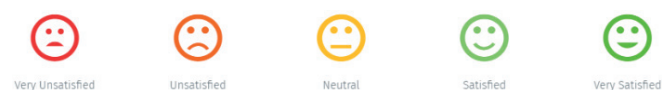


Figure 1. An example of the 5-point Likert scale of satisfaction rate of leisure time

Data processing

The satisfaction rate of leisure time in adolescent boys (45.02%, $n = 542$) and girls (54.98%, $n = 662$) from Slovakia was examined by means of Assumption of Homogeneity of Variance and Independent Samples (T-Test) and 2-Sample T-Test (Equal and Unequal Variance Assumption), of which the significance level (α) was 0.01 and 0.05. Anova (Correlation/ Regression Analysis), of which the significance level (α) was 0.01 and 0.05, evaluated the dependency and relationship between the items of the survey instrument (effect size, $r^2 = 0.10$ – small effect, 0.30 – medium effect, 0.50 – large effect) (Ibm Spss Modeler) [23, 26]. Available data of the survey group ($n = 1\,204$) was tabulated in a database design, precisely for a single measure comparative (descriptive) study [24]. Descriptive statistics (e.g., arithmetic mean, percentage frequency) described the basic features of the survey group ($n = 1\,204$).

Results

In terms of the study aim, Table 2 shows the satisfaction rate of leisure time in the survey group ($n = 1\,204$), which was 3.36 (‘neutral’) out of the 5-point scale ($p > 0.05$; $p = 0.184$), with 0.08 difference (\bar{x}) in favor of adolescent girls (3.40; 54.98%, $n = 662$) compared to boys (3.32; 45.02%, $n = 542$). In terms of presence of five sections and satisfaction rate (overall), statistical differences (0.01, 0.05) were found in: (i) active leisure (± 0.32 ; $p = 1.92E-09$); (ii) passive leisure (± 0.25 ; $p = 4.02E-08$); (iii) leisure education (± 0.20 ; $p = 2.62E-06$); (iiii) leisure caring (± 0.10 ; $p = 0.006$), and (iiiii) social leisure (± 0.12 ; $p = 0.001$) (Table 2).

The analysis of variance for the satisfaction rate of leisure time in the survey group ($n = 1\,204$) is shown in Table 3. Within the group of adolescent boys (45.02%,

Table 2. Satisfaction rate of leisure time in the survey group (n = 1204)

	Boys	Girls	Boys + girls	2-Sample T-Test
Satisfaction rate	3.32	3.40	3.36	0.184
Active leisure	2.64	2.32	2.48	1.92E-09*
Passive leisure	3.25	3.50	3.38	4.02E-08*
Leisure education	2.50	2.70	2.60	2.62E-06*
Leisure caring	2.40	2.50	2.45	0.006*
Social leisure	2.12	2.24	2.18	0.001*

* 0.01

n = 542), 0.01 and 0.05 differences of variance (Anova) in the five sections were found in: (i) active leisure ($p = 8.88E-06$, $r^2 = 0.18$); (ii) passive leisure ($p = 4.24E-08$, $r^2 = 0.22$); (iii) leisure caring ($p = 0.030$, $r^2 = 0.10$); and (iv) social leisure ($p = 0.008$, $r^2 = 0.12$) (Table 3). No difference (0.01, 0.05) in the population of adolescent boys (45.02%, n = 542) was observed in (i) leisure education ($p = 0.080$, $r^2 = 0.08$). Within the cohort of adolescent girls (54.98%, n = 662) a 0.05 difference of variance in the five sections was recorded in (i) leisure caring ($p = 0.020$, $r^2 = 0.08$). No differences (0.01, 0.05) in the group of adolescent girls (54.98%, n = 662) were found in: (i) active leisure ($p = 0.286$, $r^2 = 0.04$);

(ii) passive leisure ($p = 0.642$, $r^2 = 0.02$); (iii) leisure education ($p = 0.256$, $r^2 = 0.04$); and (iv) social leisure ($p = 0.342$, $r^2 = 0.04$).

Discussion

Examining the satisfaction rate of leisure time in adolescent boys (45.02%, n = 542) and girls (54.98%, n = 662) from Slovakia may be demanding because of its subjective nature. The authors employed instruments (a self-report) to measure the satisfaction rate of leisure time in adolescents, including interviews, observations, and questionnaires (survey) [2, 4, 16, 25, 28]. Instruments aim to capture adolescents' subjective experiences (e.g., attitudes, feelings) related to leisure activity; therefore, it is important to select instruments, which are sensitive in nature, age-appropriate, and align with aims of study. By employing these instruments, the authors gathered comprehensive understanding of the satisfaction rate of leisure time in adolescents and gained insights into factors contributing to well-being (satisfaction) in leisure activity.

Understanding the satisfaction rate of leisure time in adolescents (n = 1204) from Slovakia is important because of identifying the factors, which contribute to leisure experiences, enabling peers, parents, and educators to create supportive environments, which support adolescents' leisure needs. The satisfaction rate of leisure time in adolescents may have positive outcomes for other areas of adolescents' lives (e.g., academic, social). Understanding the satisfaction rate of leisure time in adolescents makes it easier to develop interventions (programs), which maximize positive outcomes associated with leisure activity. The satisfaction rate of leisure time in adolescents may differ depending on diverse factors (e.g., preferences, opportunities). Adolescents worldwide report life satisfaction; however, the authors observed significant

Table 3. Analysis of variance for satisfaction rate of leisure time in the survey group (n = 1 204)

	Effect size (r^2)	Anova (p)
Adolescent boys (n = 542)		
Active leisure	0.18	8.88E-06**
Passive leisure	0.22	4.24E-08**
Leisure education	0.08	0.080
Leisure caring	0.10	0.030*
Social leisure	0.12	0.008**
Adolescent girls (n = 662)		
Active leisure	0.04	0.286
Passive leisure	0.02	0.642
Leisure education	0.04	0.256
Leisure caring	0.08	0.020*
Social leisure	0.04	0.342

* 0.05; ** 0.01

drops of the satisfaction rate of leisure time in adolescents and consider this decrease as an upward trend [27]. The satisfaction rate of leisure time in the survey group ($n = 1204$) was 3.36 ('neutral') out of the 5-point scale ($p > 0.05$; $p = 0.184$), with a 0.08 difference (\bar{x}) in favor of adolescent girls (3.40; 54.98%, $n = 662$) compared to boys (3.32; 45.02%, $n = 542$). The satisfaction rate ('Happiness Scale') of 1464 adolescents in Turkey was 3.25 ± 0.60 ; however, no difference (0.01, 0.05) between adolescent boys (21.80 ± 2.24 ; 45.40%, $n = 664$) and girls (21.10 ± 1.90 ; 54.60%, $n = 800$) from Turkey was observed in the satisfaction rate ($t = 1.092$, $p > 0.05$). According to Anova, relationships between all the dimensions of the happiness scale and leisure satisfaction were significant (positive) (0.01, 0.05) [15]. When determining the frequency of dimensions for the satisfaction rate of leisure time the lowest score (average) was recorded in the 'physical' aspect (3.20). Active leisure (5-point scale) of adolescents ($n = 1204$) from Slovakia was 2.48 (\bar{x}) ($p < 0.01$), with a 0.32 difference in favor of adolescent boys (2.64; 45.02%, $n = 542$) compared to girls (2.32; 54.98%, $n = 662$); however, it was less than in 1464 adolescents from Turkey (3.20) [15]. The leisure satisfaction scale of 360 adolescents in Turkey was 132 (\bar{x}); however, no difference (0.01, 0.05) between adolescent boys (71.40%, $n = 257$) and girls (28.60%, $n = 103$) from Turkey was found in the leisure satisfaction scale ($t = 0.716$, $p > 0.05$) [2]. No difference (0.01, 0.05) between adolescent boys (21 ± 2 ; 25.4%, $n = 63$) and girls (21 ± 2 ; 74.6%, $n = 186$) of Nigeria [20], university students ($n = 423$) of China [18], and residents ($n = 398$) of Antalya [17] was reported in the satisfaction rate; however, differences of 0.01 and 0.05 were found in leisure satisfaction in terms of gender (Macao, China; Konya, Turkey) [28, 29]. Within the population of adolescent boys (45.02%, $n = 542$), differences of variance (Anova) (0.01, 0.05) in 5 sections were recorded in: (i) active leisure ($p = 8.88E-06$, $r^2 = 0.18$); (ii) passive leisure ($p = 4.24E-08$, $r^2 = 0.22$); (iii) leisure caring ($p = 0.030$, $r^2 = 0.10$); and (iv) social leisure ($p = 0.008$, $r^2 = 0.12$) when compared to girls: (i) leisure caring ($p = 0.020$, $r^2 = 0.08$) A comparison of leisure satisfaction in adolescent boys (50.90%, $n = 960$) and girls (9.10%, $n = 928$) from Spain was similar in terms of the results, with higher scores of leisure education and lower scores of active leisure [8]. Leisure satisfaction of adolescent boys is dominant when compared to girls because of adolescent girls' need for leisure; in particular, social interaction is greater [21]. According to 1594 (50%) male students (13.78 ± 0.40), active leisure (only) had positive

effects on leisure satisfaction, while by contrast, 1594 (50%) female students had negative effects on leisure satisfaction by means of passive leisure and social leisure [25].

Results of any cross-sectional study require extra formulation in light of existing limitations; therefore, we consider them to be the carrying limit (number) of surveyed adolescent boys and girls ($n = 1204$, 100%) from Slovakia and choosing two regions (Žilina, Banská Bystrica) out of eight. Another limiting element was collecting data from a population (target) at a single point in time (6 weeks; May 1 – June 10, 2023) [30]. Another limitation was the lack of motivation to fill the forms (debriefing), as participation in the study was voluntary and without incentives. Since our cross-sectional study has limitations, it provides significant data concerning the prevalence, distribution, and associations between selected variables at a specific time point. Recognizing the limitations helps the authors interpret the findings and indicates the need for a longitudinal study to strengthen the causal inference and investigate temporal dynamics.

Conclusions

Examining the satisfaction rate of leisure time in adolescent boys (45.02%, $n = 542$) and girls (54.98%, $n = 662$) from Slovakia is an important study aim, because many research gaps remain in literature (in terms of the Slovak scale); therefore, the available study provides insights into leisure preferences, engagement patterns, and satisfaction rate in adolescents ($n = 1204$) from Slovakia, contributing in the development of target interventions (policy) aimed at impacting (improving) the quality of life. Filling the existing gaps in literature, this study offers comprehensive understanding of the specific context of satisfaction rate for leisure time in adolescent boys (45.02%, $n = 542$) and girls (54.98%, $n = 662$) from Slovakia.

Encouraging adolescents to make the most of leisure time is important in terms of development (holistic), happiness, and life satisfaction; however, it is important to create a supportive environment (e.g., school, home), which promotes participation in leisure.

