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CONTENTS

Research Articles

Mengistu GARMAMO, Tesfay HADDERA, Zeru TOLA, Matiwos JALETA
Organizational Culture, Strategic Management, and Good Sports Governance in Selected Ethiopian Olympic Sports Federations: Does Organizational Size Matter? 1-32

İsmail AYDIN, Buğra AKAY, Fatih YAŞARTÜRK
Turkish Adaptation of Stadium Atmosphere Scale: A Comparison of Recreational and Fanatical Football Spectators 33-58

Uma RAGHAV, Bharti SHARMA, Harsirjan KAUR, Charu CHHABRA
Enhancing Athletes' Foot Stability: A Comparative Analysis of Gluteus Maximus and Gluteus Medius Muscle Strengthening Effects on Navicular Drop, Balance, and Foot Posture Index in Over-Pronated Foot 59-72

Serkan UZLAŞIR, Sinem PARLAKYILDIZ, Tuğçe ÇİMKE
The Effect of Pilates Exercises on Mobility and Dynamic Balance in Former Athletes and Sedentary Individuals 73-87

Büşra Nur EROL, Hande KIRIŞIK, Halime GÜLLE, Melisa İPAR, Edanur KAŞIKÇI, Ceyda KÜPÇÜOĞLU
Promoting Awareness of Sedentary Behavior and Physical Activity Awareness Among Rural Youth Through Bocce Game: A Qualitative Study 88-114

Yeliz ERATLI ŞİRİN, İrem KAVASOĞLU, Tayfun ŞİRİN, Berna CAN
Understanding "The Athletic Labour of Femininity" Through the Experiences of Turkish Female Personal Trainers 115-143

Orçun KEÇECİ, Veli Onur ÇELİK
A Qualitative Study on E-Sports Players' Leadership Perceptions Regarding Their Team Coaches 144-166

PAMUKKALE JOURNAL OF SPORT SCIENCES
ISSN: 1309-0356
dergipark.org.tr/en/pub/psbd

Ersin BALLIKAYA, Leyla SARAÇ
The Effect of 12-Week Psychological Skills Training on Coping Skills and Performance Strategies in High School Volleyball Players 167-187

Alper AŞÇI, Yusuf KÖKLÜ, Utku ALEMDAROĞLU
Variation in Match Physical Performance in Turkish Super League Soccer Players by Position Across Four Seasons 188-202

Oleh KVASNYTSYA, Valeria TYSHCHENKO, Mykola LATYSHEV, Iryna KVASNYTSIA, Mykola KIRSANOV, Oleg PLAKHOTNIUK, Maksym BUHAIOV
Team Performance Indicators That Predict Match Outcome in Rugby Union 203-216

Ahmet BAYRAK, Necmiye ÜN YILDIRIM, Mustafa Ertuğrul YAŞA, Özge ÇOBAN
Development of A New Tool to Analyze Injury Risk: Turkish Get Up Injury Risk Tool 217-233

Yücel MAKARACI, Kazım NAS, Mustafa AYDEMİR, Kerem GÜNDÜZ, Mehmet Can GEDİK
Mediolateral Postural Sway Velocity as a Possible Indicator of Ground Reaction Force-Derived 180^0 Turn Performance in Male Soccer Players: A Cross-Sectional Study 234-252

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PAMUKKALE JOURNAL OF SPORT SCIENCES
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Pamukkale J Sport Sci, 15(1), 1-32, 2024 Research Article

Organizational Culture, Strategic Management, and Good Sports Governance in Selected Ethiopian Olympic Sports Federations: Does Organizational Size Matter?

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Keywords
Ethiopian Sports federations, Good governance, Strategic management, Organizational culture, Organizational size

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ABSTRACT

This study intended to examine the moderating effect of organizational size on the influences of organizational culture and strategic management on good sports governance. We used a descriptive cross-sectional survey design to collect data through a structured questionnaire from 265 respondents randomly selected from six Ethiopian Olympic sports federations. We analyzed the data using descriptive and structural equation modeling using SPSS 25.0 and AMOS 23.0. The results, in this regard, indicate that strategic management has a significantly positive direct influence on good sports governance. However, the effect of organizational culture on good sports governance was not observed. Further, organizational size negatively and significantly moderates the relationship between organizational culture and good sports governance. However, the moderation effect of organizational size on the relationship between strategic management and good sports governance was not observed. The principal effect analysis from the moderation effect indicates that organizational size has a significantly positive impact on good sports governance. Hence, this study signifies the need for a fit between size and culture and amplifies the need to engage in strategic management for good sports governance practices in Olympic sports federations.

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INTRODUCTION

Sports organizations, compelled by main stakeholders' expectations and innovative global sports governance approaches, are expected to apply good governance practices regardless of status. However, scholars (e.g., Burger & Goslin, 2005; Geeraert, 2017; Mirkonjic, 2016) argue that the successful implementation of good sports governance can be affected by various organizational or situational factors that sports organizations and public authorities should further evaluate and understand them in a more "holistic" approach. Similarly, Aguilera et al. (2015) argue that the efficacy of governance practice depends on the characteristics of the larger institutional environment in which businesses operate.

However, despite the arguments above on the determinants of good sports governance and the ways to approach them, there is insufficient empirical research on the determinants of good sports governance, and just a few studies have looked at the factors that explain whether and to what degree sports organizations engage in good governance practices (Mirkonjic, 2019). Some of the few studies and their findings on determinants of good sports governance, for instance, are commitment and personal motivation (micro-level), competencies and responsibilities of the internal body (meso-level), and the role of the state and the umbrella organization (macro-level; Mirkonjic, 2019); structure of the board at the national level, financial capacity, leadership, and capability of the strategic planning process (O'Boyle & Shilbury, 2018); and the extant level of trust, transparent decision-making, trust-building, and leadership (O'Boyle & Shilbury, 2016). In an African context, Mrindoko and Issa (2023) found that openness and accountability, financial transparency and control, human resource competency, and policy execution are key predictors of effective governance for Tanzanian football federations and organizations.

In addition, some of the existing studies engaged in determinants focused on specific dimensions (transparency and corporate social responsibility) of good governance, hence lacking the comprehensiveness needed to fully understand the causes that explain the implementation of multi-faceted good sports governance. For instance, Král and Cuskelly (2017) found structural (membership, staff capacity), attitudinal, and knowledge-based determinants of transparency. Some studies (e.g., Babiak & Wolfe, 2009; Zeimers et al., 2020) found innovation capacity, financial autonomy, knowledge management, and human resources to be determinants of corporate social responsibility. Breitbarth and Rieth (2012) also pinpointed the 3S model, where strategy, structure, and stakeholder were key drivers of societal responsibility integration in German professional football. In an African context, Moyo

et al. (2020) found that inner factors (the organizations' internal objectives, funds, people, and resources), outer factors (external uncontrollable factors, economy, and community awareness), and stakeholder involvement were factors influencing the engagement of South African professional sports organizations in sustainable corporate social responsibility.

Despite the aforementioned studies' limitations in giving a complete picture of determinants of good sports governance (being confined to specific dimensions), they pinpoint what could determine good sport governance in national sports organizations. However, except for these few studies, including those focused on specific dimensions, determinants of good sports governance have not yet been widely studied globally (Mirkonjic, 2019) and have not yet been thoroughly investigated in Africa, where the continent remains stunted by a combination of talent drain, a lack of government investment and policy guidelines, corruption, and gross mismanagement, as Tsuma (2016) argues.

Moreover, despite the framing of sports governance and policies based on the 'sport for all' principle, the lengthened public experience in participating and governing sports, and giving due respect to sports' instrumental role in societal development in our national (Ethiopian) context (Getahun, 2009), nowadays there is a disparity between the rhetoric and the current status of good sports governance, as studies indicate that there are quests for good governance. For instance, athletics sport seems to face a lack of genuineness as youth projects are deprived of any coaching staff, sports facilities, and adequate support for athletes (Wolde & Gaudin, 2017); public wrangles for power, peer pressure, and widespread mismanagement have typified football, leaving many industrious players and the public disillusioned (Gebremariam, 2014).

Besides, the Ethiopian national reform document highlights public concerns about the representation of general councils and electoral processes, which are dominated by government, politicians, and ethnic influences (Ethiopian Sport Commission [ESC], 2020) despite the principle of 'Olympism'. The reform document also pinpoints that the sports sector lacks a strategic plan, and budget insufficiency hinders its implementation even in the presence of a strategic plan. Besides, Garmamo et al. (2024) have found that some selected Ethiopian Olympic sports federations scored below the moderate level in good sports governance, with a severely weak level of implementing transparency, and public communication and solidarity. Hence, these findings signify the need to further scrutinize what influences good sports governance practices in the surveyed sports federations.

However, despite all the drawbacks that call for the investigation of determinants of good sports governance, no such study has been conducted in the context of the Ethiopian

sports federations. More specifically, organizational culture, as it encompasses the set of attitudes that comprise the commitment, respect, proficiency, and ethics of workers, is thought to provide a mental model for viewing the world around and enables organizations to achieve homeostatic adaptations and the subsequent stability. In doing so, it lays fertile ground for good governance practice. Similarly, strategic management offers a framework for directing managerial activities and apportioning better resources to alleviate deficiencies, which can enhance good governance. However, the influences of organizational culture and strategic management on good sports governance and the moderation effect of organizational size on their relationships have not yet been studied. Hence, the purpose of this study was to examine whether organizational culture and strategic management influence good sport governance and organizational size moderates their relationships in selected Ethiopian Olympic sports federations, as the findings of this empirical study will have paramount importance for practitioners to holistically understand the contexts of national sports organizations for full-sized good governance practices.

Theoretical and Conceptual framework of the study

The underlying theories of the study

Scholars (e.g., Miller-Millesen, 2003; O'Boyle, 2012; Yusoff & Alhaji, 2012) argue that major governance theories proposed to be applied in sports organizations, such as agency theory, stewardship theory, institutional theory, resource dependence theory, network theory, and stakeholder theory, have been used independently in existing sports management literature and hence provide a narrow view of sports governance and require the combination of multiple theories. For instance, Miller-Millesen (2003) suggested three theories: agency theory, resource dependency theory, and institutional theory, which can be applied to non-profit board governance. Yusoff and Alhaji (2012) also argued that an integrated approach is preferable for understanding good corporate governance results. Similarly, O'Boyle (2012) examined the applicability of four corporate governance theories (agency, resource dependency, institutional, and stakeholder theory) in nonprofit sports organizations' governance.

Hence, this study is conducted through the integrated lens of the agency theory, institutional theory, resource dependency theory, and stakeholder theory to assess the determinant relationships between organizational size, organizational culture, and strategic management with good sports governance in sports federations, as the implementation of good sports governance happens when organizations put in place strategies, structures, and

other processes to manage external pressures (Hoye et al., 2015). Agency theory emphasizes internal monitoring, hierarchical accountability, and alignment of management decisions with board directions (Miller-Millesen, 2003; O'Boyle, 2012; Rhoades et al., 2000). This theory could emphasize, but not limited to, the checks and balances, and transparency and public communication dimensions of good sports governance.

Institutional theory also has a key place in this study as it seeks to explain how sport organizations relate to external organizations for acquiring scarce resources and hence suggests the establishment of clear statutes, bye-laws, rules, and regulations to ensure efficient operation amidst external pressures (Hoye et al., 2009, 2015; O'Boyle, 2012). It upholds (though is not limited to) the importance of democratic processes and checks and balances dimensions of good sports governance. The study also considers resource dependency theory, which suggests that sports organizations are open systems dependent on other organizations for survival. The board's role here is to minimize external pressure, gather essential knowledge, attract resources, and present a positive public image (Hillman et al., 2000; Miller-Millesen, 2003; O'Boyle, 2012). Hence, this theory in the study upholds (though is not limited to) the necessity of transparency and public communication, and democratic processes dimensions or factors of good sports governance. The stakeholder theory also plays a crucial role in understanding corporate responsibility in sports governance (Iordanakis, 2020). It also emphasizes (though not limited to) the importance of democratic processes and solidarity dimensions to develop and maintain trust among stakeholders.

Hence, from these theoretical assumptions, the conceptual model on the influences of organizational culture and strategic management on good sport governance and the moderating role of organizational size in their relationships in the surveyed sports federations is framed (see Figure 1).

Organizational culture and its influence on good governance

Organizational culture is a collection of knowledge, skills, attitudes, and values that enable an organization to perform successfully and produce competitive results, implying attitudes such as participant dedication, work forms, respect, professionalism, and ethics (García et al., 2012); hence, it provides a means by which a sports organization's members interpret how things are done and what happens in daily working life (Hoye et al., 2015).

Previous studies in public organizations indicate that organizational culture affects organizational success variables such as commitment (Neelam et al., 2015; Silverthorne, 2004); effectiveness (Gregory et al., 2009); efficiency (Aktas et al., 2011); performance (Sokro, 2012;

Valmohammadi & Roshanzamir, 2014; Zehir et al., 2011); and total quality management (Baird et al., 2011; Valmohammadi & Roshanzamir, 2014). It also influenced good governance performance (Dwi Ermayanti et al., 2019; Yuliastuti & Tandio, 2020).

Organizational culture, in the context of sport, is also found to have significant impacts on organizational success variables such as organizational effectiveness (Heris, 2014; Ramazaninejad et al., 2018; Seifari & Amoozadeh, 2014; Tojari et al., 2011); organizational performance (Bayle & Robinson, 2007); job satisfaction (Choi et al., 2008; MacIntosh & Doherty, 2010); organizational Innovation (Eskiler et al., 2016); empowerment and organization citizenship behavior (Jeong et al., 2019); knowledge management (Ramazaninejad et al., 2018) etc.

However, empirical studies on good governance overlook the significant impact organizational culture could have on it (Girginov, 2022). In this regard, this author reveals the tendency of most studies to overlook the place of a change in the value system that underpins the organization's culture as a requirement for 'the implementation of any conception of good governance' (Girginov, 2022, p. 86). This indicates that there has not been a thorough investigation of empirical studies on the impact of organizational culture on public governance, and to be more specific, its impact on good sports governance has not yet been thoroughly investigated. Hence, this study hypothesizes the following *hypothesis 1*: Organizational culture significantly and positively influences good sports governance.

Strategic management and its influence on good governance

According to the resource dependency theory of good sport governance, if an organization is to be effective and eventually survive and exist for an extended length of time, it must be capable of getting and maintaining essential resources (Pfeffer & Salancik, as cited in O'Boyle, 2012) that can only be accomplished by managing organizational activities strategically.

In this regard, several scholars have emphasized the significance of strategic management in directing organizational activities. For instance, Steiss (2003) argues that strategic management provides a framework by which nonprofit organizations can adapt to the impulses of an unpredictable environment and unreliable future and that "nonprofits that use strategic management can deliver enhanced results and performance" (Miller, 2018). Similarly, Mosley et al. (2012) found that engagement in strategic management efforts allows organizational bodies to deal with funding insecurity. Aboramadan and Borgonovi (2016) also argued that strategic management offers a framework for directing managerial activities,

apportioning better resources, supporting objectives and decisions, and increasing organizational performance.

As far as good sports governance is concerned, scholars (Blanco, 2017; Chelladurai & Zintz, 2015; Yeh & Taylor, 2008) have emphasized that a relatively recent thrust has been made to articulate the need for good governance of national sports governing bodies and to lay down the elements of good governance, as they have been the focus of much attention from both governments and scholars.

In addition, Hoye et al. (2015) pointed out that there are drivers of change in the governance of sports organizations, such as pressure from funding agencies, the threat of litigation against sports organizations, their members, or board members, and the threat of competition in the marketplace. Considering these pressures, Blanco (2017) defined sport governance as "an act of orchestrating, manoeuvering, facilitating, and mobilizing the pool of talents, resources, approaches, and processes in a much broader, fuller, and wider continuum of sports actors, agents, and stakeholders across various sectors of society" (p. 106).

Therefore, it seems imperative to note that strategic management offers a framework for directing managerial activities, apportioning better resources, supporting goals and decisions, and increasing organizational performance (Aboramadan & Borgonovi, 2016), and good sport governance is a system of directing and managing overall organizational activities (Ferkins et al., 2009). This indicates that there seems to be an influence of one factor on another.

On the premises of this relational concept, several studies confirm the significant impact strategic management has on organizational success variables (related to good governance in one way or another) of profit, non-profit, and hybrid organizations. For instance, strategic management has a significant positive impact on organizational performance (Adegbuyi et al., 2015) and on financial and non-financial performance (Aboramadan & Borgonovi, 2016; Sarker & Rahman, 2018). Regarding the link between strategic management and corporate governance, researchers (e.g., Capasso & Dagnino, 2012; Shen & Gentry, 2012) have underlined that most studies on their relationship emphasize the effect of corporate governance on strategic management. Strategic management also impacts corporate governance (Shen & Gentry, 2012).

However, the influence of strategic management on good sports governance has not yet been investigated in sports management. Hence, this study hypothesizes the following *hypothesis 2:* Strategic management significantly and positively influences good sports governance.

The moderating role of Organizational size

Scholars of public management have compared large-sized and small-sized firms and found that large organizations are acquainted with advantages that are important for organizational success despite their tendency to have a more complicated governance structure and control (Cornforth & Simpson, 2002; Jaskyte, 2013), whereas small organizations have relatively modest governance structures and centralized control mechanisms, which minimize organizations' communication and coordination expenses, perhaps making nonprofits more efficient (Andrews, 2017; Jung, 2012).

These portrayals of organizational size enable it to be in a position to change the direction and magnitude of the relationships between organizational success variables. For instance, size has significantly moderated the link between strategy and performance (Smith et al., 1989, p. 79). Similarly, Vaccaro et al. (2012) found that organizational size significantly moderated the influence of leadership behavior on management innovation, where "smaller and less complex organizations benefit more from transactional leadership in realizing management innovation, whereas larger organizations need to draw on transformational leaders to compensate for their complexity and allow management innovation to flourish.".

In addition, in a study of determinants of organizational transparency (financial disclosure), large organizations were found to have a positive relationship with financial transparency (Behn et al., 2010). In contrast, Saxton et al. (2012) argued that small organizations were positively related to transparency. These findings are found to be equivocal and may be context dependent, which calls for further scrutiny.

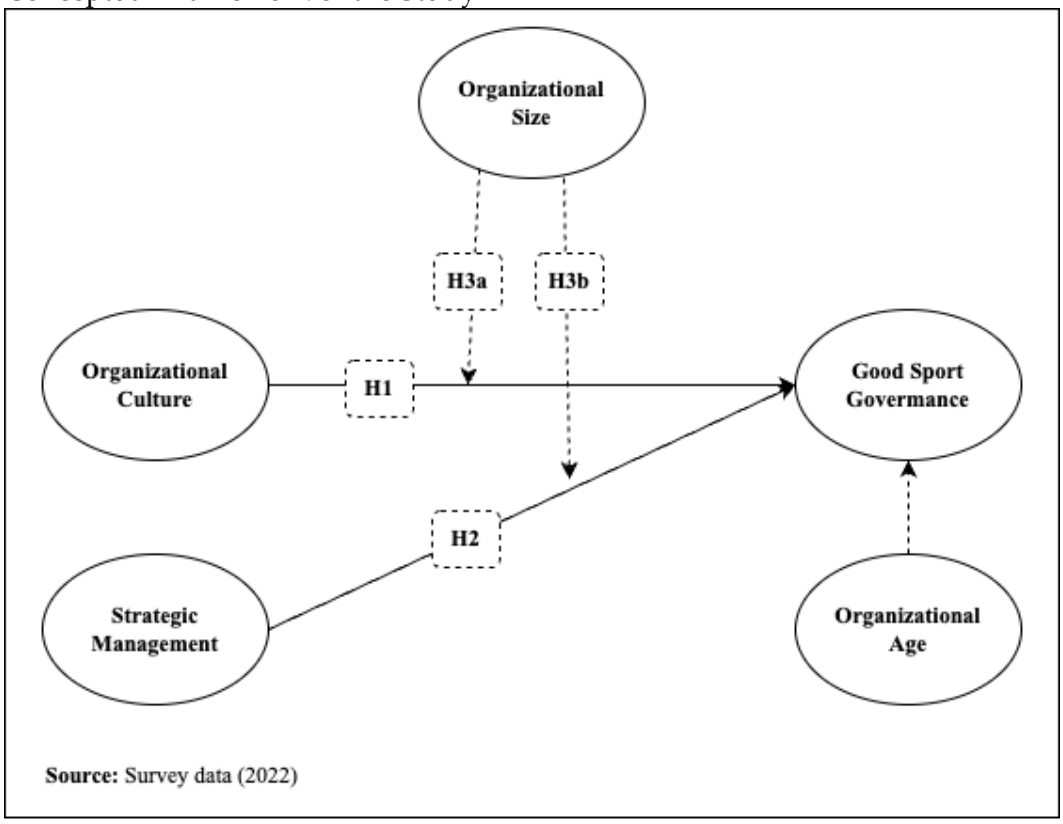
Organizational size, measured by the number of full-time employees, was also found to have a moderating influence on the association between employees' evaluations of the innovative and hierarchical climate and their aspirations for organizational innovation (Jung & Lee, 2016). Recently, Hung and Berrett (2022) also examined the moderating role of organizational size, along with government funding, on the influence of commercialization on nonprofit efficiency. Their findings contrarily indicated that there was no statistically significant interaction between commercialization and organizational size on nonprofit efficiency.

However, to our knowledge, the interaction effects of organizational size and other determinants on good sports governance have not yet been investigated by sports management researchers in our context. Hence, this study hypothesizes the following *hypotheses 3a:* Organizational size significantly moderates the influence of organizational

culture on good sports governance *hypotheses 3b:* Organizational size significantly moderates the influence of strategic management on good sports governance.

Figure 1

Conceptual Framework of the Study



METHODS

Research Design

A descriptive cross-sectional survey was used in this study, as a survey design gives a quantitative or numerical depiction of a population's trends or attitudes by analyzing a sample of that group (J.W. Creswell & Creswell, 2018). Specifically, according to Skinner et al. (2015), the cross-sectional survey design was found suitable for this study because it is designed to identify the study population, select a sample, and contact the respondents to obtain the required information from representatives of a given population at one point in time to generalize the results.

Participants

From the total of 16 Olympic sports federations, we purposively selected six federations Ethiopian Football Federation (EFF), Ethiopian Athletics Federation (EAF), Ethiopian Basketball Federation (EBF), Ethiopian Volleyball Federation (EVBF), Ethiopian Handball Federation (EHF), and Ethiopian Cycling Federation (ECF) for their being dominant

throughout the country as they have a long history (more than half a century) of establishment with an average age of 66.98 (SD = 8.09), have a number of member clubs, are with the most popular sports events, and have the highest public focus on them.

Then, from the 1213 total population comprising 48 executive boards, 133 paid staff, 420 senior coaches, and 612 senior officials of the sampled Olympic sports federations, we selected 265 respondents based on Soper's (2021) a priori sample size calculator for SEM to determine the minimum sample size and in consideration of 20% attrition rates (for the main thesis) by proportionate stratified random sampling. The stratification was based on the type of stakeholders (executive board members, staff, coaches, and officials) and the gender of the stakeholders of the respective sports federations.

Procedures

The study received ethical approval from the institutional review board committee of Addis Ababa University on February 7, 2022, numbered IRBC No. IRB/04/14/22, and adhered to the principles outlined in the Declaration of Helsinki. Participation in the study was voluntary, and participants received written and oral explanations regarding their participation and the importance of providing accurate information. Then, we conducted a face-to-face survey from February to June 2022, distributing questionnaires to the selected participants. We wrote all the necessary explanations on the data collection tools for the target participants, excluding identifying information, such as their names, to ensure that their identities remained confidential.

Good sports governance (GSG) (Dependent Variable)

Good sports governance was assessed using the slightly modified and contextualized version of the Action for Good Governance in International Sports Organizations(AGGIS) sport governance observer tool (Geeraert, 2015). The original 36 indicators were extended to 38, as the four dimensions were kept the same: transparency and public communication (12 items), democratic processes (10 items), checks and balances (7 items), and solidarity (9 items). Besides, the initial five-point Likert scale(not fulfilled at all(1), weak(2), moderate(3), good(4), and state- of- the art(5) was modified in the range from 'not fulfilled at all'(1) to 'fulfilled at all'(5) on the assumption that it should reflect measures of perceived level of implementation of good sports governance with some meaning and value to all stakeholders participating in the study, and found internally consistent in the pilot of this study with alpha values of transparency and public communication (.87), democratic processes (.84), checks and balances (.82) and solidarity (.83).

Organizational size (Orgsize) (Moderator Variable)

Three measures (employee number, annual revenue, and number of member organizations) were averaged and taken as the natural log to measure organizational size in accordance with previous empirical studies (Amis & Slack, 1996; Fong et al., 2010; Jung, 2012; Lin & Germain, 2003; Wiersema & Liebeskind, 1995). The number of paid staff and annual revenues of the respective organizations was the average of the two consecutive fiscal years for 2019/20 and 2020/21.

Organizational culture (OC) (Independent Variable)

The instrument used to assess the organizational culture (OC) of the surveyed Olympic Sports Federation of Ethiopia was Cameron and Quinn's (2006, 2011) Organizational Culture Assessment Instrument(OCAI), which is based on the Competing Value Framework (CVF) with four dimensions/scales: clan culture, adhocracy culture, market culture, and hierarchical culture, each containing six items so that it has 24 items with a 5-point rating scale ranging from strongly disagree (1) to strongly agree(5). This instrument was found to be internally consistent in the pilot study, with alpha values for clan culture (.81), adhocracy culture (.75), market culture (.83), and hierarchical culture (.74).

Strategic management (SM) (Independent Variable)

Strategic management practice was measured using the modified and contextualized version of Aboramadan and Borgonovi's (2016) 5-point Likert scale of 1(not at all) to 5(to a great extent) with four dimensions (environmental scanning/strategy analysis, strategy formulation, strategy implementation, and strategy evaluation and monitoring) and 30 items initially used to measure the strategic management practice of non-governmental organizations.

This study modified and contextualized it into a sports management perspective item-wise, keeping the number of items at 30 within four dimensions: strategic analysis (seven items), strategic formulation (eight items), strategic implementation (six items), and strategic evaluation and monitoring (nine items). Hence, the instrument has 30 items on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5) and is found internally consistent in the pilot of this study with alpha values for strategic analysis (.88), strategic formulation (.87), strategic implementation (.82), and strategic evaluation and monitoring (.85).

Organizational age (OrgAge; Control variable)

Organizational age, measured as the difference between 2022 GC and the year of establishment of the respective sports federations, is regarded as a control variable. Hung and

Berrett (2022), citing Hager (2018), suggest the controlling role of organizational age as "organizational age has a necessary control in nonprofit studies" (p. 9).

Before the data collection, the instruments were checked and approved by the institutional review board committee on February 7, 2022, in a minute numbered IRBC No. IRB/04/14/22. Then, we contacted the sampled Olympic sports federations to get assistance in the recruitment process for the required 265 respondents. The participants were then verbally informed to read and sign informed consent containing voluntary participation and withdrawal rights. Then, we conducted a face-to-face survey from February to June 2022, distributing questionnaires to the selected respondents.

Data Analysis

Data were analyzed using IBM SPSS 26 and Amos 23.0, and the level of statistical significance was set at $\alpha < .05$. In doing so, descriptive statistics for the background information and study variables were computed. The study variables were also correlated to examine their relationships.

A two-step SEM approach was used, where the measurement model (CFA) was first evaluated to assess internal consistency, convergent validity, and discriminant validity. Here, both exogenous (organizational culture and strategic management) and endogenous (good sport governance) multidimensional superordinate constructs were operationalized as first-order constructs by calculating the mean response of each dimension and treating the dimensions as direct observations (Li et al., 2008). The structural regression model was then used to test the proposed direct hypotheses.

The model fit measures for both the measurement and the structural models were compared against threshold values for determining model fit (Schumacker & Lomax, 2010, p. 76). Besides, hierarchical regression analysis was also executed using SPSS 25 to observe the moderating effects, as scholars (Sabah, 2017: Trivedi, 2020) argue it is a preferable method for testing interaction effects, especially in the case of non-categorical data or for moderation with metric moderator variables.

RESULTS

Background information of respondents and the response rate

We conducted a survey by distributing questionnaires to 265 respondents from February to June 2022, and upon serious follow-ups, collected 238 completed questionnaires with an 89.8% response rate. When we saw respondents in their stakes, officials were nearly

half (50.4%), followed by coaches covering 35.7%. The remaining 2.9% and 10.9% portions were covered by executive committee members and paid staff, respectively.

Regarding the sex and age composition of the respondents, the vast majority (87.4%) were males, and the remaining 12.6% were females. The age category above 30 comprised the large majority (83.6%). When the academic level of the study participants and years of work experience were examined, holders of BA/BSc degrees and MA/MSc degrees together had the highest share (68.5%) of the respondents. Nearly half of the respondents (52.1%) were found to have a work experience of 1-10, and 37.4% lie in the experience category of 11-20 which together form 89.5%.

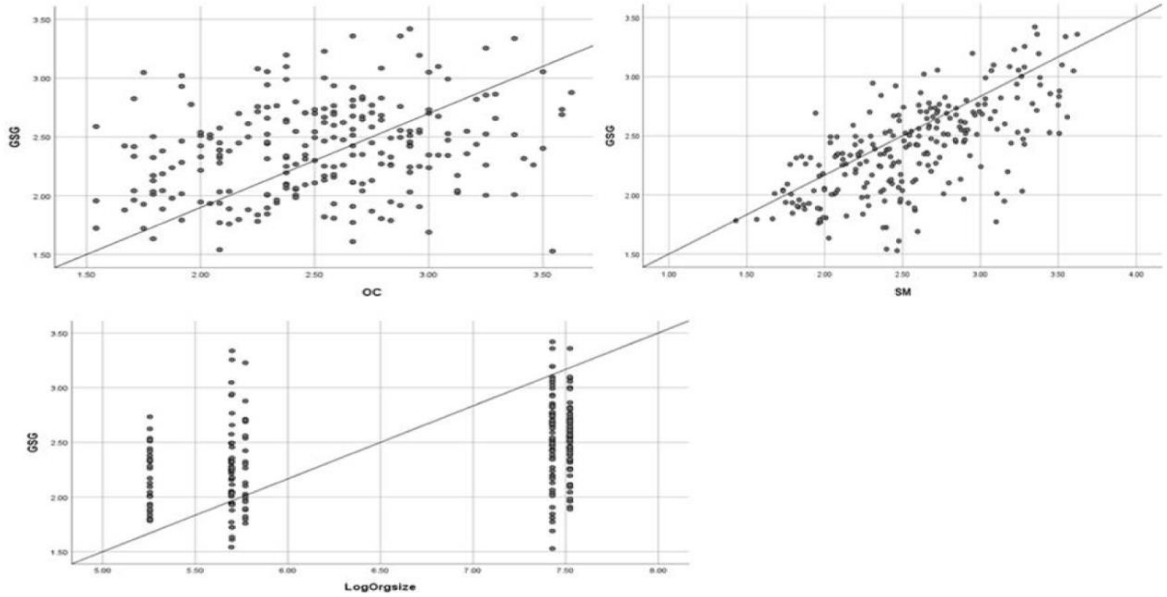
Linearity, normality, outliers, and multicollinearity

Linearity was checked graphically by the scatter plots that the independent variables (organizational culture and strategic management) and moderator variable (organizational size) were found to have linear relationships with the dependent variable good sports governance as the scatter plots reveal (see fig. 2.).

Besides, the assumption of normality was checked for all variables by using graphical analysis (the histogram), and a normal curve retained the bell-shaped curve, which is characteristic of all normal distributions (Hair et al., 2014; Ntoumanis, 2001; Randolph & Meyers, 2013). Statistically, the values for skewness were found in the range of .082 to 1.92. The values for kurtosis ranged from -3.256 to .613, indicating that there is no extreme non-normality as they are found in the region of skewness less than 3 and kurtosis less than 8 for the level of significance (Kline, 2011, 2016). Multivariate outliers were also checked by Mahalanobi's D^2 measure, where the ratio of D^2 to the degree of freedom (D^2/df) was computed and judged, as observations with values exceeding 2.5 could be designated as possible outliers (Hair et al., 2014, pp. 64–65). Hence, no outliers were detected in this data, as the highest MD^2 is 35.74 with a degree of freedom of 51.

Moreover, we checked the multicollinearity assumption by using the tolerance value and VIF (variance inflation factor) for their cut-off points of >.10 and <10, respectively (Hair et al., 2014; Kline, 2016). As the values of these parameters were all at the acceptable levels: tolerance (.86, .79, .66, & .78), and VIF (1.17, 1.25, 1.52, &1.28), they indicate that no threat of multicollinearity can easily lead to unstable regression coefficients. Hence, further multivariate analyses were conducted.

Figure 2
Scatter Plots for the Linear Relationships Between the Study Variables



Note. OC: Organizational culture; SM: Strategic management; LogOrgsize: Natural log of organizational size; GSG: Good sports governance

Common method bias

As this study used only a questionnaire as an instrument to collect the data, it becomes imperative to confirm the absence of standard method bias error. Hence, Harman's single-factor test was conducted by using SPSS. The factor analysis was performed without any rotation, and all items were loaded on only one factor. The results revealed that a single factor accounted for 22.59% of the variance, which is far less than 50%, indicating no threat of standard method bias (Kock, 2021; Harman, 1976, cited in Trivedi, 2020).

Descriptives and correlations of the study variables

As a preliminary step in testing the study hypotheses, the study variables' means, standard deviations, and correlation coefficients were examined and found significantly correlated except the relationships of organizational age with organizational culture and strategic management (see Table 1).

Table 1
Descriptives and Correlations of the Study Variables

The study variables		M(SD)	Correlations				
			1	2	3	4	5
1	**OC**	2.53(.48)	1				
2	**SM**	2.56(.48)	.33**	1			
3	**GSG**	2.40(.38)	.26**	.66**	1		
4	**LogOrgsize[1]**	6.65(.94)	.28**	.38**	.38**	1	
5	**OrgAge**	66.98(8.09)	.07	.11	.14*	.46**	1

Note. **: Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed), [1]Natural logarithms

Validity and reliability of the study constructs

The multidimensional constructs in the study were statistically checked for their reliability and validity (see Table 2). In this regard, internal consistency-reliability was ensured by generating Cronbach's alpha values for the fulfillment of the suggested cut-off value of 0.70 (Hair et al., 2014; Kline, 2011). The measurement model (CFA) for a satisfactory level of validity and reliability (Fornell & Larcker, 1981) was also computed. The model fit measures were compared against threshold values for determining model fit (Schumacker & Lomax, 2010, p. 76), and the outputs indicate that the Normed Chi-square ($\chi 2$ (106.49)/df(51) = 2.08, RMSEA =.07, CFI = 0.95, TLI = 0.94, SRMR = .043, and p-value <.001 which, according to the suggested characteristics of different fit indices (Schumacker & Lomax, 2010), demonstrate the goodness of fit that the construct validity of the measurement model was established. The factor loadings, average variance extracted, and composite reliability of the constructs were computed (see Table 2).

Table 2
A Reliability and Validity Measure of the Study Constructs

Indicators		Constructs	Λ	A	AVE	CR
Hierarchy Culture	<---	OC	.58***			
Market Culture	<---	OC	.75***			
Adhocracy Culture	<---	OC	.91***			
Clan Culture	<---	OC	.68***	.82	0.54	0.82
Strategic evaluation and monitoring	<---	SM	.76***			
Strategic implementation	<---	SM	.85***			
Strategic formulation	<---	SM	.82***			
Strategic analysis	<---	SM	.76***	.87	0.63	0.88
Transparency and public communication	<---	GSG	.45***			
Democratic processes	<---	GSG	.79***			
Checks and Balances	<---	GSG	.53***			
Solidarity	<---	GSG	.69***	.70	0.40	0.71

Note. ***: p < 0.001; OC: Organizational Culture; SM: Strategic Management; GSG: Good Sports Governance

In this regard, the factor loadings of each parceled indicator of the constructs in CFA were found to be significant, ranging from .45 (transparency and public communication in good sports governance) to .91 (adhocracy culture in organizational culture), hence indicating the initial level of convergent validity is fulfilled. Here, it seems important to note that 0.4 factor loading is the recommended threshold (having practical significance) for sample sizes 200 and above (Hair et al., 2014).

The average variance extracted approximately ranges between.4 (good sport governance) and.63 (strategic management), meaning that all except the construct good sports governance (limitation of this study) meet the recommended level of .5 and above (Hair et al., 2014). However, as argued by some previous studies (e.g., Fornell & Larcker, 1981; Lam, 2012), the average variance extracted may be a more conservative estimate of the validity of the measurement model; hence, one can conclude the convergent validity based on composite reliability. The composite reliabilities of the constructs in the model were well above the recommended level. 70 (Hair et al., 2014). So, we concluded that the convergent validity of good sports governance is adequate based on composite reliability (.71).

Hypotheses of direct paths

To address hypotheses 1 and 2 and the effect of the control variable, we developed a hypothesized structural model that specified three direct paths and appeared to have an acceptable fit, i.e., the Normed Chi-square ($\chi 2$ (132.15)/df(60) = 2.20, RMSEA =.07, CFI = 0.94, TLI = 0.92, SRMR =.047, and p-value <.001, which, according to the suggested characteristics of different fit indices (Schumacker & Lomax, 2010), demonstrate the goodness of fit of the structural model. In the direct paths of the model (see Table 3), the path coefficient from organizational culture to good sport governance was found to be statistically non-significant (β=.05, t-value =.48, p >.05), thus does not indicate support for hypothesis 1. Whereas, the path coefficient from strategic management to good sports governance was found statistically significant (β=.78, t-value =5.85, p <.001), thus indicating support for hypothesis 2 as a unit increment in strategic management can explain 0.78 increments in good sports governance.

Table 3
Direct Path Analysis Summary

Hypotheses	Path			Standardized estimates	t-value	Result
H1	GSG	<---	OC	.05	.48	Not supported
H2	GSG	<---	SM	.78***	5.85	Supported
Control variable	GSG	<---	ZorgAge	.06	.99	Not supported

Note. ***: p < 0.001; OC: Organizational Culture; SM: Strategic Management; GSG: Good Sports Governance

Hypotheses of Moderation

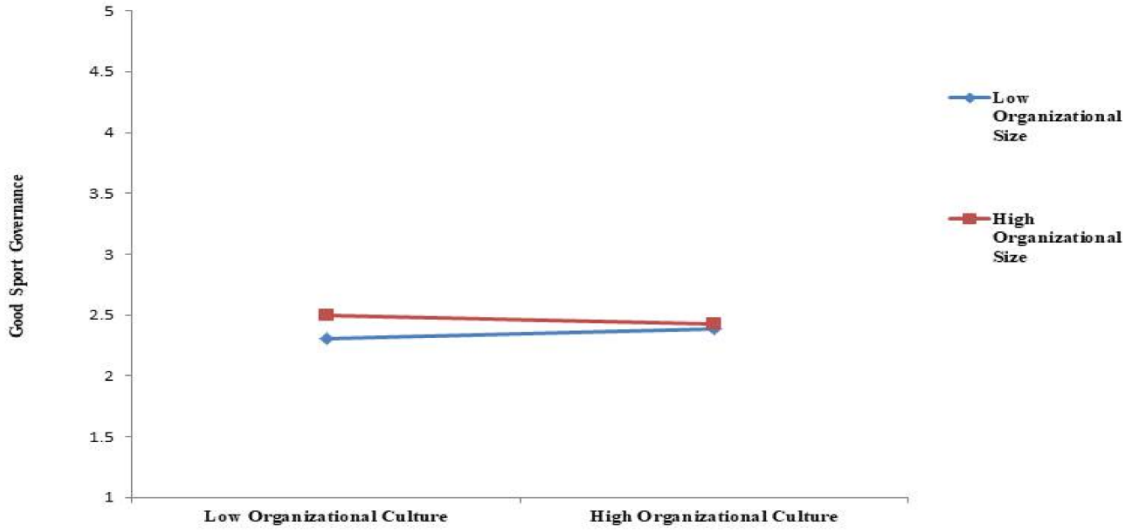
Before carrying out metric moderation by using hierarchical regression analysis, we averaged the dimensions of the constructs to create a single composite index. Then, all variables except the dependent variable were z-standardized to reduce potential multicollinearity issues (Dawson, 2014; Uedufy, April 3, 2023). The interaction variables (z-

standardized IVs*z-standardized MV) were computed to analyze the hypotheses of the interaction effects (Dawson, 2014; Uedufy, April 3, 2023).

A three-step hierarchical regression analysis using SPSS 25 was conducted to test the moderation effects of organizational size on the influences of organizational culture and strategic management on good sports governance (see Table 4). First, the effects of independent, moderator, and control variables were observed. In the second step, the interaction term obtained by multiplying organizational size and strategic management was added to the model, and its effect was observed. Finally, the interaction term obtained by multiplying organizational size and organizational culture was added to the model, and its effect was observed.

Hence, the regression results on one side, as there is a significant R^2 change (0.9%) in the third model (ΔR^2=.009, F (1,231) = 4.03, p<.05), indicates that organizational size significantly moderates the influence of organizational culture on good sport governance (β = -.10, t-Value = -2.01, P = .046, CI [-.078,-.001]). Thus, we accept hypothesis 3a. On the other hand, no significant moderation effect of organizational size was found in the relationship between strategic management and good sports governance. Thus, we rejected hypothesis 3b. The simple slope analysis was conducted to better understand the nature of this moderation effect (see Figure3).

Figure 3
The Simple Slope Analysis of the Interaction Effect of Organizational Size and Organizational Culture on Good Sports Governance



Here, the line is steeper for low organizational size, which indicates that, at a low level of organizational size, the impact of culture on good sports governance is a little bit stronger

than at a high level of organizational size. Hence, as the level of organizational size increases, the strength of the relationship between organizational culture and good sports governance decreases.

We also checked the size of the moderation effect. The variance explained with the inclusion of the significant moderation effect is 46.6%, whereas the variance explained without inclusion was 45.7%, hence an increase of 0.9% in variance explained on the dependent variable, good sports governance. This shows that the effect size is very small (.016). According to Cohen (1998) proposition, 0.02, 0.15, and 0.35 constitute moderation's small, medium, and large effect sizes, respectively. This shows that the moderating effect of organizational size does not contribute significantly to explaining good sports governance (has low practical significance).

Table 4
Hierarchical Regression Analysis Summary

Models	Regression Variables		B	T	CI	R^2	R^2 Change
	Exogenous Variable	Endogenous Variable					
Model 1	Zscore(OC)	GSG	.014	.266	-.035,-.045		.
	Zscore(SM)	GSG	.599***	11.079	.192,-.275		
	Zscore(LogOrgsize)	GSG	.150*	2.519	.013,-.104		
	Zscore(OrgAge)	GSG	.002	.040	-.041,-.043	.457	457
Model 2	Zscore(OC)	GSG	.014	.263	-.035,-046		
	Zscore(SM)	GSG	.599***	11.014	.192,-.275		
	Zscore(LogOrgsize)	GSG	.150*	2.508	.013,-.105		
	Zscore(OrgAge)	GSG	.002	.042	-.041,-043		
	ZSM * ZlogOrgsize	GSG	.002	.042	-.040,-.041	.457	.000
Model 3	Zscore(OC)	GSG	.003	.049	-.039,-.041		
	Zscore(SM)	GSG	.607***	11.200	.195,-.278		
	Zscore(LogOrgsize)	GSG	.144*	2.418	.010,-.102		
	Zscore(OrgAge)	GSG	-.002	-.038	-.043,-.041		
	ZSM * ZlogOrgsize	GSG	.022	.450	-.032,-.050	.466	.009
	ZOC * ZlogOrgsize	GSG	-.100*	-2.007	-.078,-.001		

Note. ***: P<.001, *: P<.05, β: Standardized beta coefficient, R^2: The variance explained, Zscore (OC): Standardized organizational culture, Zscore (SM): Standardized strategic management, Zscore (LogOrgsize): Standardized log centered organizational size, Zscore(OrgAge): standardized organizational age, t: Critical Ratio, CI: Confidence Interval

In addition to the moderation effect, we curiously examined the main effect of organizational size on good sports governance. Here, we compared the regression coefficients of organizational size in two models (model 1: a main effects-only model and model 3: a model

with interaction effect; See Table 4) as argued by Lorah (2020) to interpret the main effect as a conditional or average effect (p. 42). Hence, it was found that organizational size has a positive and significant direct impact on good sports governance with nearly equivalent regression coefficients in two models (β=.15, t-value = 2.52, $p<.05$ and β=.14, t-value = 2.42, $p<.05$). The findings here suggest that organizational size on average has a positive and significant influence on good sport governance, as a unit increment in organizational size can explain 0.14 increments in good sport governance.

DISCUSSION

This study examines the influences of organizational culture and strategic management on good sports governance and the moderation effect of organizational size in their relationships in the setting of Ethiopian Olympic Sports Federations. In this regard, this study's findings revealed that organizational culture's direct influence on good sports governance was non-significant. This finding is contrary to the findings of previous studies (e.g, Amali et al., 2018; Daneshmandnia, 2019; Jansen et al., 2013; Zhong et al., 2012) where organizational culture was found to have a decisive influence on information technology governance and the findings in which organizational culture was found to influence good governance performance (Dwi Ermayanti et al., 2019; Yuliastuti & Tandio, 2020), hence seeks further scrutiny in the same context.

The findings, however, indicated that strategic management has a significant and positive direct effect on good sports governance. This finding is in congruence with that of Shen and Gentry (2012), who posited the influence of strategic management on good corporate governance. Besides, the finding corroborates that of Breitbarth and Rieth's (2012) 3S model, where strategy, along with structure and stakeholders, is regarded as a critical driver of corporate social responsibility integration. Moreover, the finding corroborated the qualitative finding of O'Boyle and Shilbury (2018), who identified 'potential for strategic planning' as a determinant of good sports governance along with other factors. Hence, this finding reminds us that strategic management (innovative management) that focuses on changes and amendments to be made in the sports organization and within its interactions with the environment in which it operates (Gajda et al., 2016), should diligently fine-tune the orchestration of all activities, resources, and processes systematically, involving all sports actors to achieve organizational goals.

Moreover, in the moderation analysis, organizational size was found to have a significant and negative moderation effect on the relationship between organizational culture and good sports governance, where the increment in the level of organizational size results in a decrease in the strength of the relationship between organizational culture and good sports governance. This finding is in congruence with the finding of Lin et al. (2012), where organizational size negatively moderates the influence of disclosure of human capital information on firm performance. Andrews's (2017) finding also strengthens this as there is a negative relationship between organization size and organizational social capital: structural (connections among actors), relational (trust among actors), and cognitive (shared goals and values among actors) aspects. This finding suggests that the increased organizational size decreases the connections among sports actors, which in turn results in loosening trust, values, and beliefs among the actors in the organizations; hence, it signals the maintenance of a strong regulatory culture for good governance practices in large-sized sports organizations.

On the other hand, the findings of the moderation analyses indicated a non-significant moderation effect of organizational size on the influence of strategic management on good sports governance. This finding is consistent with that of Hung and Berrett (2022), who found a non-significant moderation effect of organizational size on the relationship between commercialization and nonprofit efficiency. However, this finding contradicts many empirical studies on the moderating role of organizational size in the relationships between organizational success variables in public organizations. For instance, it contradicts the findings of Smith et al. (1989), where size moderates the influence of strategy on performance, and Jung and Lee (2016), where organizational size (measured by the number of full-time employees) was found to have a moderating effect on the association between employees' evaluation of the innovative and hierarchical climate and their aspiration for organizational innovation. Hence, this finding suggests the importance of strategic management, regardless of the size of the sports organizations, i.e., both small and large sports federations should diligently engage in strategic management for the successful implementation of good sports governance and then their future existence while keeping pace with the rapidly changing sports environment.

In addition to the findings of hypothesized relationships, it was found that organizational size has a positive and significant direct impact on good sports governance. This finding is congruent with empirical studies on the impact of size on change and continuity in the governance of nonprofit organizations (Cornforth & Simpson, 2002), the influence of size on governance conformance and performance (Rentshcler & Radbourne,

2009), the positive association between size and the adoption of good governance policies (Lee, 2016), and the impact of size (number of staff and annual revenues) on good governance scores of some summer olympic sports federations (ASOIF, 2020, p. 9).

As organizational size in this study is operationalized through the combination of the number of paid staff, annual revenues, and number of member organizations, the direct impact it has on good governance specifically reminds us of the issues of the professionalization of human resources in most federations to be focused (EVBF, EBF, ECF, and EHF) and enhancing the total annual revenues (financial capacity) in almost all surveyed sports federations. In summary, the professionalization of sports organizations and the total annual revenues (financial capacity) are associated with organizational capacity (Hall, 2003, as cited in Willem & Scheerder, 2017). Hence, the very low level of professionalization and weak financial capacity in most of the surveyed Olympic sports federations indicate a low level of organizational capacity that hinders the implementation of good sports governance.

CONCLUSION

The findings of this study shed light on the untested relationship between organizational size, organizational culture, strategic management, and good sport governance in Ethiopian Olympic sports federations.

In this regard, first, this study suggests that organizational size, in addition to having a moderator role in the relationship between organizational culture and good ports governance, has a direct and positively significant influence on good sports sport governance. This dual role of organizational size signifies the critical importance of it in the implementation of good governance in the national sports federations, hence strengthening the call for attention to be given to upgrading most surveyed federations to the level of functional specialization and enhancement of financial capacity by diversifying annual revenues.

Besides, despite its very low practical significance, the negative and significant moderation effect of organizational size in the influence of organizational culture on good sports governance (the higher the organizational size, the lower the strength of the relationship) cautions sports organizations to tailor values, beliefs, core assumptions, and opinions to the size of their organizations in order to implement good sports governance practices as scholars (e.g., Defalla & Choong, 2022; Zeng & Luo, 2013) argue that large-sized organizations need to maintain regulatory solid culture to be efficient.

Second, this study revealed the non-significant direct effect of organizational culture on good sports governance in the surveyed Olympic sports federations.

Third, this study provides empirical evidence of the significant direct impact strategic management has on good sports governance. As good sports governance is all about mobilizing the pool of talents, resources (human, financial, material, time, etc.), approaches, and processes in the broader continuum (from internal to external) of sports actors, agents, and stakeholders across various sectors (Blanco, 2017, p. 106), this impact signifies the need to frame and guide all the pool of talents, resources, approaches, and processes of the sports federations in collectively agreed path with clear destination based on properly scanned sports environment (for opportunities & threats, potential stakeholders, competitors), and accompanied by a dedicated implementation of these activities and frequent monitoring and evaluation of the achievements (Hoye et al., 2015).

Management Implications

The current study provides a number of theoretical and practical implications for sports managers and practitioners. The findings carry theoretical implications for the literature on good sports governance, as the scope of this study is extended from merely examining its implementation to examining contextual mechanisms that influence the degree of implementation in national sports federations. This study significantly modeled the relationships between organizational size, organizational culture, strategic management, and good sports governance.

Practically speaking, this study (a) implies policy issues as it significantly indicates the importance of strategic management to govern sports organizations or to maneuver all activities, resources, and processes systematically, involving all sports actors to achieve organizational goals. (b) Signifies the two-fold importance of organizational size (moderation effect in the relationship between organizational culture and good sport governance, and the main effect it has) in implementing good sport governance and (c) pinpoints the need for a fit between size and culture for good sport governance practices in Olympic sports federations.

Limitations

Like any other scientific effort, this study has limitations. First, the operationalization of multidimensional superordinate constructs (organizational culture, strategic management, and good sports governance) as first-order constructs by calculating the mean response of each dimension and treating the dimensions as direct observations (Li et al., 2008, p. 53) might shadow the findings, as this approach confounds random measurement error with dimension specificity and disregards the relationship between each dimension and its measures

(Edwards, 2001; Koufteros et al., 2009). Hence, future studies may further utilize higher-order modeling (Koufteros et al., 2009).

Second, national sports governing bodies have stakeholders internally and externally, which obviously can benefit or be benefited by the organizations. However, this study is limited only to internal stakeholders (executive members, paid staff, senior coaches, and senior officials) to gather data that may limit the comprehensiveness of the perceived state of the study variables. Hence, future studies should better include representatives of external stakeholders.

Third, the data for this study were gathered via a cross-sectional survey, so associations between variables are insufficient to establish causal relationships. Future longitudinal analyses would be helpful to study causation.

Fourth, a future study would better consider the influence of organizational culture on good sports governance and the moderation effect of organizational size in the relationships between strategic management and good sports governance in a similar context.

Finally, as this study is quantitative in methodology, it tends to provide a partial view as it fails to incorporate qualitative, in-depth perceptions of stakeholders to validate the findings of one strand with the other. Hence, future studies should better engage in a mixed-methods study, as the concepts of good governance and contextual determinants such as organizational culture and strategic management are social constructs that hold a debatable (and elusive) position in their definition and measurement.

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Authors' contribution

The first author contributed to the conception and design, data collection, analysis and interpretation, and original draft writing of the manuscript; the second author contributed to reviewing the conception and design, interpretation of the data, and critical review, editing, and approval of the manuscript; the third author contributed to reviewing the conception and design, interpretation of the data, and critical review, editing, and approval of the manuscript; and the fourth author contributed to reviewing the conception and design, interpretation of the data, and critical review, editing, and approval of the manuscript.

Declaration of conflict interest

No potential conflict of interest was reported by the authors.

Ethics Statement

The study received ethical approval from the institutional review board committee of Addis Ababa University on February 7, 2022, numbered IRBC No. IRB/04/14/22.

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Turkish Adaptation of Stadium Atmosphere Scale: A Comparison of Football Spectators and Fans

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ABSTRACT

This study aimed to test the Turkish adaptation of the Stadium Atmosphere Scale (STAS) and reveal its psychometric properties. We collected data from 324 football spectators and fans, which were selected using the convenience sampling method. We carried out four different tests for Turkish adaptation and psychometric properties of the scale after performing Turkish language co-validation. The CFA analysis with varying configurations of the model revealed that the construct of the STAS fit well in both the correlated factor model and the hierarchical model and best fit the data collected from the Turkish population. Additionally, we tested measurement and structural invariance to examine if the scale was also performed for spectators participating for different purposes in the same way and determined that the relevant scale preserved its basic structure in both football spectators and fans and that the scale could be used as an appropriate measurement tool. These results demonstrated that the STAS would be used as a valid and reliable measurement tool for the population in Turkey.

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INTRODUCTION

People usually participate in several activities such as watching a sporting event, attending a technology festival, or going to a restaurant or concert for various purposes (Ramchandani et al., 2017; Weziak-Białowolska et al., 2019). Individuals make statements such as "the atmosphere here was great" about the event and environment after participating in the event, which indicates their satisfaction and happiness and can be effective on the subsequent preference mechanism (Uhrich & Koenigstorfer, 2009). Jones et al. (2017) defined the atmosphere as an emotional response to the totality of stimuli in a particular environment. Therefore, each environment has its unique atmosphere, resulting from the sum of its stimuli. Stimuli lead to a positive or negative evaluation of the space, depending on people's subjective preferences and perceptions (Norris et al., 2010). The research on such subjects has mostly been related to outcome variables such as customers' evaluation of the store atmosphere, purchasing behaviors (Babin & Attaway, 2000), customer satisfaction (Babin & Darden, 1996), approach/avoidance behaviors (Donovan & Rossiter, 1982). Atmospheric experience is often an additional factor contributing to the value created during the shopping process when it is evaluated in merchandising (Donovan et al., 1994). However, such experience in a sporting event is one of the main components of the total perceived service (Woratschek et al., 2020). Hence, the social actors involved in the stadium atmosphere during sporting events and they are expected to be very strong in the retail sector (Uhrich & Benkenstein, 2010).

Researchers have accepted that several factors such as the commitment of the spectators in the stands to the club, their motivation, their level of identification, and their frequency of going to the match in evaluating the stadium atmosphere (Edensor, 2015; Uhrich & Koenigstorfer, 2009). Researchers (Trail et al., 2003; Wann & James, 2018) have noted that it is essential to categorize fans to better understand the antecedents and consequences of these factors and emphasize the distinction between fans and spectators. Sloan (1989) stated that spectators are mere onlookers and observers, whereas fans are enthusiastic participants in a particular pastime. For example, fans could be motivated by the success of their favorite team, while spectators could be more motivated by the aesthetics or skill displayed in sports (Robinson & Trail, 2005). Therefore, Edensor (2015) implied that spectators' perception of the atmosphere could differ from person to person if they are somehow disconnected from the game on the field, the club, and other spectators, and if team identification is low. This reveals the importance of our study in terms of evaluating the stadium atmosphere experiences of football spectators with relatively low team identification and football fans with high team

identification by utilizing the same measurement tool when considering the classification of spectators and fans by researchers (Robinson & Trail, 2005; Sloan, 1989; Trail et al., 2003; Wann & James, 2018).

Spectators' experiences in the stadium such as functional, emotional, and social, have an impact on their perception of the atmosphere in the sporting event (Biscaia et al., 2013; Chen et al., 2013). Stadium atmosphere has been defined as the sum of the emotions experienced by spectators because of their interaction with the features and facilities of the stadium during a live sporting event and has implied the perceived quality of the ambient conditions of the stadium (Uhrich & Benkenstein, 2010). Such experiences and perceptual states stimulate the cognitive, emotional, and behavioral responses of the spectators (Balaji & Chakraborti, 2015). According to Jensen et al. (2016), the stadium atmosphere could create a unique and distinctive experience for spectators and be a catalyst for both short-term and long-term spectator behavior. Uhrich and Koenigstorfer (2009) described the stadium atmosphere as "the most important value-creating element of live sports consumption." The research demonstrated that an attractive atmosphere is the most critical factor motivating spectators to watch a sporting event in a stadium (Bauer et al., 2005). Moreover, some authors have stated that the stadium atmosphere influences spectators' intentions to return to the stadium in the future, their willingness to recommend it to others and more purchasing behavior in the stadium (Cho et al., 2019; Hightower et al., 2002; Phonthanukitithaworn & Sellitto, 2018). Thus, people's evaluations of the atmosphere could be related to their intention to participate again and consumer behaviors, which reveals the reason why the atmosphere has been studied in many fields by analyzing it in different contexts based on various theories.

The model called The Stimulus-Organism-Response (S-O-R) psychology suggests that the stimuli in the store affect consumers' emotional states such as pleasure, arousal, and dominance, which leads to approach or avoidance behaviors towards the store (Donovan & Rossiter, 1982). The model, which sports events have also applied in the study about the atmosphere in sports events, explains the relationship between stadium atmosphere and stadium loyalty (Uhrich & Koenigstorfer, 2009). Yoshida et al. (2021) comprehended that spectators' behavioral responses occur because of their exposure to environmental factors in sports stadiums. The fact that these factors include the spectators' experience in the stadium atmosphere explains social relations, reflecting social identity research in spectator sports (Underwood et al., 2001; Watkins, 2014). The research on social identity in spectators' sports has discovered that social experiences (e.g., the interaction of spectators in the stadium) contribute to social relations and increase the values shared between individuals in social

identity research in spectator sports (Ashforth & Mael, 1989). Individuals provide a positive identity through positive social relations and thus realize themselves. The fact that the spectators mainly primarily identify themselves with strong teams and star players is the most concrete example to explain this situation. Similarly, spectators' perceptions of their favorite team's stadium also explain their identification with their teams (Decrop & Derbaix, 2010). Therefore, the social identity theory implies that the stronger the interactions of the spectators with each other, the more likely they are to make positive evaluations of the stadium atmosphere (Yoshida et al., 2021).

Eventually, subsequent studies have included stimuli such as the emotions and behaviors of other people, as well as the course of the performance, social stimuli that create the stadium atmosphere, and physical elements (Holt, 1995; Madrigal, 2003; Uhrich & Benkenstein, 2010), although the first studies on stadium atmospheres have primarily focused on the physical aspects of the environment (Hightower et al., 2002; Wakefield et al., 1996). Uhrich and Benkenstein (2010) examined the stadium atmosphere's stimuli with a four-factor structure: organizer, spectators and their behavior, game action, and stadium architecture. However, the scale in this study has been developed with a relatively small number of samples and has been largely based on qualitative study results. Chen et al. (2013) addressed that the items of this instrument were developed with a relatively small number of study groups and were based on qualitative study findings. According to Karataş (2017), generalizability would be limited if the number of samples to represent the population could not be reached in qualitative research. Thus, Chen et al. (2013) developed and empirically validated the Sports Stadium Atmosphere (SSA) scale in a larger study group of basketball spectators based on the study of Uhrich and Benkenstein (2010). Çevik (2020) adapted the measurement tool Chen et al. (2013) developed to Turkish culture in a study group of football spectators. However, the scale has just statements evaluating the stadium atmosphere of fans with high team identification when the sub-dimensions (e.g., cheering groups and team traditions) and items of the measurement tool (e.g., set maneuvers performed by fans waves are frequent in New Eskisehir Stadium and color of team jersey encourages fans in New Eskisehir Stadium) are examined. Roychowdhury (2018) indicated that participants are more likely to be bored when answering the items in the scale form if a scale has of many items and is administered in sports and exercise settings. This could limit the application of the SSA scale, which consists of 10 factors and 30 items in sports settings. Accordingly, we prefer Balaji and Chakraborti's (2015) Stadium Atmosphere Scale (STAS) to the other scales in the adaptation to Turkish culture because of its functional availability.

Balaji and Chakraborti (2015) addressed the STAS in a comprehensive and short form with 14 items and four factors (physical layout, facility aesthetics, entertainment experience, social interaction). They validated the instrument on different samples of spectators, students, non-stadium spectators (those who do not watch matches in the stadium), and the general population. In Turkish literature, we noticed a lack of a measurement tool that will evaluate the stadium atmosphere experiences of both football spectators and fans with a holistic approach. Consequently, we aimed to examine whether the STAS operates way similarly in different spectator groups by testing its Turkish adaptation and determining its psychometric properties. Leitch (2018) reported a steady decline in spectator attendance at many professional and collegiate-level sporting events. Hence, researchers have believed that the stadium atmosphere is a crucial factor affecting the behavioral responses of the spectators. We also predict that this study would be quite critical as suitable a valid and reliable scale to measure the stadium atmosphere levels of spectator groups with different characteristics in Turkish culture.

METHODS

Participant

The study group consisted of football spectators and fans. We determined a total of 324 participants, 100 of whom were female (M_{age}= 30.16) and 224 of whom were male (M_{age}= 30.89) with the convenience sampling method (Yıldırım & Şimşek, 2011). We selected football fans according to a number of criteria related to their spectator experiences, including (I) watching the matches of the favorite team of the football fans in the stadium, (II) being a member of the spectator group of their favorite football team, and (III) considering oneself as a fanatic about the favorite team while we chose football spectators with recreational activity experience criteria such as (a) seeing football matches only as enjoyable social events, (b) not being part of a football team's supporters' group, and (c) not having a sense of winning and losing.

Group 1: Demographic Characteristics of Football Spectators

Table 1 demonstrates that football spectators were predominantly male (Total= 83.6%), and they had an average age of thirty years (M_{age}= 29.91). Most of them were single (Total= 80.8), they had a medium income (Total= 54. 8%), they had a university education (Total= 70.5%), they referred to watch these matches in the stadium not only to support a team (Total= 76.7%) and they would prefer to be a spectator in different stadiums (Total= 58.9%)

Group 2: Demographic Characteristics of Football Fans

Table 1 presents that the football fans were predominantly male (Total= 57.3) and had an average age of thirty-one years (M_{age}= 31.28). Many of them were married (Total= 58.4), they had a high level of income (Total= 60.1), they were educated at the university level (Total= 65.7), they do refer to watch these matches in the stadium to support only one team (Total= 70.8) and they would prefer to be a spectator in different stadiums (Total= 72.5%).

Table 1
Demographic Characteristics of The Participants (n= 324)

Demographic Characteristics	[a]**Group 1** (n = 146)	[b]**Group 2** (n = 178)
	%	%
Gender		
Female	16.4	42.7
Male	83.6	57.3
Age M.	29.91	31.28
Age SD.	7.91	7.80
Education		
Primary school	9.6	10.7
High school	19.9	23.6
University graduate	70.5	65.7
Marital Status		
Single	80.8	41.6
Married	19.2	58.6
Do you prefer to watch these matches in the stadium just to support a team?		
No	76.7	29.2
Yes	23.3	70.8
Would you prefer to be a spectator at different stadiums?		
No	41.1	72.5
Yes	58.9	27.5

Notes. M.= Mean, SD.= Standard deviation, [a]= Group 1: Football spectators, [b]= Group 2: Football fans

Procedure

Firstly, we obtained the approval of the research ethics committee with protocol number 2023-SBB-0717 from the Bartın University Social and Human Sciences Ethics Committee after permission to use the scale from Balaji and Chakraborti (2015), who developed it. Afterwards, a researcher personally visited four different stadiums (I) with the criteria recommended by FIFA and specified in international matches, (II) with a capacity of

over 50.000 spectators to reach the participants watching football matches on different dates to carry out all related processes. One researcher personally visited the stadiums during this process to carry out all relevant processes (e.g., providing information regarding the aim of the study, informing the data obtained, storage security, and all other procedures during the survey process). We started collecting the data between October 19, 2023, and November 23, 2023. The researcher explained to the participants that they could fill in the scale items on paper or online and offer a Google Form with a QR code for spectators who wanted to fill in the online scale form so that they could instantly the scale form. We collected data before the match. It took approximately 3 minutes for the participants to fill in the paper or online forms and approximately three weeks to complete all scales. We obtained 205 data through Google Forms with QR, and 166 data from scale forms on paper. 47 missing data were not included in the study and kept analyzing 324 data that were determined to be completed in full. Green (1991) suggested that the number of scale items in the study ($n \geq 50+8x$ items or $n \geq 104+$ items) should not be ignored, and a sample size that is larger because of these formulae should be preferred when determining the appropriate sample size in quantitative research. Accordingly, we predicted that several participants ($n>50+8x14$) = 162 and above would be sufficient for the study with a scale form of 14 items.

Data Collection Tools

The Stadium Atmosphere Scale (STAS) was developed by Balaji and Chakraborti (2015). The scale consisted of four subscales named (a) Physical Layout, (b) Facility Aesthetics, (c) Entertainment Experience, and (d) Social Interaction with 14 items and a 7-point Likert format. We constituted a demographic information form to determine the demographic characteristics (e.g., age, gender, education) of the participants in the study.

Language Co-Validation: Translate and Back Translate Procedure

The translation and retranslation procedure involve the process of translating texts or sentences from one language into another, involves the process of translating texts or sentences from one language into another, and then retranslating these translations back into the original language. We translated the STAS to ensure the language equivalence validity of the Turkish form from the original language (English) to the target language (Turkish). We performed this process by having the scale items translated into Turkish by a bilingual researcher and then having the relevant items translated back into the original language by another researcher who is both fluent in English and a native speaker of Turkish. Later, we asked a native-speaker researcher to compare the pre-translation and post-translation forms

and indicate the differences. The researcher reported that the two scale forms reflected the existing structure similarly after this comparison process. Table 2 presents the Turkish items of the STAS.

Table 2
English and Turkish Versions of the STAS

Factor and item in English		Factor and item In Turkish	
Physical Layout (PL)		**Fiziksel Düzen (FD)**	
PL$_1$	The general physical condition of the stadium is good	**FD$_1$**	Stadyumun genel fiziksel durumu iyi
PL$_2$	The layout of the stadium allows to get where one wants	**FD$_2$**	Stadyumun düzeni, gitmek istenilen bir yere ulaşmaya olanak sağlamakta
PL$_3$	The signs (gates, toilets, parking, seat) in the stadium are excellent	**FD$_3$**	Stadyumdaki işaretler (kapılar, tuvaletler, park yeri, koltuk) mükemmel
PL$_4$	The stadium's physical facilities are comfortable	**FD$_4$**	Stadyumun fiziksel olanakları konforlu
Facility Aesthetics (FA)		**Tesis Estetiği (TE)**	
FA$_1$	The overall design of the stadium is pleasing	**TE$_1$**	Stadyumun genel tasarımı memnun edici
FA$_2$	The stadium has an open and airy feeling	**TE$_2$**	Stadyumun ferah ve konforlu bir hissi var
FA$_3$	The stadium's decor is appealing	**TE$_3$**	Stadyumun dekoru ilgi çekici
FA$_4$	The exteriors of the stadium are visually appealing	**TE$_4$**	Stadyumun dış cephesi görsel açıdan oldukça etkileyici
Entertainment Experience (EE)		**Eğlence Deneyimi (ED)**	
EE$_1$	The game is much exhilarating to watch at the stadium	**ED$_1$**	Maçı, stadyumda izlemek çok heyecan verici
EE$_2$	Watching the game at the stadium provides an escape from my everyday activities	**ED$_2$**	Stadyumda maç izlemek, günlük aktivitelerimden bir kaçış sağlıyor
EE$_3$	Watching the game at the stadium is really entertaining	**ED$_3$**	Maçı stadyumda izlemek, gerçekten çok eğlenceli
Social Interaction (SI)		**Sosyal Etkiletişim (SE)**	
SI$_1$	I enjoy socializing with other spectators at the game	**SE$_1$**	Maçlarda diğer seyircilerle sosyalleşmekten keyif alıyorum
SI$_2$	It excites me seeing other spectators whistling, singing, chanting, and screaming in the stadium	**SE$_2$**	Stadyumdaki diğer seyircilerin ıslık çaldığını, şarkı söylediğini, tezahürat yaptığını ve çığlık attığını görmek beni heyecanlandırıyor
SI$_3$	I enjoy interacting with other spectators at the game	**SE$_3$**	Maç sırasında diğer seyircilerle etkileşim kurmaktan keyif alıyorum

Data Analysis

The validity and reliability test of the STAS were carried out in four stages. In the first stage, we tested univariate and multivariate data normality. In the second stage, we conducted Confirmatory Factor Analysis (CFA) to assess the conceptuality of the scale. In this stage, we tested the model with four different model configurations, namely single factor model, uncorrelated factors model, correlated factors model, and hierarchical model. Then, we kept analyzing the other analysis processes with the model with the best fit value. In the third stage, we used two types of construct validity such as convergent and discriminant to test the validity of the STAS. For convergent validity tests, we utilized respectively the strength of factor loading, significance of t-values and Average Variance Extracted (AVE). We fixed latent factor correlations to be equal to 1, calculated confidence intervals around latent variable correlation estimates, and AVEs whether they were greater than the squared correlation between latent constructs to test discriminant validity. We performed the internal consistency coefficient (Cronbach's alpha) and the construct reliability of the dimensions Composite Reliability (CR) to examine the reliability coefficient of the STAS. In the final stage, we tested both measurement invariance and construct invariance to ensure that the STAS used in the study are comparable and can be meaningfully compared across different groups or time points. At this stage, we used the chi-square difference test formulae of Satorra and Bentler (2010) to make comparisons between the models. Table 6 demonstrates all the details of the analysis carried out.

Here are the chi-square difference test formulae of Satorra and Bentler (2010):

"Compute the difference test scaling correction cd, where d0 is the degrees of freedom in the nested model, c0 is the scaling correction factor for the nested model, d1 is the degrees of freedom in the comparison model, and c1 is the scaling correction factor for the comparison model. Be sure to use the correction factor given in the output for the H0 model." (Mplus, 2023)

cd = (d0 * c0 - d1*c1)/(d0 - d1)

Compute the Satorra-Bentler scaled chi-square difference test TRd as follows:

TRd = (T0*c0 - T1*c1)/cd

"where T0 and T1 are the MLM, MLR, or WLSM chi-square values for the nested and comparison model, respectively. For MLM and MLR the products T0*c0 and T1*c1 are the same as the corresponding ML chi-square values." (Mplus, 2023)

To evaluate how well the model fits the data and its ability to explain the differences between the data, we used The Root Mean Square Error of Approximation (RMSEA), The

Normed Fit Index (NFI), The Comparative Fit Index (CFI), Standardized-Root Mean Square Residual (SRMR), Akaike Information Criterion (AIC) goodness of fit indices during the analysis process. Research indicated that these fit values must be between 0.06 and 0.08 for RMSEA (Byrne, 2009), less than 0.08 for SRMR (Hu & Bentler, 1999), and greater than 0.90 for CFI and TLI (Hu & Bentler, 1998). The AIC value is not a meaningful measure on its own but is used when comparing two or more models. The smaller AIC value indicates which model is a better option (Hu & Bentler, 1995). Byrne (2009) suggested that AIC is a measure that can be used to compare non-nested models with each other and reduces the complexity of the model (i.e., the use of excess parameters).