Acknowledgement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Adams K, Leibbrandt S, Moon H. Critical review of literature on social and leisure activity and well-being in later life. *Ageing Soc.* 2011;41(4):683-712. <https://doi.org/10.1017/S0144686X10001091>
2. Akdeniz H, Simsek S, Kavi O, Uzuner E, Sekban G. Levels of satisfaction with leisure time in foreign students. *J Educ Train Stud.* 2018;6(3):88-972. <https://doi.org/10.1114/jets.v6i3a.3162>
3. Andrade C. The limitations of online surveys. *Indian J Psychol Med.* 2020;42(6):575-576. <https://doi.org/10.1177/0253717620957496>
4. Bartík P, Adamčák Š, Marko M. Leisure time analysis and comparison of secondary school male students in terms of selected regions of Slovakia: cross-sectional study. *Trends Sport Sci.* 2022;29(4):161-169. <https://doi.org/10.23829/TSS.2022.29.4-3>
5. Caldwell L, Baldwin C, Walls T, Smith A. Preliminary effects of leisure education program to promote healthy use of free time among middle school adolescents. 2004;36(3):310-335. <https://doi.org/10.1080/00222216.2004.11950026>
6. Cho D, Kim S. Adolescents' self-esteem associated with solitary, passive, and active leisure activities. *Sustain.* 2022;14(9):4873. <https://doi.org/10.3390/su14094873>
7. Fredricks A, Simpkins S. Organized out-of-school activities and peer relationships: theoretical perspectives and previous research. *New Dir Child Adolesc Dev.* 2013;140(1):1-17. <https://doi.org/10.1002/cad.20034>
8. Fraguera-Vale R, Varela-Crespo L, Varela-Garrote L, Carretero-García M. The influence of gender and family educational background on leisure satisfaction among Spanish adolescents. 2021;26(1):391-404. <https://doi.org/10.1080/02673843.2021.1970595>
9. Fröberg A, Lindroos A, Ekblom Ö, Nyberg G. Organized physical activity during leisure time is associated with more objectively measured physical activity among Swedish adolescents. *Acta Paediatr.* 2020;109(9):1815-1824. <https://doi.org/10.1111/apa.15187>
10. Granic I, Lobel A, Engels R. Benefits of playing video games. *Am Psychol.* 2013;69(1):66-78. <https://doi.org/10.1037/a0034857>
11. Jaworska N, MacQueen G. Adolescence as a unique developmental period. *J Psychiatry Neurosci.* 2015;40(5):291-293. <https://doi.org/10.1503/jpn.150268>
12. Haddock A, Ward N, Yu R, O'Dea N. Positive effects of digital technology use by adolescents: a scoping review of the literature. *Int J Environ Res Public Health.* 2022;19(21):14009. <https://doi.org/10.3390/ijerph192114009>
13. Harriss D, Jones C, MacSwee A. Ethical standards in sport and exercise science research: 2022 update. *Int J Sports Med.* 2022;43(13):1065-1070. <https://doi.org/10.1055/a-1957-2356>
14. Hayes S, Chapple S, Ramirez C. Strong, smart, and bold strategies for improving attendance and retention in after-school intervention. *J Adolesc Health.* 2014;54(3):64-69. <https://doi.org/10.1016/j.jadohealth.2013.12.030>
15. Kaya S. Relationship between leisure satisfaction and happiness among college students. *Univers J Educ Res.* 2016;4(3):622-631. <https://doi.org/10.13189/ujer.2016.040322>
16. Kozanáková A, Adamčák Š, Marko M. Satisfaction rate with leisure time in a sample of Academy of Police Force students. *Slovak J Sport Sci.* 2022;8(2):39-49. <https://doi.org/10.24040/sjss.2022.8.2.39-49>
17. Lapa T. Life satisfaction, leisure satisfaction and perceived freedom of park recreation participants. *Procedia Soc Behav Sci.* 2013;93(21):1985-1993. <https://doi.org/10.1016/j.sbspro.2013.10.153>
18. Lu L, Hu C. Personality, leisure experiments, and happiness. *J Happiness Stud.* 2005;6(3):235-342. <https://doi.org/10.1007/s10902-005-8628-3>
19. Miklikowska M, Tilton-Weaver L, Burk J. With a little help from my empathic friends: the role of peers in the development of empathy in adolescence. *Dev Psychol.* 2022;58(6):1156-1162. <https://doi.org/10.1037/dev0001347>
20. Misra R, McKean M. College students' academic stress and its relation to their anxiety, time management, and leisure satisfaction. *Am J Health Stud.* 2000;16(1):41-51.
21. Mota J, Santos M, Ribeiro J. Differences in leisure-time activities according to level of physical activity in adolescents. *J Phys Act Health.* 2008;5(2):286-293. <https://doi.org/10.1123/jpah.5.2.286>
22. Nemcová L, Dulovics Sámellová S. Voľnočasové activity stredoškolskej mládeže (Leisure activities of high school students). Banská Bystrica: Vydavateľstvo Univerzity Mateja Bela; 2021.
23. Norman G. Likert scales, levels of measurement, and "laws" of statistics. *Adv Health Sci Educ.* 2010;15(5):625-632. <https://doi.org/10.1007/s10459-010-9222-y>
24. Setia S. Methodology series module 3: cross-sectional study. *Indian J Dermatol.* 2016;61(3):260-264. <https://doi.org/10.4103/0019-5154.182410>
25. Shin K, You S. Leisure type, leisure satisfaction and adolescents' psychological wellbeing. *J Pac Rim Psychol.* 2013;7(2):53-62. <https://doi.org/10.1017/prp.2013.6>
26. Sullivan M, Feinn R. Using effect size or why the p value is not enough. *J Grad Med Educ.* 2012;4(3):279-282. <https://doi.org/10.4300/JGME-D-12-00156.1>

27. Szcześniak M, Bajkowska I, Czaprowska A, Sileńska A. Adolescents' self-esteem and life satisfaction: communication with peers as a mediator. *Int J Environ Res Public Health*. 2022;19(7):3777. <https://doi.org/10.3390/ijerph19073777>
28. Tükel Y, Temel S. Examining the level of freedom, life satisfaction, and happiness perceived by college students in leisure time. *Int J Res Educ Sci*. 2020;6(4):668-678. <https://doi.org/10.46328/Ij res.v6i4.1451>
29. Vong T. Leisure satisfaction and quality of life in Macao, China. *Leis Stud*. 2005;24(2):195-207. <https://doi.org/10.1080/02614360412331313502>
30. Wang X, Cheng Z. Cross-sectional studies: strengths, weaknesses, and recommendations. *Chest*. 2020;158(1):65-71. <https://doi.org/10.1016/j.chest.2020.03.012>

Sleep, energy, and stress in collegiate female volleyball athletes

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Abstract

Introduction. Sleep duration and quality among collegiate athletes is of great importance for their recovery and has been linked to performance, but little is known about reasons for missed sleep or the relationship between sleep and stress in this population. **Aim of Study.** The aim of this study was to 1) assess the relationship between sleep quality, sleep duration, energy, and stress in female collegiate volleyball players through the four months of the competitive season, and 2) report the frequency of provided reasons for poor sleep quality and duration. **Material and Methods.** De-identified data from an athlete monitoring platform for sleep duration, sleep quality, stress, energy, and reasons for missed sleep were analyzed for this study. Data were gathered from a total of 67 female collegiate volleyball athletes during the competitive seasons from 2016 through 2021. **Results.** Sleep quality and sleep duration showed a moderate correlation ($r = 0.404$ to 0.552) across all four months of the volleyball season, $p < 0.001$. Sleep quality had a low correlation with energy for each month ($r = 0.348$ to 0.387), except September where there was a moderate correlation ($r = 0.400$, $p < 0.001$). Sleep quality and stress showed to no correlation ($r = 0.184$ to 0.266 , $p < 0.001$). Sleep duration and energy showed low to no correlation ($r = 0.160$ to 0.246 , $p < 0.001$). Sleep duration and stress were not correlated for any of the months evaluated ($r = 0.091$ to 0.195 , $p < 0.001$). The results of the study also showed that “other”, overtiredness, and worry/stress were the top reported sleep ailments for these athletes. **Conclusions.** These data can be applicable to coaches, athletes, and athletic trainers looking to gain insight on the sleep habits and effectiveness in collegiate female volleyball athletes during the competition season.

KEYWORDS: athlete monitoring, team sports, wellness.

Received: 26 May 2023

Accepted: 11 July 2023

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Introduction

Sleep is a necessary process that rejuvenates the body and mind from life activities. Sufficient amounts of sleep vary from person to person based on their energy output, age, and sex. On average, an adult should attain about 7-7.5 hours of sleep per night to maintain optimal physical and mental function [27]. Consistently attaining less than 7-7.5 hours can lead to a state of sleep deprivation, which is correlated to many health issues like decreased physical and psychological well-being and pain, decreased cognitive function, hypertension, diabetes mellitus, and coronary artery disease [9, 18, 26]. Sleep can be assessed objectively through somnography or subjectively through self-report assessments of sleep quality and duration. Research suggests that subjective measures gave more useful data than objective measures [2].

Previous studies have demonstrated that compared to non-athletes of the same gender and age, athletes report lower quality and duration of sleep [16]. Athletes endure training to induce physical stress to produce an effect that will increase athletic performance [11]. If training

and recovery methods, including sleep, are improperly balanced, a negative stress response may occur [11]. Heidari et al. determined a relationship between sleep and optimal competition condition, describing the importance of sleep in the athlete recovery routine [14]. In addition, lack of sleep has been correlated to decreased reaction time, increased injury risk, and increased perceived effort [17, 20]. Duration of sleep is not the only determinate of sleep benefits; sleep quality also impacts the effects of sleep on physiology and performance [2, 6]. In female collegiate lacrosse athletes, sleep quality proved to be a predictor of external load variables including total distance and high-intensity distance [6]. Female athletes experience stressors through school and sport that impact sleep but may face differences due to differing physiological processes like menstruation. Female athletes with an average age of 23 have been shown to have higher post-game cortisol levels during training and control conditions which may affect sleep quality and quantity [22]. Longitudinal research in female cross-country athletes found that resting heart rate increased over time and was positively associated with increased slow wave sleep but not the timing and regularity of sleep [24]. These differing characteristics are important to investigate, as female athletes are frequently underrepresented in athlete research literature [5].

College athletes participating in the National Collegiate Athletics Association (NCAA) must balance their time through their academic, athletic, and social commitments [13]. This struggle to manage time can create stress and lead to disrupted sleep [4]. Division I volleyball players reported lower levels of sleep duration and higher levels of soreness and perceived stress on days with reported pain and injury incidences [13]. Additionally, poor sleep quality before away games was reported more than home games in both female and male volleyball players [10]. Through objective measures of sleep (e.g., measurements taken through somnography), volleyball athletes reported a lower amount of sleep the day after the match, compared with pre-match sleep amounts and sleep two nights post-match [25]. Therefore, location of training or competition, time of training, or intensity of training can impact the sleep quality of the athlete.

Lack of sleep demonstrates a two-prong effect on lower performance; amount of sleep alone can predict athletic performance [2] and the physiological effect of stress caused by a lack of sleep can result in a subpar athletic performance [11, 23]. Because athletes have unique schedules and training loads that lead to stressors impacting performance, it is important to gain knowledge

about the physiological and psychological relationship of stressors with measurements of recovery [21].

Aim of Study

Evidence indicates that stress and sleep are intertwined for athletes and there may be some degree of fluctuation in these wellness markers throughout the season [11]. These aspects have not yet been explored in collegiate female athletes. The aim of the current study was to 1) assess the relationship between sleep quality, sleep duration, energy, and stress in female collegiate volleyball players through the four months of the competitive season, and 2) report the frequency of provided reasons for poor sleep quality and duration. The study includes data from the competitive season of collegiate volleyball athletes. We hypothesized that sleep quality and duration will demonstrate a strong positive relationship, and stress and energy would have moderate positive relationships between the two sleep measures. We also hypothesized that stress and worry would be the most cited reason for poor sleep quality or reduced sleep duration.

Materials and Methods

Experimental design

A retrospective, observational study design was used to test the hypotheses. De-identified data were received from an athlete monitoring platform (Metrifit, Louth, Ireland). Participants submitted data during collegiate volleyball seasons (August through November) from 2016 through 2021. This study was approved as exempt status by the Sam Houston State University institutional review board, and this study was conducted in alignment with the Declaration of Helsinki. Due to the retrospective nature of the study, informed consent was not necessary.

Participants

Data was gathered from a total of 67 female collegiate volleyball athletes from the United States through an athlete monitoring platform. Athletes were varsity players from teams competing in the NCAA, but no divisional characteristics (e.g., I, II, or III) were gathered. There were a varied number of data entries per participant, ranging from three to 429 entries. Athletes were excluded from the study if they did not complete at least three data entries per month.

Measures

The study utilized the Metrifit athlete monitoring application to gather wellness data from collegiate

volleyball athletes. Mtrifit is a mobile athlete self-report measure (M-ASRM) delivered to athletes through a phone application [8]. The application provided a daily self-report wellness assessment [7]. Wellness characteristics like stress, fatigue, mood, sleep, recovery, health status, energy [12] were collected within Mtrifit, but for the purpose of this study, only sleep quality, sleep duration, energy, and stress were analyzed. Participants received a text message notification reminder to complete these daily subjective assessments to encourage participation. Perceived sleep quality and perceived stress used a scale of 1 to 5, with higher values indicating a more positive affect. Sleep duration was a self-report measure estimated to the nearest half hour by participants. Daily reports of sleep duration and wellness sub-scores were used for analyses. Athletes also had the option to provide reasons for poor sleep. The list of reasons included: consumed alcohol/caffeine late at night, pain/irritation, overtired, worried/stressed, noise/disturbance during the night, late night, consumed food/beverage late at night, and other. These data were tallied by month of the competitive season.

Statistical analysis

Data analyses were conducted with RStudio (Boston, MA). Descriptive statistics for sleep quality, sleep

duration, and stress were tabulated for the whole season and by month of the season – August, September, October, and November. A Shapiro-Wilk test determined the data were normally distributed. For the primary aim of the study, repeated measures correlations (procedure rmcrr) were conducted for the whole data set and individual months to evaluate the relationship between the sleep quality, sleep duration, energy, and stress [1]. Correlation coefficients (r) were interpreted as no correlation (< 0.2), low correlation (0.2-0.39), moderate correlation (0.4-0.59), moderately high (0.6-0.79), and high (> 0.8) [28]. Effect sizes (q) for the difference between monthly correlations were calculated and interpreted as no effect (< 0.1), small (0.1-0.3), intermediate (0.3-0.5), and large (> 0.5) [3]. For the secondary aim of the study, total frequency of each sleep-related ailment were tallied for each month. Percent contributions of each ailment were calculated and organized into a heat map.

Results

A total of 9509 observations were included in the analyses, across 67 participants. Figure 1 shows the means and standard deviations for sleep quality, energy, stress, and sleep duration scores for each month of the volleyball season. The athletes report a slight reduction

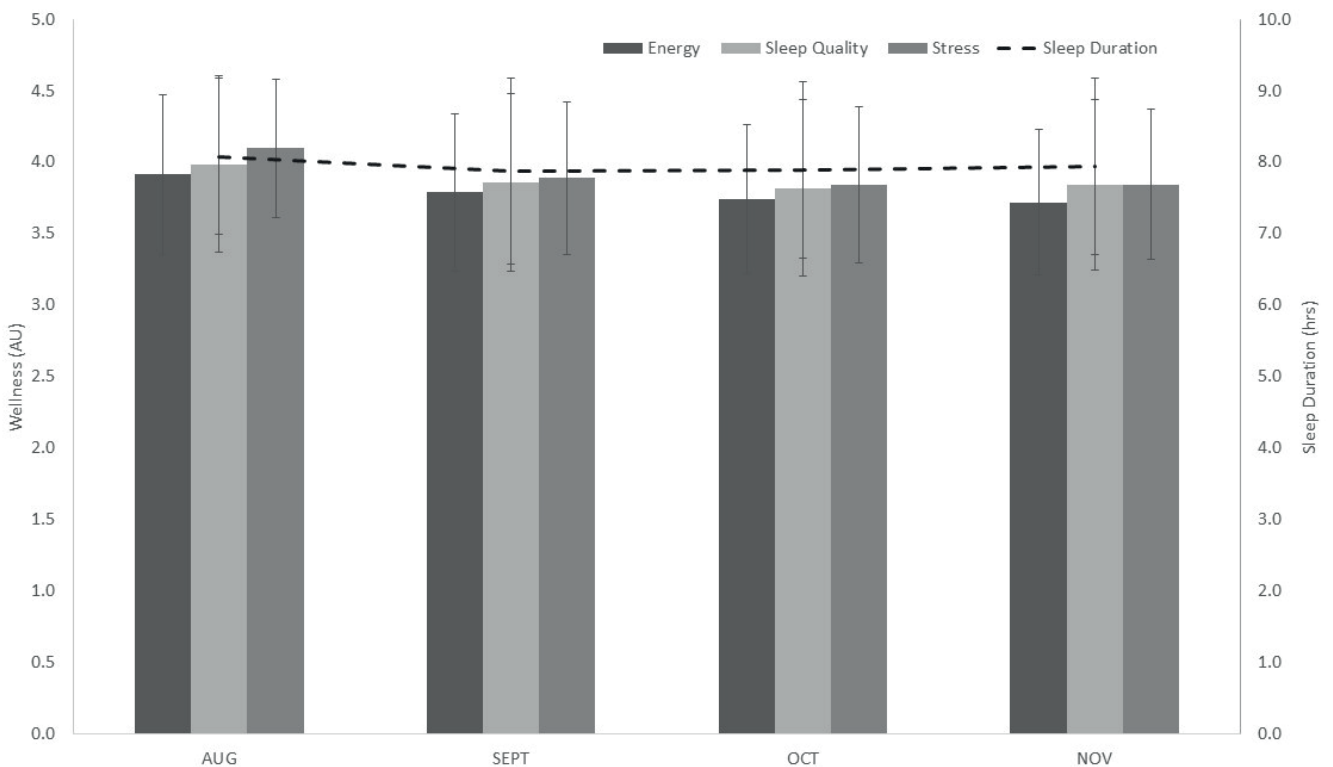


Figure 1. Means and standard deviations of wellness sub-scores and sleep duration across the volleyball season by month

in all the wellness components as the season progressed, with all scores peaking in August and reaching their lowest points in November. Sleep duration remained steady for the entirety of the season.

Table 1 shows the results of the repeated measures correlation analyses. Sleep quality and sleep duration showed a moderate correlation, with r-values ranging from 0.404 to 0.552 across all four months of the volleyball season, $p < 0.001$ for all. Sleep quality had a low correlation with energy for each month, except September where there was a moderate correlation ($p < 0.001$ for all). Sleep quality and stress showed no correlation for August and September ($p < 0.001$) and a low correlation for October, November, and the whole data set ($p < 0.001$ for all). Sleep duration and energy were lowly correlated in September, October, November, and for all of the data, but had no correlation in August ($p < 0.001$ for all). Sleep duration and stress were not correlated for any of the months evaluated.

Table 1. Repeated measures correlation coefficients (r) for wellness sub-scores for each month of the collegiate volleyball season. Bolded values indicate a moderate correlation

		Sleep duration	Energy	Stress
All data	Sleep quality	0.491	0.387	0.255
	Sleep duration		0.218	0.179
AUG	Sleep quality	0.404	0.373	0.184
	Sleep duration		0.16	0.091
SEPT	Sleep quality	0.552	0.400	0.193
	Sleep duration		0.246	0.173
OCT	Sleep quality	0.504	0.348	0.238
	Sleep duration		0.219	0.187
NOV	Sleep quality	0.501	0.356	0.266
	Sleep duration		0.224	0.195

Table 2 shows the effect sizes evaluating differences between monthly correlations. There was a small effect in sleep quality and sleep duration for August ($q = 0.122$ to 0.193) compared to the other three months of the season with no effect ($q = 0.004$ to 0.071). This was due to athletes scoring sleep quality and duration slightly higher in August compared to the other three months, and then sleep quality scores dropped by 0.2-0.3 points and sleep duration remained fairly stable. Effect sizes for sleep quality with energy and stress were all negligible. All effect sizes for sleep duration and energy

Table 2. Effect sizes to evaluate differences in monthly correlation coefficients

	SEPT	OCT	NOV
Sleep quality and sleep duration			
AUG	0.193	0.126	0.122
SEPT		0.067	0.071
OCT			0.004
Sleep quality and energy			
AUG	0.032	0.029	0.02
SEPT		0.06	0.051
OCT			0.009
Sleep quality and stress			
AUG	0.009	0.057	0.086
SEPT		0.047	0.077
OCT			0.030
Sleep duration and energy			
AUG	0.090	0.061	0.066
SEPT		0.029	0.023
OCT			0.005
Sleep duration and stress			
AUG	0.084	0.098	0.106
SEPT		0.014	0.023
OCT			0.008

were also negligible. There was also a small effect in sleep duration and stress r-values between August and November ($q = 0.106$), but all other q effect sizes are interpreted as no effect.

Table 3 shows a heat map of the distribution of sleep-related ailments reported by the athletes per month of the competitive season. The color shading starts at dark red (high frequency of reporting) and fades to green (low frequency reporting). The light colored/white shades represent moderate reporting. The category of “other” was the highest reported sleep ailment for each month of the season, representing approximately 40% of all sleep ailments. Overtired was the second highest sleep ailment cited, with highest amounts in the middle of the season in September and October. Noise/disturbance as the primary reason reported for negative sleep quality comprised 15.3% of the total responses. Worried/stress

as the reason for a decreased sleep quality contributed to 14.4% of total reported reasons. However, this reason was reported more frequently as the season progressed from August to October. Athletes reported being worried/stressed at an increasing rate throughout each month of the season. Late night consumption of food, beverage, alcohol, and caffeine were least frequently reported as a reason for poor sleep.

Table 3. Percent frequency distribution of identified reasons negatively affecting sleep quality

	AUG	SEPT	OCT	NOV	Total
Alcohol/caffeine late	0.4%	0.7%	0.2%	0.3%	0.4%
Pain/irritation	5.6%	4.0%	4.2%	3.6%	4.2%
Overtired	14.4%	19.3%	19.4%	15.4%	17.6%
Worried/stressed	7.4%	12.3%	14.6%	20.0%	14.4%
Noise/disturbance	23.2%	16.2%	11.4%	15.2%	15.3%
Late night	4.6%	2.6%	9.9%	12.9%	8.1%
Food/beverage late	0.4%	0.2%	0.8%	1.0%	0.6%
Other	44.0%	44.7%	39.5%	31.7%	39.4%

Note: Red indicates a high frequency, white is moderate, and green is low, with deeper shades of each color representing higher values

Discussion

The current study assessed the relationship between collegiate volleyball athletes' stress, sleep quality, energy, and sleep quantity during the competitive season. Reasons for poor sleep quality and duration were also reported. We hypothesized that sleep quality and quantity would have a strong positive relationship and stress and energy would have moderate positive relationships with the two sleep measures. There was a moderate correlation between sleep quality and quantity, but there was low correlation with sleep quality and energy and stress, and no correlation between sleep duration and stress or energy. The volleyball athletes' subjective scoring for sleep quality and duration were stable over the course of a volleyball competition season. The top three reasons reported for diminished sleep quality were other, over-tiredness, and worry/stress. As the season progressed, worry/stress increased as the primary reason for lower sleep quality, while other was reported less frequently.

The results showed a moderate correlation between sleep quality and sleep duration during the whole season (August-November, $r = 0.491$). This moderate correlation may be attributed to athletes preferring

different durations of sleep and if the athlete's sleep habits aligned with their chronotype. These findings may be used to better regulate athletes' rest, recovery, and in-season training. Knufinke and colleagues emphasized that the body adjusts necessary sleep time according to the need for recovery from physical exertion [16]. Compared to their respective age groups, 88% of elite athletes had lower sleep, alluding to the need for more athlete-sleep data to better understand the relationship between athlete sleep duration and quality. The present study shows that sleep duration and quality were stable with each month of the season and correlated with one another. Encouraging athletes to increase their time spent in bed may subsequently improve sleep duration, quality, and efficiency. This should be further explored through both objective and subjective methods.

Energy and stress had low correlations with sleep quality ($r = 0.387$ and $r = 0.255$, respectively). Low correlations between these variables concur with previous research that investigated well-being factors of sleep, stress, and delayed onset of muscle soreness during a semi-pro soccer season in male athletes [21]. However, a study by Brandt and colleagues on elite male and female athletes competing in team and individual sports found notable correlations between perceived sleep quality and mood state [2]. The researchers defined mood state as encompassing vigor, tension, depression, anger, fatigue, and mental confusion. Specifically, they found that higher levels of sleep quality were directly correlated with high vigor and lower depression, anger, fatigue, and mental confusion, associating better sleep quality with a more positive mood state. These differences in study findings may be attributed to differences in sport type, level of competition, and gender of athletes. Specifically, Mascaro and colleagues reported that women athletes reported higher levels of negative mood and stress, and this should be considered when comparing studies with different genders represented [19].

Interestingly, there were no substantive changes in the wellness sub-scores and sleep duration as the season progressed. The athletes consistently obtained less than the optimal eight hours of sleep throughout the season. This is concerning because athletes deal with life stressors like school, family life, and relationships alongside athlete specific stressors like high caloric and mental expenditure. Weekly sleep analysis in male rugby players detailed differences in sleep duration of athletes between competition, low load, and high load weeks [4]. Essentially, when addressed in a more granular fashion – within a week – there were sleep differences as opposed to analyzing sleep via analog methods over

a month or season. This can be applied to the current study because the data was compiled over monthly amounts, providing no notable differences based on the time in season. A weekly analysis may have provided more insight towards the specific difference in sleep duration during different weeks of load. Many studies detail specific daily or weekly differences in sleep duration for athletes based on scenarios like presence or absence of a competition and the extent of training. For example, Vitale and colleagues conducted a study where they assessed differences in total sleep time pre-match and days post-match, finding that sleep was lower the first night post-match [25]. This alludes to the current study assessing athlete sleep duration in a more general expanse over months of a season instead of daily or weekly data analysis. The secondary analysis nature of the present study did not include knowledge of when competitions were relative to their sleep and wellness, just that the athletes were within the competition phase of the training year. Future studies should consider both in their assessments when able.

Monthly data was gathered from athletes on perceived sleep ailments across the four months of the competitive season. The “other” category was reported most often during the competitive season (Table 3), followed by overtired which peaked in the months of September and October. Worried/stressed and noise disturbance followed with peaks in separate months. Worry/stressed steadily increased as the season progressed, peaking in November. This finding is important due to implications of other factors like increased academic demands and impending post season competition near the end of the semester. Noise disturbance peaked in August, which was likely associated with beginning of the semester celebrations in college housing. Additionally, both ailments could have possibly become an issue due to the different environments of home and away games, such as athletes sleeping in a hotel. Previous research involving male volleyball players investigated sleep quality prior to an away game, home game, and training days and found that sleeping in a hotel before an away game demonstrated greater occurrences of nocturnal awakenings, reduced sleep latency (time it takes to fall asleep), poorer overall sleep quality, and less total sleep [10]. The former study may explain why “other” and noise/disturbance were commonly reported in this study. Many athletes must sleep in hotel rooms and unfamiliar environments with multiple teammates during competition season and they may have perceived this environment as noisy or classified the experience as “other” while reporting what decreased their sleep

quality. A study focusing on worry/stress in elite Australian male and female athletes, described the top sleep ailments the night before a competition as thoughts about competition at 83.5% and nervousness at 43.8% [15]. This result is reflected in the present study as worry/stress were reported more as the season progressed. This could be attributed to more pregame nervousness prior to more important competitions as the season advanced, as well as academic stress due to intra-term exams and finals.

A limitation in the current study is the use of de-identified data. This data lacked information related to athletes’ training calendars and level of play, referring to the NCAA division. This information provides context to the commitment and rigor expected of athletes. Another limitation is variation in number of data entries. While this was controlled for in the correlation analysis, an athlete with more data entries would have a larger influence over the descriptive data provided in this study compared to an athlete with few entries. The athletes completing more entries may have also experienced survey fatigue. Another limitation of the data is sleep-related ailments category “other”. This category cannot be decoded and holds vital information for the most reported category of sleep-related ailments. Decoding this could have provided useful information about why athletes report a reduced sleep quality. Insight from the “other” category would also aid in the understanding of why female, college athletes are experiencing a reduced sleep quality. Lastly, this study did not assess for training volume or timing of games relative to sleep and stress. This information may provide contextual insight for fluctuations in sleep duration and wellness sub-scores.