RESULTS

The Testing of Stadium Atmosphere Scale: Validity and Reliability Stages

Stage 1: Screening of the Data

Firstly, we tested the data based on the assumption that they fit univariate and multivariate normal distributions. We provided statistical tests of skewness and kurtosis, with visual screening of item histograms and stem-leaf diagrams through Mplus. According to the results of the analysis, we found that eleven items were positively skewed to a low degree except for three items (ee1, ee2, ee3). Tabachnick and Fidell (1996) suggested that the reflection of each variable should be taken and analyzed with the effect of some transformations such as square root and logarithmic transformation, to correct the medium and high-level skewness. Accordingly, the results of square root and logarithmic transformation revealed that there was no significant skewness in the research data (Z-Scores, $p < 0.05$). We found that the kurtosis and skewness values of all variables were ±2.00, which indicated a univariate normal distribution (George & Mallery, 2019; Tabachnick & Fidell, 2012). However, we calculated Mardia (1970) skewness and kurtosis values to determine whether the data violated the assumption of multivariate normality. We noticed that the results violated the assumption of multivariate normality since the P value of Mardia skewness ($p=0.00>0.05$) and Mardia kurtosis ($p=0.00>0.05$) values were less than 0.05. In such cases, researchers generally prefer Robust Maximum Likelihood (MLR), which is a nonparametric estimation method (Şen, 2020).

Stage 2: Comparison of the Models

In the second stage, we used CFA to test the conceptuality of the atmosphere in the stadium. Noar (2003) implied that CFA can also provide some details such as (I) enabling researchers to go beyond exploratory analytical techniques by confirming that the

psychometric properties of a scale are satisfactory, (II) making it possible to compare several competing models reflecting conceptualizations that are variations of each other rather than testing the fit of a single model, (III) getting additional information about the dimensionality of a scale by testing several models against each other, and (IV) ensuring more details about how items-structures in a scale are related to each other to researchers. Thus, we tested four different model configurations, namely single factor model, uncorrelated factors model, correlated factors model and hierarchical model in the study (Table 3).

The single-factor model tests whether the STAS can be measured with a single general factor instead of four separate factors. The literature does not provide any results indicating that the STAS is directly measured as a single factor.

The uncorrelated factors model tests the inference that each of the four dimensions of the STAS is independent. If this model is supported, it will mean that each dimension of the stadium atmosphere is independent and uncorrelated.

The correlated factors model tests the claim that the four dimensions of the STAS are interrelated. If this model is supported, it will show that it is not only concerned with the physical space of the facility, but also with the emotional and sensory elements that make it special.

The hierarchical model tests the idea that a second-order factor explains the relationships between the four stadium atmosphere dimensions. This model recognizes that the STAS dimensions are related to each other, but also concludes that the dimensions are related to a factor at a higher level, as does the correlated factors model. Therefore, this model can be considered as an extension of the correlated factors model. Noar (2003) interpreted such accepted models as an indication that the sum of the whole scale represents an appropriate and meaningful score.

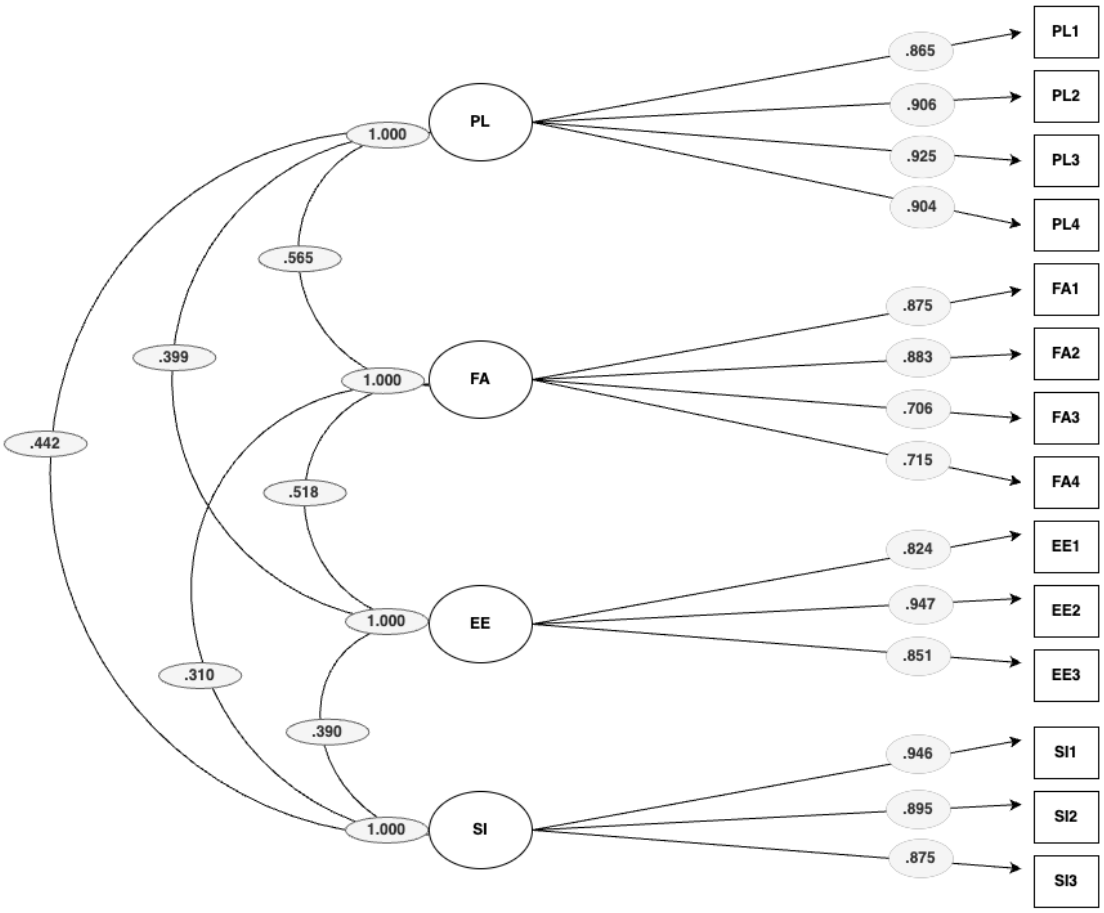
We figured out some results about the fact that the correlated factors model and the hierarchical model give better-fit results than these models in the CFA of the STAS when reviewing the literature (Balaji & Chakraborti, 2015). Similarly, we hypothesized that the correlated factors model would best fit the data collected from the Turkish population in this study.

Table 3
Comparisons of the Models

Model	X^2	df	RMSEA	SRMR	TLI	CFI	AIC
The single-factor model	1926.43	77	0.27	0.16	0.41	0.50	10413.77
The uncorrelated factors model	415,41	77	0.11	0.18	0.86	0.88	2988.75
[a]The correlated factors model	205.50	71	0.07	0.03	0.95	0.96	8704.83
[b]The hierarchical model	222.76	73	0.08	0.05	0.95	0.96	8718.10

Note. [a]= The model with the best fit value, [b]= The model with acceptable fit value

Figure 1
The Correlated Factors Model

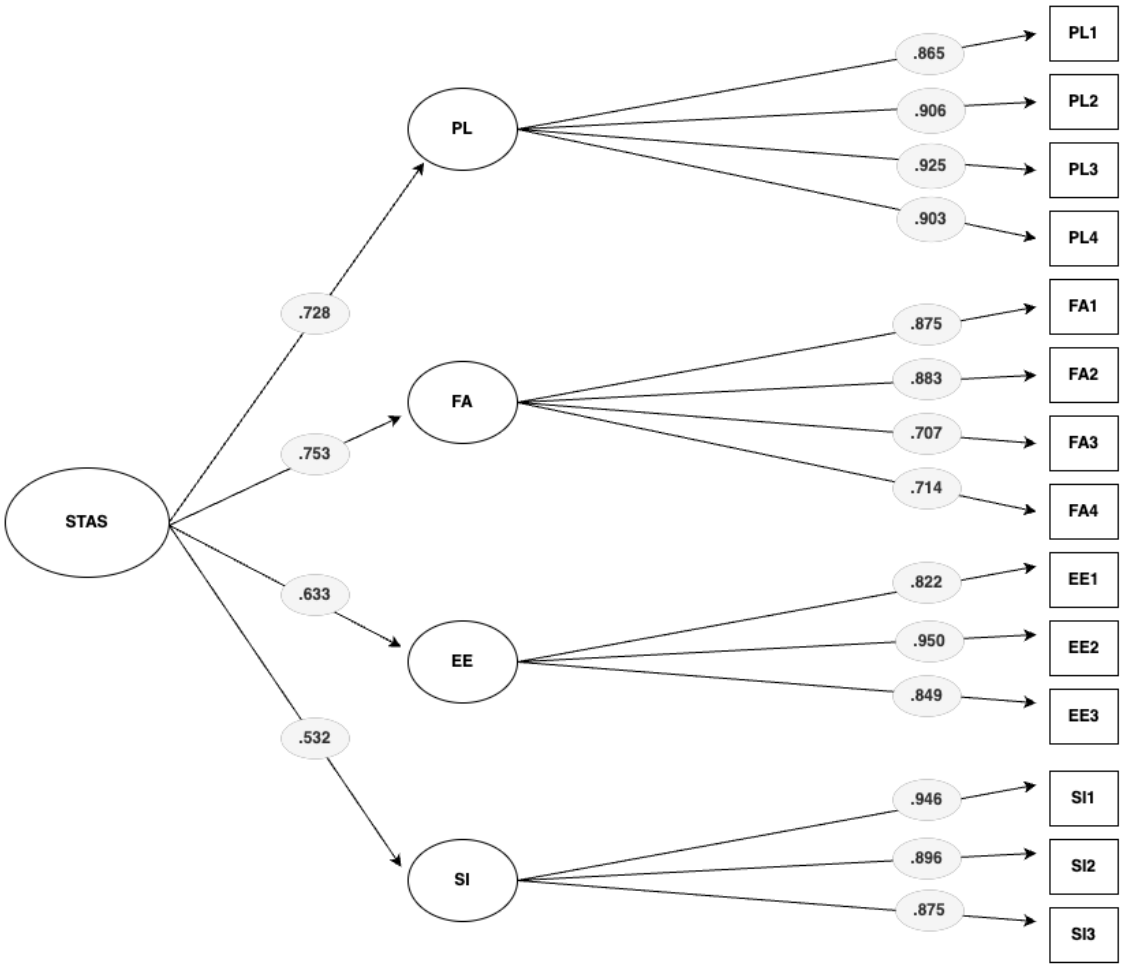


Note. PL= Physical layout, FA= Facility aesthetics, EE= Entertainment experience, SI= Social interaction

The goodness of fit indices revealed that the correlated factors model best fit the data (Table 3). The correlated factors model had the best-fit indices and a significant chi-square difference ($\Delta\chi 2 = 17.26$, $\Delta df = 2$, $p < 0.001$), while the goodness of fit indices for the hierarchical model remained within acceptable ranges. We would expect the dimensions of the STAS to be similarly related to other variables if the STAS were truly a unidimensional measure. Some

authors (e.g., Danes & Mann, 1984; Hunter & Gerbing, 1982) clarified this situation as external consistency or parallelism, which also provides evidence that the scale is unidimensional. According to Rubio et al. (2001), the criterion should be evaluated multidimensionally if this cannot be achieved.

Figure 2
The Hierarchical Model



Note. STAS= Stadium atmosphere scale, PL= Physical layout, FA= Facility aesthetics, EE= Entertainment experience, SI= Social interaction

Stage 3: The Testing of Validity and Reliability

At this stage, we carried out the validity and reliability tests of the STAS through the correlated factors model, and used two types of construct validity, convergent and discriminant. Byrne (2009) explained convergent validity as the extent to which independent measures agree in assessing the same construct, while discriminant validity is interpreted as the extent to which independent measures differ in assessing these constructs. We used the strength of factor loading, significance of t-values, and AVE for convergent validity tests in the study (Table 4).

Some researchers have accepted standardized factor loading as more (>0.70) since low factor loading means that the latent factor captures less than 50% of the variation in the indicator. This means that the variance due to error will be larger than the variance captured by the latent construct (Fornell & Larcker, 1981). We tested the significance level of the t-value of each item in the study after standardized factor loading power. Anderson and Gerbing (1988) stated that convergent validity could also be assessed by determining whether the estimated model coefficient of each indicator on the hypothesized basic structure factor is significant (i.e., the significance of t-values). Eventually, we concluded that all item loading of the STAS was statistically significant (t-values ≥ ± 1.96), and the null hypothesis that the factor loading was equal to zero was rejected in the results (Table 4). These results provided evidence in favor of convergent validity. Additionally, we calculated AVE values within the study. Fornell and Larcker (1981) accepted AVE as an important statistical criterion used to evaluate the internal consistency and validity of a measurement tool, to evaluate the fit of the model to the data in structural equation modelling analyses and to ensure the reliability of measurement tools. The AVE value below 0.50 could create doubt on the validity of the construct measured. Table 5 presented that all AVEs are above Fornell and Larcker's limit value.

Table 4
The Results of Confirmatory Factor Analysis

Variables	λ	*t*-value	SE	R^2	M	SD
Physical Layout (PL)					4.59	1.02
PL_1	0.86	50.74	0.017	0.73	4.63	1.10
PL_2	0.90	67.23	0.013	0.81	4.51	1.04
PL_3	0.92	80.68	0.011	0.84	4.63	1.12
PL_4	0.90	67.91	0.013	0.81	4.61	1.13
Facility Aesthetics (FA)					4.59	1.02
FA_1	0.87	47.71	0.018	0.75	4.43	0.94
FA_2	0.88	49.63	0.018	0.77	4.35	0.90
FA_3	0.70	22.45	0.031	0.49	4.26	0.78
FA_4	0.71	23.27	0.031	0.50	4.48	0.80
Entertainment Experience (EE)					4.39	0.72
EE_1	0.82	39.74	0.021	0.67	4.47	0.76
EE_2	0.94	69.83	0.014	0.88	4.32	0.76
EE_3	0.85	44.67	0.019	0.72	4.37	0.85
Social Interaction (SI)					4.31	0.93
SI_1	0.94	86.32	0.011	0.88	4.34	0.91
SI_2	0.89	63.76	0.014	0.79	4.34	1.02
SI_3	0.87	55.33	0.016	0.75	4.26	1.03

We utilized some discriminant validity tests to evaluate the structure of the STAS after the convergent validity tests. In the first stage of the validity test, we individually fixed the correlations between the latent constructs so that each could equal 1. Then, we used the chi-squared difference test to provide an indication of whether this restriction influenced the model fit and to determine discriminant validity. All the differences between the fixed and free solutions were statistically significant, indicating that discriminant validity was satisfied, as shown by the results in Table 5 (Bagozzi & Phillips, 1982). Furthermore, we provide further evidence of discriminant validity since all confidence intervals did not include a value of 1.0 as reported in Table 5. Indeed, it has been suggested that the confidence interval (± two standard errors) around the correlation estimate between two factors is 1.0. could be determined by a complementary assessment of discriminant validity, according to Anderson and Gerbing (1988). We used AVE values in the final analysis for convergent validity. Fornell and Larcker (1981) stated that the AVE calculated for each latent construct should be greater than the squared correlations between each construct. All squared correlations were below each of the structure AVEs in Table 5.

Table 5
The Reliability of The Constructs and Factor Correlations of The STAS

Variables	1	2	3	4	α	CR	AVE
1. Physical Layout (PL)	-	0.50 (403.59) [0.30-0.59]	0.39 (211.14) [0.13-0.34]	0.42 (318.44) [0.22-0.50]	0.94	0.94	0.80
2. Facility Aesthetics (FA)		-	0.47 (520.00) [0.17-0.36]	0.28 (176.87) [0.10-0.34]	0.87	0.87	0.63
3. Entertainment Experience (EE)			-	0.39 (365.26) [0.11-0.30]	0.90	0.90	0.75
4. Social Interaction (SI)				-	0.92	0.92	0.81

Note. Chi-square values in brackets (p<0.001), confidence intervals reported in square brackets

We assessed the reliability of the STAS, analyzing the internal consistency coefficient (Cronbach's alpha) and the CR of its dimensions. Table 5 presents that all Cronbach's alpha values were above 0.70. Various studies have reported reliability coefficients equal to or higher than 0.70 as acceptable (Nunnally, 1978). Besides, we calculated the CR value, which is frequently used to evaluate the reliability of measurement instruments containing multiple variables, to evaluate the reliability of measurement instruments containing multiple variables

in the study (Fornell & Larcker, 1981; Li et al., 1996). According to Bagozzi and Yi (1988), the CR value should be a minimum value of <0.60. After all, we could interpret that the STAS could be used as a valid and reliable measurement tool in the evaluation of the atmosphere created during sports activity by researchers.

Stage 4: The Testing of Measurement Invariance and Structural Invariance

At this stage, we tested measurement invariance and construct to ensure that the STAS used in the study are comparable and can be meaningfully compared across different groups or time points. Gardner and Qualter (2011) referred to measurement invariance as the ability of a measurement to produce repeatable and stable results under different conditions. Measurement invariance is extremely important for the reliability and validity of measurement. The results are expected to be similar when the invariance of measurement is ensured when the same object or event is measured at different times or by different observers. Şen (2020) stated that structural invariance is used to evaluate whether a measurement tool or structural model maintains the same basic structure between different groups or time intervals. Table 6 demonstrates the fit values of the models in measurement and structural invariance analyses.

According to the invariance analyses, we figured out that all the models tested respectively have good fit values, and the chi-square difference test results, which were used for comparison between models at different levels at the measurement invariance stage, are also significant (p>0.05), and measurement invariance is ensured (Table 6). Table 6 presents that equal factor variances have fit values with $X^2(15) = 345.66$, p<0.0001; RMSEA= 0.07, CFI= 0.95; TLI= 0.94; SRMR= 0.12, equal factor means has fit values with $X^2(11) = 286.43$, p<0.0001; RMSEA= 0.06, CFI= 0.96; TLI= 0.95; SRMR= 0.06. We determined with the chi-square difference test that the fit of the equality restriction in the factor variance invariance model was significantly worse than in the scalar model. However, the factor variance invariance model has an adequate fit. We calculated the chi-square value of the difference test= 52.71, degrees of freedom= 15 and the p-value obtained was 0.00 when we compared the two models. Similarly, we determined that the equality restriction in the factor mean invariance model significantly worsens the fit compared to the factor variance model with the chi-square difference test (p<0.05) and detected the chi-square value of the difference as 43.74, the degree of freedom as 11, the p-value as 0.00 in this model comparison. The chi-square difference test was significant (p<0.05), which indicates that the more restricted factor variance invariance model significantly worsened the fit.

Table 6
Fit Values of The Models in The Invariance Analyses

Analysis	X^2	df	ΔX^2	Δsd	*p*	RMSEA	SRMR	TLI	CFI	AIC
Single group solution										
[a]Group 1 (n= 146)	138.45***	71				0.08	0.04	0.93	0.94	4143.83
[b]Group 2 (n= 178)	119.96***	71				0.06	0.03	0.96	0.97	4530.73
Measurement invariance										
Equal form (Configural)	257.66***	142				0.07	0.04	0.95	0.96	8674.56
Equal factor loading (Metric)	264.63***	152	8.63	10	0.56	0.06	0.05	0.95	0.96	8665.34
Equal indicator intercept (Scalar)	280.84***	162	16.11	10	0.09	0.06	0.05	0.95	0.96	8661.14
Equal indicator residual variance (Strict)	344.00***	176				0.07	0.06	0.95	0.95	8680.39
Structural invariance										
Equal factor variances	345.66***	177	64,82	15	0.00	0.07	0.12	0.94	0.95	8716.02
Equal factor means	286.43***	166	59.23	11	0.00	0.06	0.06	0.95	0.96	8659.28

Note. ***p<0.0001, a= Group 1: Football spectators, b= Group 2: Football fans, Δ= Difference

Kline (2016) predicted that the chi-square test is more likely to be significant in large samples, which could cause the chi-square difference test to produce incorrect results in measurement and structural invariance. In such cases, Cheung and Rensvold (2002) stated that CFI values are relatively unaffected by model characteristics such as the number of indicators per factor and suggested that changes of 0.010 or less in the CFI value could be evidence for the rejection of the more restricted invariance to obtain accurate results in some cases, there are no precise criteria for how much the difference between these indices should be. Similarly, some researchers (e.g., Cheung & Resnvold, 2002; Chen, 2007; Meade et al., 2008) suggested that the difference between the fit indices should be considered instead of the chi-square test when large sample groups are analyzed. Table 6 exhibits that the difference between CFI and RMSEA values, which are the fit indices of "Scale Model X Factor Variance" and "Factor Variance X Factor Mean" model comparisons, is 0.010. We could be interpreted as providing evidence that structure invariance is achieved.

DISCUSSION

The atmosphere's components in the stadium impact a significant part of the service provided to consumers in spectator sport event organizations (Yoshida & James, 2011). Once the atmosphere in the stadium is clearly understood, it will be very useful for researchers to study the relevant experiences of consumers who prefer this type of service. Therefore, the

study aimed to test the Turkish adaptation of the stadium atmosphere scale (STAS) developed by Balaji and Chakraborti (2015) and to reveal its psychometric properties.

The STAS includes some factors that are common with other studies on measuring stadium atmosphere. For example, Chen et al. (2013) performed a study on sports stadium atmosphere at spectator sporting events, in which the research examined entertainment and facility dimensions, which are common factors in assessing stadium atmosphere. Uhrich and Benkenstein (2010) conducted a study with stimuli emanating from the spectators and their behavior and game progress stimuli on the Multiple Indicators Multiple Causes (MIMIC) of stadium atmosphere. These reflect the dimensions of social interaction and entertainment experience in our study. These stimuli are related to the spectators' support behavior for their team. In our study, the social interaction factor includes the sharing of emotions and experiences with each other in addition to the supportive behavior of the spectators for their team. Baker et al. (1994) examined the atmosphere in the context of the store with the dimensions of ambient, design and social, which design dimension in this study includes visual elements such as the architecture and aesthetics of the store and functional elements such as layout and comfort. Therefore, we could imply that the STAS measures constructs similar to the dimensions of facility aesthetics and physical layout. Additionally, Baker et al. (1994) focused on the number of other customers and staff as social factors in the store environment and the clothing style of salespeople. According to Nash (2000), some rituals, such as cheering, whistling, choreographing, etc., create emotional bonds in sporting event spectators. Thus, the STAS focuses on audience interactions with each other, unlike social factors in the store environment.

The researchers have addressed the physical layout factor in their previous studies examining the atmosphere in the stadium in different contexts (Rosenbaum & Massiah, 2011; Yüce et al., 2020; Wakefield et al., 1996). This factor in the STAS relates to the fan's assessment of the functional aspect of the stadium, signage, easy accessibility, and attractiveness of the environment. Therefore, the literature on atmosphere supports the four-factor model of the STAS. These factors are the physical layout of the stadium, which provides ease of access and comfort for spectators; the aesthetics of the facility, which assesses its design and decor of the entertainment experience, which stimulates spectators' experiences and the social interaction, which involves spectators' communication with each other, respectively. Overall, we presented a short form (14 items) to measure the stadium atmosphere in this study. Groups of spectators could complete the STAS in 5 minutes and has good psychometric properties. We suggested that researchers could utilize the scale after testing the scale on different spectator

groups in different sporting facility to assess their ambient atmosphere although we adapted the STAS for just football spectators and fans.

Limitations

There are some limitations in the study. Firstly, the validity and reliability of the STAS have been tested based on the responses obtained from spectators with different purposes (recreational or fanatic purposes) in a single sport (football) in a single country (Turkey). This situation reveals its limitation in terms of sample. For this reason, the STAS could also be analyzed in the context of other sports competitions (e.g., basketball, volleyball, handball) that can be held in facilities with different atmospheric characteristics, both in different countries and with spectators with different participant characteristics. Testing the stadium atmosphere scale in intergroup, intercultural, and international studies is very important. This would also ensure the generalizability of the STAS. The other limitations are the assessment of the STAS with just four dimensions (physical layout, facility aesthetics, entertainment experience, social interaction) and testing its psychometric properties. This situation reveals the STAS's limitations in size and test. It is important to consider the atmosphere in the stadium in different dimensions and to explain the relationship between the stadium atmosphere scale and the spectator outcomes. For this reason, it is recommended to carry out studies that include the audience's demographic characteristics and conduct different test methods. Finally, we have considered that several variables influence spectators' decision to attend a live sporting event in a stadium and have suggested that researchers should examine the effect of the STAS on other consumer behavioral outcomes such as spectators' loyalty, motivation, and interest/involvement in future studies.

CONCLUSION

In conclusion, we determined that the STAS maintained a high internal consistency in various groups, preserved its 14-item 4-factor structure in its Turkish form, and could be used as a valid and reliable measurement tool in the Turkish population. The STAS differs from other related scales such as leisure involvement and spectator motivation, due to its components and the psychometric properties it assesses. The STAS with four-dimension combinations is crucial in predicting how spectators evaluate the stadium atmosphere. We also made significant theoretical and managerial implications in the Turkish adaptation of the STAS tested through a rigorous scale validity and reliability process approach.

PRACTICAL IMPLICATIONS

Most atmospheric studies have focused on store atmospheres, with few studies evaluating atmospheres in the context of spectator sporting events. In current studies, stadium atmosphere has been addressed with the dimensions of parking, aesthetics, scoreboards, seat comfort, accessibility, space allocation, signage and desire to stay (Wakefield et al., 1996), organizer, spectators, and their behavior, game action and stadium architecture (Uhrich & Benkenstein, 2010), entertainment, electronic equipment, facility, team traditions, team performance, spectator passion, professional staff, spectator behavior, team competition. In this study, we contributed to the literature by addressing the social interaction of the spectators with each other, unlike the existing measurement tools (Chen et al., 2013; Çevik, 2020; Wakefield et al., 1996).

Compared to previous studies, we have provided a more concise and comprehensive overview of the factors that spectators use to evaluate the atmosphere in a stadium. Additionally, we examined the reliability and construct validity of this adapted measurement tool with measurement invariance and structural invariance, unlike the measurement tools used to assess stadium atmosphere in Turkey. This is crucial to reveal the generalizability and comparability of the psychometric properties of the STAS across groups (spectators versus fans). Indeed, we believe our current research could expand the existing stadium atmosphere measurement tools in Turkey as different fan groups evaluate the stadium atmosphere.

Service quality has been accepted as another construct that evaluates the stadium environment in the sports marketing literature. Researchers have evaluated service quality with the dimensions of parking, food and beverages, cleanliness, fan control, crowd and spent time (Hill & Green, 2000), employees, price, facility access, concessions, fan comfort, game experience, showtime, convenience, and smoking (Kelley & Turley, 2001). However, service quality in sports environments and stadium atmosphere could be accepted as similar. However, service quality focuses on access, aesthetics, layout, and interaction with staff. In contrast, stadium atmosphere involves the social interactions of spectators in the consumption of a sporting event. We believe that the difference between these two structures demonstrates the value of the STAS adapted.

Compared to previous studies (Gençer, 2005; Soygüden, 2021), the study's results were expected to contribute to the understanding of the factors used by the spectators and fans to assess the atmosphere. We also believe that methodologically, these research results have extended existing cross-cultural stadium atmosphere measurement research. Strong empirical

evidence was also provided to test and validate the four-factor model of the STAS with data from different samples using robust psychometric procedures. In particular, the results of the study have revealed both the stability and generalizability of the factor structure by replicating and validating it in different samples and studies. In addition, it has extended our knowledge of what constitutes the atmosphere in a stadium through some of the dimensions of stadium atmosphere identified in this study, as they have been overlooked in previous studies. In addition to such theoretical inferences, we assume that managerial inferences can be made with this study. For example, the fact that the STAS addresses the consumption of a live sporting event for both spectators and fans is very important for the sports marketing and recreation literature as well as for the relevant sector managers.

For example, the stadium architecture, the stadium layout, the match features, and the attitudinal and behavioral patterns of the spectators and fans during the match could all play a role in improving attendance and spectators and fans' satisfaction. Positive results could be achieved if stadium managers focus on these. Furthermore, organizers of sports events would be able to determine how consumers value and consume sporting events by being able to measure the atmosphere in the stadium. As the spectator experience is rooted in the stadium, where the sport is simultaneously "produced, consumed and delivered to the sports spectator," this could have a profound impact (Westerbeek & Shilbury, 1999). Consequently, research into spectators and fans' behavior could help us to better understand why people care about the sports and what factors encourage them to attend sporting events in the stadiums. This will allow sports marketers to identify different audience segments better and allocate resources to create a sport offering which is relevant to them. Finally, researchers and practitioners would gain further insight into cultural and geographical differences in the spectator experience by measuring the stadium atmosphere. The stadium atmosphere could guide sports managers and sports marketers to effectively modify both management and marketing strategies for export, as cultural meanings and individual dispositions influence each other.

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Authors' contribution

All authors have been involved in revising the manuscript and interpreting the results. The final version of the manuscript was read and approved by all authors.

Declaration of conflict interest

The authors have not reported any potential conflicts of interest.

Ethics Statement

We obtained the approval of the research ethics committee with protocol number 2023-SBB-0717 from the Bartın University Social and Human Sciences Ethics Committee.

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Pamukkale J Sport Sci, 15(1), 59-72, 2024 Research Article

Enhancing Athletes' Foot Stability: A Comparative Analysis of Gluteus Maximus and Gluteus Medius Muscle Strengthening Effects on Navicular Drop, Balance, and Foot Posture Index in Over-Pronated Foot

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ABSTRACT

This study aimed to determine the effectiveness of gluteus maximus versus gluteus medius muscle strengthening exercises on the navicular drop (ND), balance, and foot posture index (FPI 6) among athletes with over-pronated feet. A pre-post experimental study design with a total of 54 athletes with bilateral over-pronated feet were randomly assigned into group A (n=18), group B (n=18), and group C (n=18). Medial longitudinal arch height (MLA) was assessed with the Navicular Drop Test, the static and dynamic balance was determined with the stork stance test (SST) and modified Star Excursion Balance Test, and Foot Posture was assessed with Foot Posture Index 6. Multivariate Repeated measures ANOVA was used to analyze the effects of gluteus maximus versus gluteus medius muscle strengthening and short foot exercises. At four weeks, the gluteus medius along with short foot exercises (group B) showed significantly less ND and FPI 6 while showing more excellent SST and modified SEBT than the gluteus maximus muscle strengthening along with short foot exercises (group A) and control group (group C). These results suggest that adding gluteus medius muscle strengthening exercises to short foot exercises (SFE) was more effective in supporting the medial longitudinal arch and improving balance than performing SFE alone.

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INTRODUCTION

Overuse injuries arise when tissue is damaged by recurrent stress on bone and musculotendinous tissues at a rate that exceeds the body's ability to recover them. Athletes are more susceptible to overuse injuries due to a confluence of intrinsic or anatomical factors such as ligamentous laxity, flexibility deficits, and bone alignment of the limbs, as well as extrinsic ones, including environmental and training faults (Krivickas et al., 1997). Two of the many risk factors for injury in athletics are balance and foot position, which have been the subject of much research (Nicholas & Marino, 1987). Ankle injuries are the most common type of injury in different sports, leading to significant loss of playing time (Robbins & Waked, 1998). Ankle sprains account for 10% to 45% of running and jumping injuries, and there are roughly 27,000 ankle sprains per day in the US, or one for every 10,000 persons (Hintermann & Nigg, 1998).

Running is one of the most common activities that lead to lower extremity overuse injuries (Ferber et al., 2009). According to many epidemiological studies, about 27% and 70% of recreational and competitive distance runners suffer from an overuse injury at some point each year (Ferber et al., 2009). Anatomical or biomechanical anomalies, lack of flexibility, lack of strength, muscular imbalance, shoe type and/or the use of orthotics, and the kind of running terrain are the most frequent causes of foot and ankle injuries from running (Hintermann & Nigg, 1998). Lower extremity stress fractures have frequently been linked to improper lower extremity posture and/or over-pronation (Nur Saibah, 2020).

Over-pronation is a dysfunctional movement when the foot must turn excessively in from its neutral line. The medial portion of the foot may, therefore, wind up supporting most of the body's weight. In this instance, the body is supported during toe-off by the big toe and the second toe of the foot rather than the ball of the foot. When the range of motion exceeds 15° angle when walking (heel strike and push-off) and exceeds 5° angle when standing, it is frequently characterized as over-pronation (Kernozek & Richard, 1990). According to biomechanical research, changed lower limb alignment can result in dramatic changes in foot posture and function (Riskowski et al., 2013). If not appropriately treated, overpronation and over-supination can lead to future injury and chronic function instability of the foot, such as ankle and subtalar joint instability. Furthermore, Mitchell et al. (2008) believe that an unstable subtalar joint has a slower reaction time to generate an ankle sprain mechanism than a stable joint (Mitchell et al., 2008).

However, foot alignment may additionally be affected by the strength and function of the proximal muscles of the lower extremity (Chuter & Janse de Jonge, 2012). With hip

abductor and external rotator muscle strengthening for six weeks, a study on asymptomatic individuals with flatfoot showed a decrease in hindfoot eversion range of motion (Snyder et al., 2009). According to Seshan et al. (2021), excessive internal hip rotation results from the weakening of the hip stabilizers (hip extensors, abductors, and external rotators), which leads to foot pronation. Reactivating the gluteal muscles will restore correct muscular recruitment patterns, enhancing strength and performance (Seshan et al., 2021).

Over-pronated feet are common among runners and can lead to alteration in lower limb biomechanical alignment, predisposing the individual to injuries and decreasing athletic performance. Strengthening of gluteus maximus and gluteus medius has been found to treat over-pronated feet among healthy adults (Engkananuwat & Kanlayanaphotporn, 2023; Goo et al, 2016). A study of strengthening of the gluteus maximus and gluteus medius to correct over-pronated feet among runners will help the physiotherapist as a guidance stone for using either muscle strengthening.

There are studies on excessive pronation among athletes in the literature. However, there is limited literature on the efficacy of gluteus maximus and gluteus medius strengthening to correct over-pronated feet among athletes. A comparative study of the efficacy of gluteus maximus and gluteus medius strengthening to correct over-pronated feet among athletes will help determine which treatment is superior to the other.

This research and study are intended to:

To find out the efficacy of gluteus maximus muscle strengthening on Navicular drop, Balance. Foot posture index among athletes with over-pronated feet. To find out the efficacy of gluteus medius muscle strengthening on Navicular drop, Balance. Foot posture index among athletes with over-pronated feet.

METHODS

Participants

This pilot study was conducted at Tau Devi Lal Stadium, Gurugram, Haryana-122001. Fifty-four athletes included in this study were individuals identified with bilateral over-pronated feet. The study adhered to the principles outlined in the Declaration of Helsinki. Participation in the study was voluntary, and participants received written and oral explanations regarding their participation and the importance of providing accurate information. Before allocating the exercises, the muscle strength was tested by means of manual muscle testing. Then the participants were randomly allocated to Gluteus Maximus Muscle strengthening along with short foot exercises (Group A = 18), Gluteus Medius Muscle

Strengthening along with short foot exercises (Group B =18) and Control group (Group C = 18), here by the term "Short foot exercises" mean a particular exercise to strengthen the foot intrinsic muscles. The chit method was used for random allocation. It was a single-blinded study, as the participants were unaware of the intervention, while the accessor was aware of the treatment being given to the subject. The selection criteria of the participants were both genders, between 18 to 30 years of age, with asymptomatic bilateral over-pronated feet with a navicular drop more significant than 10mm (Goo et al., 2016) and a positive foot posture index (Mulchandani et al., 2017) The following conditions were considered grounds for exclusion from the study: discomfort, any structural deformities of the spine or lower extremities, neuromuscular diseases, visual, speech, or hearing impairments, or those having a prior history of foot/ankle fractures or surgery (Goo et al., 2016). The anthropometric data of athletes are mentioned in (Table 1). All parameters reported large effect size (partial eta squared) as mentioned in (Table 3).