Conclusions

This study provided a general concept of perceived sleep quality, stress, energy, and self-reported sleep duration of many female volleyball athletes throughout the competitive season. To our knowledge, this is the first study to evaluate the relationships between these variables in this population. This study found that sleep quality and duration are moderately correlated during the competition season of collegiate volleyball players, although there was little to no correlation for sleep quality, sleep duration, stress, and energy. Wellness sub-scores also presented no change over the course of the four-month season. The results of the study also showed that “other”, overtiredness, and worry/stress were the top reported sleep ailments for these athletes. These data can be applicable to coaches, athletes, and athletic trainers looking to gain insight on the sleep habits and

effectiveness in collegiate female volleyball athletes during the competition season. Athletes should aim for consistency in their sleep habits as often as possible, which will likely positively impact their sleep quality. Coaches should speak regularly about good sleep habits with their athletes and let them know that sleep duration and quality are linked, but these sleep parameters are not necessarily related to their stress or energy levels. Future directions for study could isolate the competitive level of athletes to determine if competition level such as Division I, II, or III athletes get different amounts of sleep. The study could even explore different athletes of various sports to see if the results are consistent across sports.

Conflict of Interest

The authors declare no conflict of interest.

References

- Bland JM, Altman DG. Statistics notes: Calculating Correlation coefficients with repeated observations: Part 1—correlation within subjects. *BMJ*. 1995;310(6977):446.
- Brandt R, Bevilacqua GG, Andrade A. Perceived sleep quality, mood states, and their relationship with performance among brazilian elite athletes during a competitive period. *J Strength Cond Res*. 2017; 31(4):1033-1039. Available from: https://journals.lww.com/nsca-jscr/Fulltext/2017/04000/Perceived_Sleep_Quality_Mood_States_and_Their.20.aspx
- Cohen J. Statistical power analysis for the behavioural science (2nd Edition). *Statistical Power Analysis for the Behavioral Sciences*: Hillsdale, NJ; 1988.
- Conlan G, McLean B, Kemp J, Duffield R. Effect of training/competition load and scheduling on sleep characteristics in professional rugby league athletes. *J Strength Cond Res*. 2022;36(12):3390. Available from: https://journals.lww.com/nsca-jscr/Fulltext/2022/12000/Effect_of_Training_Competition_Load_and_Scheduling.16.aspx
- Costello JT, Bieuzen F, Bleakley CM. Where are all the female participants in Sports and Exercise Medicine research? *Eur J Sport Sci*. 2014;14(8):847-851. <https://doi.org/10.1080/17461391.2014.911354>
- Crouch AK, Jiroutek MR, Snarr RL, Bunn JA. Relationship between pre-training wellness scores and internal and external training loads in a Division I women's lacrosse team. *J Sports Sci*. 2020;39(9):1070-1076. Available from: <https://www.tandfonline.com/action/journalInformation?journalCode=rjsp20>
- Cullen BD, McCarren AL, Malone S. Ecological validity of self-reported wellness measures to assess pre-training and pre-competition preparedness within elite Gaelic football. *Sport Sci Health*. 2021;17(1):163-172. <https://doi.org/10.1007/s11332-020-00667-x>
- Duignan CM, Slevin PJ, Caulfield BM, Blake C. Exploring the use of mobile athlete self-report measures in elite gaelic games: a qualitative approach. *J Strength Cond Res*. 2021;35(12):3491-3499. Available from: https://journals.lww.com/nsca-jscr/Fulltext/2021/12000/Exploring_the_Use_of_Mobile_Athlete_Self_report.31.aspx
- Durmer JS, Dinges DF. Neurocognitive consequences of sleep deprivation. *Semin Neurol*. 2005;25(1):117-129. Available from: <http://www.thieme-connect.com/products/ejournals/html/10.1055/s-2005-867080>
- Erlacher D, Schredl M, Lakus G. Subjective sleep quality prior to home and away games for female volleyball players. *International Journal of Dream Research*. 2009;2(2):70-72. Available from: <https://journals.ub.uni-heidelberg.de/index.php/IJoDR/article/view/412>
- Hamlin MJ, Deuchrass RW, Olsen PD, Choukri MA, Marshall HC, Lizamore CA, et al. The effect of sleep quality and quantity on athlete's health and perceived training quality. *Front Sports Act Living*. 2021;10(3):245.
- Hamlin MJ, Wilkes D, Elliot CA, Lizamore CA, Kathiravel Y. Monitoring training loads and perceived stress in young elite university athletes. *Front Physiol*. 2019;10:34. <https://doi.org/10.3389/fphys.2019.00034>.
- Haraldsdottir K, Sanfilippo J, McKay L, Watson AM. Decreased sleep and subjective well-being as independent predictors of injury in female collegiate volleyball players. *Orthop J Sports Med*. 2021;9(9):23259671211029284. <https://doi.org/10.1177/23259671211029285>
- Heidari J, Beckmann J, Bertollo M, Brink M, Kallus KW, Robazza C, et al. Multidimensional monitoring of recovery status and implications for performance. *Int J Sports Physiol Perform*. 2019;14(1):2-8. Available from: <https://journals.humankinetics.com/view/journals/ijsp/14/1/article-p2.xml>
- Juliff LE, Halson SL, Peiffer JJ. Understanding sleep disturbance in athletes prior to important competitions. *J Sci Med Sport*. 2015;18(1):13-18.
- Knufinke M, Nieuwenhuys A, Geurts SAE, Møst EIS, Maase K, Moen MH, et al. Train hard, sleep well? Perceived training load, sleep quantity and sleep stage distribution in elite level athletes. *J Sci Med Sport*. 2018;21(4):427-432.
- Kroshus E, Wagner J, Wyrick D, Athey A, Bell L, Benjamin HJ, et al. Wake up call for collegiate athlete sleep: narrative review and consensus recommendations from the NCAA interassociation task force on sleep

- and wellness. *Br J Sports Med.* 2019;53(12):731-736. Available from: <https://bjsm.bmj.com/content/53/12/731>
18. Lateef OM, Akintubosun MO. Sleep and reproductive health. *J Circadian Rhythms.* 2020;18(1):1-11. Available from: <https://pubmed.ncbi.nlm.nih.gov/32256630/>
 19. Mascaro L, Drummond SPA, Leota J, Boardman JM, Hoffman D, Rajaratnam SMW, et al. Cognitive fitness modulates gender differences in sleep and mental health among competitive athletes under chronic stress. *Front Physiol.* 2023;8;14.
 20. Nicholls AR, Backhouse SH, Polman RCJ, McKenna J. Stressors and affective states among professional rugby union players. *Scand J Med Sci Sports.* 2009;19(1):121-128. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1111/j.1600-0838.2007.00757.x>
 21. Nobari H, Gholizadeh R, Martins AD, Badicu G, Oliveira R. In-season quantification and relationship of external and internal intensity, sleep quality, and psychological or physical stressors of semi-professional soccer players. *Biology (Basel).* 2022;11(3). Available from: <https://pubmed.ncbi.nlm.nih.gov/35336840/>
 22. O'Donnell S, Bird S, Jacobson G, Driller M. Sleep and stress hormone responses to training and competition in elite female athletes. *Eur J Sport Sci.* 2018 May 28;18(5):611-618. <https://doi.org/10.1080/17461391.2018.1439535>
 23. Saw AE, Main LC, Gastin PB. Monitoring the athlete training response: Subjective self-reported measures trump commonly used objective measures: A systematic review. *Br J Sports Med.* 2016;50(5):281-291. Available from: <https://bjsm.bmj.com/content/50/5/281>
 24. Sekiguchi Y, Adams WM, Benjamin CL, Curtis RM, Giersch GEW, Casa DJ. Relationships between resting heart rate, heart rate variability and sleep characteristics among female collegiate cross-country athletes. *J Sleep Res.* 2019;28(6):e12836.
 25. Vitale JA, Banfi G, Galbiati A, Ferini-Strambi L, La Torre A. Effect of a night game on actigraphy-based sleep quality and perceived recovery in top-level volleyball athletes. *Int J Sports Physiol Perform.* 2019;14(2):265-269.
 26. Whale K, Gooberman-Hill R. The importance of sleep for people with chronic pain: Current insights and evidence. *JBMR Plus.* 2022;6(7):e10658. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1002/jbm4.10658>
 27. Worley SL. The extraordinary importance of sleep: The detrimental effects of inadequate sleep on health and public safety drive an explosion of sleep research. *Pharmacy and Therapeutics.* 2018;43(12):758. Available from: [/pmc/articles/PMC6281147/](https://pubmed.ncbi.nlm.nih.gov/306281147/)
 28. Zhu W. $p < 0.05, < 0.01, < 0.001, < 0.0001, < 0.00001, < 0.000001, \text{ or } < 0.0000001 \dots$ *J Sport Health Sci.* 2016; 1;5(1):77-79.

How to be praised in sports newspapers: a performance analysis from soccer matches

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Abstract

Introduction. Soccer players attribute particular importance to media and how newspapers portray their individual performances. However, these analysis can be biased and unfair to players. **Aim of Study.** This study analyzed how sport newspapers rated soccer players' performances, comparing them to performance variables from a data-driven platform (SofaScore). **Material and Methods.** Ratings from the last five games of the Portuguese first division (2021/22 season) were collected from 'A Bola', 'O Jogo' and 'Record' newspapers, in addition of SofaScore data: SofaScore rating, goals scored, saves (for goalkeepers), assists to goals, successful exits (for goalkeepers), accurate passes, key passes, success dribbles, ball lost, shots on target, tackles and duels won (both aerial and on the ground). **Results.** Correlations between newspapers and between newspapers and SofaScore Rating were moderate to strong (0.54-0.64, $p < 0.001$). Goalkeepers received higher ratings ('A Bola': 5.77 ± 0.99 ; 'O Jogo': 5.73 ± 0.83 ; 'Record': 2.85 ± 0.80). Goalkeepers receive higher newspaper' ratings if they perform more Exits ('A Bola' and 'Record') and won Duels ('O Jogo'). Outfield players receive higher newspaper' ratings if they score ('A Bola', 'O Jogo' and 'Record') or assist ('O Jogo' and 'Record') goals. **Conclusions.** With this information, players can better understand newspapers ratings, while the media can evaluate the fairness of those evaluations, especially regarding players that are usually distant from goal situations.

KEYWORDS: soccer, technical, media, game, fairness, score.

Received: 2 July 2023

Accepted: 18 August 2023

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Introduction

Soccer matches are watched by many people and can exceed half a billion viewers in specific games such as the UEFA Champions League final [14]. However, matches are not displayed exclusively for the public. Computer programs provide information concerning performances of both teams and individual players by gathering information labeled by professional observers. For example, the UEFA website discloses players' stats such as goals scored, passes completed and goalkeeper saves. These stats discriminate different technical actions that players perform during matches and can even report an overall rating of player performance. For instance, the number of goals scored, shots on target, dribbles won, penalties converted, and key passes showed a higher correlation with the probability of being nominated for the more prestigious individual award in soccer: the Golden Ball [18]. No surprise arises regarding various performance analysis approaches when attempting to correctly classify individual performances.

Expected goals are one of the most famous approaches and focus on the production process instead of accounting

only for what happens on the score line [3]. Another example is the Elo system that considers expectations before the match – if a player exceeds expectations, his rating will increase [24]. These protocols use algorithms that combine different information and report classification of players' performance. Then, this information is treated and shared with or without a required payment from users. Generally, clubs and scouts pay for a complete dataset provided by companies such as InStat and Stats Perform. The free option has fewer data available and is mostly destined for fans and the general public. SofaScore and WhoScored are examples of the latter.

However, soccer is a complex sport so that several variables can influence the outcome and one rating can fall short in the task of correctly assessing one individual's performance. For example, differences can be expected regarding playing positions, while capabilities such as communication, support and movement into scoring positions are also seen as technical requirements even though they can be difficult to measure in the previously cited protocols [7]. The Premier League, considered by many as the best league in the world, uses the EA Sports Player Performance Index, a rating system to assess players' performances, which results from a partnership between the Premier League, the Football League, Football DataCo and the Press Association [15]. This index is then shared across the media and widely used for several analyses.

Despite these advanced assessments, players receive other performance evaluations, generally classified as success or failure, attributed by fans using platforms such as social media [4]. Importantly, one previous study reported that poor performances can engage fans to mock and threatened athletes [20]. Additionally, newspapers also present individual performance ratings [17], which can be biased [16]. This is particularly important, as they can decisively influence players' performance [1]. Players' self-confidence can suffer from negative media exposure, increasing the pressure felt by these athletes [8, 9]. Fazenda et al. [6] reported that 45% of the Portuguese first-division players considered that the media greatly influence their performance. In Portugal, sport newspapers also classify individual performances of players after each match. Considering the previous studies, these classifications can impact players and questions arise if they are accurate and fair to players.

Aim of Study

The purpose of this study was to analyze Portuguese sports newspaper ratings and how they compare to

a database platform (SofaScore), including differences between playing positions.

Materials and Methods

Procedures

Match performances from the last five games of the 2021/22 season for all teams competing in the Portuguese first division were collected from three Portuguese sport newspapers – 'A Bola', 'O Jogo' and 'Record' – and from the SofaScore platform. The five game sample provided more than 1000 datapoints for each newspaper. These three journals are the national reference when it comes to sports newspapers and are available daily and nationwide. SofaScore uses Opta Sports real-time data collection to provide their data: SofaScore rating, goals scored, saves (for goalkeepers), assists to goals, successful exits (for goalkeepers), accurate passes, key passes, success dribbles, ball lost, shots on target, tackles and duels won (both aerial and on the ground). The Opta system has been previously validated to code players' match actions [13].

Playing positions were classified according to the platform and newspapers diagrams, and divided into goalkeepers, central defenders, fullbacks, central midfielders, wide midfielders, and forwards.