Table 1
Anthropometric Data of Athletes (Runners)

Parameters	Experimental Group A (N=18)		Experimental Group B (N=18)		Control Group C (N=18)	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
AGE (in years)	20.56	1.88	21.06	2.36	20.78	1.98
Height (in centimeters)	169.1	10.1	171.4	10.4	169.0	9.35
Weight (in kilograms)	63.11	9.88	61.67	14.4	59.5	12
BMI (kg cm-2)	22.08	2.54	20.7	2.88	20.68	2.74
LLD R (cm)	89.01	8.06	88.08	10.8	89.57	9.56
LLD L (cm)	88.71	8.55	88.3	11.3	89.94	9.73

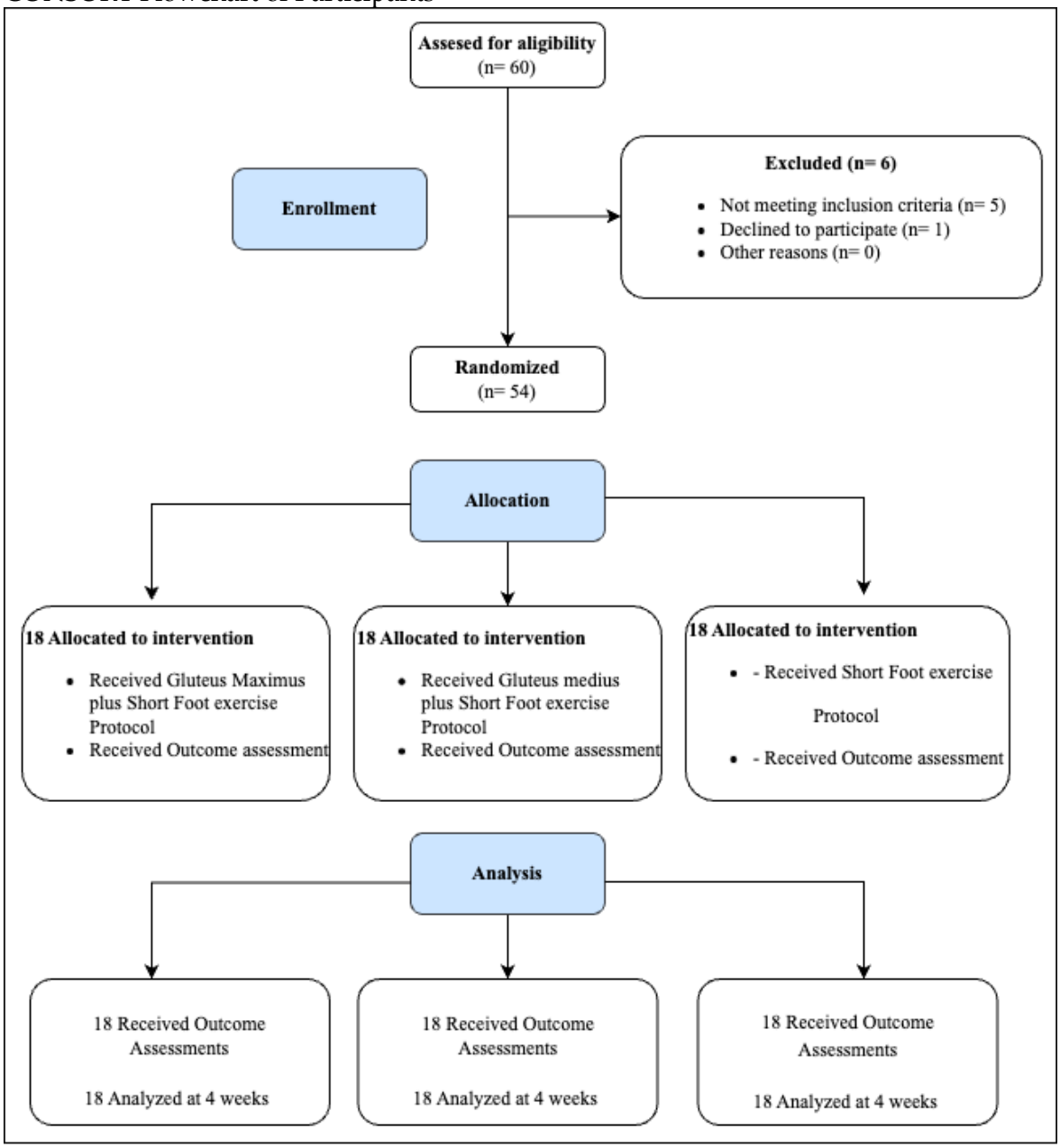
Note. Group A - Gluteus Max Strengthening + Short Foot Exercises; Group B - Gluteus Med. Strengthening+ Short Foot Exercises; Group C - Short Foot Exercises; SD – Standard Deviation.

The study was performed according to (Figure 1) displays a CONSORT diagram showing the flow of participants through each stage of the study.

Procedures

Inclusion and exclusion criteria were used to choose subjects. The individuals were split into three groups using simple random selection and random allocation.

Figure 1
CONSORT Flowchart of Participants



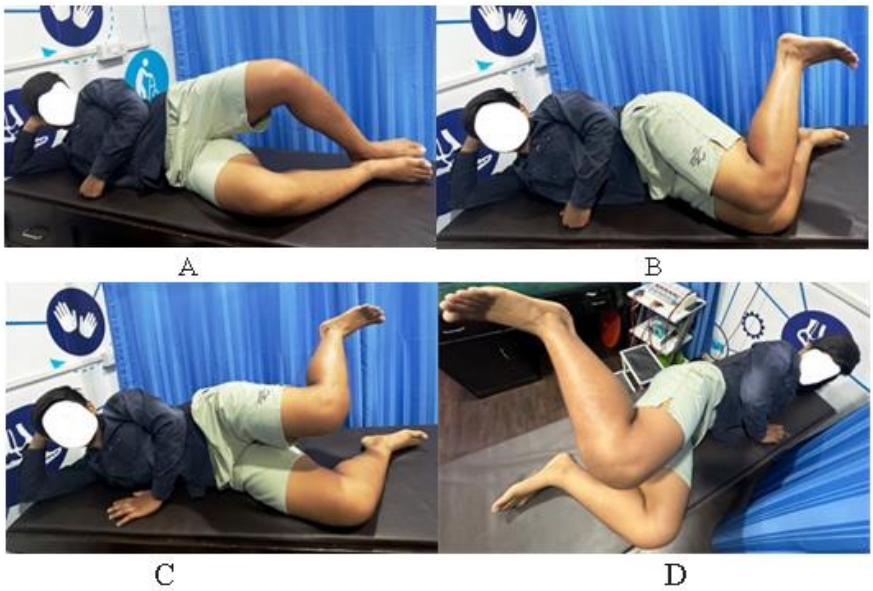
All outcome variables were evaluated at the beginning of the study in the following order for each subject: Navicular Drop Test, Static Balance, Dynamic Balance, and Foot Posture Index. The participants were given a rest time of one minute each between the given tests. A training session was held to ensure that the participants understood the progressions and how to appropriately do the exercises to do the exercises appropriately. The home exercises were given to the participants. Three times weekly observations were made to ensure that they were carried out precisely and with the correct form, where the patient performed the exercises while being on a video call, where the postural corrections were elaborated. Exercises were corrected from time to time, in which case the accessor was the same person who provided the

training to the participants. Visits to the academy were made three times a week to accomplish this. All participants had to come to the clinic twice: once at the beginning and once after four weeks to get the outcome measurements and review the activities.

Exercises to strengthen the gluteus maximus were performed in the experimental group (Group A) while lying on one is back with the leg flexed to 90 degrees. The patients were told to maintain their knee flexion at 90 degrees and hip abduction at 30 degrees. The person was told to move their hip away from the plinth, and measurements were taken using a goniometer. For four weeks, these exercises were performed six days a week for 20 repetitions (Goo et al., 2016).

The second experimental Group, Gluteus Medius Muscle Strengthening Exercises (Group B), included exercises to increase strength, and four progressions were applied. Progressions one through three were performed with the exercising leg on top, the hips flexed 45 degrees, the knees slightly flexed, and the feet together, and measurements were taken using a goniometer. The hip was held in a slightly extended position for Progression 4, as shown in (Figure 2). Every exercise in the sequence was done for ten repetitions with a 10-second break between each set. For four weeks, the workout was done six days a week (Engkananuwat & Kanlayanaphotporn, 2023).

Figure 2
Hip Abductor Exercise: Progressions A-*D*



The Control Group / Short Foot Exercises (Group C) consisted of subjects following an intrinsic muscle-strengthening protocol. The short foot exercise has been found to effectively strengthen the intrinsic foot muscles (Mulligan & Cook, 2013; Unver et al., 2019). The participants were instructed to draw the metatarsal heads back towards the heel and hold the

position for five sec without the toes curling. The SFE progressed over three phases, beginning in a seated position before advancing to a double-leg stance and single-leg stance (Engkananuwat & Kanlayanaphotporn, 2023).

Data Collection Tools

Navicular Drop Test

The medial longitudinal arch is assessed for capacity by utilizing the navicular drop test. The navicular tuberosity moves a certain distance when standing as the subtalar joint transitions from neutral to relaxed. Subjects sat with their feet flat on a hard surface; knees extended to 90 degrees, and ankle joints in a neutral posture for the Navicular drop test. Keeping the sub-talar joint in a neutral position, the most prominent position of the navicular tuberosity was identified and marked with a marker. The card should be vertically inserted into the navicular bone inside the back foot as it is viewed from the ground. Finally, the difference between the original navicular tuberosity heights and a measuring tape was used to quantify the magnitude of the navicular decline (Adhikari et al., 2014).

Static Balance

The static balance was tested using the stork stand balance technique. The stork test monitors an individual's progress in maintaining a condition of equilibrium (balance) in a static position. The Stork test required the person to lift one leg and lay their toes on the knee of the other leg while standing comfortably on both feet and with their hands on their hips. The patient was instructed to raise their heel whenever necessary by standing on their toes. The stopwatch started when the heel was lifted off the ground (Kranti Panta, 2015).

Dynamic Balance

Utilizing the Modified Star Excursion Test (mSEBT), Dynamic Balance was assessed. The participant's leg was measured before the test. In the supine position, measure the length of the limb from the anterior superior iliac spine to the medial malleolus. At the center of the testing grid, participants stand barefoot in a double-limb stance (i.e., with their feet together). Participants try to cover the most significant distance possible in each direction with the part of their reaching foot that is furthest away from them, make touch with the directional line, and then make their way back while remaining balanced on the support. The trial is complete when the individual resumes a double-limb stance following the reach. The acquired distance, commonly measured in centimeters, displays how the stance limb performs dynamically in terms of postural alignment (Picot et al., 2021). The normalized scores will be calculated for each direction according to the formula: *"Normalized score (%) = (reach distance cm/limb length*

cm) / 100". Composite Score Calculation: *"Composite score = (normalized ANT + normalized PM + normalized PL)/3."*

Foot Posture Index

The foot posture index (FPI) is the most accurate tool for categorizing patients into overpronation, over-supination, and normal groups. While the six variables listed below were measured, subjects were advised to stand still, barefoot, with their arms at their sides and their heads straight. Encourage the patient to move around the room while marching before settling into a relaxed standing position. (Nur Saibah, 2020) Figure 3 illustrates the criteria for calculating the foot posture index 6.

Figure 3
The Foot Posture Index 6 Criteria

Data Analysis

The gathered data was analysed using the IBM Statistical Package for Social Sciences 27 (SPSS) program. The data was found distributed uniformly, as shown by the Shapiro-Wilk test. One-way ANOVA was used to compare all variables between groups at baseline. Multivariate Repeated Measures ANOVA was used to compare all the variables pre and post intervention in the three groups. Post-hoc analysis was done for multiple comparisons (Tukey HSD) to make pairwise analysis. Partial eta square values for all outcome variables for significant time*group interaction effects were calculated.

RESULTS

All 54 participants completed the 4-week intervention. All outcomes at four weeks changed significantly from baseline ($p<0.001$; Table 2). Gluteus medius strengthening along with short foot exercises (Group B) increased significantly from baseline, and this increase was significantly more significant than groups A and C at four weeks ($p<0.001$). The pre and post Navicular drop, Stork Stance Test, modified Star Excursion Balance Test, and Foot Posture Index were therefore compared within and between the groups using a Multivariate Repeated Measures ANOVA, which showed significant differences between groups for all outcomes of the intervention. The multivariate analysis revealed significant time group interaction effects ($p = 0.000$). Partial eta squared values for interaction effects for each variable are mentioned in Table 4. and indicate large effect sizes for all the variables. A p-value of 0.05 was regarded as significant for each test.

Table 2
Comparison of Parameters Within and Between the Groups

OUTCOME VARIABLES		Experimental GROUP A	Experimental GROUP B	Control GROUP C		
		Mean ± SD	Mean ± SD	Mean ± SD	P	F
Navicular Drop (mm)	Pre ND-R	14.11±2.91	15.11±3.14	15.77±3.00	0.305	
	Post ND-R	9.88±2.26	7.33±2.65	13.11±2.65	0.000*	958.2
	Pre ND-L	14.94±2.83	15.55±3.38	16.38±3.48	0.383	
	Post ND-L	10.58±2.73	8.44±2.59	13.55±3.01	0.000*	1153.0
Stork Stance Test (sec)	Pre SST-R	5.59±2.34	5.61±2.59	5.22±1.80	0.879	
	Post SST R	9.94±2.48	12.39±2.52	7.28±1.70	0.000*	350.5
	Pre SST-L	5.41±2.45	6.06±2.77	4.06±2.36	0.067	
	Post SST L	9.53±2.74	12.83±2.70	6.67±2.44	0.000*	428.8
Modified SEBT	Pre mSEBT R	231.96±17.0	232.71±16.6	233.51±17.6	0.204	
	Post mSEBT R	258.53±23.1	262.53±11.2	244.5±16.0	0.000*	503.6
	Pre mSEBT L	233.01±17.7	231.28±18.0	228.96±18.0	0.241	
	Post mSEBT L	256.51±21.0	264.94±17.1	235.53±16.9	0.000*	409.7
Foot Posture Index	Pre FPI-R	10.0±1.50	9.94±1.66	10.22±1.39	0.858	
	Post FPI R	6.35±1.11	4.11±1.18	8.22±1.43	0.000*	550.9
	Pre FPI-L	9.82±1.59	10.06±1.47	10.17±1.54	0.912	
	Post FPI L	6.53±1.06	4.33±.970	8.17±1.200	0.000*	565.2

Note. *Indicates significant difference in Post 4th week than pre-treatment with $p<0.05$; ND: Navicular Drop Test; SST: Stork Stance Test; mSEBT: modified Star Excursion Balance Test; FPI: Foot Posture Index; R: Right Foot; L: Left foot; SD: Standard Deviation.
Group A: Gluteus Max Strengthening + Short Foot Exercises.
Group B: Gluteus Med. Strengthening+ Short Foot Exercises.
Group C: Short Foot Exercises.

Table 3
Pairwise Mean Difference and Significance Value of Control Group and Experimental Groups (A & B)

OUTCOME VARIABLES	Control Group v/s Gluteus Maximus + SFE		Control Group v/s Gluteus Medius + SFE		Gmax+SFEv/s Gluteus medius + SFE	
	Mean Difference	P value	Mean Difference	P value	Mean Difference	P value
Post ND R	-2.44	0.029	-3.22	0.002*	0.77	0.679
Post ND L	-2.20	0.084	-2.97	0.002*	0.76	0.731
Post SST R	1.51	0.094	-2.75	0.001*	-1.24	0.201
Post SST L	2.11	0.038	4.08	0.000*	-1.97	0.055
Post mSEBT R	7.71	0.543	-1.49	0.001*	8.21	0.502
Post mSEBT L	8.82	0.452	2.94	0.001*	5.87	0.701
Post FPI R	-1.05	0.046	-2.19	0.000*	1.15	0.026
Post FPI L	-0.99	0.048	-1.97	0.000*	0.98	0.051

Note: *Indicates significant difference in Post 4th week than pre-treatment with $p<0.05$; ND: Navicular Drop Test; SST: Stork Stance Test; mSEBT: modified Star Excursion Balance Test; FPI: Foot Posture Index; R: Right Foot; L: Left foot; SD: Standard Deviation.
Group A: Gluteus Max Strengthening + Short Foot Exercises.
Group B: Gluteus Med. Strengthening+ Short Foot Exercises.
Group C: Short Foot Exercises.

Table 4
Partial Eta Square Values for all Outcome Variables for Significant Time*Group Interaction Effects

Outcome Parameters	*Partial Eta Squared Value (univariate)*
ND R	*.788*
ND L	*.764*
SST R	*.579*
SST L	*.561*
mSEBT R	*.810*
mSEBT L	*.799*
FPI R	*.654*
FPI L	*.670*

Note. ND: Navicular Drop Test; SST: Stork Stance Test; mSEBT: modified Star Excursion Balance Test; FPI: Foot Posture Index; R: Right Foot; L: Left foot.

Post hoc analysis (Tukey HSD, Multiple comparisons) revealed significant differences in Group A and C for ND R ($p = 0.029$), SST L ($p = 0.038$), FPI R (0.046) and FPI L (0.048). Also, significant differences were found between Group B and C for ND L ($p = 0.012$), SST R ($p = 0.001$), SST L ($p = 0.000$), FPI R ($p = 0.000$) and FPI L ($p = 0.000$). Furthermore, significant differences were observed between group A and B for FPI R ($p = 0.026$).

DISCUSSION

This study determined the effectiveness of Gluteus Maximus versus Gluteus Medius muscle strengthening on navicular drop, balance, and foot posture index among athletes with over-pronated feet. The findings of our current study suggested that there was an improvement in the navicular drop, Static Balance, and Dynamic Balance and Foot Posture shown by the navicular drop test, Stork Stance Test, modified Star Excursion Balance Test, and Foot Posture Index 6 with both – the conventional Short Foot Exercises program given to control group (Group C) and the Gluteus Medius Muscle strengthening program along with Short Foot Exercises to the experimental group (Group B) and the Gluteus Maximus Muscle strengthening program along with Short Foot Exercises to experimental (GROUP A).

Over the same period, however, the Group B intervention was more effective than the Group A and C interventions, with a greater reduction in navicular drop, significant improvement in Static and Dynamic Balance, and better foot posture and function in Group B subjects than in Group A and C subjects. According to Koh et al. (2013) hip external rotator weakness and dysfunction can cause hip adduction, medial rotation, and dynamic knee valgus, all of which can impair foot pronation. The gluteal muscles (maximus, medius, and minimus) stabilize the hip by counteracting gravity's hip adduction torque and maintaining proper leg alignment by eccentrically controlling thigh adduction and internal rotation and externally rotating lower extremity alignment, reducing foot pronation. Gluteal muscle weakness causes the hip joint to rotate internally and causes foot pronation. Reactivating the gluteal muscles will restore standard muscular recruitment patterns and improve gluteal muscle strength and performance. As a result, strengthening the gluteal muscles indirectly strengthens the kinetic chain and aids in the improvement of flat feet (Brijwasi &Borkar, 2023).

Previous research has linked neuromuscular alterations in the gluteus medius to ankle hypermobility, ankle injury, iliotibial band friction syndrome, and patellofemoral pain syndrome. Thus, strengthening the gluteus medius is advised to avoid and manage a variety of lower extremity dysfunctions caused by excessive pronation of the subtalar joint (Koh et al., 2013).

This study aimed to examine the effects of short foot workouts combined with gluteal muscle strengthening activities on overpronated feet. Gluteal muscles fight gravity's impact on hip adduction to keep the legs in the correct alignment and reduce foot pronation. They control thigh adduction, internal rotation, and external rotation at the lower extremity alignment (Goo et al., 2016). Engkananuwat et al. (2023) stated that insufficient gluteal muscles

cause the hip joint to spin, which pronates the foot internally. Thus, by reactivating the gluteal muscles, correct recruitment patterns will be restored, the excessive medial shift of the weight-bearing line will be minimized, and foot pronation will be decreased. Indirectly strengthening the kinetic chain and reducing the incidence of flat feet improves hip and knee muscle function and strength (Engkananuwat et al., 2023). Strengthening the Gluteus Medius improves the ability of the intrinsic foot muscles to effectively support the medial longitudinal Arch (MLA), according to Choi et al. (2020). Like this study, Engkanauwat et al. (2023) found that performing Gluteus Medius exercises in addition to brief foot workouts increased navicular drop, arch height index, static balance, and dynamic balance more than performing foot muscle exercises alone.

According to Friel et al. (2006) and Negahban et al. (2013), hip weakness can lead to functional changes at the ankle (Friel et al., 2006; Hubbard et al., 2007). Friel et al. (2006) discovered a decline in hip abductor strength in Chronic Ankle Instability patients. Based on these findings, it has been proposed that hip abductors aid in keeping the hip abducted, hence minimizing foot pronation and avoiding ankle inversion. Kant et al. stated that the lower extremity is a serial linkage of multiple joints where the problem at one joint can be caused or corrected by compensation by the other joints Powers CM (2010). Foot moments during single leg stance can be influenced and compensated by hip abductor strength Friel (2006), Powers CM (2010).

The statistical analysis results supported the alternative hypothesis, demonstrating that gluteal muscle strengthening combined with short foot exercises is the most cost-effective and effective in reducing navicular drop, static and dynamic balance, and static and dynamic balance, thus improving foot posture and function.

CONCLUSION

The findings supported the primary hypothesis, revealing that a four-week gluteal muscle strengthening exercise program significantly improved foot posture and balance in athletes with over-pronated feet by reducing navicular drop. Furthermore, it was shown that gluteus medius muscle training combined with brief foot motions was more efficient than gluteus maximus muscle strengthening alone. As a result, this research shows that strengthening the gluteus medius muscle considerably influences over-pronated feet.

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Authors' contributions

All authors contributed in study design, statistical analysis and manuscript preparation.

Declaration of conflict interest

No conflict of interest is declared by the authors.

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Pamukkale J Sport Sci, 15(1), 73-87, 2024 Research Article

The Effect of Pilates Exercises on Mobility and Dynamic Balance in Former Athletes and Sedentary Individuals

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ABSTRACT

Workout programmes have proven physiological benefits, and it is widely accepted that they can yield more positive health outcomes when parameters such as balance and mobility are at play. This study intends to examine the effects of a 12-week mat pilates workout program on mobility and dynamic balance parameters in the former athlete group (FAG) and the sedentary group (SG). The study was designed in an experimental design with pre-test and post-test in two groups. The study group consisted of 30 female participants, SG (n=15) and FAG (n = 15). Dynamic balance values were measured using the Star Excursion Balance Test, and lower extremity mobility was measured using the Sit and Reach Test. Both groups conducted mat pilates exercises twice a week for 12 weeks. At the end of the 12-week mat pilates workout programme, a significant difference of increase was obtained in the mobility values of the FAG ($p<0,002$) and the SG ($p<0,001$). The Y Balance Test identified a significant difference of increase with pre-test and post-test in anterior ($p = 0.04$), postero-lateral ($p = 0.03$), posteromedial ($p = 0.04$) directions balance in the FAG. In the difference between groups, SG showed a significant increase in posterolateral ($p = 0.001$) and posteromedial ($p = 0.002$) directions balance than FAG at post-test. At the end of the 12-week mat pilates workout programme, it was revealed out that the FAG scored better in post-test in dynamic balance than the SG although it scored lower in the dynamic balance pre-test than the SG.

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INTRODUCTION

Workout programmes have known health outcomes for individuals. The developer of the Pilates technique, Joseph Pilates, struggled with asthma and rheumatic disorders since his childhood, and his first intention was to strengthen his own body (Latey, 2001). Pilates argues that his method can be used for mental and physical development irrespective of age, gender and physical capacity, and it can also serve as a valuable tool for every individual (Pilates & Miller, 2001). Pilates exercises follow the basic principles of strength-building of popular fitness programmes such as yoga and Tai Chi. Core stability or core strength building has recently become a well-known fitness trend in the world of sports medicine. It can be suggested that workout programmes can yield more positive health outputs when they include parameters such as mobility and balance.

Core stabilization is known to improve athletic performance, prevent injuries, and relieve pain (Akuthota et al., 2008). Pilates includes low and medium-intensity mental-physical exercises oriented at core stability, muscle strength, breathing, and posture. Lange et al., (2000) report that pilates exercises offer benefits in physiological (resistance, force, muscle strength), psychological (mood, motivation, concentration) and motor functions. The outcomes of workout programmes for core or segmental stability are considered low (Wirth et al., 2017). Lower abdomen and inguinal injuries are considered among the most common reasons for both pain and lost playtime in sports. Studies in the literature demonstrate important results on core exercise programmes about performance improvement (Willardson, 2007) and reducing the risk of injury (e.g. back and lower extremity injury; Trajkovic & Bogataj, 2020). Strengthening the core muscles is considered essential to maximize force build-up, minimize loads on joints and for an efficient biomechanical function in all kinds of activities from running to throwing (Kibler et al., 2006).

Pilates seems to have a positive impact on muscle strength and resilience also by making positive changes in the body mass index in addition to various physical developments such as improved flexibility, bone density, and dynamic balance (Caldwell et al., 2009; Jago et al., 2006; Johnson et al., 2007). Mobility gradually decreases after 17 years of age in both men and women. Mobility workouts can prevent and reduce the risk of injury in sedentary individuals (Otto et al., 2004) and athletes (Bertolla et al., 2007). A significant increase in mobility is reported in sedentary individuals (Segal et al., 2004) and athletes (English & Howe, 2007) who engage in pilates workouts. Pilates exercises are also considered influential on balance as well as flexibility. Strengthening core muscles and improving spinal stabilization

are considered important in avoiding situations such as loss of balance and falls and reducing the associated risk of injury (Lange et al., 2000; Von Sperling de Souza & Vieira, 2006). Regular pilates exercises seem important for improving balance in sedentary individuals and athletes (Johnson et al., 2007). Clinical pilates practices implemented for rehabilitation target the local stabilizer muscles in the lumbar pelvic area and intend to improve posture and movement control through neuromuscular control techniques that are believed to improve lumbar spinal stability (Suárez-Iglesias et al., 2019). Therefore, it can be suggested that pilates core exercises on dynamic balance and mobility in sedentary individuals and former athletes. Based on this, we hypothesize that pilates exercises impact mobility and balance. This study aims to examine the differences in impacts on mobility and dynamic balance in sedentary individuals and former athletes at the end of a 12-week pilates workout programme.

METHODS

Participants

Demographic information was collected from former athletes (FAG) and sedentary (SG) groups on the first day. General evaluation parameters were inquired thereafter. Only females were included in the study to eliminate physiological differences. First, general background information was collected from all female participants in the study. Information collected for participant history includes:

- Demographics (age, height, weight, education)
- Sports branch, years in active sports, if any
- Systemic disorders such as hypertension, diabetes etc., if any
- Neurological disorders, if any,
- Surgical history, if any,

The study included females between the ages of 18 and 25, who had no lower extremity injuries, no chronic diseases, no symptomatic musculoskeletal or head injuries, and no known balance disorders. The inclusion criteria were that females in the SG group had never participated in active sports, while women in the FOG group had been experts in any sport for at least four years. The FAG consists of active athletes in volleyball (4), basketball (4), taekwondo (4), and football (3), and the SG consists of individuals without a history as an athlete.

The study's power analysis was performed with G-Power (latest ver. 3.1.9.3: Heinrich-Heine-Universität Düsseldorf, Germany). The study covered 20 female participants in total, 10 with an athlete history and 10 sedentary, with 0.65 effect size, 5% type 1 error and 0.85

power (Park et al., 2016). A total of 30 students who were enrolled in Nevşehir Hacı Bektaş Veli University and took elective Pilates classes voluntarily took part in the study. The purpose of the study was explained to the participants. This study was reviewed and approved of by Nevşehir Hacı Bektaş Veli University Non-Invasive Clinical Studies Publication Ethics Board (No: 2300022766, 19.04.2023).

Data Collection

In the study, test batteries were applied following a five-minute jogging and two-minute m. gastrocnemius muscle stretching exercise as a warm-up programme on day two. Lower extremity mobility was calculated based on the mean of three different measurements with the Sit and Reach (SR), one of the most commonly used linear flexibility measures, which measured the distance from the feet adjacent to the toes (Castro-Piñero et al., 2010; Holt et al., 1999). As a linear test, SR distinguishes as an easy method as it requires minimum skills, equipment, and cost compared to angular tests (Castro-Piñero et al., 2010; López-Miñarro & Rodríguez-García, 2010). The Star Excursion Balance Test (SEBT) was modified and arranged for dynamic balance values in Y form, and anterior, antero-medial and postero-lateral measurements were taken on day three. The Y Balance Test (YBT) measurements were repeated three times, and the mean values were calculated. The means were divided by the leg length, and the values were normalized (Burcal et al., 2019). YBT was performed with the dominant lower extremity. The dominant lower extremity of the participants was identified based on the foot they used to kick the ball (Van Melick et al., 2017).

YBT is a low cost, clinical dynamic balance measure used in sports requiring balance on a single leg (Neves et al., 2017). YBT evaluates limb symmetry through a reaching task by a single lower extremity in three different directions (anterior, postero-medial and postero-lateral; Greenberg et al., 2019). YBT is considered an important tool in clinical practice, especially in sports. The dynamic stability tested by YBT has extensor and abductor strength depending on the stiffness of the lower extremities and lumbopelvic stability (Ambegaonkar et al., 2014). Dynamic balance and flexibility values were measured twice as pre-test and post-test. Both groups were made to do mat pilates exercises two days a week for 12 weeks. The mat pilates exercises implemented for 12 weeks are provided in the following table.

Table 1
Mat Pilates Workout Programme

Exercise	Repetition
Hundred	5+5(10 breathes) x10
Roll Up	5-8
Leg Circles	6-8
Rolling like a Ball	6-8
Single Leg Stretch	6-12
Double Leg Stretch	6-12
Single Straight Leg Stretch	6-12
Double Straight Leg Lower Lift	6-12
Criss Cross	6-12
Spine Stretch Forward	5-8
Corkscrew	4-8
Saw	6-8
Shoulder Bridge Prep	5-8
Front and Back/Up and Down/Circles	10-12
Inner Thigh Lift & Circles	8-15
Beats on Belly	10-15
Teaser	3-5
Teaser One Leg	3-5
Swimming Prep	6-10
Push Up	3-5

Data Analysis

Data collected from the study group was analysed using SPSS 22.0 (IBM Corp.; Armonk, NY, USA). Descriptive statistical methods were used for data analysis. Mean ± standard deviation was used for the representation of numeric data, and ratio (%) was used for the expression of categorical data. For SG and FAG mobility and balance and mobility data, the Repeated-measures analysis of variance with one fixed factor was used. Bonferroni correction was performed for statistically significant results in multiple comparisons. Variables were presented as mean ± standard error. Effect sizes were evaluated using partial eta-squared (ηp2). Effect sizes were measured <0.01 small, 0.01-0.06 medium, and >0.14 large (Richardson, 2011). Statistical significance was set for $p < 0.05$.

RESULTS

The study consisted of 30 participants in total, 15 in the SG (age: 19.4±0.4 years, height: 1.70±0.2 cm, weight: 63.2±3.21 kg) and 15 in the FAG (age: 20±0.5 years, height: 1.66±0.1 cm, weight: 59.52±3.39 kg).

Table 2
Demographics

Measures Gender (M/F)	FAG (n = 15) 0/15 Mean ±SE	SG (n = 15) 0/15 Mean ±SE	p
Age (years)	20.00±0.50	19.40±0.43	0.453
Height (m)	1.66±0.01	1.70±0.02	0.085
Body weight (kg)	59.52±3.39	63.21±3.21	0.155
Dominant side (Right/left)	15/0	15/0	

Note. FAG: Former Athlete Group, SG: Sedentary Group, SE: Standard error, m: meter, kg: kilogram

A significant increase was recorded in the intra-group flexibility values in SG ($p<0.001$, $\eta_p^2 = 0.57$) and FAG ($p<0.002$, $\eta_p^2 = 0.31$) after the 12-week mat pilates workout programme. No inter-group difference was observed (Table 3).

Table 3
Flexibility Results (Interaction Factor 1, p<0,001)

Flexibility	Mean±SE			
	Pre-test	**Post-test**	**p value**	**Partial Eta Squared (η_p^2)**
FAG (cm), (n=15),	20.35±1.76*	23.07±1.69*	**0.02**	**0.31**
SG (cm), (n=15)	18.04±1.70	22.53±1.64	**0.01**	**0.57**
P value	0.35	0.82	---	----------
Partial Eta Squared (η_p^2)	0.003	0.002	---	----------

Note. FAG: Former Athlete Group, SG: Sedentary Group, Cm: Centimeter, η_p^2: Partial eta squared, SE: Standard error *Time difference ($p < 0.05$).

The star excursion balance test obtained a significant difference of increase in the FAG with inter-group ($p = 0.002$, $\eta_p^2 = 0.29$) and pre-test post-test ($p = 0.04$, $\eta_p^2 = 0.26$) in anterior balance, inter-group ($p<0.001$, $\eta_p^2 = 0.42$) and pre-test post-test ($p = 0.03$, $\eta_p^2 = 0.16$) in postero-lateral balance, inter-group ($p = 0.002$, $\eta_p^2 = 0.29$) and pre-test post-test ($p = 0.04$, $\eta_p^2 = 0.26$) in postero-medial balance (Table 4, 5, 6).

Table 4
Dynamic Balance Results Anterior (Interaction Factor 1, p<0,03)

Dynamic Balance Results (Anterior Right)	Mean±SE			
	Pre-test	**Post-test**	**p value**	**Partial Eta Squared (η_p^2)**
FAG (cm)*, (n=15),	55.92±2.32†*	64.07±2.88*	**0.04**	**0.26**
SG (cm)*, (n=15)	66.80±2.24†	70.66±2.78	0.136	0.08
P value	**0.002**	0.111	---	----------
Partial Eta Squared (η_p^2)	**0.29**	0.09	---	----------

Note. FAG: Former Athlete Group, SG: Sedentary Group, Cm: Centimeter, η_p^2: Partial eta squared, SH: Standard error *Time difference ($p < 0.05$). †Inter-group difference ($p < 0.05$).

Table 5
Dynamic Balance Results Posterolateral (Interaction Factor 1, p<0,014)

Dynamic Balance Results (Posterolateral Right)	Mean±SE			
	Pre-test	Post-test	p value	Partial Eta Squared (η_p^2)
FAG (cm), (n=15),	49.57±2.52*†	55.07±2.13*†	**0.03**	**0.16**
SG (cm), (n=15)	64.86±2.24†	68.20±2.06†	0.16	0.07
P value	**0.001**	**0.001**	---	----------
Partial Eta Squared (η_p^2)	**0.41**	**0.42**	---	----------

Note. FAG: Former Athlete Group, SG: Sedentary, Group Cm: Centimeter, η_p^2: Partial eta squared, SH: Standard error * Time difference ($p < 0.05$). †Inter-group difference ($p < 0.05$).

Table 6
Dynamic Balance Results (Interaction Factor 1, p<0,05)

Dynamic Balance Results (Posteromedial right)	Mean±SE			
	Pre-test	Post-test	p value	Partial Eta Squared (η_p^2)
FAG (cm)*, (n=15),	48.85±2.54*†	54.57±2.51*†	**0.04**	**0.26**
SG (cm)*, (n=15)	62.86±2.24†	66.26±2.42†	0.136	0.08
P value	**0.001**	**0.002**	---	----------
Partial Eta Squared (η_p^2)	**0.36**	**0.29**	---	----------

Note. FAG: Former Athlete Group, SG: Sedentary Group, Cm: Centimeter, η_p^2: Partial eta squared, SH: Standard error * Time difference ($p < 0.05$). †Inter-group difference ($p < 0.05$).

DISCUSSION

The study examined the balance and mobility values of 30 former athletes and sedentary individuals after doingathletes and sedentary individuals after doing pilates exercises for 12 weeks. It was found out that the FAG and SG had their mobility improved and the FAG had better dynamic balance results than the SG after the pilates workout programme.

Based on the guidelines of the American College of Sports Medicine (ACSM), the flexibility component of the study demonstrated significant improvement through the implementation of the Pilates exercise prescription (ACSM, 2013). More research has examined the impact of incorporating a particular extensibility program into physical education lessons on adolescents' hamstring extensibility (González-Gálvez et al., 2019). These studies, which lasted between five and eight weeks, used three to seven minutes per session, twice weekly, and demonstrated notable improvements following the experimental period (Mayorga-Vega et al., 2014; Sánchez Rivas et al., 2014). These outcomes are related to the current study's findings, which has the benefit that the Pilates method is a more comprehensive approach that enhances extensibility (González-Gálvez et al., 2019).

Although the exact mechanism is unknown, two theories are being considered. The Golgi tendon organ plays a crucial role in regulating muscle tension during stretching exercises. When tension decreases, as is the case in slow stretches associated with Pilates, the Golgi tendon organ inhibits alpha motor neurons, allowing the muscle fibers to lengthen and promoting flexibility and range of motion. This mechanism helps prevent excessive muscle contraction and potential injury during stretching activities. (McArdle & Katch, 2017). Second, the improvement in range of motion associated with stretching exercises, according to Shrier and Gossal, may be attributed to changes in viscoelastic properties (Shrier & Gossal, 2000). This could involve a reduction in the resistance of tissues to deformation or an increased tolerance to the stretching sensation. Kubo et al.'s findings on the effects of static stretching on tendon viscoelasticity align with this explanation (Kubo et al., 2002)

In the literature, studies on pilates exercises about balance rather focus on geriatric (Długosz-Boś et al., 2021), Parkinson's (Çoban et al., 2021), Multiple sclerosis (Arik et al., 2022) and similar neurological origin disorders. Balance is an essential component of all sports. The fact that pilates mainly focuses on core exercises based on the centring principle encourages more research to be done in this field. The literature includes a study of the impact of pilates on footballers' static and dynamic balance performance (Keziban et al., 2020) and a comparison of YBT performances of women who regularly do pilates workouts and sedentary women (Ateş & Öztürk, 2019). However, a comparison of former athletes and sedentary individuals is important for exhibiting the impact of pilates exercises in different populations.

Both groups had their mobility improved after pilates workouts that lasted for 12 weeks. Increased mobility with these exercises for this period of time can be considered normal. Performing the moves in a certain rhythm and harmony and controlling them with resistance at different angles play an important role in improving mobility. Available studies also demonstrate that Pilates can improve mobility (Hınçal, 2019; Karadenizli & Kambur, 2016). Considering the dynamic balance results of the study, there is a significant increase in all directions in the YBT and the pre-test post-test values of the FAG. Considering inter-group differences, a significant difference is present in postero-lateral and postero-medial values.

There is a difference in the pre-test values of the FAG and SG. This difference is in favor of the SG and to the detriment of the FAG. This difference may be attributed to the fact that the FAG covers different branches such as volleyball (4), basketball (4), taekwondo (4), and football (3). It can be said that they did not include misloading or balance education in their branch-specific field training. Because, dynamic balance performance is a whole-body reaction

depending on many basic physiological factors including proprioception, sight, vestibular function, reaction time, coordination and muscular strength.

Dynamic posture covers voluntary movement levels based on support. A practice to be implemented on individuals with reduced core stability, muscle imbalance, and abnormal movement patterns is thought to be beneficial in preventing injuries (Ateş & Öztürk, 2019; Yaprak & Dellekoğlu, 2021). When 12-week pilates exercises were included in the training programme of former athletes, their dynamic values rapidly exceeded the values of sedentary individuals thanks to having a sports history. As can be understood here, it can be said that their training did not include balance exercises. In this respect, it is essential to use specific balance exercises in the training programmes for athletes. As can be seen in our study, the increased balance in athletes engaging in pilates exercises compared to the other group is proof of this. The impact of pilates on mobility and balance, especially in athletes, should be paid attention to. In many different sports, it is necessary to have the balancing skills to reach maximum competitiveness and prevent lower extremity injuries (Hrysomallis, 2007, 2011; Kiers et al., 2013). Balance controls visual, vestibular, and somatosensory information to generate motor movements that coordinate the central nervous system and the activation ignition of muscles (Roijezon et al., 2015; Shumway-Cook & Woollacott, 2007; Speers et al., 2002). A systematic compilation published in this field demonstrated that archers' static balance skills were correlated with their shooting accuracy, and ice hockey players' dynamic balance skills were correlated with their skating speed (Hrysomallis, 2011). It was reported that gymnasts had a similar dynamic balance to that of footballers (Bressel et al., 2007; Davlin, 2004). Additionally, it was demonstrated that footballers had a similar dynamic and static balance to swimmers and basketballers (Davlin, 2004; Matsuda et al., 2008; Thorpe & Ebersolei, 2008).

There are few evidence in studies for core muscles (Wirth et al., 2017). Lower abdomen and inguinal injuries are among the most common reasons for pain and loss of playtime in sports (Mulry et al., 2021). Several studies provided information about the importance of core training and testing to enhance performance (Willardson, 2007) and reduce the risk of injury (e.g., back and lower extremity injury; Leetun et. al., 2004; Willson et al., 2005) in various populations (Tabacchi et al., 2019; Trajković & Bogataj, 2020). Spinal stability depends on not only muscle strength but also suitable sensory input, which alerts the central nervous system about the interactions between the body and its surroundings, provides constant feedback, and allows for the improvement of movement (Hodges, 2003). Core stability is considered extremely important for an efficient biomechanical function to maximize force build-up and

minimize loads on joints in all activities, from running to throwing (Kibler et al., 2006). In this sense, pilates exercises can have a significant impact on increasing the stability of core muscles.

This study evaluates mobility and dynamic balance between former athletes and sedentary individuals. For this reason, that further research is required to demonstrate the impact of pilates exercises on elite and professional athletes. The limitation of our study is that former athletes are from different sports. It can be suggested that it is necessary to do comparative studies with athletes from a single sport due to the fact that trainings are programmed differently in different sports.

CONCLUSION

It was found that former athletes and sedentary individuals had improved mobility when they engaged in pilates workouts, and former athletes had improved dynamic balance results compared to sedentary individuals when they engaged in core pilates exercises. Great balance and mobility are essential for all sports. Pilates should be used as an exercise component in training models. However, the importance of mobility and balance practices is ignored in training modeling. The results of our study support this situation. It is thought that the increase in the mobility and balance of former athletes who apply Pilates program will reflect positively on their sports branches. Former athletes, whose pre-test results were less than sedentary athletes, showed more post-test results after the Pilates program than sedentary individuals. Consequently, it is important to include Pilates program in the training programs regardless of the branch. Gained balance and mobility means reduced risk of injury. Pilates exercises are crucial to include in programs, especially for physiotherapists who specialize in preventive rehabilitation and athletic performance coaches who design training models.

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Authors' contribution

All authors revised the manuscript and contributed to the interpretation of the results. All authors have read and approved the final version of the manuscript.

Declaration of conflict interest

Authors declare no conflict of interest.

Ethics Statement

This study was reviewed and approved of by Nevşehir Hacı Bektaş Veli University Non-Invasive Clinical Studies Publication Ethics Board (No: 2300022766, 19.04.2023).

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Promoting Awareness of Sedentary Behavior and Physical Activity Awareness Among Rural Youth Through Bocce Game: A Qualitative Study

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ABSTRACT

In youth, it is important to promote physical activity habits. The multifactorial nature of rural areas affects individuals' physical activity habits, and sustainable strategies are needed to promote sedentary behavior and physical activity awareness among rural youth. The research data consists of qualitative interviews with healthy rural youth after the bocce game activity. In-depth interviews were conducted with 11 volunteers who participated in the activity using a semi-structured interview form. Qualitative findings are divided into nine main themes: Thoughts on bocce game activity; meaning of physical activity and thoughts on the topic; physical activity and its effect on health; thoughts on the frequency, duration, intensity, and type of physical activity; meaning of sedentary behavior and thoughts on the topic; sedentary behavior and its effect on health; thoughts on the frequency and duration of sedentary time and the type of sedentary behavior; promoting awareness of sedentary behavior and physical activity through bocce game; expectations from institutions. The findings highlight that bocce is a vital strategy to encourage physical activity and sedentary behavior awareness among youth in rural areas. Local authorities have a critical role in supporting physical activity and sedentary behavior awareness in rural areas.

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INTRODUCTION

Excessive sedentary time is increasing among young individuals worldwide (LeBlanc et al., 2017). Among children and youth aged 5-17, it has been reported that they spend more than 2.25 hours per day engaging in sedentary activities such as watching TV/DVDs or playing electronic games, indicating higher sedentary behavior (SB) levels than recommended in guidelines (Australian Bureau of Statistics, 2013; Australian Government Department of Health, 2021). Increased SB and high screen time in youth have negatively affected body composition, cardiometabolic risk, fitness, behavior, and self-esteem (Carson et al., 2016). Physical inactivity, a leading cause of non-communicable diseases, remains widespread globally (Katzmarzyk et al., 2022). Increased physical activity (PA) and reduced SB have positive health effects on youth, including improved physical fitness, cardiometabolic health, bone health, mental health, and adiposity reduction (Carson et al., 2016; Chaput et al., 2020). Despite the known health benefits, most youth worldwide do not meet PA recommendations (Steene-Johannessen et al., 2020).

Initiating PA is closely related to the environment one lives in. People living in rural areas have limited opportunities for PA participation (Meyer, Moore, Abildso, et al., 2016). Some studies emphasise the inadequate physical activity levels of young people living in rural areas in Türkiye (Esatbeyoğlu & Kin İşler, 2018). The presence of safe areas for PA, easy access to exercise equipment, the availability of recreational places such as parks and gyms, and the presence of individuals engaging in PA in the surroundings can increase participation in PA (Meyer, Moore, Abildso, et al., 2016). Supporting young individuals in adopting an active lifestyle is crucial for long-term individual and community health (Guthold et al., 2020). PA programs should encompass planned, curriculum-defined, cognitive-enhancing indoor and outdoor school activities that promote young individuals' learning experiences (Hodge et al., 2008). Safe, engaging, developmentally appropriate PA programs are recommended to support young people in being active for at least 60 minutes daily (Chaput et al., 2020). Bocce, a special Olympics sport, is frequently chosen by young individuals and offers opportunities for social interaction, physical development, and building self-confidence (Sood et al., 2016). There are different types of bocce game. Petanque is one of them and is a game played by hand using iron balls. Petanque is a game that can be played regardless of gender and age. This game aims to make the closest shot to the pallino (target ball) with the thrown iron ball (Phytanza et al., 2022). Bocce involves individual and team competitions, traditional strategic games against rival teams, as well as timed competitions that involve speed, endurance,

strength, hand-eye coordination, aerobic and anaerobic power capacity, flexibility, balance, and body composition components, making it a sport with physical performance characteristics (Türkmen et al., 2013).

In addition, the suitability of the bocce game for implementation in rural areas, its potential to increase PA and decrease sedentary time, its known health benefits, its suitability for individuals with different health issues, its ease of play, its ability to be played regardless of age and gender, its ease of organization, its enjoyable nature, and its ability to be played individually or in teams contribute to making the game appealing (Gündüz & Keskin, 2019; Sood et al., 2016; Türkmen et al., 2013, 2018).

Supporting strategies that reduce SB and increase PA in individuals (Chaput et al., 2020) and developing intervention programs to enhance PA and SB awareness are recommended (Tassitano et al., 2020; Van Sluijs et al., 2007). Despite the existing recommendations, very few studies focus on individual perceptions and interpretations of individuals. Therefore, presenting the effects of bocce on PA and SB in rural areas through individuals' perceptions and presenting the intention and motivation of individuals towards behavior change together with these perceptions and comments is crucial to inform future studies for different intervention programs that could be developed in rural areas.

As a result of the literature review, it has been seen that there is a need for sustainable practices to be developed to support the awareness of SB and PA in young individuals living in rural areas. In this context, this research seeks answers to the following questions: (1) What is the role and importance of the bocce game activity in supporting the awareness of SB and PA among young people living in rural areas? (2) What are the participants' thoughts on SB and PA? (3) What are the expectations of the participants from the institutions regarding the awareness of SB and PA?

The conceptual framework of this research is based on the concepts of SB and PA awareness. In this context, the research draws from the World Health Organization's (WHO) guidelines on SB and PA (Chaput et al., 2020) and behavior change theories that encompass intention to change or motivations (Ajzen & Schmidt, 2020; DiClemente & Graydon, 2020). The WHO guidelines cover issues related to PA (the relationship between PA and health outcomes, dose-response relationship, relationship between type or domain of PA and health outcomes) and SB (the relationship between SB and health outcomes, dose-response relationship, the relationship between type or domain of SB and health outcomes) that have been addressed by the WHO Youth Work Group (World Health Organization, 2020).

According to many commonly used theoretical models, intention to change or motivation is a crucial determinant of behavior change (Ajzen & Schmidt, 2020; DiClemente & Graydon, 2020). Whether an individual intends to change their behavior depends on their belief that changing the behavior will reduce health risks and how much they perceive their behavior as "unhealthy" (Schuman-Olivier et al., 2020). In the context of this research, the physical, cognitive, and social activity of the Bocce game is based on increasing PA, reducing sedentary time, and promoting behavior change potential in individuals, thus supporting awareness of SB and PA.

METHODS

Study Design

In this study, a phenomenological approach, a qualitative research design that aims to investigate individuals' life experiences and daily experiences deeply, was employed (Creswell & Poth, 2016). Phenomenological research aims to achieve saturation by focusing on in-depth and specific data from a small sample (Bhattacharya, 2017). Given the practical nature of the research question and to better understand the effects of interventions and inform future studies, the study aimed to explore the personal perceptions, interpretations, and experiences of rural youth's awareness of SB and PA through the activity of the bocce game. These factors were the driving factors behind choosing a qualitative phenomenological approach. Published guidelines for qualitative phenomenological research were applied in the scope of this research (Cypress, 2018). The Standards for Reporting Qualitative Research checklist guided reporting (Brien et al., 2014). Qualitative interviews were conducted after obtaining research ethics approval from the Ankara University Ethics Committee (Approval Number: 56786525-050.04.04/580730). The research adhered to the Helsinki Declaration (Human, 2001), and in addition to obtaining verbal consent from voluntary participants, informed consent was obtained from the parents/guardians of the participants to allow their children to participate in the research.

Study Group

Healthy young men and women living in the rural district of Haymana in Ankara, whose parents/guardians gave informed consent to allow their children to participate, were included in the study. Individuals between the ages of 15-18, which is the "youth category" representing young individuals in the bocce game of the Türkiye Bocce Bowling and Dart Federation, and individuals who had never played bocce before were included in this study

(Türkiye Bocce Bowling and Dart Federation, 2022). Based on self-report, individuals with serious neurological or orthopedic problems that could hinder playing bocce or those with advanced cardiovascular disease that significantly affected their mobilization were not included in the study. A total of 20 young individuals who met the inclusion criteria for the bocce game activity participated in the research, and among these individuals, those who volunteered for qualitative interviews (n = 11) were included in the research. Participants agreed to complete an in-depth interview as part of their general participation. Interviews were concluded when saturation was reached (Bhattacharya, 2017).

The research team consisted of individuals (BNE, HK) who had previously worked in clinical practice on bocce game, PA, and SB topics and integrated them, as well as individuals (HK) with expertise in qualitative research methods. Members of the research team (BNE, HG, Mİ, EK, CK) had received expert training in qualitative data collection and analysis methods before the research. The research team contributed jointly to the coordination of intervention activities, intervention design, and data collection. Participants knew that the research team was interested in their intervention experiences, SB and PA awareness perceptions, as part of the study evaluation.

Data Collection Tools

The data for the study consisted of qualitative interviews conducted after the bocce game activity designed to support SB and PA awareness among young rural individuals. The research used a commonly used interview technique to reveal individuals' feelings, thoughts, perceptions, and experiences (Bhattacharya, 2017). In-depth interviews were conducted with 11 volunteers participating in the bocce game activity. Semi-structured interview forms were used in the interviews. The interview form prepared by the authors (BNE, HK) included adapted questions for the bocce activity based on the guidelines for SB and PA for children and adolescents by the WHO (Chaput et al., 2020), as well as demographic questions. After review for clarity and appropriateness, the prepared interview form was administered. A purposeful sampling technique was used in the research. This technique involves examining rich information cases to effectively use limited resources (Duan et al., 2015).

Considering the facilitator factors necessary for the adoption, implementation, and sustainability stages of PA and SB interventions in real-world settings mentioned by Cassar et al., the availability of these factors in the bocce game was one of the reasons for choosing the bocce game (Cassar et al., 2019). The bocce game activity implemented in the research was carried out in collaboration with Ankara University, the Türkiye Bocce Bowling and Dart

Federation, Haymana District Directorate of National Education, Haymana District Directorate of Youth and Sports, and Haymana Municipality. Information about the participants' location, date, time, and age was conveyed through posters and verbal announcements prepared for the bocce game activity. The activity took place outside of school hours. On the day of the game, participants registered and received player numbers from the researchers when they arrived at the game area. A total of 20 individuals, including ten women and ten men, participated in the activity. Before the activity, a field inspection was conducted by a referee appointed by the Turkish Bocce Bowling and Dart Federation to ensure the suitability of the field. Six fields were created with a length of 15 meters and a width of 4 meters. Player matches were made randomly by drawing lots by the referee, and female and male participants were assigned randomly. Before the activity, warm-up exercises were performed for about 15 minutes, accompanied by a physiotherapist (BNE), in order to minimize the risk of injury to the participants. Participants competed as a player (solo) against a player. The activity was played in the "petanque" type of bocce game. Since the petanque is a game that can be played regardless of gender and age, male and female participants competed in the same category.

At the end of the activity, which progressed in quarter-finals, semi-finals, and final games, the participants were given medals. In addition, qualitative interview appointments were obtained from volunteer participants whose parents/guardians had ethical approval for the research at the end of the activity. One-on-one, face-to-face, semi-structured in-depth interviews were conducted with 11 volunteers participating. The interviews lasted an average of 30-50 minutes and were recorded using a voice recording device. The digitally recorded data were transcribed verbatim using a professional service. The interview transcripts were reviewed for accuracy and anonymized before thematic analysis. Participant names were replaced with codes. The participants were coded in order of registration on the list as "P01, P02, P03, P04, P05, P06, P07, P08, P09, P10, P11". The transcripts were analyzed and transferred to a computer environment.

Data Analysis

Thematic and descriptive qualitative analysis was performed using the NVivo 10.0 program. Frame themes were established based on the literature review and the semi-structured question form. Interview transcripts were coded separately by the researchers (BNE, HK). The codes were then brought together and matched, and a consensus decision was made for each code. The codes were placed under framework themes and then categorized

into thematic categories using the thematic analysis method. The responsible researcher (BNE) reviewed the codes and themes. Then, the themes were reorganized and revised, focusing on the perceptions of the bocce game and the relationships between SB and PA awareness perceptions and intervention experiences. All research team members met again to review, discuss and improve the themes. The themes were discussed and refined with all team members until a consensus was reached. The researchers identified the emerging findings and supporting participant quotes (BNE, HK). The reliability and validity of the data were tested using kappa analysis. According to the results of the kappa analysis, there was a 100% agreement in scoring. Discussions and decisions made during data collection and analysis were documented to ensure an audit trail. Participant quotes were directly transcribed from their own words during the analysis to enhance the reliability of the data. After interpreting the research findings, an expert researcher in the field of qualitative research evaluated the study to avoid bias and provided expert opinions. Preliminary findings of the research were presented at an academic conference in September 2022.

RESULTS

Participants

Qualitative interviews were conducted with 11 volunteers participating in the bocce game activity. Among the volunteers, five were female (45.5%) and six were male (54.5%). The age range of the participants was 15-17 years old, with an average age of 15.9. Most participants (72.7%) were born and raised in Haymana, and the participants with the shortest duration of residence had been living there for one year. Young individuals maintain at least one and up to three PA routines. In the participants' PA routines, it was observed that they engage in activities such as playing volleyball (54.5%), walking (36.3%), playing soccer (27.2%), running (27.2%), playing basketball (18.1%), playing table tennis (9%), and riding bicycles (9%). The majority of female participants prefer playing volleyball (60%), while the majority of males prefer walking (50%) and playing volleyball (50%). Participants mentioned that they engage in volleyball, basketball, soccer, and table tennis activities both during and after school, while they engage in walking, running, and cycling activities outside of school hours (during the day or in the summer). The demographic information of the participants is provided in Table 1.

Qualitative findings

After conducting the interviews, nine themes were identified based on the participants'

responses. These themes cover various aspects of PA, SB, and perceptions of the bocce game activity. The themes and their corresponding codes are presented in Table 2. The code tree is not created.

Table 1
The Demographic Information of the Participants

Participant ID	Age (Years)	Sex	Class (High School)	Physical Activity Routine (Type/Frequency)	Duration of Residence
01	15	Male	1st	Walking/Daily	Local
02	15	Female	1st	Walking/Daily	Local
03	16	Female	2th	Volleyball/Sometimes Football/Sometimes	Local
04	17	Female	3rd	Running/Daily	1 year
05	15	Male	1st	Walking/Daily Running/Daily Basketball/Sometimes	Local
06	17	Male	3rd	Football/Daily Volleyball/Daily	Local
07	15	Male	1st	Walking/Daily Cycling/Sometimes Volleyball/Sometimes	7 years
08	15	Female	1st	Volleyball/Sometimes	Local
09	17	Female	3rd	Volleyball/Sometimes	Local
10	17	Male	3rd	Table tennis/Sometimes Volleyball/Sometimes Basketball/Sometimes	Local
11	16	Male	3rd	Running/Daily Football/Daily	6 years

Thoughts on the bocce game activity

Most participants stated that they played the bocce game for the first time. In their thoughts about the bocce game activity, they generally mentioned that playing bocce with their peers made them feel good and enjoyable. One participant (P05), even though they did not particularly enjoy sports, thought that bocce pleased them, and they believed that enjoying the activity made them play well. Another participant (P04) compared bocce to a marble game they played as a child, which evoked positive feelings. Participants with code name P08 supported the idea that even people who have not dealt with this sport before can quickly grasp bocce, saying, "It was my first time playing, I learned.". Participants expressed their thoughts about the game with the following words:

"To be honest, I thought it would be boring at first. But as I played, I realized that I enjoyed it. I used to like playing marbles when I was little. I also really like bocce now." (P04)

"I played Bocce for the first time in my life. I am not really someone who is deeply involved in such sports, but I had fun for the first time in a sport like this. I think I played quite well and enjoyed it. I had a great time." (P05)

"I had a fun time playing with my peers. It made me feel good. I got interested. It was my first time playing, I learned." (P08)

Table 2
Themes and Codes

	Themes	Codes
1	Thoughts on the Bocce Game Activity	Enjoyable game, pleasant game, fun game, exciting game.
2	Meaning of Physical Activity and Thoughts on the Topic	Beneficial activity, developmental activity, sports, movements related to the body.
3	Physical Activity and Its Effect on Health	It positively impacts health, prevents excess weight, and prevents physical problems that may arise in old age.
4	Thoughts on the Frequency, Duration, Intensity, and Type of Physical Activity	Consistency and continuity, body capacity.
5	Meaning of Sedentary Behavior and Thoughts on the Topic	Inactivity, laziness, examples of sedentary behavior.
6	Sedentary Behavior and Its Effect on Health	Affects health negatively and adversely, currently doesn't affect, leads to illnesses.
7	Thoughts on the Frequency and Duration of Sedentary Time and the Type of Sedentary Behavior	Pain, fatigue, sluggishness, adverse effects of technology.
8	Promoting Awareness of Sedentary Behavior and Physical Activity Through Bocce Game	Awareness was achieved, awareness was not achieved, partially achieved.
9	Expectations from Institutions	Encouraging, organizing tournaments, increasing courses.

The bocce game positively affects individuals physically, socially, mentally, and cognitively. Some participants (P09, P10) mentioned that the bocce game supports them socially and highlighted its emotional, mental, and cognitive effects on individuals.

"It developed social activities. It improved our feelings among us. It made us focus more." (P09)

"Well, you also need to think strategically a bit. It is not just about getting points, but it is also fun because you need to move your opponent's ball away." (P10)

When asked if they would like to get together and play bocce again in the future, 9 participants (P02, P03, P04, P05, P06, P08, P09, P10, P11) responded positively, one participant (P07) expressed uncertainty, and one participant (P01) did not provide an opinion. Some participants' views on this matter are as follows:

"I would come again if it is played again. I had fun." (P08)

"Well, most likely I want to because, you know, interactions like these among us are very nice. Playing bocce is a fun activity." (P09)

Young individuals mentioned that the enjoyable nature of the bocce game and the pleasure of playing with peers motivated them and made them want to play bocce again. The motivational contributions of the bocce game on individuals and their desire to play bocce again could be seen as essential steps for behavioral changes in individuals (Ajzen & Schmidt, 2020; DiClemente & Graydon, 2020).

Meaning of physical activity and thoughts on the topic

PA is any bodily movement carried out by skeletal muscles that requires energy expenditure (World Health Organization, 2019). For individuals to participate in PA, they must understand the meaning of PA and perceive how active they are in their daily lives. In response to questions about their perceptions and interpretations of PA, six participants (P04, P05, P06, P07, P10, P11) consider themselves physically active, while four participants (P02, P03, P08, P09) do not consider themselves active, and one participant (P01) did not express an opinion.

Participants mainly associate the meaning of PA with sports activities and physical actions in daily life. Participants provided examples of PAs such as walking, running, playing volleyball, soccer, basketball, table tennis, and cycling. Some of their statements related to the meaning of PA include:

"*In my opinion, physical activity includes activities that allow you to develop physically. Sports like volleyball, soccer, bocce, and the like...*" *(P03)*

"*I think physical activity encompasses all the tasks a person does in a day. But from a sports perspective, things like volleyball, basketball, soccer can be examples.*" *(P06)*

Since Haymana is a small district, participants usually walk to the places they go. Apart from that, participants mainly participate in school team practices within the school and engage in sports activities in the schoolyard after school. Therefore, it can be observed that participants mainly engage in PA within the school premises. Some statements from participants regarding this topic are as follows:

"I usually do it daily. There is a long walking distance between my home and school. Walking, running, these are things that are part of my life. But whenever I get a chance, I do training with my friends because they are in the volleyball team." (P05)

"For example, I ride my bike when I am in the city, especially during summers. We play volleyball with friends on school days. And walking, I do that every morning when I come to school." (P07)

In participants' interpretations of PA, walking, riding a bike, and playing volleyball, soccer, and basketball seem to be highlighted. Individuals mostly view activities that involve relatively high energy expenditure in skeletal muscles as physical activities. However, only one participant (P03) mentioned playing bocce as an example of PA. Some participants' definitions of PA also included daily activities and broadened the scope of the definition. Considering the participants' opinions, it can be suggested that the geographical, economic, and cultural characteristics of their region might have influenced their PA behaviours and perceptions.

Physical activity and its effect on health

The beneficial effects of PA on health are supported by evidence in the literature (Chaput et al., 2020). Nevertheless, inadequate levels of PA among young people are a significant concern (Steene-Johannessen et al., 2020). Therefore, participants' thoughts regarding the effects of PA on health are important in the context of participation in PA and behavior change. When asked about the effects of PA on health outcomes, participants indicated that engaging in PA positively and effectively influences health. They mentioned that PA prevents obesity, helps maintain a healthy weight, prevents physical problems that may arise in old age, and enhances endurance. Some participants expressed the effects of PA on health outcomes with the following statements:

"I believe it prevents obesity in the first place. Generally, lazy people tend to be overweight." (P04)

"I think diseases like osteoarthritis occur in the elderly. To prevent these from developing in advance, it is necessary to make the body move, or I think physical activity is important to prevent things like hunchback." (P10)

One participant (P03) thinks that they tire less quickly than their peers because they are interested in different sports branches compared to their peers.

"When my friends get tired quickly from doing a sport, I tire more slowly than them. I have been interested in other sports as well. Not just volleyball. That has an impact too, of course." (P03)

Participants' general thoughts are consistent with the literature, emphasizing the positive effects of PA on health. In addition to the contributions of PA to current physical well-being, the idea that specific future issues can be prevented through PA is also present in participants' opinions.

Thoughts on the frequency, duration, intensity, and type of physical activity

Participants believe consistency and continuity in engaging in PA are important to achieve positive health outcomes related to PA frequency, duration, and intensity. Some participants have the following thoughts about the impact of the frequency, duration, and intensity of PA on these health outcomes:

"Definitely. For instance, a person who engages in sports once a year cannot turn around and say, 'I am constantly doing sports.' And that sport will not have any effect on them. It is necessary to do it at least every two or three days." (P04)

"Of course, there is an effect. If a person plays volleyball all day long for one day and then does not play volleyball for 100 days, it will not be of any benefit to them." (P05)

P10 emphasizes the importance of performing activities without excessive fatigue, taking into account the body's capacity regarding activity intensity with the words, "There's something in the human body, there is endurance, so it should be done according to that.".

P06 points out the importance of engaging in PA in a way that will not harm the body and doing so regularly. P06 also highlights the role of PA in weight control and maintaining health:

"So, we should do it regularly, in a way that will not exhaust us too much won't exaggerate. We should do it according to a regular schedule, at the same time every day. For example, at least we can maintain our weight and health." (P06)

Regarding the impact of activity type on health outcomes, one participant (P05) believes that the effects will not be the same since different body movements lead to different muscle activations:

"Each sport has its challenges in its field, after all. I think, as I said, since each sport affects different parts of the body that influence health, of course, it has an impact." (P05)

Overall, participants emphasize the concepts of consistency, continuity, body capacity, and type of activity in engaging in PA to achieve positive health outcomes.

Meaning of sedentary behavior and thoughts on the topic

When examining PA's effects on young people's health, it is evident that SB should also be considered an important factor alongside PA (Katzmarzyk et al., 2019). SB is characterized by activities such as sitting, lying down, or reclining that expend ≤1.5 metabolic equivalents (METs) of energy while an individual is awake (Tremblay et al., 2017). Common SBs include smartphone/tablet use, watching TV, playing video games, computer use, driving a car or riding in a car, and reading/studying while sitting (LeBlanc et al., 2017).

When participants were asked about the meaning of SB, they associated it with inactivity, technology use, not going outside, not engaging in PA, not participating in social activities, not walking, and laziness. Some participants' statements about this issue are as follows:

> "*Is it the other name for laziness? Most likely, it is what people who do not go out and do not do sports do.*" *(P04)*
>
> "*Doing nothing all day, eating and sleeping. Also, it is like avoiding cleaning the house. It is like going home and lying down, sleeping. This is an example of sedentary behavior.*" *(P09)*

Some participants associate SB with living inactively, shutting themselves in at home, and spending a significant portion of their time on phones and computers.

> "*Some people cannot leave their homes. This could be an example of living inactively. That is, they are not moving, not doing sports. Like that. Looking at the phone, using the computer. For 3-4 hours.*" *(P03)*

Participants mostly provided examples of spending more than 3-4 hours per day using computers and phones as sedentary behavior.

> "*My sedentary behaviour is probably being on the phone. I usually do this to communicate with my friends and occasionally play games. I spend about 3-4 hours a day on the phone at home.*" *(P05)*

Participants' perceptions of SB and their examples are similar to the literature. However, it was observed that the participants' general statements about their own SB were above the SB durations recommended in the guidelines (Australian Government Department of Health, 2021; Chaput et al., 2020; Tremblay et al., 2011). While some participants use technology for non-entertainment purposes, it is noteworthy that the majority use it for entertainment purposes due to the lack of alternatives, as seen in the statement of the participant coded P06, "...out of boredom, you know."

Sedentary behavior and its effect on health

Participants generally believe that SB has adverse effects on health, causing obesity, musculoskeletal problems, sleep issues, headaches, and problems in social relationships. Some participants' views on the impact of SB on health are as follows:

> *"Inactivity, as I said at the beginning of this conversation, significantly affects weight gain. So, when you gain extra weight, your body becomes sluggish. When you want to do something, you get tired quickly. I also think it has a significant impact on relationships. Because a person shuts themselves in at home and forgets about the outside world when they go out." (P05)*
>
> *"It can cause laziness, bone pain, sleep problems, and headaches. It can lead to many things." (P07)*

One participant (P03) mentions that SB could lead to health problems in older ages and emphasizes the negative aspects of entertainment-oriented technology use among the types of SB:

> *"It does not affect me right now. Haymana is a small place, after all. We walk everywhere. It does not affect me now, but I think it will affect me in the future. This is one of the negative aspects of technology." (P03)*

It is known that preserving and maintaining health at a young age will have positive contributions to health in later years. In this context, P03's statement, "It does not affect me right now, but I think it will affect me in the future" indicates that the individual perceives their SB as "unhealthy." Furthermore, due to the conditions where P03 lives, engaging in walking activities frequently, they believe this behavior will help prevent the adverse effects of SB in their youth. Looking at participants' statements, it can be observed that they generally believe that SB will negatively affect health both physically and socially.

Thoughts on the frequency and duration of sedentary time and the type of sedentary behavior

When participants were asked about the impact of the frequency and duration of sedentary time on health outcomes, most participants (81.8%) believed that an increase in the duration and frequency of SB would lead to negative health outcomes. For example, P04 discusses the negative health consequences of not engaging in regular PA, such as pain, weight gain, and muscle atrophy. They emphasize the importance of gradually increasing PA and maintaining the current level.

> *"Definitely. When the body does not move, your bones start to collide with each other. For instance, athletes' bodies get stiff after they quit sports, and they constantly struggle*

with pain. Because the body has gotten used to movement, it wants more, but when you do not satisfy it, you will experience more pain and gain more weight. Moreover, muscle wasting can also occur." (P04)

While it is believed that spending 4-5 hours or more in entertainment-oriented technology use would harm endurance, there is an opinion that breaking SB into specific periods is important. P05's thoughts on this matter are as follows:

"Of course, a person needs to sit and be inactive when they are tired, but they need to do it without exaggerating. If you do this for 4-5 hours a day, your body will become completely sluggish. But if it is done with intervals of 1-1.5 hours, to have fun, meet friends, I do not think there will be any problems." (P05)

Participants generally believe that an increase in the frequency and duration of entertainment-oriented technology use, a type of SB, would negatively affect health outcomes. There is also a notion that the type or domain of SB might have varying effects on health outcomes. One participant (P10) advocates the contribution of reading books during SB to personal development and cognitive functions while highlighting additional negative effects of entertainment-oriented phone use, such as radiation exposure.

"Because there are factors like radiation in phones, which are not present in books. They can be more harmful or beneficial to the human body. When reading a book, you can improve your brain to some extent. I do not think the same is possible with a phone. So, it exists." (P10)

"In general, participants reported that entertainment-oriented technology use could have negative effects on overall health, eye health, and endurance, with examples such as "For example, playing on the phone all day negatively affects health." (P08) and "If there is too much technology, our eyesight may deteriorate." (P11).

Participants particularly mentioned the negative consequences of increased frequency and duration of entertainment-oriented technology use while adopting a more positive stance toward types of SB like reading books. All these findings reflect young people's perception and awareness regarding SB potential negative health outcomes.

Promoting awareness of sedentary behavior and physical activity through bocce game

Participants mentioned that playing bocce contributes to SB and PA by promoting physical and mental activity and enjoying time with peers. These findings, along with the statement from participant P05, "I had a great time with my friends... it was the most enjoyable game for me after bodybuilding," indicate that the bocce game enhances individuals' desire

and motivation. Participants used the following statements to discuss whether playing bocce contributes to increasing PA and reducing SB and its impact on health outcomes:

> "*Absolutely. We constantly change the rings (bocce balls). We throw them by moving ourselves.*" *(P03)*
> "*It does. Since we are constantly in motion, it contributes to us both mentally and physically.*" *(P06)*

When participants were asked if playing bocce contributes to awareness about SB and PA, seven participants (P03, P04, P05, P06, P08, P10, P11) stated that it does, while two participants stated that it does not (P02, P07), and one participant (P09) said it partially does. One participant (P01) did not provide an opinion. Participants mentioned that playing bocce helped raise awareness about SB and PA by recognizing the benefits and necessity of PA, the importance of warm-up exercises, and using time for playing bocce instead of computer use. Thus, they could utilize a time that could have been spent sedentarily for PA. Additionally, the statement from participant P04, "Yes, I might even be licensed," reflects their intention and willingness to play bocce again.

Among the seven participants who believed that playing bocce contributes to awareness about SB and PA (P03, P04, P05, P06, P08, P10, P11), two participants (P03, P08) we were stated that they did not consider themselves physically active in other statements. Five participants (P04, P05, P06, P10, P11) described themselves as physically active. Among those who considered bocce not to contribute to awareness about SB and PA (P02, P07), participant P02 considered themselves not physically active, while participant P07 considered themselves physically active. The participant (P09) who did not consider themselves physically active stated that playing bocce partially developed awareness in them. These findings indicate that playing bocce contributes to awareness about SB and PA for most participants, regardless of whether they consider themselves physically active or not. Furthermore, when looking at the other statements of participants, among the six participants who described themselves as physically active (P04, P05, P06, P07, P10, P11), five (P04, P05, P06, P10, P11) expressed a desire to play bocce again. One participant (P07), who considered themselves physically active, remained undecided about playing bocce again. In light of these findings, we can also say that individuals' intention and motivation to change their PA behavior positively developed through the bocce game.