Ratings

Newspapers presented ratings as follows: 1-10 in 'A Bola', 0-10 in 'O Jogo' and 0-5 in 'Record'. The 'Record' newspaper rated all players regardless of time played, differently than other newspapers and the SofaScore. For example, if a player played for only one minute and did not impact the game (as a goal or an assist), only 'Record' rated that player. This rating was

Table 1. Newspaper and SofaScore ratings (means \pm SD)

	'A Bola' (n = 1285)	'O Jogo' (n = 1338)	'Record' (n = 1358)	SofaScore Rating (n = 1372)
GK	5.77 \pm 0.99	5.73 \pm 0.83	2.85 \pm 0.80	6.83 \pm 0.82
CD	5.44 \pm 0.90	5.48 \pm 0.85	2.59 \pm 0.80	6.84 \pm 0.60
FB	5.41 \pm 0.91	5.45 \pm 0.85	2.52 \pm 0.80	6.77 \pm 0.53
CM	5.45 \pm 0.97	5.63 \pm 0.87	2.49 \pm 0.82	6.81 \pm 0.82
WM	5.48 \pm 0.93	5.67 \pm 0.86	2.43 \pm 0.81	6.83 \pm 0.55
FW	5.35 \pm 1.19	5.53 \pm 0.88	2.24 \pm 0.82	6.83 \pm 0.62
All	5.46 \pm 0.97	5.57 \pm 0.89	2.49 \pm 0.83	6.82 \pm 0.57

Note: GK – goalkeeper, CD – central defender, FB – fullback, CM – central midfielder, WM – wide midfielder, FW – forward

excluded, since it was a single data point, and thus no comparison was available.

Data from the SofaScore was retrieved as numbers and not as a percentage in order to avoid misleading ratings. For example, if a player had only one pass and it was successful, the player would have 100% efficacy, which could be misleading when compared to other players. SofaScore ratings are generated by an algorithm that evaluates players' performance on a scale up to ten, depending on what the players did during their time on the pitch [21]. Finally, since goalkeepers are usually excluded from several game actions of the game such as goals or assists, the following goalkeeper data from the SofaScore was excluded: goals, assists, key passes, success dribbles, ball lost, shot on target and tackles.

Statistical analysis

Means \pm standard deviations (SD) were calculated in Microsoft Excel for all newspaper and SofaScore ratings.

Pearson's (r) correlation analysis was conducted to compare ratings between newspapers, newspaper ratings and SofaScore variables for each playing position using jamovi (the jamovi project [23]). Magnitudes of correlation were classified as follows: 0-0.19 as very weak; 0.2-0.39 as weak; 0.40-0.59 as moderate; 0.6-0.79 as strong and 0.8-1 as very strong [2]. Linear regression was calculated to predict newspaper rating outcomes from SofaScore variables using jamovi (the jamovi project) [23]. The three highest slopes (variables) were selected for each newspaper and each playing position. Additional regressions are presented in Supplementary information with the respective equations.

Results

Averages ratings from newspapers and SofaScore are presented in Table 1. Goalkeepers had the higher average classification for all newspapers. The average lowest rating was given to forwards ('A Bola' and 'Record') and fullbacks ('O Jogo'). All analyzed correlations were statistically significant ($p < 0.001$) and varied from strong to moderate: $r = 0.64$ ('A Bola' and 'O Jogo'), $r = 0.60$ ('A Bola' and 'Record'), $r = 0.59$ ('O Jogo' and 'Record'), $r = 0.57$ ('A Bola' and SofaScore Rating), $r = 0.60$ ('O Jogo' and SofaScore Rating), and $r = 0.54$ ('Record' and SofaScore Rating). Linear regressions with highest slopes between the three SofaScore variables and newspaper ratings are presented in Figures 1 ('A Bola'), 2 ('O Jogo') and 3 ('Record'). Additional regressions are presented in Supplementary Information. Linear regressions with the highest slope show that goalkeepers would receive

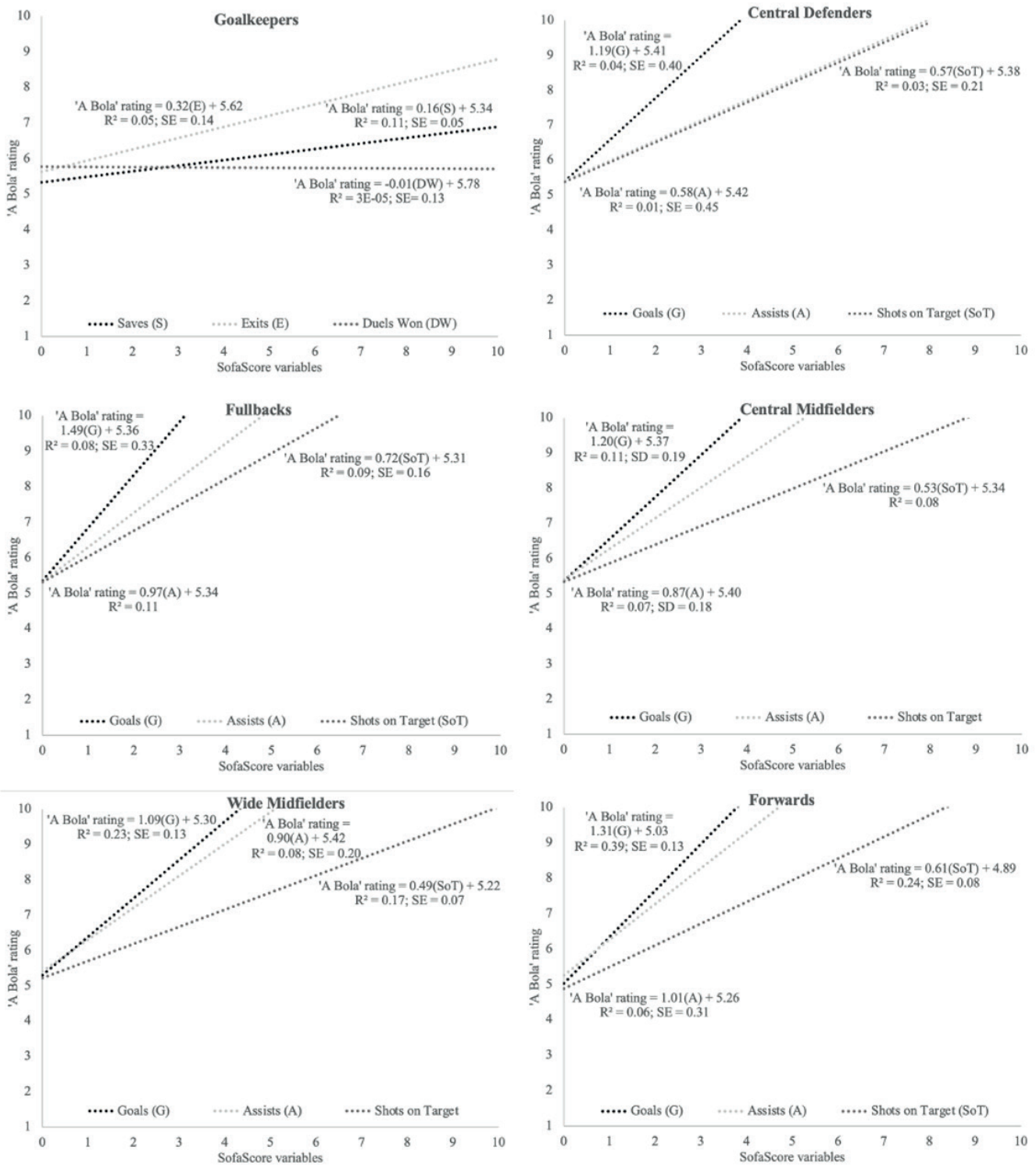
higher ratings if they perform more Exits ('A Bola' and 'Record'; Figures 1 and 3), and won more duels ('O Jogo'; Figure 2); central defenders would receive higher ratings if they score more goals ('A Bola', 'O Jogo' and 'Record'; Figures 1, 2 and 3); fullbacks would receive higher ratings if they score more goals ('A Bola', 'O Jogo' and 'Record'; Figures 1, 2 and 3); central midfielders would receive higher ratings if they score more goals ('A Bola', 'O Jogo' and 'Record'; Figures 1, 2 and 3); wide midfielders would receive higher ratings if they score ('A Bola' and 'Record'; Figures 1 and 3) or assist more goals ('O Jogo'; Figure 2); and forwards would receive higher ratings if they score more goals ('A Bola', 'O Jogo' and 'Record'; Figures 1, 2 and 3).

Discussion

Since mass media can impact players' performance, we aimed to analyze newspaper ratings of players' match performances. Our first finding was that newspaper ratings correlate moderately and strongly with each other. Thus, newspapers share similarities while also having differences when classifying individual performances. Pappalardo and co-workers [17] also reported strong correlations ($r = 0.76$) between three Italian newspapers ('Gazzetta dello Sport', 'Corriere dello Sport' and 'Tuttosport'). As expected, soccer matches differ from isolated values, such as the number of passes or goals. If the opposite was true, newspapers would rate equally between each other, without subjectivity at rating players' performance. However, subjectivity can be due to something else happening in the game or how one values an individual action. For example, one can praise immensely the player's ability to successfully complete passes and devalues if a player wins or loses a duel with an opponent. The moderate and strong correlations between newspaper and SofaScore ratings confirms that idea: i.e. newspaper ratings have some, but not all, components of subjectivity.

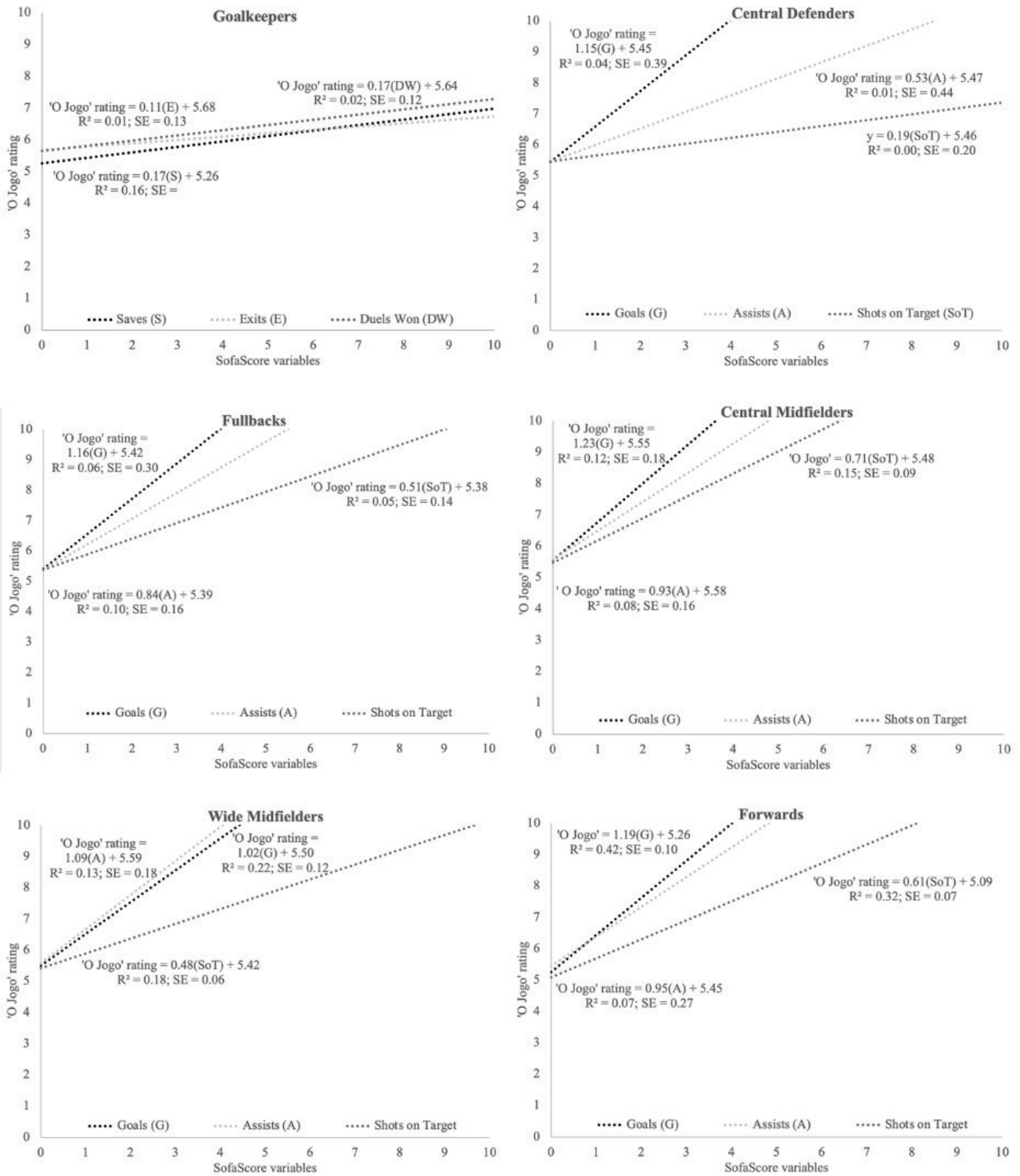
Goalkeepers received higher rankings from newspapers for their performances (Table 1), which is particularly interesting, because goalkeepers tend to receive less media coverage, except when they make a "miraculous save" or clearly fail [10]. Portuguese sports newspapers appear to approach this position differently. In contrast, forwards – a position that traditionally receives more attention and may be under more scrutiny from the media [9] – received the lowest rating in 'A Bola' and 'Record', as shown in Table 1.

To assess if one particular action was differently weighted in match performance evaluation, we conducted a linear regression for SofaScore variables with newspaper



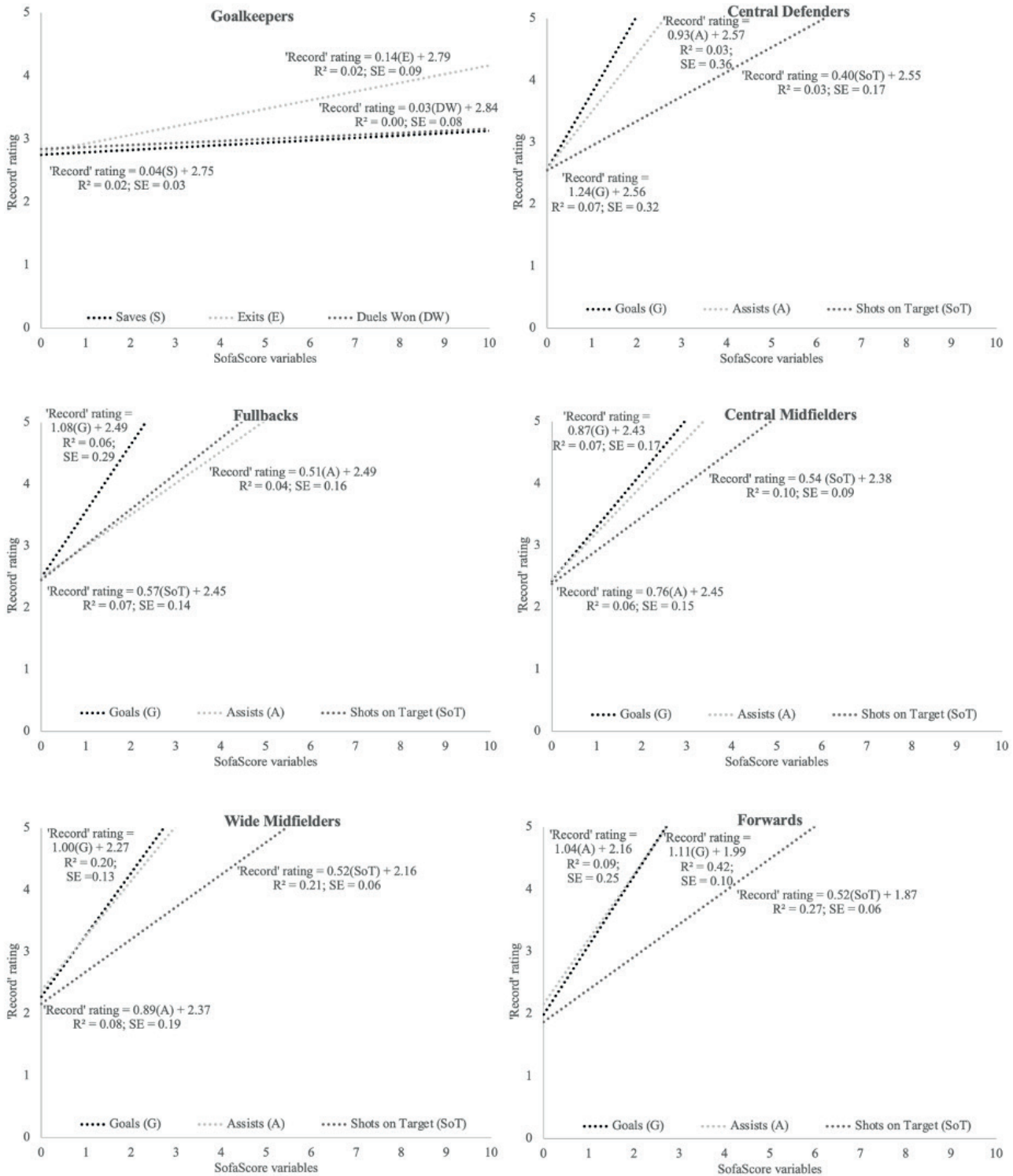
Note: from all regressions, the three with highest slope were selected. The presented equation refers to the expected 'A Bola' rating (dependent variable) according to the SofaScore variable (independent value). SE = standard error.

Figure 1. Linear regressions between 'A Bola' ratings and SofaScore variables



Note: from all regressions, the three with highest slope were selected. The presented equation refers to the expected 'O Jogo' rating (dependent variable) according to the SofaScore variable (independent value). SE = standard error.

Figure 2. Linear regressions between 'O Jogo' ratings and SofaScore variables



Note: from all regressions, the three with highest slope were selected. The presented equation refers to the expected 'Record' rating (dependent variable) according to the SofaScore variable (independent value). SE = standard error.

Figure 3. Linear regressions between 'Record' ratings and SofaScore variables

ratings and each playing position (Figures 1 to 3). A goalkeeper would have to perform 14 successful exits ('A Bola' and 'Record') or win 25 duels ('O Jogo') to reach a perfect rating. This means that newspapers value goalkeeper interference in the game, especially in their defensive actions. The opposite was reported for other defensive roles (central defenders and fullbacks), with newspapers valuing goals, assists and shots on target. Previous research stated that defenders (central defenders and fullbacks) from top teams are more involved in attacking actions than in defensive ones [12]; accordingly, Portuguese newspapers appear to value more offensive actions than defensive ones in defensive positions.

Similarly, newspapers also highly valued these actions to other playing positions. For example, according to our data, forwards would receive a maximal rating if they scored three ('Record') or four ('A Bola' and 'O Jogo') goals. Goals represented the variable with the highest impact in forwards' assessment, which was also reported regarding central midfielders and wide midfielders, except in 'O Jogo', where assists greatly impacted wide midfielders' classifications.

Interestingly, key passes had a smaller impact than assists, which can be seen as newspapers giving more importance to how the play was finished than how it was constructed. For example, according to our data, if a player passes the ball to a teammate creating a scoring opportunity, that pass would be highly valued if the teammate scores. This was also seen in the high value of assists, especially to wide midfielders and forwards in a study by Pappalardo et al. [17]. Another interesting analysis refers to the low valuation given by newspapers to defensive actions, because defensive players could be at a disadvantage, as they would probably have fewer attacking actions than offensive positions. With this, free-kicks and corner-kicks could have a higher importance to these positions to obtain a higher classification.

This study outlines three major practical implications, regarding the sport protagonists (soccer players), the media (sport newspapers), and the public (fans). The subject of this study has huge importance due to the influence the media exerts on players' self-confidence [8, 9]. Starting with players, this study shows that newspapers increase their ratings with actions related to goals. For example, if a central midfielder has a brilliant performance by passing assertiveness, tackling opponents, and winning duels, newspapers will probably rate that performance as average if that player does not assist or score a goal during that match. This approach provides goalkeepers and especially forwards

with a greater possibility of receiving higher or lower ratings. Conversely, missing a clear goal opportunity can lead newspapers to a poorer individual performance rating. As such, understanding these classifications can potentially help players cope with the pressure felt due to the media influence [6]. Secondly, newspapers should consider that their ratings influence players' performance [6] and, therefore, be careful while rating individual performances. Increasingly, these ratings could potentially affect the players' perception of unfair treatment by newspapers [1]. As previously stated, a player could be distant from goals (own and opposition), and that should not exclusively jeopardize a high rating. This is of particular importance for league bottom teams, where defensive positions are less involved in attacking actions [12]. It is true that the main objective in soccer is to score more goals than the opposition, but individual performances could easily be praised by other actions. One example of this different approach is the SofaScore ratings that presented greater rating similarities between individual positions than it is done by sport newspapers. Finally, the public perception of individual performances can also affect players' support, whether at the stadium, in the social media or other interactions [5]. Furthermore, players' performance contributes to their daily visibility in the media [22], and considering that newspapers place greater value to goal situations/opportunities, goalkeepers and forwards could be more subject to media coverage [9, 10]. Increasingly, fans' expressions on social media can express negative pressure regarding players' performance [11], which has been identified as a psychosocial stressor [19]. With these findings, fans can better perceive how newspapers classify players' performances, which may impact their perception of players' importance and contribution to the game, changing their interaction with players.

Conclusions

Our data show that newspaper ratings relate to each other and with the SofaScore rating, suggesting that these evaluations were not as subjective as one may suspect. Additionally, offensive actions – such as goals, assists and shots on target – had a high impact in all positions, while defensive actions, such as tackles and duels, had a small impact on the overall rating. Finally, goalkeepers received the highest rating in the three sports newspapers, while forwards received the lowest rating in two of the analyzed newspapers.

Birkner and Nölleke [1] quoted a professional player who reported that he read reports to analyze his performance, highlighting the importance of understanding these

classifications. Although investigating just one league, previous comparisons between leagues reported similar technical performances between the Spanish, English and French leagues and limited differences between the Italian and English leagues in dribbles [25]. Future research could compare data with those of other leagues, especially countries that compete under similar competitions, such as the Champions League. Additionally, we did not analyze the match outcome, because despite sharing a team and a match outcome, individual performances can substantially differ between players, which was observed when collecting the data, but not through statistical analysis.

Funding

The author Rui Marcelino has received a grant by FCT – Fundação para a Ciência e a Tecnologia, I.P., within the scope of the project “2021.02330.CEECIND”. The funding had no influence in study design or conclusion report.

Conflict of Interest

The authors declare no conflict of interest.

References

- Birkner T, Nölleke D. Soccer players and their media-related behavior: A contribution on the mediatization of sports. *Commun Sport*. 2016;4(4):367-384.
- BMJ. Correlation and regression. 2022. Available from: <https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression>
- Brechot M, Flepp R. Dealing with randomness in match outcomes: How to rethink performance evaluation in European club football using expected goals. *J Sports Econom*. 2020;21(4):335-362.
- Burch LM, Billings AC, Zimmerman MH. Comparing American soccer dialogues: Social media commentary surrounding the 2014 US Men’s and 2015 US Women’s World Cup Teams. *Sport Soc*. 2018;21(7):1047-1062.
- Cleland J. Racism, football fans, and online message boards: how social media has added a new dimension to racist discourse in English football. *J Sport Soc Issues*. 2014;38(5):415-431.
- Fazenda T, Costa AM, Garcia-Mas A, Carvalho PG. How media influence is perceived by professional soccer players: a qualitative case study in Portugal. *Sport Soc*. 2022;25(12):2541-2552. <https://doi.org/10.1080/17430437.2021.1944115>
- Hughes M, Caudrelier T, James N, Redwood-Brown A, Donnelly I, Kirkbride A, et al. Moneyball and soccer: An analysis of the key performance indicators of elite male soccer players by position. *J Hum Sport Exerc*. 2012;7(special issue 2):402-412.
- Kristiansen E, Halvari H, Roberts GC. Organizational and media stress among professional football players: Testing an achievement goal theory model. *Scand J Med Sci Sports*. 2012;22(4):569-579.
- Kristiansen E, Ivarsson A, Solstad BE, Roberts GC. Motivational processes affecting the perception of organizational and media stressors among professional football players: A longitudinal mixed methods research study. *Psychol Sport Exerc*. 2019;43:172-182.
- Kristiansen E, Roberts GC, Sisjord MK. Coping with negative media content: The experiences of professional football goalkeepers. *Int J Sport Exerc Psychol*. 2011;9(4):295-307.
- Kvillemo P, Nilsson A, Strandberg AK, Björk K, Elgán TH, Gripenberg J. Mental health problems, health risk behaviors, and prevention: A qualitative interview study on perceptions and attitudes among elite male soccer players. *Front Public Health*. 2023;10.
- Liu H, Gómez MA, Gonçalves B, Sampaio J. Technical performance and match-to-match variation in elite football teams. *J Sports Sci*. 2016;34(6):509-518.
- Liu H, Hopkins W, Gómez AM, Molinuevo S. Inter-operator reliability of live football match statistics from OPTA Sportsdata. *Int J Perform Anal Sport*. 2013;13(3):803–821.
- May J, Roche C. Super Bowl vs Champions League final: which is the most watched sporting event? 2023. Available from: <https://en.as.com/nfl/super-bowl-vs-champions-league-final-which-is-the-most-watched-sporting-event-n/>
- McHale IG, Scarf PA, Folker DE. On the development of a soccer player performance rating system for the English Premier League. *Interfaces (Providence)*. 2012;42(4):339-351.
- Oelke D, Geißelmann B, Keim DA. Visual Analysis of Explicit Opinion and News Bias in German Soccer Articles. In: Matkovic K, Santucci G, editors. *International Workshop on Visual Analytics*; 2012. pp. 49-53.
- Pappalardo L, Cintia P, Pedreschi D, Giannotti F, Barabási AL. Human Perception of Performance; 2017. Available from: <http://arxiv.org/abs/1712.02224>
- Pastor-Vicedo JC, Contreras-Jordán O, Prieto-Ayuso A. Performance indicators as a resource for the selection of talented football players. In: *11th World Congress of Performance Analysis of Sport*; 2017. p. 797-806.
- Rice SM, Purcell R, De Silva S, Mawren D, McGorry PD, Parker AG. The Mental Health of Elite Athletes:

- A Narrative Systematic Review. *Sports Medicine*. 2016;46(9):1333-1353.
20. Sanderson J, Truax C. "I hate you man!": Exploring maladaptive parasocial interaction expressions to college athletes via Twitter. *J Issues Intercol Athl*. 2014;7(1):333-351.
 21. SofaScore. SofaScore player rating.
 22. Tatiana F, Carvalho PG. Media influence on elite football performance: a literature review to develop a model. *J Phys Educ Sport*. 2018;18(5):1980-1985.
 23. Team RC. R: A language and environment for statistical computing [Internet]. 2021. Available from: <https://cran.r-project.org>
 24. Wolf S, Schmitt M, Schuller B. A football player rating system. *J Sports Anal*. 2020;6(4):243-257.
 25. Yi Q, Groom R, Dai C, Liu H, Gómez Ruano MÁ. Differences in Technical Performance of Players From 'The Big Five' European Football Leagues in the UEFA Champions League. *Front Psychol*. 2019;10:1-8.