Expectations from institutions

Local governments, policymakers, and funding providers have essential roles in supporting young individuals to increase PA and reduce SB (Klepac Pogrmilovic et al., 2020). Therefore, one of the topics addressed in this research is the expectations of young people from local governments (municipalities, village leaders) and other institutions (universities, government, etc.) regarding the development of SB and PA awareness and the reduction of SB while increasing participation in PA. Expectations related to this issue primarily include demands for demand-driven courses for young people in Haymana, increasing the number of existing courses, organizing fun and different tournaments like bocce, and ensuring their continuity. The opinions of the participant coded P05 on this matter are as follows:

> *"Yes, encouraging is important. Because every person, well, they must be following a sport or have an interest in it. I think courses can be opened for young people based on their interests. Or games or nice things can be organized for them. In Haymana, we have one public sports hall where, as far as I know, table tennis is closed, there is a volleyball course, and now a Muay Thai course. I think they can bring different games like basketball or bodybuilding like I am interested in or new games like bocce to encourage people to try new things." (P05)*

Some participants believe that it's important to encourage individuals to engage in these activities due to lack of information or motivation for activities. For example, P09 mentions that there are opportunities for sports in Haymana for those who want to do sports, but people are not enthusiastic about participating:

> *"It would be great if many young people played, but they can get bored easily. It varies from person to person because these people choose to be active or sedentary, or there are already many sports that can be done in Haymana, but they are not choosing them, you know." (P09)*

Additionally, some participants perceive certain aspects of living in rural areas as disadvantages for PA, noting that they lack suitable physical conditions to spend their day engaging in PA and lack facilities with adequate equipment. In addition, P11 expresses how these kinds of opportunity disparities force them to engage in entertainment-related sedentary activities:

> *"We try to do things ourselves more, but there is not much available. There's an indoor sports hall, but there are not enough things we can do there, like equipment or such things, they could be provided... We are forced to resort to technology for entertainment.*

I could utilize that time better if I had the opportunity, but since we do not really have many opportunities, we are forced to use what we have." (P11)

The statement "I could utilize that time better if I had the opportunity" from participant P11 reflects their intention to change. In participants' statements, it is evident that living in rural areas poses disadvantages in terms of accessing various opportunities, and there are expectations from institutions to improve these opportunities.

DISCUSSION

This study sheds light on the perspectives, perceptions, and interpretations of young individuals in rural areas regarding enhancing SB and PA awareness through the game of bocce. Structured settings (such as after-school programmes, summer camps and PA/sports programmes) have been reported to be necessary for PA participation as they have the infrastructure and resources to promote PA and reduce SB, and young people spend most of their time in these environments. After-school programs and routine practices at school have been reported to provide significant amounts of PA and limit SB for young individuals. Additionally, non-structured periods outside of school, like vacation periods, have been defined as critical times associated with adverse effects on youth's health due to reduced exposure to structured environments and lack of routine (Tassitano et al., 2020). Economic factors that influence the resources and quality of environments that facilitate participation, such as available transportation options for reaching school, and cultural factors, such as common beliefs regarding the importance of PA for health, can lead to variations in levels of out-of-school PA. Therefore, it is considered essential to expand PA interventions to encompass both in-school and out-of-school settings (Bann et al., 2019). For these reasons, supporting activities in structured environments during school and non-school periods and creating awareness for SB and PA through activities like bocce seem essential. The statements of the young participants in our study also support the idea that bocce is an effective tool to increase awareness of SB and PA in rural areas.

WHO PA guidelines state that young individuals can engage in PA in various settings, such as recreational and leisure activities, physical education, transportation, or household chores. It is crucial to encourage all young individuals to have access to safe and equitable opportunities and motivate them to participate in enjoyable, diverse, age-appropriate PA. In WHO reports, numerous beneficial health outcomes have been linked to higher quantities and intensities of PA, including improved cardiorespiratory, muscle, bone, and cardiometabolic health. Furthermore, positive impacts of PA on mental health, cognitive function, adiposity,

and academic outcomes have been reported (World Health Organization, 2020). In our study, participants similarly described the effects of PA on health outcomes as seen in the literature. It can be inferred from participants' responses that they perceive PA behavior as "healthy." While WHO guidelines do not precisely determine the optimal PA dose associated with improved health outcomes, a daily minimum of 60 minutes of moderate-to-vigorous intensity PA is recommended. Evidence shows that aerobic PA enhances cardiorespiratory fitness in youth, and resistance exercises increase muscle fitness, with some evidence indicating more significant benefits from engaging in both. Young individuals are advised to engage in muscle and bone-strengthening activities at least three days per week. However, no definitive evidence in the literature indicates how health outcomes might vary based on the type or domain of PA (Chaput et al., 2020; World Health Organization, 2020). The frequency of PA suggested by participants is similar to the literature's recommendations, and we believe this might positively influence participation, especially among those who perceive themselves as not engaging in sufficient PA.

Over the past decade, the issue of increasing SB has gained recognition through extensive public health guidelines. Given the high exposure to SB and its adverse effects on public health, this has led to the implementation of intervention studies aiming to reduce SB across various contexts and populations (Australian Government Department of Health, 2021). Guidelines recommend that recreational sedentary screen time for youth should not exceed 2 hours per day (Tremblay et al., 2011). However, it is worth noting that many participants' sedentary times, especially those involving entertainment-related technology use exceeded the recommended durations. In our study, participants believe increasing SB would have adverse health effects. Regarding whether these relationships vary based on the type or domain of SB, some participants believe that activities involving sitting while reading might impact personal and cognitive development, whereas SB, like entertainment-related phone use, might have adverse health effects due to radiation exposure. Participants' statements indicate that they perceive their own SB as "unhealthy". WHO guidelines state that there is insufficient evidence to define dose-response relationships between SB and health outcomes fully, and whether these relationships vary based on the type or domain of SB (Chaput et al., 2020). A systematic review examining interventions' effectiveness in reducing sitting and screen time found that interventions resulted in small but significant changes in sedentary time (Nguyen et al., 2020). Given that different strategies can yield comparable benefits and considering individuals who struggle with moderate-intensity PA might need to replace SB with light-intensity PA (Nguyen et al., 2020; Stamatakis & Gill, 2019), bocce appears to be a

promising alternative for young individuals. Engaging in bocce allows individuals to reduce SB and increase PA levels without necessitating strenuous effort.

Bhuiyan et al. suggest enhancing knowledge and awareness about how rurality affects health and behavior to promote the expansion of PA interventions in rural communities and reduce health-related inequalities linked to rural areas (Bhuiyan et al., 2019). Furthermore, public health policy agendas in rural communities emphasize the need to diversify PA environments, encourage school-based physical education classes, and promote access to team sports during out-of-school hours (Patterson et al., 2015). Similarly, the opinions of participants in our study suggest the need to increase the number of various activities and their promotion among young people. Among rural youth, lack of motivation and self-confidence, distance to activities, and lack of preferred options are identified as the key barriers to PA. In contrast, peer acceptance of activities, prioritisation by family, more education about activities and more excellent gender equality opportunities in activities are highlighted as facilitating factors for PA (Chen et al., 2018). Our study shows that rural youth desire more skills and self-confidence for PA participation, peer acceptance, and a greater variety of activities. Among youth who receive positive peer support for PA, the built environment was reported to have stronger facilitating effects on PA (Loh et al., 2019). This suggests that participation in activities like bocce, which can be played with peers and enjoyed, could help weaken environmental barriers for rural youth. Additionally, motivational factors related to engaging in activity have been shown to influence SB (Kamath et al., 2008). Converting interventions into practice, especially in complex environments with limited resources like rural communities, can be challenging (Meyer, Perry, Sumrall, et al., 2016). Due to its nature, bocce becomes a highly advantageous PA option for rural youth, as it can be played with a small number of inexpensive and easily accessible equipment and does not require highly equipped game facilities or extensive training. The participants' statements further validate this perspective. Additionally, considering participants' perceptions of the health benefits of PA, adverse health effects of SB, their perception of SB as "unhealthy," the awareness effects of playing bocce on SB and PA among youth, and the willingness of most participants to play bocce again, it can be observed that there is an intention for change and motivation for behavior change in the context of behavior change (Ajzen & Schmidt, 2020; DiClemente & Graydon, 2020). We believe bocce could be a preferred option to reduce SB and increase PA among rural youth.

Furthermore, inadequate PA is globally associated with a significant economic burden. The worldwide cost of this situation to healthcare systems is estimated to be around 53.8

billion dollars (Ding et al., 2016). Evidence linking substantial public health benefits and economic gains achievable by increasing PA across populations encourages governments to develop PA policies (Klepac Pogrmilovic et al., 2018). Local governments, policymakers, and funding providers also play important roles here. Supporting cost-effective activities like bocce highlights that with potentially lower investment, these activities might reach even more individuals. Additionally, the feasibility of SB policies is generally lower than PA policies (Klepac Pogrmilovic et al., 2020). This is due to public awareness of potential adverse health outcomes of SB that have only recently started to develop. Steps need to be taken to enhance this awareness. Policies can only be effective when implemented; therefore, national governments should invest in mechanisms that facilitate the better implementation of PA and SB policies and promote their adoption (Klepac Pogrmilovic et al., 2020). Given the significant public health impacts that bocce and similar low-cost and easily accessible activities can bring, supporting them seems essential.

CONCLUSION

To the best of our knowledge, this research is the first qualitative phenomenological study in the literature that investigates the potential of bocce game to enhance PA and SB awareness among rural youth. The research findings indicate that engaging in bocce game during leisure time outside school can effectively promote PA and SB awareness among rural youth. This suggests that bocce game could be an encouraging intervention to foster participation in PA and reduce SB in this population. Consequently, it is believed that bocce game could mitigate potential adverse health outcomes and alleviate a significant burden on public health.

Furthermore, based on the results of our research, we believe that the contribution of bocce in reducing SB and promoting PA among young people living in rural areas should be further disseminated with the support of local governments and policymakers. It is evident that sustainable services supporting PA and targeting to reduce SB are necessary, as young people tend to spend more time in SB compared to active behavior.

Limitations

This study follows a qualitative phenomenological research design, deeply exploring individuals' subjective views. While individuals' perceptions and interpretations of SB and PA are crucial, it can be argued that solely evaluating them might fall short in awareness. Therefore, it might be necessary to complement qualitative data with quantitative data. One

limitation of our research is that we did not conduct objective measurements of young individuals' actual PA and SB levels, relying solely on their perceived levels, including their perceived PA and SB levels during bocce game. Another limitation of the study is that we do not know the current PA levels of the participants. Another limitation is the absence of validated scales in the native language of our chosen population for assessing these measurements.

Given the limited research on SB and PA awareness, many questions remain unanswered. In future studies, it is recommended to conduct mixed-methods research where individuals' objective PA measurements are taken using wearable technologies during bocce game, and subjective qualitative data support these measurements. We also recommend that future research investigate the potential for awareness to lead to behaviour change, investigate different strategies to reduce SB and increase PA awareness among rural youth, and find ways to disseminate these strategies. Particularly in rural areas, it is paramount for local authorities and policymakers to take steps toward providing services that support SB and PA awareness, and to incentivize their promotion.

PRACTICAL IMPLICATIONS

- In young people, reducing sedentary behavior and increasing participation in physical activity remains a critical issue.
- The multifactorial nature of rural areas affects individuals' physical activity habits and sustainable strategies are needed to promote sedentary behavior and physical activity awareness among rural youth.
- This research covers various aspects of physical activity, sedentary behavior, and perceptions of the bocce game activity that may affect sedentary behavior and physical activity awareness.
- The study results indicated that out-of-school time bocce for rural youth is an intervention that improves awareness of sedentary behavior and physical activity and encourages participation in physical activity and reduction of sedentary behavior.
- It seems essential for local authorities and policymakers to produce and promote services that support sedentary behavior and physical activity awareness, especially in rural areas.

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Authors' contribution

Author BNE conceptualized and designed the study, analyzed and interpreted the data, critically revised the manuscript, and wrote the article. Authors (BNE, HK, Mİ, EK, and CK) conducted interviews and reviewed interview transcripts. All authors (BNE, HK, HG, Mİ, EK, and CK) approved the final manuscript. Furthermore, BNE and Mİ provided funding, and HK entered the data into NVivo. HG translated the article into English.

Conflict of interest declaration

The authors have no conflicts of interest to report.

Ethics Statement

This study was reviewed and approved of by the Ankara University Ethics Committee (Approval Number: 56786525-050.04.04/580730)

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Understanding "The Athletic Labour of Femininity" Through the Experiences of Turkish Female Personal Trainers

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ABSTRACT

The momentum of social media in the world of sports has created a wide range of opportunities for women in sports. One of the most obvious of these opportunities is undoubtedly related to economic visibility. The current research aims to examine how female trainers in the health and fitness sector, who actively participate in the creation and consumption of sports, represent themselves on Instagram through the concept of the athletic labour of femininity in the light of Turkey's gender regime and neoliberal feminism. In this study, which applied quantitative content analysis to a total of 1100 photographs of eleven individual coaches (11), eight in-depth individual interviews were conducted, and these qualitative data were analyzed by thematic analysis method. The quantitative and qualitative findings of the research show that women trainers in the health and fitness sector construct coaching that is in line with neoliberal femininity. On the other hand, power relations based on Turkey's neoconservative, religious patriarchal norms influence the market-based decisions trainers make about their sharing. As a result, Turkey-specific dynamics are at the forefront of trainers' athletic endeavours, which they focus on building a brand image. This study offers a perspective on how personal trainers serving in the healthy living and fitness industry use Instagram as a marketing tool, what economic opportunities they get, and what they negotiate while improving their visibility on Instagram, in the context of neoliberal femininity and Turkey's gender regime.

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INTRODUCTION

Today, the widespread and effective use of social media by the sports world has brought about significant changes in the production and consumption of sports (Abeza et al., 2019; Abeza, 2023; Bruce, 2016; Hayes et al., 2019; López-Carril et al., 2020a, 2020b; Osborne et al., 2021) and social media platforms have become an integral part of today's sports culture (Abeza & Sanderson, 2022). A notable aspect of these changes concerns women athletes and women's sports. Unlike traditional media, social media platforms provide many advantages to female athletes such as being more visible, interacting with fans, representing themselves as they wish, presenting different aspects of their lives, developing a personal brand image, sponsorship and collaboration opportunities, and creating their advertisements (Bruce, 2016; Burch & Zimmerman, 2019; Geurin, 2017; Geurin-Eagleman & Burch, 2016; Thorpe et al., 2017; Toffoletti et al., 2022). Yet the increasing visibility of female athletes on social media has also created some risks. Much research has shown how female athletes are constantly judged by their fans and followers, with some subjected to various forms of online abuse and virtual maltreatment (Kavanagh et al., 2019; Kavanagh et al., 2022; Litchfield & Osborne, 2022; Litchfield et al., 2016; Toffoletti et al., 2022).

The international literature on female athletes and social media analysis emphasizes that female athletes use social media platforms for a wide variety of purposes and that these platforms provide economic visibility and gains for female athletes that they cannot achieve in mainstream media (Geurin-Eagleman & Burch, 2016; Li et al., 2021; Thorpe et al., 2017; Toffoletti & Thorpe, 2018a, 2018b). While sports and social media researchers in the Western context continue to present their analyses on sportswomen in a nuanced and complex manner and deepen the debates, the literature in Turkey has missed the mark (Kavasoğlu & Koca, 2022). As yet, no research in Turkey has explored the athletic labour of femininity that women who are physically active in online spaces present on Instagram.

Toffoletti and Thorpe (2018a), two of the most influential and agenda-setting researchers in sports and social media research, suggest that we pay attention to the complexities that female athletes must negotiate when trying to produce an authentic feminine sports identity and brand in a postfeminist consumer culture. Bruce (2016) emphasizes the need for further exploration of different cultural contexts to understand the much greater diversity of representation of sportswomen. Turkey has a cultural context dominated by a neoliberal, neo-conservative climate, and patriarchal power relations. On the other hand, Turkey is said to be the only modern, democratic, Islamic country, which makes it somewhat

of an anomaly in the Islamic world, and the status of Turkish women visibly marks this difference (Müftüler-Bac, 1999). Modern Turkey is also unique among Islamic countries because it is a secular state (Arat, 1996). Therefore, the Instagram experiences of women in Turkey's sports ecosystem allow us to hear different and unique voices on gender relations. To hear these different voices, the current research will try to explore the athletic endeavours of female coaches within the health and fitness sector on Instagram (Rahikainen & Toffoletti, 2021; Toffoletti & Thorpe, 2018a).

Theoretical Framework

In this research, the concept of *athletic labour of femininity* developed by Toffoletti and Thorpe (2018a) was used as a conceptual framework. This concept emphasizes the economic visibility of women in sports and was developed about neoliberal feminism. In this context, in this part of the study, we will touch upon neoliberalism, neoliberal feminism and the femininity values produced by this feminism, and we will try to understand the neoliberal femininity values produced by women in sports fields.

Neoliberalism is a dominant political rationality that moves to and from the management of the state to the inner workings of the subject, normatively constructing and interpellating individuals as entrepreneurial actors (Rottenberg, 2014). In this context, a neoliberal subject construction takes place, centring on the ideals of self-discovery, autonomy, and self-realization. In the construction of the neoliberal subject, the feminine has gained a unique importance and women are encouraged to produce themselves as objects of the gaze (Özyeğin, 2018).

According to neoliberal feminism, women are entrepreneurial subjects, neoliberal feminism is hyper-individualizing (Banet-Weiser et al., 2020) and this feminism offers no critique – immanent or otherwise – of neoliberalism (Rottenberg, 2014). This neoliberal feminism is helping to produce a particular kind of feminist subject. Using key liberal terms, such as equality, opportunity, and free choice, while displacing and replacing their content, this recuperated feminism forges a feminist subject who is not only individualized but entrepreneurial in the sense that she is oriented towards optimizing her resources through incessant calculation, personal initiative and innovation (Rottenberg, 2014).

In late capitalist economies individuals are primarily valued and understood in market terms as buyers, sellers and consumers. What is being "sold", then, in a neoliberal marketplace is the female athletic body as a gendered product (Toffoletti & Thorpe, 2018b). As Rottenberg (2014) underlines, in connection with this, "a new trend is on the rise: increasingly, high-

powered women are publicly and unabashedly espousing feminism." (p. 418). This statement also bears evidence of the emergence of neoliberal femininity and how it was popularly adopted.

Feminist analyses of neoliberal feminist sentiments are valuable in helping us to understand the broader cultural conditions that influence how many sportswomen engage with social media, particularly as a form of self-branding in the context of neoliberalism (Thorpe et al., 2017). Toffoletti and Thorpe are among the first feminist sports scholars to critique how sportswomen are internalizing neoliberal discourses of self-entrepreneurialism about their self-branding and use of social media (Thorpe et al., 2017). They propose a new conceptual framework – the athletic labour of femininity – to understand how elite sportswomen cultivate an authentic brand in the sports marketplace. More than a type of 'bodywork', the athletic labour of femininity responds to consumer expectations that women demonstrate a successful feminine subjectivity characterised by notions of personal choice, individual responsibility and self-management (Toffoletti & Thorpe, 2018a). For example, many Western studies have identified that sportswomen emphasize their personal lives and sexuality on social media. These studies reveal that female athletes' posts that embrace sexually attractive and heterosexual femininity are one of the contents in which they build their brands and present themselves on social media (Clavio & Eagleman, 2011; Geurin-Eagleman & Burch, 2016; Smith & Sanderson, 2015; Thorpe et al., 2017). This desirable, sexy and attractive female body can be interpreted as the neoliberal subject's regulation of herself according to market conditions and expectations. Because the female body that gains economic visibility on social media for the consumption culture strengthened by neoliberal policies is the female body that the followers/market want/desire.

Neoliberal feminism is the manifestation of a new kind of mainstream feminism, where gender inequality is being called out (rather than repudiated) but responses and reactions to such inequalities are framed by neoliberal discourses of individual entrepreneurialism and economic independence only. Simply, women who can individually overcome structural inequalities and obtain economic independence and success are celebrated as feminist subjects (Thorpe et al., 2017). To Toffoletti and Thorpe (2018a), positioned as neoliberal subjects required to respond to market conditions, elite sportswomen do so by marketing their lifestyles online, with a particular focus on curating authenticity via bodily appearance, as a means to achieve sporting visibility (p.313). For example, emphases such as love yourself (or love your body), self-disclosure, and self-empowerment in the branding strategies of

contemporary athlete women on social media platforms may mean that athletes respond to the needs of the market by neoliberal femininity (Toffoletti & Thorpe, 2018b).

Toffoletti and Thorpe (2018a) argue that studies of athlete self-presentation and branding on social media would be considerably enriched by paying greater attention to the social conditions influencing how sportswomen represent the self online and the gender power relations that serve to govern expressions of desirable athletic femininity (p. 300). Instead, they argue that social media interaction between female athletes and fans is governed by gender norms and arrangements that expect and reward female athletic articulations of empowerment, entrepreneurialism and individualization in the context of postfeminism, and as it intersects with consumer cultures of leisure, lifestyle, sport and fitness (Toffoletti & Thorpe, 2018a).

There is a need for further exploration of different cultural contexts to understand the much greater diversity of representation of sportswomen (Bruce, 2016). In this respect, Turkey presents a cultural context in which a neoliberal, neo-conservative climate prevails, and patriarchal power relations are dominant. Due to this context, the experiences of women in sports in Turkey are different from their counterparts in both Western and Muslim countries. The present research offers an opportunity to hear these different voices.

The current research focuses on understanding how women with coaching experience in the health and fitness sector in Turkey, a secular and Muslim state of law, use Instagram as part of their profession. The concept of the athletic labour of femininity developed by Toffoletti and Thorpe (2018a) is highly functional for our research problem. As emphasized by Toffoletti and Thorpe (2018a) research on sportswomen's self-presentation on social media, applying the athletic labour of femininity framework would enable researchers to attend to the complexities that female athletes must negotiate when attempting to produce an authentic feminine sporting identity and brand in a postfeminist consumer culture (p. 313). We use the concept of the athletic labour of femininity as a conceptual framework since it allows us to explore the social conditions of our country and the gendered power relations that serve to govern desirable expressions of athletic femininity in the self-representations that Turkish women coaches construct while branding themselves on Instagram.

Women, Sports and Social Media in Turkey

In Turkey, female athletes experience various discriminations and disadvantages due to gender inequality and patriarchal power relations in the fields of sports and physical activity (Öztürk & Koca, 2019; Koca, 2021; Koca et al., 2009). These experiences of inequality

and discrimination, or the difficulties experienced by women in participating in sports and exercise due to traditional gender roles, are not limited to licensed female athletes but also include women participating in physical activity and exercise (Bulgu et al., 2017,; Hacısoftaoğlu, 2005; Kara, 2016; Koca et al., 2009). On the other hand, the Gender Equality in Sports in Turkey 2021 Report emphasizes that in recent years, women athletes have made significant progress in the fields of participation in sports and participation in the Olympic and Paralympic Games. For example, according to the data of this report, the proportion of female athletes in the total number of licensed athletes in Turkey is 34.84% (4,001,245) and has increased by 109.47% in 2021 (Kasfad, 2021).

With this increase in women's participation in sports, their visibility on social media has also increased. When we follow successful female athletes on social media, it is understood that social media provides economic opportunities for female athletes in our country. We can say that Turkish elite female athletes develop their brand image through their social media accounts just like their counterparts abroad. For example, Nike sponsored Yasemin Adar, the world champion, 4 times European Champion in a row and the first women's wrestling medalist in the history of our country at the Olympics. And this sponsorship formed an important part of Yasemin Adar's Instagram posts. In addition, Kübra Dağlı (796B followers) is another athlete who has represented Turkey in taekwondo -poomse- branch with significant success -three world and four European championships- and has a sponsorship agreement with Red Bull. In many of her posts, especially in her sports life poses, she makes this brand visible. Another elite athlete sponsored by Red Bull is Hazal Nehir. Hazal Nehir is Turkey's first female parkour athlete and the first athlete to represent Turkey at the Red Bull Art of Motion Final. In many of his posts, we see a trace of Red Bull. Finally, Ebrar Karakurt (1.6M followers) is a national volleyball athlete who comes into question with her short pink hair and her shares with her girlfriend on Instagram. In Turkey, which has homophobic values both in social life and in sports (Bilgehan Özturk, 2011; Kavasoğlu, 2021; Nuhrat, 2022; Ozeren et al., 2016; Öztürk, 2018; Sakallı-Uğurlu &Uğurlu, 2016; Saraç & McCullick, 2017; Yertutanol et al., 2019), she is well-known for her notable volleyball accomplishments, her short pink hair, and the commercials she appeared in for Elidor, a well-known Turkish shampoo company. In these advertising campaigns, the slogans "Dedim Olabilir (I said it could be)" and in the following advertisement, "Dedik Olabilir (We said it could be)" developed discourses pointing to difference and diversity. In the Elidor commercials, with the words "They said if it would be a girl with short hair. I said it could be", Karakurt emphasized that there are different representations of femininity and that all of them are valuable, in an advertisement that has

been viewed millions of times. Thus, we can say that a female athlete in Turkey who is not in line with norms of normative femininity has come to the forefront in traditional and social media. All these developments encourage women in sports and physical activity in Turkey, especially young women, to use social media for collaboration, sponsorship opportunities, and improving their brand image.

Research on women's sports and social media in Turkish sports fields is quite new and limited compared to the international literature (Ayhan & Demir, 2022; Demir & Ayhan, 2022; Ekinci & Koca, 2022; Kavasoğlu & Koca, 2022; Kavasoğlu et al., 2023). However, significant research on women and social media in sports has been conducted for several years. Thanks to this research, we have an idea about the problems such as discrimination, sexism, cyber violence and harassment experienced by women in different areas of sports (such as elite sports, exercise, and sports media) on social media platforms and can see how women represent themselves on these platforms. Moreover, we can learn about the emphasis on femininity and nationalist images in the brand-building of elite female athletes on Instagram. And in these areas, we can understand what kind of sexist, patriarchal and gender-based violence women are subjected to (Demir & Ayhan, 2022; Kavasoğlu & Koca, 2022; Kavasoğlu et al., 2023). In the current research, we focus on the experiences of female personal trainers in the health and fitness sector who play an active role in the production and consumption of sports on social media. We will try to understand the content produced by these coaches on Instagram and their branding experiences on Instagram through the concept of *the athletic labour of femininity* (Toffoletti & Thorpe, 2018a). We will foreground the dynamics of this labour specific to Turkey's gender regime.

METHODS

In this study, we used a mixed methods design with a feminist lens because both Instagram posts and the experiences of the personal trainers were important in explaining the research problem. Mixed method is defined "as research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches or methods in a single study or a program of inquiry" (Tashakkori & Creswell, 2007). We followed implemented data collection sequentially, first collecting quantitative data on trainers' Instagram posts followed by qualitative interview data (quan followed by qual; Hanson et al., 2005) and we used partially mixed sequential dominant status design. This design refers to a study that is implemented sequentially in two stages and in which one of the qualitative or quantitative components is more dominant (Baki & Gökçek,

2012; Leech & Onwuegbuzie, 2009). In the research, the qualitative research phase was the more dominant phase.Our methodological decision-making is shaped by the theoretical understanding offered by Toffoletti and Thorpe (2018a, 2018b) on the economic visibility of sportswomen on social media and the athletic labour of femininity, which guided our data collection and analysis procedures. In this research, we will try to understand how female coaches in the culture of exercise, healthy living, and fitness in Turkey use Instagram as a marketing platform and how they present themselves on this platform. How do the representations of Turkish personal trainers (PTs) on social media make themselves visible in a neoliberal and neo-conservative culture? What techniques of oppression and surveillance do they negotiate in the current political and cultural climate? Considering this information, we first analyzed the last 100 posts (1100 photos in total) on the Instagram accounts of female PTs (11 participants) and then conducted in-depth (online) individual interviews lasting an average of one hour with 8 PTs who agreed to participate in the interviews. We analyzed the 100 most recent posts shared by each participant. Our data collection process started on August 2, 2022 and ended on November 8, 2022.

Participants

We used two methods to reach the participants. The first one was to reach out to women who are pursuing their PhD studies at our faculty and have been coaching for many years (around 10 years) in areas such as fitness, pilates and reformer pilates. One of the two PhD students had her studio and used Instagram as part of her job (Buket). The other one had just opened her studio and stated that she did not actively use Instagram. We asked both coaches to help us contact women coaching in Adana and other provinces in Turkey for the research invitation. In addition, Buket became the first participant in the research since she was a very suitable person for the research purpose and showed great dedication in reaching out to other coaches throughout the process. Our second method was to use the Instagram account of one of the authors. Since we used Instagram as a research field, we typed the letters PT into the search engine, as well as the participants who have existed in our Instagram account from previous studies (Kavasoğlu & Koca, 2022). We asked the coaches if they would like to participate in the research. 11 coaches, whom we contacted with these two methods and received positive feedback, constituted the participants of the research. However, these responses only covered the cities of Adana and Istanbul.

The ages of the participants, all of whom are university graduates, vary between 29 and 42. They identify themselves as Turkish and Kurdish and have different religious beliefs

such as Muslim, Christian, and Deist. They are middle- and upper-class women. They may be single, divorced or married and some have children. We have participants who have their studio, who go to the homes of their members and give private lessons, who serve through Instagram lessons or videos, or who work in a studio. Some of the participants also have YouTube channels. Among the other social media platforms (Facebook, Twitter and YouTube), the participants reported that they actively use Instagram the most. The participants have sports experiences in different sports - tennis, swimming, gymnastics, volleyball, and athletics - with various forms of participation - competitive or recreational (Table 1). Their various sports experiences, identities, religious and ethnic backgrounds, and social media platforms contributed to the richness of the data.

Procedures

To analyze the photos, we used the codebook developed by Toffoletti and Thorpe (2018a). The following categories were included for our analysis, and we used them without modification: Family and friends, fashion, and beauty do not fit into any of these categories. Their health and lifestyle-related category was adapted as an Exercise program, health and lifestyle in this study. We did not use the sporting performance, training and achievement and athlete corporate sponsors categories that Toffoletti and Thorpe (2018a) used in their study. Because in the exercise program, health and lifestyle categories, coaches presented their sporting performance. In addition, our participants had collaborations and promotions rather than sponsorship agreements. In the current research, the following new categories emerged: Brand promotion and marketing; Being wife, partner and/or mother; Social sensitivity, solidarity, celebration; vocation and entertainment. Thus, we had a total of nine categories (Table 2). We subjected these categories to quantitative content analysis separately as two authors. We used Miles and Huberman's formula of coding reliability. Our agreement percentage is 90.1%.

Our participants Derya, Zeynep, Elif, Eda and Zehra have their own studios. Büşra works as a trainer at someone else's sports center. Merve goes to the homes of her members and gives private lessons. Şeyma has both private lessons and gives lessons through social media platforms. There are different social media platforms that coaches use. However, they stated that they use Instagram most actively. In addition, after a while, they started using Instagram as a part of their coaching.

Table 1
Personal Information of the Interviewed Participants

Name	Age	Marital status	Ethnicity and Religious	Education	City	Year of Employment in the Profession	Social media platforms used	Year of using Instagram	Instagram as part of your profession
Derya	34	Married	Turkish/Muslim	Doctorate	Adana	12 years	Instagram	7 years	6 years
Merve	42	Single	Turkish/Muslim	University	Adana	5 years	Instagram Facebook	8 years	3.5 years
Büşra	29	Married	Turkish/Muslim	University	Adana	7 years	Instagram Facebook	8 years	3 years
Zeynep	38	Single	Turkish/Deist	University	Adana	7 years	Instagram Facebook Twitter	11 years	7 years
Elif	43	Single	Turkish/Muslim	University	Adana	21 years	Instagram Facebook	8 years	8 years
Eda	40	Married	Armenian/Christian	University	İstanbul	20 years	Instagram YouTube Spotify	9 years	8 years
Zehra	36	Single	Turkish/Muslim	Masters	İstanbul	19 years	Instagram Facebook YouTube Tiktok	7 years	7 years
Şeyma	40	Married	Turkish/Muslim	University	İstanbul	12 years	Instagram YouTube	3 years	3.5 years

Table 2
Participants' Instagram Content

Category	Definition
Exercise programme, health and lifestyle related	It refers to the exercise videos, exercise photos, healthy eating and healthy living shares that the trainer prepared for his members and followers.
Fashion and beauty	These are the posts that emphasize the beauty and fashionable femininity of the trainer.
Brand promotion and marketing	It is the trainer's promotion and marketing of a brand, product.
Media appearances	Involvement of the coach in media such as magazines and television.
Family and friends	Private life and leisure time sharing with family and friends.
Being wife, partner and/or mother	These are the posts emphasizing that she is married, has a boyfriend and/or is a mother.
Vocation and entartaintment	It is the sharing that makes the holiday and entertainment life visible.
Social sensititivity, solidarity, celebration	These are posts that celebrate Turkish holidays, special days, and express sensitivity to nature, animals, and all living things.
Did not fit into any of these categories	Posts that do not fall into any of the above categories.

Most of the interviews were conducted via digital platforms (WhatsApp and Zoom) and ranged from 45 minutes to 1 hour. The interviews explored themes such as the meaning of social media platforms in terms of their professions, their purpose of using social media, the advantages it brings to their professions, the risks of visibility, cultural norms, and strategies for dealing with risks, and the methods they use to earn more from social media.

Data Analysis

We used the six steps proposed by Braun and Clarke (2006) to conduct an interpretive thematic analysis. First, familiarization with data – the data were organized in the transcripts. Then authors read and re-read transcripts to become familiar with the content. Second, the generation of initial codes – authors and two colleagues from the sports sciences field (one sport management, and one gender studies researcher) separately identified features in a systematic manner using general codes across the data set. Third, searching for themes – the researchers met and discussed their preliminary codes and compared interpretations of further themes. Fourth, reviewing themes – the coded data were developed by consensus into a thematic map, whereby the researchers considered the arrangement of themes and sub-themes. Fifth, defining and naming themes – to refine all themes, definitions were derived for each label. Sixth, producing the report – each theme's title was amended to reflect the study's data and these were related to the research questions and the literature (Braun & Clarke, 2006).

The study received ethical approval from the Ethics Committee of Çukurova University (Year 2021 and decision number 41) and adhered to the principles outlined in the Declaration of Helsinki. Participation in the study was voluntary, and participants received written and oral explanations regarding their participation and the importance of providing accurate information. Before the Instagram analysis and the interviews, we made them sign a voluntary participation form and asked them again during the interviews. We explained their rights to end the interview at any time and to skip any question they did not want to answer. We kept the identities of all participants secret and gave them pseudonyms. We shared the transcripts of the research with them and told them that we would remove any parts they did not want us to use in the analysis. There were no parts they wanted to remove. We used triangulation of data (quantitative and qualitative) and researcher (two researchers made independent evaluations during the analysis of data) to ensure the credibility of the study (Denzin, 2012).

RESULTS

In this section, we have collected our findings under three themes:

1. A sine qua non of the profession: "Our Instagram profiles are our electronic resume."
2. Components of Building Brand Image
3. The athletic labour of femininity is unique to Turkey: "This is Turkey, we cannot share such things here."

The first theme gives us information about the purposes for which they use Instagram regarding their profession and what kind of content they produce on Instagram. In the second theme, we understand how Instagram has turned into a marketing and brand-building area for female personal trainers. This theme also allows us to see what benefits Instagram posts provide for their profession and what advertising, sponsorship and collaboration opportunities they provide. In the last theme, we make inferences about understanding the negotiations in the coaches' Instagram posts and how their athletic labour of femininity is established to avoid conflict with their followers and damage the brand image.

A sine qua non of the profession: "Our Instagram profiles are our electronic resume."

In this theme, we will try to understand how the coaches we interviewed interpret Instagram as a platform for their profession and what sort of profile (content) they try to create on Instagram. All of the participants see Instagram as an indispensable part of their profession. Therefore, they think that using Instagram actively is very important for their careers. They think that using Instagram actively has numerous benefits for their professions, especially in terms of gaining more followers and members (customers) and being visible in the sector they work in:

> *"The more actively you use it in your profession, the more you shine your profession and the more people you reach, the side network. I can say that Instagram is the medium that helps you make a difference in your sector, ensures that people do not forget you, allows you to have interactive conversations with people, and keeps you on the agenda. The reason why I call it a visual feast is that Instagram has become a platform that allows you to share the knowledge you want to convey through your competencies, actually your show" (Zehra).*

> *"I started using Instagram as a part of my profession around 2016. At that time, Sinem (her daughter) had just been born and I took a break. In this period, at first, I started using it in order not to stay away from the market. I was sharing the movements I did at home as stories and posts, so that people would not forget me, to say that I am still in the business. And nowadays, I think that the heart of sports beats there, especially in our business" (Derya).*

It is acknowledged that the participants take care to ensure that the female coaching they display on Instagram is genuine, joyful, happy, and brimming with positive energies. In addition, they take care to present all aspects of their lifestyle to their followers:

"Right now, our Instagram profiles are our electronic CVs. Even a woman who does not know me can get information about me when she enters Şeyma Alpay. Therefore, this was opened up all over the world. How would you like to introduce yourself? By the way, are you her? My page is a real page, it reflects real life... I share images of a mother, a wife, a sports trainer, a woman, a working woman, and whatever I do in my daily life (Şeyma)."