Match-related technical performance of qualified and eliminated teams in the group stage of Qatar 2022 World Cup

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Abstract

Introduction. Match-related technical performance is one of the most important factors for success in modern soccer. **Aim of Study.** This study aimed to try to determine which of the attacking and goal scoring, passing and organizing and defending variables contributed to the success of the national teams participating in the Qatar 2022 FIFA World Cup to qualify for the knockout stage. **Material and Methods.** The sample consisted of 48 group stage matches. The data were collected from the Whoscored website, which is based on the OPTA system. **Results.** Results showed that there are statistically significant differences between qualified and eliminated teams in goal efficiency and pass accuracy ($p < 0.05$). However, the effect size was moderate in variables of goal efficiency ($ES = 0.74$), pass accuracy ($ES = 0.78$), total passes ($ES = 0.69$), and short passes ($ES = 0.62$). **Other variables have small or trivial effect. Conclusions.** In conclusion, goal efficiency, pass accuracy are the important success factors in stage group of 2022 World Cup. Therefore, coaches must focus heavily on these variables in their training in order to succeed in qualifying for the knockout stage in the upcoming World Cup tournaments.

KEYWORDS: match performance, success factors, pass accuracy, goal efficiency.

Received: 14 August 2023

Accepted: 24 August 2023

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Introduction

Soccer is a multifactorial sport that depends on physical, technical, tactical, mental, and social affective aspects [7, 29], and external factors such as temperature, humidity, altitude and field condition [2, 5, 31], as the interaction of these factors explains performance in soccer [8, 24, 30]. However, it is difficult to determine which factor has the greatest impact on the success of the team during matches, similarly as in other team sports [10]. Match-related technical performance is one of the keys to success in modern soccer matches [1], it is represented in various defensive, attacking, passing and organizing skills, whether with or without the ball, such as shots, passes, dribbles, tackles, interceptions and offside [15, 20, 25].

Technical performance in soccer matches needs to be analyzed similarly as other physical and tactical aspects to identify characteristics, strengths and weaknesses of players and teams, based on many tracking systems, such as AMISCO, OPTA, and ProZone [33]. This analysis helps to determine the number and type of skills and techniques of each player and each winning and losing team, and also provides us with indicators that help in determining the style of play, such as possession or direct play [14, 19]. That can help coaches to improve their technical and tactical training and prepare for matches and tournaments [27].

There are many studies that have analyzed the technical performance of professional soccer teams, initiated by a study of Bate [3], who showed that direct play and access to the attacking third quickly and with the least back and side passes help create more chances and score goals in the English third division. Similarly to these

findings, when analyzing the technical performance of national teams, Lepschy et al. [19] found that defensive actions and direct play are more effective than ball possession. Collet [6] concluded that ball possession did not hold significant importance in the success of teams in the Champions League. Additionally, he noted that the advantages associated with ball possession are limited to a specific geographical and competitive context, primarily benefiting elite teams.

On the contrary, it has been concluded that teams that rely on possession play and make many successful passes have a high probability of creating more shooting opportunities and scoring goals [1, 9, 12, 17, 21]. Kubayi and Larkin [16] found that shots on target, total passes, accurate passes, medium passes and ball possession are the most important variables that helped national teams qualify for the knockout stage during the 2018 World Cup.

The difference in the results of these studies is due to the development of soccer playing methods and their difference from one tournament to another [23]. Therefore, studying the technical performance and success factors of teams in national and international tournaments is extremely important, as it guides coaches in tailoring training processes to meet demands of modern soccer. The main aim of this study was to try to determine which of the variables of attacking and goal scoring (total shots, shots on target, shots from open play, shots from counter attack, goal efficiency, aerial won, dispossessed, and offside), passing and organizing (possession, total passes, pass accuracy, short passes, long balls, crosses, through balls, key passes, and successful dribbles), and defensive (tackles, interceptions, fouls, clearances, shots blocked, and total saves) contributed to the success of the

national teams participating in the Qatar 2022 World Cup to qualify for the knockout stage.

Material and Methods

Sample

The sample consisted of the group stage matches of the Qatar 2022 FIFA World Cup from November 20 to December 4, as they numbered 48 matches, with an average of 3 matches for each team. At this stage, the national teams are divided into 8 groups, with 4 teams per group. The number of national teams qualified for the knockout stage were $n = 16$, and the eliminated teams were $n = 16$.

Data and reliability

The data were collected from the Whoscored website (www.whoscored.com), which specializes in the in-depth analysis of detailed soccer data. It based on the OPTA system, which has been used in previous soccer studies [19, 20, 21, 33], thus being a reliable tracking system to collect live soccer match statistics (intra-class correlation coefficients: 0.88-1.00; standardized typical error: 0.00-0.37) [22]. The study was conducted following the Helsinki Declaration [32].

Match performance indicators

Twenty three variables were selected to express the technical performance of the matches, which were chosen according to the available studies [19, 20, 21, 33], and they were divided into three groups representing attacking and goal scoring, passing and organizing, and defending variables. Table 1 shows the definitions of the variables chosen in the study as reported in the literature [20, 21, 33].

Table 1. Selected match performance indicators

Groups	Variables	Definition
Attacking and goal scoring	Total shots	The total number of attempts to score a goal, including both shots on target and shots off target.
	Shots on target	The number of shots that are directed towards the goal and require an intervention to prevent a goal.
	Shots from open play	The number of shots taken during regular play, excluding set pieces.
	Shots from counter attack	The number of shots taken during a rapid offensive move immediately after a defensive action.
	Goal efficiency (goals \times 100/total shots)	The ratio of goals scored to total shots taken.
	Aerial won	The winning ball in the air by a player after an aerial challenge by two players.
	Dispossessed	Losing the ball by the player due to an opponent's tackle or challenge.
	Offside	The number of times a player is in an offside position at the moment the ball is played to them.

Passing and organizing	Possession (%)	The percentage of time a team controls the ball during a match.
	Total passes	The overall number of passes attempted by a team's players.
	Pass accuracy (%)	The percentage of passes successfully completed out of the total attempted passes.
	Short passes	The number of passes covering short distances, typically within the midfield or defensive zones.
	Long balls	The number of passes that cover longer distances, often aiming to change sides or get the ball to the attackers.
	Crosses	The number of passes from wide areas into the penalty area, typically with the intention of creating goal-scoring opportunities.
	Through balls	The number of passes played to a teammate who runs into open space behind the opposing defense.
	Key passes	The number of passes that directly lead to a goal-scoring opportunity for a teammate.
	Successful dribbles	The number of instances where a player successfully advances with the ball while avoiding challenges from opponents.
Defending	Tackles	The number of challenges made by players to regain possession of the ball from opponents.
	Interceptions	The number of times a player interrupts an opponent's pass or intended action, leading to a change in possession.
	Fouls	The number of times that players make interventions on the opponent requires a foul to be awarded to the opposing team according to the arbitration rules.
	Clearances	The number of times players kick or head the ball away from their own goal area to prevent opponents' attacks.
	Shots blocked	The number of times players position themselves to block incoming shots from opponents.
	Total saves	The number of times the goalkeeper prevents the ball from entering the goal and secures it.

Statistical analysis

In this study, data were reported as means \pm standard deviation (SD). The data were arranged in Microsoft Excel (Excel 2021, Microsoft, Washington, USA) before being transferred to SPSS (SPSS 26, IBM, Armonk, USA) for statistical analysis. Independent sample t-test was used for between-groups comparison. The significance level was considered $p \leq 0.05$. The effect size (ES) was used to find out the magnitude of differences between groups in all variables. ES values were estimated as described by Hopkins et al. [11],

based on the smallest worthwhile change (SWC) and the standardized difference in effect size (ES, 90% CI), as trivial (<0.20), small (0.20-0.59), moderate (0.60-1.19), large (1.20-2.00), and very large (>2.00).

Results

Table 2 shows differences in match-related technical performance between the teams qualified for the knockout stage and the teams eliminated from the group stage of the 2018 World Cup, with statistically significant differences between qualified and eliminated teams in

Table 2. Differences in match-related technical performance variables between qualified to the knockout stage and eliminated teams in 2022 FIFA World Cup

Variable	Qualified (mean \pm SD)	Eliminated (mean \pm SD)	Sig	ES
Variables related to attacking and goal scoring				
Total shots	11.57 \pm 3.73	10.70 \pm 3.98	0.52	0.22 (Small)
Shots on target	4.18 \pm 1.65	3.49 \pm 1.56	0.23	0.42 (Small)
Shots from open play	8.37 \pm 2.46	7.58 \pm 3.37	0.45	0.26 (Small)
Shots from counter attack	0.36 \pm 0.44	0.32 \pm 0.43	0.81	0.09 (Trivial)

Goal efficiency	13.95 ± 5.29	9.49 ± 6.63	0.04*	0.74 (Moderate)
Aerial won	13.49 ± 3.67	14.16 ± 2.25	0.53	0.22 (Small)
Dispossessed	9.00 ± 1.63	9.31 ± 2.63	0.68	0.14 (Trivial)
Offside	1.72 ± 1.11	2.03 ± 1.21	0.46	0.26 (Small)
Variables related to passing and organizing				
Possession (%)	52.13 ± 12.97	47.66 ± 8.43	0.25	0.40 (Small)
Total passes	517.10 ± 155.12	423.74 ± 110.06	0.057	0.69 (Moderate)
Pass accuracy (%)	83.45 ± 5.10	79.70 ± 4.44	0.03*	0.78 (Moderate)
Short passes	470.25 ± 158.58	391.00 ± 90.42	0.09	0.62 (Moderate)
Long balls	51.68 ± 9.65	56.81 ± 7.89	0.11	0.58 (Small)
Crosses	16.56 ± 5.26	17.37 ± 4.88	0.65	0.15 (Trivial)
Through balls	1.00 ± 1.09	1.31 ± 1.01	0.40	0.29 (Small)
Key passes	8.66 ± 2.84	7.85 ± 3.13	0.44	0.27 (Small)
Successful dribbles	5.44 ± 2.09	5.73 ± 2.53	0.72	0.12 (Trivial)
Variables related to defending				
Tackles	15.76 ± 4.19	16.38 ± 2.69	0.62	0.17 (Trivial)
Interceptions	7.73 ± 2.18	8.71 ± 2.45	0.23	0.42 (Small)
Fouls	11.68 ± 2.73	12.43 ± 3.17	0.47	0.25 (Small)
Clearances	17.58 ± 6.42	18.87 ± 5.78	0.55	0.21 (Small)
Shots blocked	2.68 ± 1.32	2.98 ± 1.44	0.55	0.13 (Trivial)
Total saves	2.25 ± 1.47	2.80 ± 1.25	0.26	0.40 (Small)

*p < 0.05

goal efficiency (p < 0.05; ES = 0.74) and pass accuracy (p < 0.05; ES = 0.78). The results also showed that

there are no statistically significant differences between qualified and eliminated teams in other variables (p > 0.05). Regarding the effect size, total passes (ES = 0.69) and short passes (ES = 0.62) also have a moderate effect. Other variables have small or non-significant effects (Figure 1).

Discussion

The main purpose of the study was to determine differences in match-related technical performance between qualified and eliminated teams in the group stage of the 2022 FIFA World Cup. The results showed a statistically significant difference between the qualified and eliminated teams in goal efficiency and pass accuracy, with the effect size being small or non-significant in most of the defensive and offensive variables. However, it was moderate in goal efficiency and in some passing and organizing variables, represented in pass accuracy, total passes, and short passes.

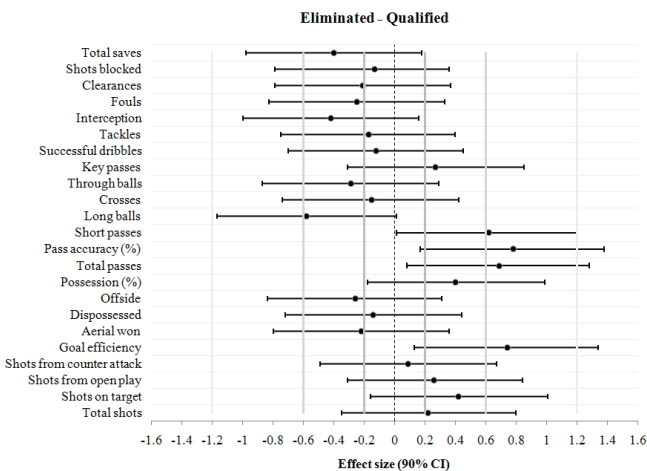


Figure 1. Effect size of each match-related performance variable of eliminated and qualified teams

These results differed from previous findings for earlier editions of the World Cup 2002, 2006 and 2010, where the winning teams made more shots than the losing or drawing teams, as well as the number of shots on target for the winning teams were greater than the drawing and losing teams [4]. Liu et al. [21] also found that shots on target, shots from counter attack and shots from inside penalty area were the keys for winning teams in 2014 World Cup. Kubayi and Larkin [16] concluded that qualified teams to the knockout stage in 2018 World Cup had a greater number of shots on target and a greater number of set-piece goals than eliminated teams. Similarly, it was concluded that shots on target and total attempts are the major predictors of success in the UEFA Champions League [6, 20]. For another scoring and attacking variable there was a statistically significant difference between qualified and eliminated teams in the variable of goal efficiency in favor of qualified teams. This finding is consistent with those reported in many previous studies, where goal efficiency was the most important factor of success in soccer matches of the first Bundesliga [34], and a success factor in FIFA World Cup 2014 and 2018 [19]. This indicates that qualified teams to the knockout stage were more decisive in front of goal than the eliminated teams despite the similarity in the number of shots, which confirms that shot quality is more important than the number of shots.