On Instagram, the participants take care to present themselves as athletic, strong, self-confident, successful, knowledgeable, entrepreneurial, full of good (positive) energy, beautiful, attractive, and healthy lifestyle female coaches:

I want them to see a successful, strong female coach, and more importantly I want them to see a knowledgeable trainer... I would like them to speak of me as an experienced knowledgeable and successful trainer and to trust me. As a woman, I want my followers to respect me and my work. I would like them to look at me and say, "Well done, she is doing her job, she is a disciplined female trainer". For example, it is often said that I am very energetic. They say, "You have a lot of energy, you motivate us". I want to reflect this energy to them when they look at Instagram too (Derya).

The research in this area demonstrates that female PTs share various types of content on Instagram. The quantitative findings of the study show that female PTs post the most on exercise programs, health, and lifestyle (56.60%) and fashion and beauty (17.20%) content; the least on media appearance (1.40%) and promotion and sponsorship (1.20%) content. In their posts, the participants mostly convey the message that women who follow them should turn exercise and healthy eating into a lifestyle for a healthy life. Qualitative findings support this too. Qualitative findings reveal that the participants' Instagram content, too, emphasizes turning exercise, healthy eating, and healthy consumption into a lifestyle. To do this, they share stories, posts, and reels with snippets and poses from their own and their members' workouts, about how they eat, dress, live (such as cafes, holidays, family, friends, and personal life), and how informed, energetic, and highly motivated they are. According to the respondents, Instagram provides them with various benefits in their industry. To take advantage of these benefits, the participants shape it according to the needs of the market and the expectations of their followers. All of this, as Toffoletti and Thorpe (2018a; 2018b) underline, is related to the construction of elite women of sport on social media in conformity with neoliberal femininity. In other words, these posts have a relationship with neoliberal femininity. These contents reflect the representations of women who are active, strong, at peace with their bodies, have high self-confidence, have economic power, and manage their

own lives (Şener, 2019) put forward by neoliberal femininity. In the market, they serve – wellness and fitness – these trainers are trying to establish their self-branding as entrepreneurial subjects through their posts. Moreover, they create a new market with their own women's individual trainer bodies, in which the female body celebrates active values such as exercise, healthy living, fashion, beauty and entertainment. The bodies (and lives) of female individual trainers, who are both subjects and objects of consumption, are marketed to their followers and consumed by their followers (members). This body and this lifestyle as a whole are marketed to the trainers' followers. Here we ask the following question: Isn't this body and lifestyle that the trainers present on their Instagram pages a body and lifestyle constructed by patriarchal power relations and neoliberal policies (and market-based relations)? (Akgöz, 2016; Bozok & Küçükdoğan, 2022; Timurturkan & Demez, 2018). We can find the answer to this in the explanations of Toffoletti and Thorpe (2018): In late capitalist economies individuals are primarily valued and understood in market terms as buyers, sellers and consumers. What is being "sold", then, in a neoliberal marketplace is the female athletic body as a gendered product (Toffoletti & Thorpe, 2018b).

Components of Building Brand Image

The participants described Instagram as a very important advertising and marketing opportunity for promoting their athletic abilities, and coaching skills and building their brand image. According to the participants, Instagram is an important advertising tool for them to express themselves and promote their coaching and they believe that they have become a brand with the lifestyle and coaching they present on Instagram. They think that as their visibility on Instagram increases, they will become more known and reach more members and followers: Mine, for example, explained this by saying, "*I generally use Instagram more actively to promote myself and make my name known*".

> *"In our business, you need to find a different channel to reach more people. That's why Instagram has to be there ... The more you are known on Instagram, the more you come to mind ... Most importantly, awareness of people about you increases. Now, instead of searching for Pt on Google, everyone looks at you by tracing hashtags on Instagram, typing Pt (Zeynep)."*

> *"When I first opened my studio, I was aiming to attract customers and people, to attract students on Instagram. Therefore, I was sharing photos and videos about the exercises I did, and the equipment I used, so that I could attract people to the studio. That was my first goal. From there, I reached a lot of people, even more than my capacity. And they*

reached me too. I was able to continue pleasantly working in my studio in this way. In that sense, it was very, very useful (Eda)."

Participants stated that as their visibility on Instagram increased, potential customers reached them via DM and asked them questions about the exercise service they would provide. At this point, for example, Derya, who has her studio, emphasized that she increased her Instagram posts when the number of members decreased. She underlined that when she made these shares, the number of new members coming to her studio increased. Similarly, Merve, who gives private lessons to women by going to their homes, stated that more than half of her members reached her through Instagram after she opened her profile on this platform and started to post regularly. Thus, coaches are aware that their active use of Instagram provides them with new members.

"I see it as a showcase. I can consider it as an advertising medium with a visual feast where I can convey information to people, be a role model in the areas I know best and make announcements by sharing content about my current school, my training and my schools (Zehra)."

"I think Instagram is the platform where you can express yourself and advertise yourself the best. I started personal training and my Instagram page first with my circle of friends. After my page became active, I met people I just corresponded through DM and started classes in Adana. Instagram is that effective (Merve)"

Coaches think that one of the main advantages of Instagram for their professional lives is advertising.

"When it comes to advertising, I think of Instagram directly. I mean, its heart is beating there. No matter how good a trainer you are, if you cannot use Instagram, neither your members increase, nor you are counted (cared about) by the trainers in the profession. I am experiencing this firsthand. For example, when things get a little stagnant when the number of members decreases, I use Instagram more actively, stories and so on, messages come immediately, can we get price information, where is your place? The number of members coming to the hall is starting to increase (Derya)."

"Instagram has been very effective for me as a business, I used to advertise a lot before Instagram, but after I started using my page actively, I didn't need to advertise at all...I promote my classes and studio, I actively share which classes are available in the salon... These make a profit for me, people see what we do from there and want to register. Every new member I get also provides me with financial income (Elif)."

Osborne et al., 2021 highlight that social media provides a space, a phenomenon that was ignored in traditional media fields until today, for female athletes to create their media (and advertising). One of the greatest opportunities that social media usage provides for female athletes is undoubtedly for their economic gain (visibility), such as personal marketing, advertising, self-branding, and catching sponsorship opportunities (Geurin, 2017; Geurin-Eagleman & Burch, 2016; Li et al., 2021; Thorpe et al, 2017; Toffoletti et al. 2022, Toffoletti & Thorpe, 2018a; 2018b). In Turkey, although no studies are focusing on the personal brand advertising and sponsorship opportunities of female personal trainers in social media, we realize that it is important for women in sports in Turkey to use social media actively and have high follower numbers in their collaborations with world-famous brands.

Participants are aware that as the number of followers increases, brands attract their attention. With this awareness, they promote themselves and their coaching on Instagram and create their brand image. Participants believe that when they develop their brand image in a quality way, collaboration opportunities will increase, and they experience this. For example, Merve, who stated that she currently has around 23 thousand followers, stated that she goes to her summer house in Bodrum during the summer period and regularly shares her exercise program there and her own exercise life, which she places in her holiday life. She said that after these shares, Trendyol company reached out to him and signed a cooperation agreement with this company. After this cooperation, she started to share the links of the sports products she uses (such as sneakers, tights, bras, pilates equipment), special day clothes or care products she uses as a story or post. She stated that she earned 20% for each member who shopped from the links she prepared. Like Merve, all participants of the study have made important collaborations with local, national, and international brands.

As the participants' visibility on Instagram increased, they stated that when they successfully developed their brand image on Instagram, they, not the brand, decided which brands to deal with anymore. They emphasized that this made them feel stronger and more confident:

> *... I work with fewer and fewer but concise brands and people. I get a lot of project offers, for example, but if it doesn't fit, I don't think it suits me to accept it just to make money, and I don't have such a character ... Instagram is a platform for me where I only want to announce things I approve of... If I get ten offers, I turn eight of them down.A vegan frozen food came in yesterday for example, I won't name it, it's being vegan was very good, but since I don't eat frozen food, I can't promote it (Şeyma).*

The findings show that the participants use Instagram for economic purposes such as promoting their coaching in the sector, promoting their studio (if any, or where they work), personal advertising, introducing themselves to brands, and increasing the number of their members. The most important opportunities provided by social media use for female athletes are for their economic gain such as personal marketing, advertising, self-branding, and sponsorship opportunities (Geurin, 2017; Geurin-Eagleman & Burch, 2016; Li et al., 2021; Thorpe et al, 2017; Toffoletti et al. 2022, Toffoletti & Thorpe, 2018a; 2018b). We can interpret the effort of the participants as "the athletic labour of femininity" (Toffoletti & Thorpe, 2018a) and we can say that they gain strength through these posts.

The athletic labour of femininity is unique to Turkey: "This is Turkey, we cannot share such things here."

In this theme, we will try to understand how negotiation with Turkey's religious patriarchal and conservative norms plays a role in the athletic labour of the female coaches we interviewed in the health and fitness sector. The findings reveal that although the coaches take care to display attractive sporty femininity, they are very careful not to make overly sexy posts and they attach importance to emphasizing the representation of the athletic female body on their Instagram profiles. In addition, self-censorship of their bodies is part of their athletic endeavours on Instagram. Finally, not sharing about religious and political issues is one of the strategies that coaches pay attention to avoid conflicts with their followers and not to damage their brand image.

> *"Today I am half a million on YouTube, 135 thousand on Instagram. If I change my outfit, or my style, I can become a trending topic in an instant. I know this a lot, but I pay attention not to wear that décolleté, that is, not to wear exaggerated clothes. Even though I am a very civilized and very free, comfortable person in my own life, I pay attention to the perception in people's eyes in those shares. Sometimes I also share posts in bikinis. For example, I do somersaults in the sea and sometimes I get comments saying that I exaggerate, usually from women... I pay attention to this, I take care not to give any freckles, and I take care not to shift my content to a different side other than the perception of sports. So those posts are not sexy (Zehra)."*

Participants care about having an athletic and attractive body. On the other hand, they pay attention to the fact that the female coaching they represent on Instagram is not to be too sexy. Participants believe that such posts would lower the quality of their pages and do not find overly sexy female coaches respectable.

"First of all, my debut team, YouTube, production, agency, and the people I know and follow, always tell me that if you get naked, it will happen. I said there is no such thing. I mean, dress more openly, let's shoot from the ass, let's shoot from the breast and so on. It's a way, it's a choice, it's a preference. I mean, I could be 5 million right now if I showed my ass, my head, my breast ... (on other pages) the body is very much in the foreground. there can be pornographic content... but I mean, that image seems to me to be something that cheapens women a lot ... There is someone called XXX, for example, I think she is a great woman, she does a lifestyle just like me. She is a mother and a wife and she started her own business. That woman is very stylish, and I think she is a top-of-the-line woman. I respect those kinds of things, but for others, I just look at the movements and pass by (Şeyma)."

Western research examining how women in sports use social media and construct their brand image reveals that elite female athletes do not hesitate to post sexually suggestive as well as athletic femininity and embrace heterosexual femininity in their posts (Clavio & Eagleman, 2011; Geurin & Burch, 2016; Smith & Sanderson, 2015; Thorpe et al., 2017). According to some research results in this context, elite female athletes exist on social media platforms in accordance with market conditions, with little challenge to the over-sexualized female athlete body (Thorpe et al., 2017; Toffoletti & Thorpe, 2018a; 2018b). Kavasoğlu and Koca (2022) examined the Instagram use of elite-level Turkish bikini fitness athletes and found that these athletes were extremely careful not to make overly sexy posts. They stated that athletes practised self-surveillance about Turkey's religious patriarchal norms. Kavasoğlu et al., (2023), in a qualitative study conducted with 15 female students of the faculty of sports sciences who were physically active on Instagram, revealed that these young women self-censor their Instagram posts to avoid being exposed to cyber neoconservative, religious and patriarchal violence. For the young female athletes they interviewed, protecting themselves against online and offline violence and potential risks could mean not sharing in sportswear such as tights and bustiers. This research allows us to understand the reasons for the experiences of the participants of the current study.

The findings reveal that different conservative and patriarchal norms married coaches and coaches with children have to negotiate in their Instagram displays of female coaching. For example, Büşra said, "My circle, my husband's friends say, '*Son, how do you let her post these videos? I would not let.*' Sometimes my female members who are in very good positions say, *'You post such videos, but doesn't your husband say anything? I mean, you wear a lot of décolletés, but doesn't your husband interfere?'*" and thus expressed the social pressures she received from her

environment regarding her Instagram posts. The quantitative findings of the study also revealed that the participants pay attention to making posts indicating that "wife, partner and/or mother" (7.82%; Table 3).

Table 3
Participants' Instagram Content

Photo Content	Merve	Derya	Beyza	Zehra	Sibel	Büşra	Tuğba	Zeynep	Elif	Şeyma	Eda	Total	%
Exercise Programme Health and Lifestyle Related	57	50	53	36	86	58	17	60	91	58	84	650	59.09
Fashion and Beauty	25	8	27	24	13	17	37	13	-	8	-	172	15.64
Brand promotion and marketing	2	-	-	3	-	-	3	4	-	-	3	15	1.37
Media appearances	3	-	-	10	-	1	-	-	-	-	6	20	1.81
Family and friends	-	-	1	-	1	4	5	5	2	2	-	20	1.81
Being wife, partner and/or mother	-	36	9	4	-	13	16	-	-	8	-	86	7.82
Vocation and Entertaintment	12	4	9	16	-	7	22	7	3	12	-	92	8.37
Social Sensitivity, Solidarity, Celebration	-	-	-	7	-	-	-	11	4	6	6	34	3.09
Did not fit into any of these Categories	1	2	1	-	-	-	-	-	-	6	1	11	1.00
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**1100**	**100**

The contents on the participants' Instagram profiles reveal the market conditions constructed according to the gender regime in Turkey, and it is understood that the participants pay attention to this when presenting the athletic labour of femininity. Moreover, Şeyma's experiences show that she consults her husband while sharing her posts:

> *"Even if I consider that now I am married and a mother too, I try to share according to my judgments, customs, traditions, and practices, not according to what this country or people think. For example, when I am going to share a content in a swimsuit, or something like that, I ask Tarık (her husband),* 'Darling, is it suitable for you' *... By the way, even if Tarık is not there, I still pass it through a filter. Because I never want to break my stance and line. I mean, breasts come to your mouth, a very short skirt, etc. ... Yes, I make money*

with my body, but I also show my body as much as my job requires. I mean, that's femininity and let me tell you that I know I'm doing it right since, if I have 100 followers, 91.8 of them are women. If I can provide this, yes, I am doing something right (Şeyma).”

In addition to Şeyma's experiences above, some participants also mentioned that they may have problems with Instagram posts about their female members. These problems are more evident among participants living in Adana. The coaches we interviewed stated that they could not share the athletic development about the sports lives of their female members on Instagram. These coaches stated that some of their female members said, "*Coach, my husband does not allow it, please do not share on Instagram*" and therefore they did not share anything with these members:

“I've had a lot of members who don't want me to post about our workouts on Instagram. They don't even want me to post when we are side by side on the mat. Not even posts about movement. She says: ‘My husband doesn't want me to share them on social media.’ or ‘my fiancé doesn’t want’. It happens a lot, a lot. (Merve)”

Research conducted from the perspective of sports and communal gender in Turkey has revealed that patriarchal power relations create serious obstacles to women's participation in sports and exercise. Body policies, especially those in which female athletes are controlled and disciplined, disrupt the free, equal and empowering context of their sports and exercise experience (Hacısoftaoğlu, 2005; Koca et al., 2005; Koca & Hacısoftaoğlu 2011a; 2011b; Koca et al., 2010; Öztürk & Koca, 2019; Talimciler, 2006; Yarar, 2005; Yarar et al., 2015). Attempts to control women's bodies and sexuality and cultural barriers to their participation in sports are undoubtedly common experiences of women in Turkey and other Muslim countries (Ben et al., 2010; Hacısoftaoğlu & Pfister, 2012; Harkness, 2017; Koca, 2021; Sehlikoglu, 2015, 2016). Not only studies in the field of sports sociology but also studies in the literature on gender and femininity reveal that the female body and sexuality are controlled by religious, patriarchal, traditional and cultural norms, and neoconservative values, and disciplined and punished by discourses such as honour and morality (Acar & Altunok, 2013; Atuk, 2020; Cindoglu & Unal, 2017; Güneş-Ayata & Doğangün, 2017; Kandiyoti, 2016). Accordingly, the trainers we interviewed are influenced by these cultural codes while constructing themselves as objects of gaze, and these codes can be decisive in the construction of the entrepreneurial neoliberal subject.

Participants feel tension while browsing Instagram. One of these tensions is the self-control they apply to their bodies. However, this self-control is more evident among coaches living in Adana. While some coaches stated that they do not share with a bra, others stated

that they do not share bikini poses on their pages. Some participants stated that they do not share videos in which their hips are in the foreground, that they pay attention to the angle of the camera when sharing squat movements, and that if they wear shorts in their training videos, they wear tights under these shorts:

> *"Of course, there are things I pay attention to when I post on Instagram ... yes, we all wear a bra, but I would never wear a bra that shows off all of your breasts ... or in the posts, I share in summer, in my videos with shorts, I always wear tights under the shorts…wear tights underneath and shorts on top... I don't like décolleté very much. I mean, I think these poses in the profile lower the quality of the page. (Merve)"*

The body that some coaches living in Adana, such as Derya and Merve, discipline by the Turkish religious and patriarchal gender regime is not only their own body. They also monitor and control the bodies of other female colleagues who use Instagram as a marketing tool. For example, Merve pointed to the Instagram post of a fitness trainer in İzmir and said "*I would never do Pilates with such a swimsuit*". We think that behind this discourse is the adoption of a femininity that is specific to Turkish culture, that is, a femininity that is valued in Turkey and not criticized or judged. Although other participants did not use such a sharp expression, it is understood that there are some elements that they pay attention to in their Instagram posts. In this context, while some of the coaches we interviewed carry out their promotions and brand-building on Instagram, there is a representation of women's coaching that they expect other women in the market to follow. In this representation, the coach may be strong, attractive, independent and cheerful, but he is expected not to be extremely attractive. This situation may be related to the fact that traditional Turkish femininity norms are established far from overly suggestive sexual femininity (Kandiyoti, 2013, 2014). In addition, we can also highlight that some of the female trainers we interviewed here were in a role that controlled the bodies and sexuality of other women in the industry. The patriarchal view is maintained by some female trainers and they are trying to create docile bodies (Foucault, 1980).

Another aspect of the participant's athletic labour of femininity is their care not to post about religious and political issues. According to the findings, all participants were careful not to post about religion and politics on their pages, and not to interact or discuss these issues with their followers:

> *"I certainly do not share anything about religion or politics on my page. I mean, the elections are approaching, and I don't share anything about the elections or politics (Elif)."*

"After my morning class, I shared a post saying "coffee break." That day was the first day of Ramadan, I forgot, and I got distracted. I don't fast. Because of this, I got a lot of messages. A very close friend of mine immediately warned me on Instagram and said that I would be lynched, so I should remove it. But by the time she wrote this to me, I had already received a lot of messages. There were some disturbing ones too, such as, we don't think it suits you to be so far away from religion, don't you fast... (Büşra)."

Rahikainen and Toffoletti (2021) mentioned the concept of 'noncontroversial demeanour' as a specific strategy used by female climbers to maintain an attractive profile and minimize criticism and controversy. This concept was used to describe sportswomen's experiences of avoiding online discussions that could deter followers, jeopardize their online brand, and cause personal distress. One of the sponsored and professional female climbers in this study, who faced backlash from her followers for expressing her opinions on Instagram, said: "As an athlete girl, you don't talk about politics, religion". According to the authors, this led to athletes learning to self-censor. The findings of this study also suggest that female athletes may prefer not to comment on religious and political issues both depending on Turkey's current cultural and political climate and through some of the reactions they receive on Instagram.

CONCLUSION

In this study, we explored how female personal trainers in the health and fitness sector represent themselves on Instagram through the concept of the athletic labour of femininity in light of Turkey's gender regime and neoliberal feminism. According to the results of the research, Instagram is an important marketing tool/area where female trainers can build and strengthen their coaching (personal brands) for the sector they serve. In this context, for the participants of the study, Instagram is seen as an integral part of their profession and is considered an effective tool for their economic visibility.

According to the results of the research, the trainers we interviewed promote themselves and their coaching through their Instagram shares. In this promotion effort, the trainers' goals of building and developing their brand image are at the forefront. While branding their coaching, the participants take care to present themselves as strong, self-confident, energetic, happy, positive, natural, knowledgeable, and successful female coaches on this platform. They try to convey the message to their followers that they are in control of a healthy life and that this can be realized through their efforts. In this respect, the athletic

labour of the participants in their Instagram use is compatible with the neoliberal narratives of femininity.

The results of this study show that being active and visible on Instagram brings participants more followers and members and that this platform provides a significant economic benefit to their profession through opportunities such as advertising, marketing, promotion and collaboration. There are some factors that participants, who gain more members and economic power thanks to their Instagram posts, pay attention to in order not to lose these advantages. The female trainers we interviewed are aware that the needs or expectations of the market expect them to build a style of coaching and femininity that complies with Turkey's neoconservative, religious and patriarchal norms. Moreover, quantitative findings show that personal trainers have the content of being a mother and a wife in their brand building (Table 3). This content is one of the findings that show the athletic labour of femininity unique to Turkey. For this reason, in addition to the cheerful, self-confident, knowledgeable, enterprising, positive and disciplined female coaching they offer on Instagram, they do not adopt coaching that is careful not to be overly attractive sexually. The discourse of sex selling for women in sports in the Western world should be rearranged for the trainers in the context of this research. The trainers we interviewed also embrace sexy and attractive femininity and celebrate it, but they think that overly attractive femininity will harm their brand image due to the negative interaction they will receive, sometimes from their followers and sometimes from their social circles. We interpret this cultural context and the trainers' experiences of negotiating with them as the athletic labour of femininity specific to Turkey. This labour differs from the embrace of sexually attractive femininity by women in the Western sports world (Geurin-Eagleman & Burch, 2016; Toffoletti & Thorpe, 2018a; 2018b; Thorpe et al., 2017).

According to the results of the research, for the coaches we interviewed, not posting religious and political content is at the forefront of the athletic labour of femininity specific to Turkey. This is in line with the *uncontroversial stance* that Rahikainen and Toffoletti's (2022) research with elite-level female mountaineers, argued that athletes use an to describe their experiences of avoiding online discussions that might deter followers, jeopardize their online brands, and cause personal distress. The participants in this study also preferred not to comment on religious and political issues to avoid jeopardizing their brand image.

This study offers a perspective on how personal trainers serving in the healthy living and fitness industry use Instagram as a marketing tool, what economic opportunities they get, and what they negotiate while improving their visibility on Instagram, in the context of

neoliberal femininity and Turkey's gender regime. Future research will focus on understanding women in the field of sports, who perform gender-based labour to present themselves in an online world that develops almost every day, to build brands, capture economic opportunities, make sponsorship and cooperation agreements, in different sports branches and different positions such as athlete, coach, manager, fan, media.

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Authors' contributions

The first author's contributions are conceptualization, methodology, writing - review and editing. The second author's contributions are conceptualization, methodology, data analysis, writing-original draft, writing - review and editing. The third and fourth author's contributions are data collection, discussion, review and editing.

Conflict of interest declaration

No conflict of interest is declared by the authors.

Ethics Statement

The study received ethical approval from the Ethics Committee of Çukurova University in Year 2021 and decision number 41.

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A Qualitative Study on E-Sports Players' Leadership Perceptions Regarding Their Team Coaches

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ABSTRACT

Having emerged following the professionalization of digital gaming, e-sports has created its ecosystem and become a large-scale industry itself. Teams involved in this industry experience a social environment just like in other organizational structures. As e-sports is a relatively newer branch when compared to other sports branches, leadership in e-sports is not a commonly studied topic in the literature. Therefore, the aim of this study is to explore leadership perceptions of e-sports players in a comprehensive way. A team coach is often considered the leader in e-sports. The study was designed according to the principles of phenomenology, which is a qualitative research method. The semi-structured interview form developed by the researchers was used as the data collection instrument. The interviews were conducted with a group of e-sports players who met the predetermined criteria for participation in the study. The data was analyzed by using the content analysis method. First, the codes were determined, and later, the categories, and finally, the themes were identified out of these categories. Accordingly, it was found that leadership in e-sports is perceived under five themes: physical characteristics, personality traits, professional qualifications, technical skills, and management skills. Finally, it can be concluded that leadership in e-sports is quite similar to leadership in other traditional sports in many ways. However, the study showed that it has unique characteristics that need studying within the framework of the digital age and technological advancements.

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INTRODUCTION

Although being a digital gamer naturally requires taking individual actions during the games, some players had unofficially assumed the role of a leader when teams started to get involved in tournaments. E-sports has developed out of the digital game sector and has been professionalized in today's world. Although the sector primarily involves individual players, it often witnesses fierce competition between teams rather than individuals (even in some individual games, players win points for their teams). Thus, a social environment with the presence of teams gives us an opportunity to associate this sport with leadership.

E-sports refers to an activity in which mostly professional players compete in competitive games in a virtual game environment via digital games on the internet by displaying their mental and physical abilities (Wagner, 2006). Dating back to the late 1990s, e-sports started to become widespread in the early 2000s and was considered a significant career option as of 2010s (Mustafaoğlu, 2018). Just like in traditional sports, e-sports has also a unique organizational structure (Kabadayı, 2020).

There are various definitions of e-sports in the literature. Breaslau (2012) defines e-sports as competition-based games that have evolved in line with the new world order and become an industry, following traditional sports. According to Keach (2015), e-sports is the ecosystem in which individuals can earn high amounts of money, lucrative sponsorship agreements are signed, transform into a career path rather than a game for talented individuals, and video games become professional. If we need to make a synthesis definition of e-sports based on the previous definitions, it can be said that "it is a branch of sports that covers all components of traditional sports and competes in digital games through technological equipment." Adams et al. (2019) state that all of the definitions made by both theorists and practitioners are descriptive but add that e-sports can be defined in shorthand as "the organization of playing digital games competitively."

Although e-sports are similar to traditional sports in some features, they also have some distinctive features. It can be said that the concept of virtuality is the most important one of these features. The performances of e-sports players turn into output in a virtual environment. In order for this activity in the virtual environment to be accepted within the scope of e-sports, it must be competitive and framed by binding rules (Seo, 2013). Argan and Akın (2007) list the basic features of e-sports as follows:

- Can be played in all virtual environments such as computers,
- Requires large financial resources in terms of facilities and equipment,

- It is possible to participate in this sport all over the world,
- Includes feelings of competition and winning,
- Having game-specific tools and equipment,
- Requires mental and physical effort.

When we look at the definitions and characteristics of e-sports, it can be seen that it is at a level that can sustain its own ecosystem from a professional perspective. When we consider the fact that e-sports are a social activity as well as a professional one, it can be concluded that these organizational structures involve a sort of leadership process.

Leadership has been studied in a lot of research in social sciences and many theories have been developed to explain this concept. According to the related literature, the basic approaches to explain leadership include a theory claiming that leadership is related to personality traits (traits), another theory suggesting that behaviors are more important than personality traits (behavior), and still another theory highlighting that behaviors determine leadership behaviors according to existing conditions (situational) (Northouse, 2010). In modern times, the literature is getting more and more comprehensive thanks to some new theories proposed by researchers. In these theories, leadership is associated with certain concepts such as mission, vision, decision-making ability, culture, personality, communication, authority, persuasion, influencing, ethics, conflict, and stress management (Güney, 2015).

Looking at the main definitions from the mid to late 1900s; According to Hemphill and Coons (1957), leadership is the behavior of an individual in directing the activities of a group to a common goal. Katz and Kahn (1978) define leadership as the level of obedience beyond mechanical obedience to the routine directives of the organization. Rauch and Behling (1984) provide an explanation for leadership as the process of influencing the activities of an organized group to achieve goals. According to Richards and Engle (1986), leadership means putting forward a vision, giving life to values, and creating an environment where things can be achieved. Jacobs and Jaques (1990) define leadership as the process of providing a purpose to the joint effort and stimulating the will to achieve that purpose. According to Schein (1992), the ability to go beyond the existing culture to initiate more adaptive evolutionary changes is defined as leadership. Drath and Palus (1994) see leadership as the process of giving meaning to the things people do together and ensuring that they understand and commit to it. According to House et al. (1999), leadership is a person's ability to influence and motivate other people to contribute to the success of the organization.

When we look at the definitions of leadership made in the modern period, it is seen that diversity continues. Hedlund et al. (2003), leadership is a complex performance field that requires the ability to solve organizational problems and in which followers voluntarily commit to the vision put forward by the leader. According to Gürüz and Gürel (2009), a leader is a person who undertakes the mission of cognitively, emotionally, and operationally intensifying the members of a certain community towards a certain purpose and target. All behaviors in line with this mission are called leadership. Northouse (2010) defines leadership as the process of directing people to certain goals based on influence. Common points derived from these definitions: Leadership is a process that involves influencing, occurs within the group, and has common goals.

Bolden (2004) argues that the difficulty of defining leadership arises from the fact that it is a complex process that touches many people in organizational and social processes. This complex process is an influence process that enables people to move towards group goals through motivation, not through coercion. For this reason, which definition will be accepted varies according to the predispositions of individuals, conditions of organizations, and beliefs. When the definitions of leadership are examined, as a result; even today, the question of when a person emerges as a leader and under what abilities and conditions, he is considered a leader remains a mysterious issue. It is understood from this that there is no single leadership model that is valid always, everywhere, and under all conditions.

Leadership is an interesting topic to study in the field of sports sciences; especially in terms of leadership behaviors of both coaches and administrators. Many studies have focused on leadership orientations, skills, perceptions, and typologies of individuals in various sports branches (O'Boyle et al., 2015). Despite the ongoing discussions regarding whether e-sports is really a sport or not, this branch has a federation in more than 50 countries and was determined as an ancillary event in the 2024 Summer Olympics, which has attracted the attention of researchers in the field of sports sciences (Kabadayı, 2020). In this respect, leadership allows researchers to examine sports and e-sports concepts together.

One of the groundbreaking studies on leadership in sports is Chelladurai's (1990) Three-dimensional Leadership Model in Sports. According to this theory, there are three dimensions affecting productivity of leadership in sports organizations. One of these dimensions is antecedents, which include situational characteristics, leader's characteristics and members' characteristics. The second dimension, which emerges due to the effects of the above-mentioned characteristics, is leader behaviors. The three subdimensions of the second dimension are required behaviors imposed by certain factors such as rules and organizational

culture, actual behaviors of leaders, and behaviors preferred by members. These behaviors lead to the third dimension, which is consequences. This dimension is examined under two subdimensions: performance and satisfaction of members. Chelladurai's theory is taken as the theoretical background of the present study so that leadership in e-sports can be examined.

Some basic components are necessary to carry out e-sports activities. Among these components are game developers, matches and tournaments, players, teams, referees, game consoles, and other equipment. Audiences, broadcasting platforms, and sponsors are the secondary components of such activities (Kilci, 2019). Many factors interact in such a complex structure; therefore, it seems impossible for e-sports players to deal with every issue by themselves. Mental, physical, technical, and strategic support of team coaches are especially crucial so that players can succeed in competitive games. At this point, it is possible to foresee the significance of a guiding leader.

The literature review revealed only a few studies in which e-sports and leadership concepts were examined together. The first study on this issue focused on the development of leadership through e-sports. Nuangjumnong (2016) states that roles in digital games affect real social life and might improve leadership skills. Another study conducted by Falkhental and Byrne (2020) deals with distributed leadership in university e-sports teams. The study explained how distributed leadership style, hierarchy, and reliability help the distribution of power within teams. Similarly, Keçeci and Çelik (2021) in their study examined leadership in e-sports organizations within a theoretical framework. Therefore, there is a growing need to conduct research on leadership in e-sports due to the limited number of available studies in the current literature.

Due to some prevailing vagueness regarding leadership in e-sports, there is a possibility that it differs from the nature of leadership in traditional sports. First, e-sports matches take place in a virtual environment requiring an interaction at the cyber level, although players often come together in a physical environment. In this regard, the aim of the study is to explore and explain leadership profiles and processes as perceived by e-sports players during e-sports events.

Due to the fact that many practices today have been virtualized, this development is quite likely to affect sports as well. Introduction of virtual reality glasses into people's lives, the emergence of crypto money stocks, new experiences through augmented reality images, virtual visits to museums, business meetings held in virtual environments, online certificate programs, internet websites publishing video content, and applications such as metaverse that bear characteristics of a virtual environment have started to play an important role in people's

lives. Just like the above-mentioned phenomenon, it is not surprising that e-sports is a digitalized form of sports. When these developments are evaluated in relation to leadership, it is expected that leadership has been subject to certain changes during the digital age, just like it evolved according to different conditions of the classical period, neo-classical period, and the modern period. In this respect, it is essential to examine how the leadership paradigm will evolve in e-sports according to the conditions of the new era in terms of sports management for both the branch itself and sports in general.

METHODS

This study was designed according to the qualitative methodology in order to define leadership as perceived by e-sports players of their coaches. Since this branch is one of the recent branches in the field, leadership in e-sports still needs to be explored more in detail although it is an easily observable phenomenon. Yıldırım and Şimşek (2018) define phenomenology as a qualitative research design employed in order to explain situations which one is aware of its presence but lacks detailed information. Therefore, the present study was designed according to the principles of phenomenology design.

Research Model

In terms of the researchers' stance, this research is handled on the basis of the constructivism-interpretivism paradigm. This approach is thought to be a more suitable paradigm for social sciences due to the human factor. According to Ponterotto (2005), when the issue is considered from an ontological perspective, the constructivism-interpretivism approach emphasizes that reality is subjective. From an epistemological perspective, it is accepted that reality is socially constructed in the relationship between participants and the researcher. Thus, the dynamic interaction during the data collection phase of the research allowed us to capture and describe the lived experience of the participants. The fact that the researcher who collected the data was an e-sports player also contributed to this situation. However, since none of the qualitative coders -except the researcher who collected the data- during the data analysis phase, were experts in the field of e-sports, it was aimed to reach the findings without bias. From an axiological perspective, it is accepted that the results of this research cannot be completely free of biases according to the constructivism-interpretivism paradigm in any case. The rhetorical structure and methodology of the research were designed and implemented according to this approach.

According to Hsieh and Shannon (2005), when a phenomenon is addressed scientifically for the first time, the categories obtained through qualitative analysis are derived directly from textual data. This situation requires an inductive approach in science. Therefore, the findings of the research are discussed with an inductive thought.

Participants

The population of the study is professional e-sports players playing for e-sports teams in Türkiye. The study group consists of 21 e-sports players who voluntarily participated in the study. The participants were determined by using the criterion sampling method, which is a non-probability sampling. Criterion sampling (purposive sampling) is defined as selecting individuals who meet predetermined criteria for participation in a study (Gitmez, 2020). Accordingly, the following criteria were determined in the present study: actively playing in team sports and having participated in at least one national tournament. The demographic information about these 21 participants who fulfilled these criteria is presented in Table 1 below.

The ethical principles of the World Medical Association's Declaration of Helsinki (https-1) were taken into consideration regarding the participants' participation in the research. Accordingly, Eskisehir Technical University Ethics Committee permission was obtained to conduct the research (16/10/2023, 20/4). The voluntary participation form, which was among the documents submitted to the ethics committee, was read by the participants before data collection. Interviews for data collection were initiated with both verbal and written permission from the participants and they were reminded that they could leave the study at any time if they deemed it necessary.

Table 1
Demographic Characteristics of the Participants

Demographic Categories	The Data Groups	Participants Frequencies
Age	Mean = 23,2	It ranges between 19 and 32 years
Gender	Male	17
	Female	4
Games	Counter-Strike: Global Offensive (CS:GO)	6
	Valorant	4
	League of Legends (LoL)	6
	FIFA 22 (Pro Clubs mode)	5
Types of games	First-Person Shooter (FPS)	10
	Multiplayer Online *Battle Arena* (*MOBA*)	6
	Sport	5
Game platform	Computer	16
	PlayStation	4
	Xbox	1
Digital gaming experience	Mean = 13,4	It ranges between 10 and 24 years
E-sports experience	Mean = 3,3	It ranges between 1 and 7 years

Procedures

The data collection instrument used in the study was a semi-structured interview form, which included eight main questions and some drill questions for each main question. The first question was not an open-ended one since it only asked about the status of the leader of the team. The aim of this question is to confirm the assumption that the leader in an e-sports team is a team coach. The other questions in the form except the last one were based on different dimensions of Chelladurai's (1990) theory; the second and third questions on "Characteristics" dimension, the fourth and fifth ones on "Leader's Behavior" dimension, and sixth and seventh questions on "Consequences Involving Performance and Pleasure" dimension. The last question aimed to get further opinions of the participants so that the researchers could access all the information that was beyond their knowledge. The questions were based on "leadership in sports" literature. The questions derived from this literature review were prepared by taking into consideration the suggestions made by Creswell (2007) for successful interview questions to be used in phenomenology design. The researcher also asked for expert opinion in order to evaluate to what extent the interview questions were suitable for collecting appropriate data for the purposes of the study. The form was finalized by taking into consideration the feedback received from the experts, who were an academician conducting studies on leadership, another academician experienced and knowledgeable about qualitative studies, and a teacher of the Turkish language.