Goal efficiency is related to several factors represented in the physical, technical and tactical factors. Rodenas et al. [26] reported that the power and accuracy of shooting, positioning, the quality of the teams, set pieces, possession play, the action that precedes the goal (passing or assisting), the location of the match (home or away) and the time of the match are all factors that can control the goal efficiency. Since the current study investigated the technical and tactical performance of the qualified and eliminated teams in the group stage of the World Cup, it showed a statistically significant difference in one of the factors affecting goal efficiency, which is the accuracy of passing. This may indicate that accurate passes helped teams that qualified for the knockout stage to finish attacks better, because accurate passes and assists that reach players in good shooting positions can help in efficient shooting and goals [28]. There is another factor that can be an important factor in goal efficiency for the qualified teams and not represented in this study, which is the quality of the players, as the positioning, shooting technique, anticipation and decision-making are among the most important characteristics of the decisive players [14, 26].

For passing and organizing variables, a moderate effect size was obtained in total passes, short passes and successful passes, with a significant difference in the pass accuracy variable ($p < 0.05$). This is similar to previous findings in the FIFA World Cup [16, 21], the UEFA Champions League [33], and the Spanish Professional Soccer League [17]. This indicates that passing accuracy and avoiding random play and long balls are some of the most important success factors in soccer matches [15, 18].

Although passing variables are related to possession [1, 15, 16], this study proved that the teams qualified for the knockout stage made more accurate passes than the eliminated teams, while possession was close for both categories. This confirms that ball possession involves a complex interplay between strategic choices, defensive tactics and quality of ball handling [6], rather than being dependent solely on passing accuracy. In turn, when we look at the effect of passing accuracy as a single variable without linking it to possession of the ball, passing accuracy has a great importance in the success of teams in soccer, as it helps to create opportunities to score goals as previously explained. This variable can also determine the team's ability to move from the defensive to offensive stage efficiently [13]. While possession of the ball remains an essential aspect, the mere quantity of it may not guarantee success for soccer teams [6].

Regarding defensive variables, performance was close between the teams that qualified for the knockout stage and eliminated teams, and this is consistent with what has been found in the literature [16, 33]. In contrast to prior results of the FIFA World Cup 2014 and 2018, defensive variables were the most important factor of success [19].

The similarity in defensive performance between the qualified teams and the eliminated teams indicates a convergence in the level of defensive performance for both categories, in addition to the remarkable results in passing, organizing, attacking and scoring goals. The study demonstrated a similarity in performance across most variables, with exceptions noted in goal efficiency and passing accuracy variables. These variables were identified as crucial technical factors in determining the teams that progressed to the knockout stage. Therefore, it can be inferred that both categories of teams exhibited comparable levels of performance in the variables studied. This leads us to the limitations of the study, which did not address all the variables associated with the technical performance, with the technical aspect being one part of performance in soccer. It did not look at other important factors such as the physical, tactical

and psychological aspects, and some other factors such as training strategies and players' injuries [2].

Conclusions

In conclusion, the findings of this study confirm that significant differences exist between qualified and eliminated teams in the group stage of the 2022 World Cup, particularly in terms of goal efficiency and pass accuracy. Notably, the observed effect size was moderate for the aforementioned variables, as well as the total number of passes and the number of short passes. Therefore, the authors suggest that coaches heavily emphasize enhancing goal efficiency and passing-related variables, especially passing precision, during their technical and tactical training. This emphasis may help teams to succeed in reaching advanced stages in the upcoming World Cup tournaments.

Conflict of Interest

The authors declare no conflict of interest.

References

- Andrzejewski M, Oliva-Lozano JM, Chmura P, Chmura J, Czarniecki S, Kowalczyk E, et al. Analysis of team success based on match technical and running performance in a professional soccer league. *BMC Sports Sci Med Rehabil.* 2022;14(1):82. <https://doi.org/10.1186/s13102-022-00473-7>
- Bangsbo J, Mohr M, Poulsen A, Perez-Gomez J, Krstrup P. Training and testing the elite athlete. *J Exerc Sci Fit.* 2006;4(1):1-14.
- Bate R. Football chance: tactics and strategy. In: Reilly T, Lees A, Davids K, Murphy W, editors. *Science and Football.* London: E & FN Spon; 1988. pp. 293-301.
- Castellano J, Casamichana D, Lago C. The Use of Match Statistics that Discriminate Between Successful and Unsuccessful Soccer Teams. *J Hum Kinet.* 2012;31:139-147. <https://doi.org/10.2478/v10078-012-0015-7>
- Chmura P, Liu H, Andrzejewski M, et al. Is there meaningful influence from situational and environmental factors on the physical and technical activity of elite football players? Evidence from the data of 5 consecutive seasons of the German Bundesliga. *PLoS One.* 2021;16(3):e0247771. <https://doi.org/10.1371/journal.pone.0247771>
- Collet C. The possession game? A comparative analysis of ball retention and team success in European and international football, 2007-2010. *J Sports Sci.* 2013;31(2):123-136. <https://doi.org/10.1080/02640414.2012.727455>
- Díez A, Lozano D, Arjol-Serrano JL, et al. Influence of contextual factors on physical demands and technical-tactical actions regarding playing position in professional soccer players. *BMC Sports Sci Med Rehabil.* 2021;13(1):157. <https://doi.org/10.1186/s13102-021-00386-x>
- Forcher L, Forcher L, Wäsche H, Jekauc D, Woll A, Altmann S. The influence of tactical formation on physical and technical match performance in male soccer: a systematic review. *Int J Sports Sci Coach.* 2022;18(5). <https://doi.org/10.1177/17479541221101363>
- Grant A, Williams AM, Lee D, Reilly T. Analysis of the successful and unsuccessful teams in the 1998 World Cup. *Insight FA Coaches Assoc J.* 1998;1:21-24.
- Higham DG, Hopkins WG, Pyne DB, Anson JM. Performance indicators related to points scoring and winning in international rugby sevens. *J Sports Sci Med.* 2014;13(2):358-364.
- Hopkins WG, Marshall SW, Batterham AM, Hanin J. Progressive statistics for studies in sports medicine and exercise science. *Med Sci Sports Exerc.* 2009;41(1):3-13. <https://doi.org/10.1249/MSS.0b013e31818cb278>
- Hughes M, Franks I. Analysis of passing sequences, shots and goals in soccer. *J Sports Sci.* 2005;23(5):509-514. <https://doi.org/10.1080/02640410410001716779>
- Hughes M, Lovell T. Transition to attack in elite soccer. *J Hum Sport Exerc.* 2019;14(1):236-253.
- Jamil M. Where do the best technical football players in the world come from? Analysing the association between technical proficiency and geographical origin in elite football. *J Hum Sport Exerc.* 2022;17(2):244-260. <https://doi.org/10.14198/jhse.2022.172.02>
- Kessouri O. Match performance difference between African and Top Five teams in the group stage of the 2022 World Cup. *Trends Sport Sci.* 2023;30(1):5-11. <https://doi.org/10.23829/TSS.2023.30.1-1>
- Kubayi A, Larkin P. Match performance variables that differentiated between qualified and eliminated teams in the group stages of the 2018 FIFA World Cup. *Ger J Exerc Sport Res.* 2022;52:105-109. <https://doi.org/10.1007/s12662-021-00744-4>
- Lago-Peñas C, Lago-Ballesteros J, Dellal A, Gómez M. Game-Related Statistics that Discriminated Winning, Drawing and Losing Teams from the Spanish Soccer League. *J Sports Sci Med.* 2010;9(2):288-293.
- Lepschy H, Wäsche H, Woll A. How to be successful in football: a systematic review. *Open Sports Sci J.* 2018; 11:3-23. <https://doi.org/10.2174/1875399X01811010003>
- Lepschy H, Woll A, Wäsche H. Success Factors in the FIFA 2018 World Cup in Russia and FIFA 2014 World Cup in Brazil. *Front Psychol.* 2021;9:12:638690. <https://doi.org/10.3389/fpsyg.2021.638690>
- Liu H, Gómez MA, Gonçalves B, Sampaio J. Technical performance and match-to-match variation in elite

- football teams. *J Sports Sci.* 2016;34(6):509-518. <https://doi.org/10.1080/02640414.2015.1117121>
21. Liu H, Gomez MÁ, Lago-Peñas C, Sampaio J. Match statistics related to winning in the group stage of 2014 Brazil FIFA World Cup. *J Sports Sci.* 2015;33(12):1205-1213. <https://doi.org/10.1080/02640414.2015.1022578>
 22. Liu H, Hopkins W, Gómez AM, Molinuevo SJ. Inter-operator reliability of live football match statistics from OPTA Sportsdata. *Int J Perform Anal Sport.* 2013;13(3):803-821. <https://doi.org/10.1080/24748668.2013.11868690>
 23. Mitrotasios M, Gonzalez-Rodenas J, Armatas V, Aranda R. The creation of goal scoring opportunities in professional soccer. Tactical differences between Spanish La Liga, English Premier League, German Bundesliga and Italian Serie A. *Int J Perform Anal Sport.* 2019;19(3):452-465. <https://doi.org/10.1080/24748668.2019.1618568>
 24. Modric T, Malone JJ, Versic S, Andrzejewski M, Chmura P, Konefał M, et al. The influence of physical performance on technical and tactical outcomes in the UEFA Champions League. *BMC Sports Sci Med Rehabil.* 2022;14(1):179. <https://doi.org/10.1186/s13102-022-00573-4>
 25. Rampinini E, Impellizzeri FM, Castagna C, Coutts AJ, Wisløff U. Technical performance during soccer matches of the Italian Serie A league: effect of fatigue and competitive level. *J Sci Med Sport.* 2009;12(1):227-233. <https://doi.org/10.1016/j.jsams.2007.10.002>
 26. Rodenas JG, Malaves RA, Desantes AT, Ramirez ES, Hervas JC, Malaves RA. Past, present and future of goal scoring analysis in professional soccer. *Retos.* 2020;37:774-785.
 27. Sampaio J, Leite N. Performance indicators in game sports. In: McGarry T, O'Donoghue P, Sampaio J, editors. *Routledge Handbook of Sports Performance Analysis.* Abingdon: Routledge; 2013. pp. 115-126.
 28. Smith RA, Lyons K. A strategic analysis of goals scored in open play in four FIFA World Cup football championships between 2002 and 2014. *Int J Sports Sci Coach.* 2017;12(3):398-403. <https://doi.org/10.1177/1747954117710516>
 29. Stølen T, Chamari K, Castagna C, Wisløff U. Physiology of soccer: an update. *Sports Med.* 2005;35(6):501-536. <https://doi.org/10.2165/00007256-200535060-00004>
 30. Sun H, Soh KG, Mohammadi A, Wang X, Bin Z, Zhao Z. Effects of mental fatigue on technical performance in soccer players: A systematic review with a meta-analysis. *Front Public Health.* 2022;10:922630. <https://doi.org/10.3389/fpubh.2022.922630>
 31. Trewin J, Meylan C, Varley MC, Cronin J. The influence of situational and environmental factors on match-running in soccer: a systematic review. *Sci Med Footb.* 2017;1(2):183-194. <https://doi.org/10.1080/24733938.2017.1329589>
 32. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA.* 2013; 27;310(20):2191-2194. <https://doi.org/10.1001/jama.2013.281053>
 33. Yi Q, Gómez M, Liu H, Sampaio J. Variation of match statistics and football teams' match performance in the group stage of the UEFA Champions League from 2010 to 2017. *Kinesiology (Zagreb).* 2019;51(2):170-181. <https://doi.org/10.26582/k.51.2.4>
 34. Yue Z, Broich H, Mester J. Statistical Analysis for the Soccer Matches of the First Bundesliga. *Int J Sports Sci Coach.* 2014;1;9(3):553-560. <https://doi.org/10.1260/1747-9541.9.3.553>

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<i>UCP2</i>	DD					ID					II					
	Sex	<i>N</i>	\bar{x}	<i>SD</i>	<i>Min</i>	<i>Max</i>	<i>N</i>	\bar{x}	<i>SD</i>	<i>Min</i>	<i>Max</i>	<i>N</i>	\bar{x}	<i>SD</i>	<i>Min</i>	<i>Max</i>
F		42	45.65	6.14	32.30	59.00	36	45.66	7.18	30.60	59.80	7	45.07	7.60	35.00	54.80
M		72	54.01 ^a	6.20	40.30	79.00	70	55.60	7.32	42.30	76.80	12	59.07 ^a	9.04	49.70	74.90

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