The semi-structured interviews were conducted face-to-face between November 2nd, 2021, and April 2nd, 2022. The duration of the interviews ranged between 54 minutes and 67 minutes. The means for the duration of the interviews was calculated as 60.5 minutes and the standard deviation as 2.70 ($\bar{X}$ = 60,5 ± 2,70). The interviews were audio recorded, and later, the recordings were transcribed in order to obtain raw data.

Data Analysis

Strauss and Corbin (1990) propose two types of data analysis for qualitative analyses: descriptive analysis and content analysis. In the descriptive analysis method, data are summarized and interpreted according to predetermined criteria, while content analysis aims to identify concepts that might account for collected data. It is clear that content analysis is subject to more in-depth data processing when compared to descriptive analysis. Therefore, content analysis was thought to be more suitable for the present study since leadership in e-sports is still a concept that needs to be defined more comprehensively. The following procedures were completed in turn as the steps of content analysis in the study:

1) Coding the data;

2) Categorizing the data;

3) Outlining themes from the data;

4) Organizing codes, categories and themes;

5) Defining the findings.

Validity and Reliability

Guba et.al (2000) suggest that there are some strategies to enhance quality in qualitative research; however, they emphasize that these strategies might be applied through alternative concepts that are more suitable for the nature of a qualitative study rather than within validity and reliability concepts. These concepts are called persuasiveness, transferability, consistency and confirmability.

Persuasiveness (internal validity) was achieved by having long-lasting interactions with the participants and asking them to confirm their opinions stated during the interviews, which met the criteria of "accurate representation of reality" through research findings. This ensures that there is no missing or incorrect data.

In order to ensure transferability (external validity), some of the raw data obtained from the interviews were presented to readers in the "Findings" section of the study without making any changes. Thus, readers are given the opportunity to comprehend and describe the data clearly, which meets the criteria of "evaluation of results" in qualitative studies.

As for the consistency (internal reliability) of the study, all the interviews were conducted by the same researcher. He was careful with using the same tone of voice and intonation while asking the questions to each participant and not directing them towards a specific opinion. As a result, the "consistency" criterion was achieved as an important criterion for qualitative research.

In order to meet confirmability (external reliability) criteria, the researchers sent the raw data to a group of experts qualified in leadership and qualitative research. By doing so, the researchers aimed to meet the criterion of "being objective and unbiased" by obtaining others' opinions in addition to theirs. The qualitative coders of the study were two academicians who conducted this study: an academician who is an expert in leadership and another academician who is an expert in qualitative research. They continued to examine and code the data and identify themes until they reached an agreement. At this point, the researchers made use of the formula developed by Miles and Huberman (1994) for reliability in qualitative data analysis. According to this formula, reliability is calculated as *reliability* =

consensus / (consensus + disagreement) x 100. An analysis revealing a coefficient higher than 0.70 is accepted as reliable. As a result of the opinions of all coders (4) in this study, the coefficients calculated for all interviews (21) were higher than 0.70 for each theme. The coefficients are as follows: Physical Characteristics = 0,82; Personality Traits = 0,78; Professional Qualifications = 0,84; Technical Skills = 0,80; Management Skills = 0,78.

RESULTS

The tables below display the codes, the categories, and the themes obtained from the qualitative data. The raw data are presented to readers under each related table without making any changes. The participants were anonymized so as not to reveal their real names. The following codes were used for the participants in the analyses: P1 - P2 - P3 - P4 - P5 - P6 - P7 - P8 - P9 - P10 - P11 - P12 - P13 - P14 - P15 - P16 - P17 - P18 - P19 - P20 - P21.

Table 2
Categories and Codes for the Theme "Physical Characteristics"

Theme	Categories	Codes
Physical characteristics	Physical appearance	Having an attractive look
	Age	Being older than other players

Table 2 reveals that two codes were prominent in the outlining of the theme "physical characteristics," which accumulated under the categories of physical appearance and age. Some of the raw data used to determine the codes are presented below:

Age

"Another characteristic, I mean he is a person who is respected more because he is, in fact, older" (P1)

"Generally, leader is older than players. So, they have more life experience than players. For instance, some players perceive leadership intuitively. It is something we can't explain through data but it happens like that. Leader has this experience earlier. A 5-year difference in age means 2000-5000 more games in e-sports. That number of games make a difference in experience" (P2)

Physical Appearance

"But some teams play only to be noticed by giving game scores a secondary importance. The leaders of these teams might be advertising face of the team. Of course, in such situations, physical appearance also matters." (P6)

"First of all, he is a person who is careful about his clothes. It is said that physical appearance is important before you meet someone. Physical appearance is the first thing people look at for a positive first impression. I find my coach successful in that." (P14)

"For me, one should be a good example in every way if he wants to be the leader in an organization. We can all include his physical appearance, tone of voice, language use, educational background, being fair and making correct decisions, etc." (P15)

Table 3
Categories and Codes for the Theme "Personality Traits"

Theme	Categories	Codes
Personality traits	Communication	Good command of language Being honest Talking with a clear diction Establishing an effective communication Not being offensive Having a sense of humor Having good social relationships Having good personal relationships
	Traits	Brave Well-disciplined Revealing intense feelings Energetic Entrepreneur Strong Trustworthy Ambitious Determined Accepting mistakes Reflecting some characteristics of other gamers Keeping calm Respectable Appealing Responsible Intelligent Having unique characteristics Good observer
	Attitudes towards other players	Fair Respectful Transparent Consistent Role model Paternalist

According to Table 3, 32 codes under three categories (Communication, Traits, and Attitude towards other Players) play a role in the emergence of the theme "Personality Traits". Some of the raw data used to determine the codes are presented below;

Communication

"One reason for me to accept and support him is to promote and help him feel relaxed. What leads to this is his good management of personal relationships" (P1)

"He knows how to talk according to the person he talks to. There are 15-16 players in the team. It is so difficult to please everyone. But he is good at that. Sometimes he has to say different things to different people but he keeps the balance well. In other words, the basic answer is human relationships" (P5)

"In my opinion, the most important thing is communication skills. Even if a person with good communication skills makes a mistake, he can make correct decisions thanks to the value he gives to sharing opinions with others. There is not a strict rule stating that leaders in e-sports and leaders in life in general always think correctly. So, I believe that people who are open to different opinions and able to establish healthy communication with other people is one step ahead in life" (P7)

Traits

"Being transparent and fair is enough for me. It should be clear to everyone. Also, he needs to motivate the team. He should be energetic" (P3)

"What is important here is, of course, personality. A coach should be sincere and reliable if he wants to be not only the coach but also a leader. He should have an influence on others" (P13)

Attitudes towards Other Players

"For me, it is important for a leader to establish communication in the correct way. He should be able to explain things clearly. He should not act unjustly; he should be fair and treat people equally. He should be clever." (P4)

"Since a leader is supposed to be a role model, he should do first what he expects from the team to do. If he is hardworking, players also become hardworking. If he is lazy, players also become lazy." (P8)

"You cannot set out with a person unless you trust him. He should keep his promises and be a man of his word. If he talks to players one by one, he shouldn't tell different things to different players. I mean, he should be consistent about what he tells different people at different times." (P9)

Table 4
Categories and Codes for the Theme "Professional Qualifications"

Theme	Categories	Codes
Professional qualifications	General qualifications	Well-educated A good professional background Competence in cyber technology Knowledge of traditional sports
	Branch-specific qualifications	Experience in e-sports Reputation in e-sports Keeping up with current developments Playing well Knowledge of e-sports sector

Table 4 shows that the "Professional Qualification" theme consists of nine codes under two categories: "General Competencies" and "Branch-specific Competencies". Some of the raw data used to determine the codes are presented below:

General Qualifications

"Since you say leadership in e-sports, he should be knowledgeable about this branch and sports in general. The necessity of having a good command of sports is the existence of everything in e-sports and, in fact, in traditional sports" (P15)

"This also depends on understanding the mentality of the game. Indeed, it is just software. Although we often forget during the games due to excessive excitement, the only thing we do, in fact, is to give commands to computers. Therefore, leaders should have a command of the game and computers." (P6)

Branch-Specific Qualifications

"First of all, he should have a good command of the game we are playing. FIFA Pro Clubs mode already requires multiple players, at least 11 players. He should be at least at the same level as -if possible, at a higher level than - the players" (P3)

"Since our leader is experienced in e-sports, we take advantage of his experiences. He is knowledgeable about the field. He knows how players feel comfortable and focus on the game with full motivation since he has already gone through difficult times and challenges." (P8).

"In addition, a leader should be well informed about the community involved in the games. Knowing rivals well is a better advantage than knowing your own team." (P10)

"For me, knowing the people involved in this (e-sports) and having a wide network in the community are the most critical criteria. It is crucial to have a good command of the video world game. I believe that a person equipped with this knowledge can have a strong

influence on players as well. I am of the opinion that one can easily be a leader if he is both knowledgeable and talented in video games and has strong connections in the e-sports community. I believe that such a person might have a stronger influence on players." (P12)

"The competitive games in e-sports are frequently updated. So, I expect my leader to update himself frequently" (P14)

Table 5
Categories and Codes for the Theme "Technical Skills"

Theme	Categories	Codes
Technical skills	Contribution to players	Improving players Keeping players informed Taking good care of players' nutrition Taking good care of players' resting Taking good care of players' physiology Taking good care of players' equipment Providing psychological support for players Foreseeing and preventing potential mistakes
	Analysis	Making a technical analysis of games Analyzing opponents
	Influence during games	Immediate interventions during games Success in assigning players
	Knowledge of game	Keeping up playing Competence in-game terminology Advanced level of game knowledge
	Contribution to the team	Discovering potential talents Preparing a periodic program Success in player selection Developing strategies for games Good choice of technical staff Providing team unity

According to Table 5, the "Technical Skills" theme was outlined from 21 codes, which accumulated under five categories: Contribution to players, influence during the game, knowledge of the game, and contribution to the game. Some of the raw data used to determine the codes are presented below:

Contribution to Players

"He shows us where we are late - such as, in making decisions or use of mouse- after analyzing how we play in the games. So, we notice our drawbacks and learn what we should do to improve ourselves." (P12)

"The couch's duty is to prepare daily, weekly, monthly, and yearly programs. To coordinate while applying these programs. The leader should do these so that the team should progress towards the same goal. He should prepare us by giving correct tactics so that we can play a good match. He should keep us physically robust. He should care about our nutrition" (P13)

Analysis

"It is necessary to determine well the areas and times when players are connected to each other. It is necessary to position yourself accordingly in the game. The person who will ensure all this is the leader. He must analyze the game requirements and the abilities of the players well and bring holistic harmony to the team." (P6)

"Since we started playing in high-level tournaments, we have started to watch the matches of our possible opponents. I say "we started" because he doesn't just watch it himself, he makes us watch it too. We conduct competitor analysis just like in other sports. In these aspects, I think the coach provides effective leadership." (P10)

Influence During Games

"He should have a strong competence in issues such as technique, tactics, selecting players and assigning roles to players, etc." (P3)

Knowledge of Games

"He should have a command of branch-related terminology. For instance, there is a term called "mid" in the game we play. If you assign a person who doesn't have any ideas about such terms as the leader of the team only because he invests some money in e-sports branch, no good will come of it." (P6)

Contribution to Team

"What I meant here is being able to continue to collaborate in the tasks. Acting in accordance with the goals of the team. For instance, I may not get on well with one of my teammates in our daily life. I might even be offended by him or her. But this should not be important during the game. No matter how much angry we are at each other, this should not affect our sense of mission. Since our leader does important things to ensure us to act together for the team, we listen to his words" (P7)

"Those whom a leader would like to work with are also important so that he can be successful. He should choose these people carefully. Both players and other people who assist the leader should be quality people" (P9)

"It is even necessary to discover potential talents, young talents beforehand so that such talents should be integrated into the team before it is too late." (P10)

Table 6
Categories and Codes for the Theme "Management Skills"

Theme	Categories	Codes
Management Skills	Interaction with players	Balancing between authority and democracy Managing players' egos Providing feedback Treating everyone equally Providing motivation Increasing players' excitement Being obeyed Inspiring players
	Team Atmosphere	Providing social unity in the team Saving time for procedures related to team Acting like a bridge between players and admin Successful political management Successful stress management Successful conflict management Improving communication within the team Adopting the team
	Decision making	Making accurate decisions Explaining the reasons of the decisions made Consulting different opinions Being open to others' contributions
	External environment	Assuming spokesman role in the team Defending players' rights Lobbying at the upper administration level Ability to talk about issues other than e-sports

According to Table 6, the "Management Skills" theme was outlined from 24 codes, which accumulated under four categories: Interaction with Players, Team Atmosphere, Decision Making, and External Environment. Some of the raw data used to determine the codes are presented below:

Interaction with Players

"I think that the leader also affects the results in terms of motivation. Keeping us all together, telling what he wants to convey without hurting us, and explaining why we do what we do always affect our scores." (P3)

"Sometimes it would be nice to have some toughness. Discipline must be maintained. It may not be good if it is too soft. It is very difficult to catch the consistency in that middle point. People who can handle it, I think, can be very good leaders." (P4)

"I think it's important for the leader to treat everyone in the team fairly, to admit when he makes a mistake, to take the opinions of everyone in the team, not just by what he says." (P5)

Team Atmosphere

"I think he is guiding us in the right way. It nicely tells us what we need to do about the game and outside of the game. It acts as a bridge between the team owner and the players. I guess it is not a pleasant feeling to be between such two levels, but he fulfills this task properly. The fact that he thinks for us and speaks for us mostly eases our load." (P11)

Decision Making

"He must be able to make effective decisions. Technical, tactical, player selection, assignment, etc. The ability to decide must be strong". (P3)

"A person with strong communication skills can manage to make the right decisions, even if he is wrong, thanks to the value he attaches to exchanging ideas with other people. There is no rule that individuals who are leaders both in e-sports and in life, in general, will always think about what is best. For this reason, I think that people who are open to different opinions and can communicate healthily are one step ahead". (P7)

External Environment

"A little while ago, I talked about being able to talk to the leader about non-team issues. Although this event may seem out of the team, it can affect a match when appropriate. Because a moment you experience on an issue unrelated to e-sports increases your respect for the leader and you can think about it during the match and fight for the coach more." (P7)

"He also takes care of us in our daily life. We can spend time with him without even talking about games. We know that we are valued as e-sports players, but it makes us feel valued as human beings outside of e-sports." (P15)

DISCUSSION

According to the findings of the study, the hierarchical position accepted as the leader in e-sports is usually team coach, just like in traditional sports branches. The titles given to this position change from branch to branch, such as "technical director" or "head trainer" etc. The term preferred in e-sports is "team coach". It is acknowledged that team coaches' physical appearances, personality traits, professional qualifications, technical skills and management skills considerably affect productive leadership in e-sports teams.

Personality traits have a stronger effect than physical appearance in e-sports. There are some studies reporting that coaches' personality traits have a considerable effect on effective leadership (Chelladurai & Saleh, 1980; Smoll & Smith, 1989; Smith et al., 2013). The presence of categories related to communication and attitude toward players clearly indicates that communication between leaders and players affects the quality of the leadership process. At this point, leadership in e-sports is similar to leadership in traditional sports branches as defined by Williams and Widmeyer (1991) and Gardner et al. (1996).

The findings regarding the "professional qualification" theme showed that e-sports players want to have a leader and team coach who has improved himself both in e-sports and in general. It is possible to come across some successful trainers who do not have a bright career as players. However, e-sports does not seem to have such examples since e-sports players expect their team coach - as the leader of the team- to have a successful background as a player, play well even during coaching, and keep up with advancements in cyber technologies. Such an expectation might be a branch-specific consequence or it might be due to the common presence of Generation Z as players in e-sports. Çetin and Çelik (2022) suggest that Generation Z has the potential to think differently from prevailing traditional judgments in terms of expectations from sports.

The findings about the theme "technical skills" revealed that the team coach's contribution to e-sports players and the team prior to and after the game is perceived as significant. Since the codes and categories under this theme are some parameters that might affect sports performance, the replies of the participants are primarily performance-oriented and score-oriented at the competitive level. Team coaches, as leaders in e-sports, should have high levels of technical skills so that sportive achievement can be reached. Smoll et al. (1993), in their studies on traditional sports branches, found that a coach's technical contribution to players' improvement, player outcomes, and effective teaching is crucial for achievement in sports.

As for the findings regarding "management skills", the codes and categories are mostly related to leader's behaviors. Indeed, much research in the literature claims that behaviors are more important than personality traits. There are also studies highlighting the importance of trainer behaviors in traditional sports branches (Boardley et al., 2008; Chelladurai, 1984; Cote et al., 2010; Luthans & Avolio, 2003).

Leadership in e-sports differs from others due to its unique features. For instance, sportive performance is achieved in a digital environment. Physical attempts of e-sports players while using hardware such as a keyboard, mouse, etc., turn into a performance

outcome as a video. Therefore, team coaches should have higher levels of knowledge and competence in cyber technology than other coaches in traditional sports branches so that they can perform effective leadership. In addition, the mental and physical readiness of e-sports players is a strong predictor of productive performance. Thus, team coaches should be as competent and knowledgeable as other trainers in traditional sports branches in terms of sports psychology, exercise physiology, training programming and nutrition. In conclusion, leadership in e-sports, in general terms, is quite similar to the dimensions mentioned in Chelladurai's (1990) theory. Just like in many organizational structures in most sectors, leadership in e-sports also depends on certain characteristics, behaviors, and situational conditions. Leadership in e-sports is an adapted version of traditional leadership theories to the digital age and technological innovations in the sports sector.

Limitations

The data collection phase of this research was limited to individuals who practice e-sports as a profession. The findings do not include results regarding recreational video game activities and digital gamers. At the same time, the data collection process consists of a five-month period. This process was not a limitation determined from the beginning but was finished when it was thought that data saturation was reached. The data subjected to content analysis was limited to those obtained from participants who answered the first question of the data collection tool as a team coach. The data containing answers other than the team coach were excluded from the research. Other roles for leadership are suitable for different research, but this research focuses on perceptions regarding team coaches.

PRACTICAL IMPLICATIONS

As for researchers and field experts, some research topics might be recommended for further research. Based on the limitations of the research, studies on leadership in roles other than team coach may be conducted in e-sports. Considering the research limitations regarding the distinction between sports and recreation, it may be beneficial for social science to examine the issue of leadership within the scope of recreational digital gaming. Exploring the leadership process in e-sports according to team coaches' perceptions may be beneficial. Developing quantitative data collection instruments for leadership in e-sports can enable various measurements to be made. Examining modern leadership theories that are specific to the e-sports population can fill the gap in the literature. Also, it is important to determine correlations of leadership in e-sports with different concepts and phenomena.

When we consider the issue from e-sports players' perspective, we can understand that the physical appearance of the person they consider as the leader is not that important. Instead, personality traits, professional qualifications, technical skills, and management skills are primarily significant. Therefore, some suggestions can be made for those who would like to assume a role in e-sports as a leader. To be a better e-sports leader, it is important to try to be a good-mannered person. Having a good background at e-sports will contribute to this. Also, keeping up with developments in digital technologies while playing games actively is important. In addition, it is suggested that gain respect through behaviors rather than taking advantage of the team coach position.

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Authors' contributions

All authors contributed in study design, statistical analysis and manuscript preparation.

Declaration of conflict interest

There is no conflict of interest that may arise as a result of the publication of the research report.

Ethics Statement

Eskisehir Technical University Ethics Committee permission was obtained to conduct this research (16/10/2023, 20/4).

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Pamukkale J Sport Sci, 15(1), 167-187, 2024 Research Article

The Effect of 12-Week Psychological Skills Training on Coping Skills and Performance Strategies in High School Volleyball Players

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ABSTRACT

This study aims to analyze the effect of Psychological Skills Training (PST), which includes goal setting, imagery, relaxation, and self-talk, on high school volleyball team players in terms of athletes' ability to cope with sportive problems and selected performance strategies. The study groups for this research were determined in two steps. In the first step, high schools in Mersin's central districts and those carrying out educational activities with the same curriculum were reviewed so that the study groups would have similar characteristics. With the purposeful sampling method, nine Anatolian High schools located in non-vocational Anatolian type-high schools and preparing for competitions in volleyball, a young female category was determined, and two of these high schools were suitable for the study. In the second step, two high school teams were assigned as experimental groups (*n = 14) and control groups* (*n = 14*) by drawing lots. The mean ages of the participants were 14.93 (*SD* = .730) and 15.14 (*SD* = .770) for the experimental and control groups, respectively. The Personal Information Form, Coping Scale with Sports Problems (ACSI-28), and Performance Strategies Test (TOPS) were used as data collection tools. In the data analysis, a two-factor ANOVA test was used for mixed measurements. As a result, it was found that PST carried out in the school environment has no effect on athletes' ability to cope with sports problems or performance strategies other than imagery in training.

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INTRODUCTION

Problems such as muscle strain, lack of concentration, and self-confidence under pressure caused by high levels of anxiety and hyper-stress during sports activities are defined as sportive problems (Smith et al., 1995). Since sporting problems create adversities for athletes and teams, athletes need to know how to make decisions and cope with the stressful situations they experience when under pressure (Woodman & Hardy, 2001). It is emphasized that in today's professional or semi-professional sports matches, the difference in physical performance between winning and losing has decreased, resulting in increased pressure on athletes. Therefore, Psychological Skills Training (PST) has become essential for athletes in recent years (Birrer & Morgan, 2010; Weinberg & Gould, 2019).

PST is an applied discipline in which human psychology and behavior in sports and exercise activities are studied scientifically. When we look at its recent history, it can be seen that it drew attention in North America in the 1980s and became a widely researched topic (Foster et al., 2016; Gill et al., 20170; Martens, 1987; Vealey, 1988, 2007; Weinberg & Gould, 2019). In general, PST is defined as a process that includes developing psychological skills with appropriate techniques, scheduled practices, activities, and exercises to increase performance, where the psychological preparations concretize. (Konter, 1998; Martens, 1987; Vealey, 2007; Weinberg & Gould, 2019). PST aims to provide athletes with the necessary psychological skills to solve problems that may occur before or during the matches (e.g., high anxiety, low motivation) and to achieve the perfection of the movement. It is also considered important for young athletes since they are still budding (Martens, 1987; Weiss, 2011). It is thought that young athletes must gain the ability to cope with sporting problems to maintain their motivation and not decrease their performance levels (Foster et al., 2016; Horn et al., 2011; Weinberg & Gould, 2019; Weiss, 2011). Folkman and Lazarus (1985) defined the ability to cope with difficulties necessary for resolving sporting problems as behavioral and emotional reactions that are put forward to control environmental and internal desires and conflicts and minimize life tension. Weinberg and Gould (2019) also state that for success in sports, stress management, coping with difficulties, and the solution to sporting problems caused by anxiety during injury or pressure can be provided by PST. Each psychological skill gained through PST is determined as a performance strategy (Thomas et al., 1999; Vealey, 2007). Goal setting, imagery, relaxation, and self-talk are the foremost common strategies of the studies conducted with young people (Gould et al., 1991; Klien, 2017; McCarthy et al., 2010; Vealey, 1988, 2007; Weinberg & Gould, 2019). Goal setting is defined as a technical strategy that creates positive

changes in critical psychological situations like anxiety, lack of trust, or motivation that affect the performance of athletes of various ages and skill levels (Locke & Latham, 2002). Imagery is a sensual (seeing, feeling, hearing) strategic experience without external stimuli. Through imagery, anxiety, despair, or joy during a game can be imagined and experienced before the game, contributing to the development of psychological skills (Martens, 1987). Relaxation reduces muscle strain, de-escalates the overactivity of the sympathetic nervous system (related to adrenalin and heart rate), and calms the mind through productive strategic activities (e.g., imagery; Burton & Raedeke, 2008). Self-talk is defined as a dialog that enables athletes to interpret their emotions and perceptions, organize their assessments and beliefs, give instructions, and reinforce themselves (Hackfort & Schwenkmezger, 1993). This study assumed that coping skills with sporting problems are a variable that increases in parallel with the acquisition of performance strategies.

Studies involving PST in which more than one technique is applied are regarded as multimodal, and it is stated that the performance strategies (e.g., imagery, relaxation) developed to ensure the use of psychological skills in these multimodal studies are interrelated and it is more beneficial to use them together (Martens, 1987). Therefore, when we examine the research on the subject, we can see that it is effective to use performance strategies together. For example, Horn et al. (2011) performed PST research on college softball and baseball players which including goal setting, imagery, relaxation, and self-talk techniques. As a result, they found that players started to use their psychological skills, and their performance improved. Fulgham (1999) carried out a PST study that included imagery and goal-setting techniques to improve the psychological skills of high school female volleyball players, and it was concluded that these techniques improved the performance strategies of the players.

When we look at the research on psychological skills training in Turkey, we can give examples of the research conducted by Miçooğulları and Kirazcı (2016) and Urfa and Aşçı (2018) because they work with young athletes. Miçooğulları and Kirazcı (2016) conducted a six-week PST program that included team cohesion, goal setting, imagery, relaxation, and self-talk techniques to develop psychological skills in young basketball players. The results showed that PST positively affected team cohesion and self-confidence in athletes. Urfa and Aşçı (2018) conducted ten weeks of PST with the participation of young soccer players, which included goal setting, imagery, self-talk, a pre-performance routine, concentration, and self-monitoring techniques and strategies. They observed that young soccer players' self-esteem and attention levels improved.

According to the literature, athletes over the age of 13 strive to improve and exhibit their sportive skills, and young athletes must improve their psychological skills in terms of their performance and careers; however, present studies about the psychological preparation process of young athletes are not sufficient (Coté & Hay, 2002; Foster et al., 2016; Horn et al., 2011; Miçooğulları & Kirazcı, 2016; Weinberg & Gould, 2019; Weiss, 1991). Regarding this insufficiency, Vealey (1988, 2007) stated that since the physical skills of elite athletes are developed and psychological factors are thought to have a considerable and essential role in their performance, most PST studies are focused on elite athletes. However, it is also crucial for non-elite athletes to improve their psychological skills. He claimed that studies with athletes from high school and college, as well as athletes who retired because of disability, will make a significant difference. Gilbert et al. (2007) stated that the use of sports psychology in high schools is low, and PST should be supported for student-athletes. Foster et al. (2016) presented that despite Vealey's call (2007) to increase PST research on young participants, there has not been sufficient research in England in this area, and they stated that PST with young people will benefit their psychological development and physical performance. Likewise, Danish et al. (2005) emphasized that schools are one of the most critical places where young people's development is contributed, and PST programs will help them gain psychological skills. Several authors claimed that schools are appropriate for PST because routine education programs provide many psychological skills for athletes to gain (Coté & Hay, 2002; Foster et al., 2016; Gilbert et al., 2007; Weismann, 2005). Besides, Martin (2005) indicated that the experiences gained at a young age by PST have a positive effect on expectations and attitudes towards the practices of receiving psychological support in the following years. Considering that the nonformal PST programs are expensive and trainers do not spare enough time for this work (Martens, 1987; Weinberg & Gould, 2019; Weismann, 2005), we can say that having young athletes in the selected sample is essential. This study aims to investigate the effect of PST, which comprises goal setting, imagery, relaxation, and self-talk, on high school volleyball team players in terms of athletes' ability to cope with sportive problems and selected performance strategies. This study, performed in a school environment, will contribute to PST research and provide up-to-date data for the related training programs.

METHODS

Research Model

This study is designed as a quasi-experimental model, including pretest-posttest comparison groups. Quasi-experimental models are defined as models in which cause-and-effect relationships cannot be established, and where manipulation or control of the model cannot be made or is partially made due to natural or practical reasons (Erkuş, 2005). Apart from the pretest and post-test, which are necessary for repeated measurement, a third (follow-up) test was performed to monitor the persistency. Hence, the design of this study can be named a 2 x 3 factorial design.

Participant

The study groups were determined in two steps. In the first step, high schools in Mersin's central districts with the same curriculum were reviewed so that the study groups would have similar characteristics. Using the purposive sampling method, nine Anatolian high schools located in non-vocational Anatolian high schools prepared for volleyball competitions. A young female category was determined, and two high schools were suitable for the study. The acceptability criteria for the schools determined by the criterion sampling method (Büyüköztürk et al., 2008), which is one of the types of purposive sampling methods, are as follows: i) Similar academic success levels of both schools (determined according to the data of the Provincial Directorate of National Education); ii) regular preparations and participation in provincial level volleyball team competitions in the last two years; iii) preparation for the provincial competitions in the young female's volleyball category and having at least 14 student-athletes actively participating in the volleyball team; iv) a minimum of 1 year of experience in volleyball competitions (playing at school or in a club) for athletes; v) volleyball team trainers being physical education teachers; vi) carrying out volleyball practices in similar physical conditions. Sporting experience was not inquired about, but the inclusion criterion was having played volleyball for at least one year.

In the second step, two high school teams were assigned as the experimental group (n= 14) and the control group (n= 14) by lot. The mean ages of the participants were 14.93 (SD= .730) and 15.14 (SD= .770) for the experimental and control groups, respectively.

Procedure

This study obtained research permissions from the Mersin Governorship and Mersin Provincial Directorate for National Education, and Ethics Committee Approval from Mersin University Ethics Committee (31.12.2018/017). The students in the research groups and their

parents were informed about the aim and characteristics of the study, and students signed an informed consent form. After ACSI-28 and TOPS were applied as a pre-test to the participants, the athletes in the experimental group to be applied PST were trained about PST, and it was ensured that the athletes gained the necessary knowledge. In this process, the control group did not intervene. The PST program, determined after the trainer's opinions, athlete interviews, and necessary observations, was applied for 12 weeks. At the end of the 12th week, a posttest was conducted with the same scales (Figure 1). Because of the constraints of the research schools, the follow-up test was performed to eight weeks later, and then the analyses were started. Eight weeks is an appropriate time range for the follow-up test in the literature (Davis & Moore, 1935; Haynie, 1997). The PST program delivered as part of the research is presented in Table 1 and Table 2 shows a sample of the 3-day PST used in the 12-week program described above.

Figure 1
Research Process Flow Chart

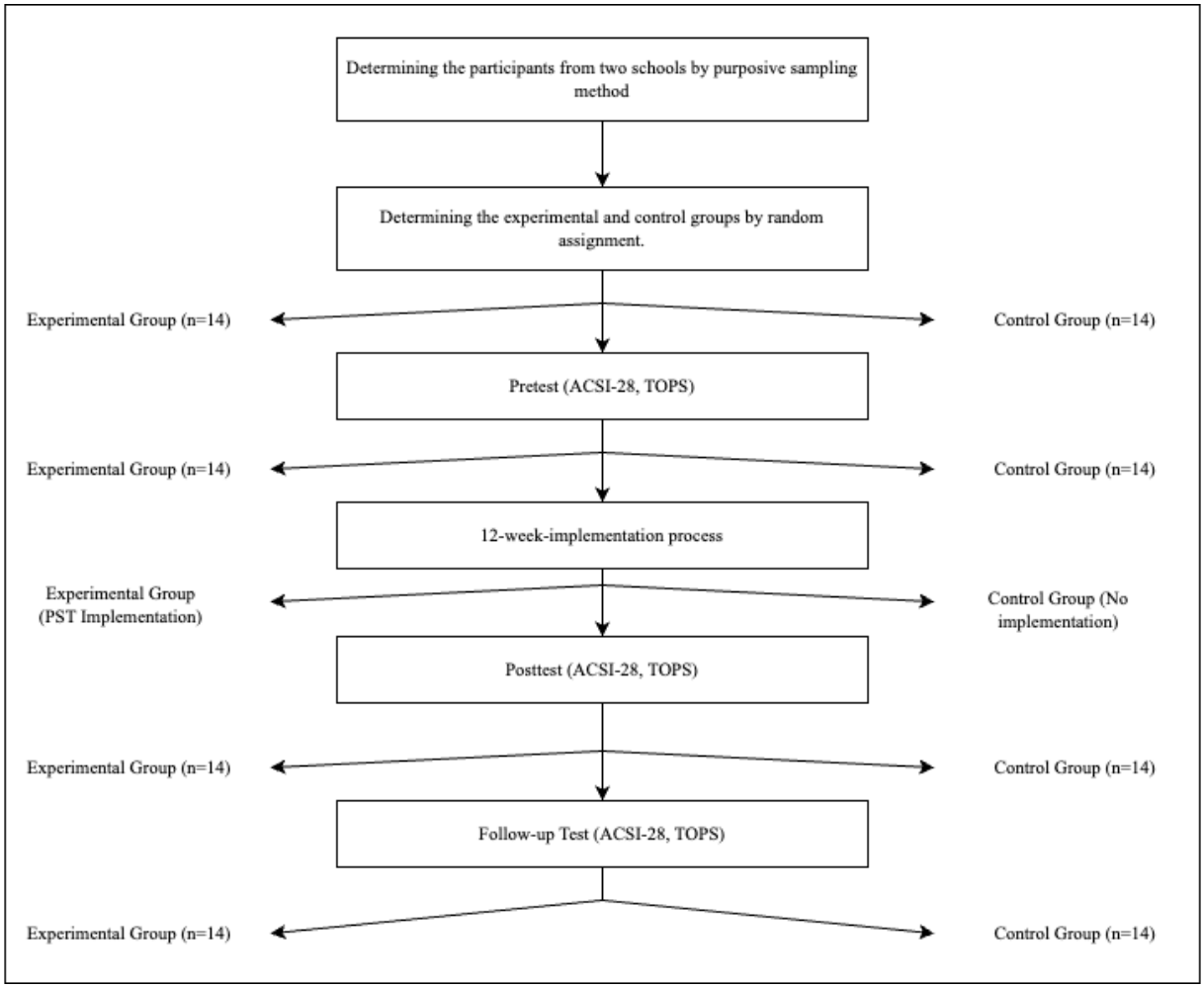

Table 1
12-Week PST Program

Day (Duration)	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
Monday (20-30 min)	First meeting and orientation with athletes	Explanation of the definition, principles, and importance of goal-setting	Explanation of the definition, principles, and importance of imagery	Explanation of the definition, principles, and importance of relaxation	Explanation of the definition, principles, and importance of self-talk	Goal-setting application
Tuesday (20-30 min)	Explaining the volleyball game relationship with and importance of PST	Goal-setting practice	Imagery practice	Relaxation practice	Self-talk practice	Imagery practice Relaxation practice
Thursday (20-30 min)	Explaining the volleyball game relationship with and importance of PST	Goal-setting practice	Imagery practice	Relaxation practice	Self-talk practice	Self-talk practice
Day (Duration)	7st Week	8th Week	9rd Week	10th Week	11th Week	12th Week
Monday (20-30 min)	Goal-setting practice Self-talk practice	Goal-setting practice Self-talk practice	Goal-setting practice Self-talk practice	Goal-setting practice Self-talk practice	Goal-setting practice Self-talk practice	Goal-setting practice Self-talk practice
Tuesday (20-30 min)	Imagery practice Relaxation practice	Imagery practice Relaxation practice	Imagery practice Relaxation practice	Imagery practice Relaxation practice	Imagery practice Relaxation practice	Imagery practice Relaxation practice
Thursday (20-30 min)	The use of psychological skills in the game	The use of psychological skills in the game	The use of psychological skills in the game	The use of psychological skills in the game	The use of psychological skills in the game	The use of psychological skills in the game

Table 2
Examples of the Use of PST in the Study

1st Day	**Subject: First meeting and orientation with athletes** Duration: 30 min Activity Performed: Ice Breaking Activity and learn about sports psychology by telling athletes' stories. Implementation: Before the training session, the athletes are taken to the volleyball court by their PE teachers. Out by the athletes. This is aimed at getting the athletes to develop the best slogan for the team. This will help to communicate with the athletes and help to develop the ability to work together. General explanations about sports psychology are given to the athletes after the icebreaker activity. This is mainly based on defining and explaining the principles involved. Afterwards, examples of psychological processes experienced by experienced athletes are provided (Hasırcı et al., 2018; Weinberg & Gould, 2019).
2nd Day	Subject: Explaining the volleyball game relationship with and importance of PST Duration: 30 min Activity Performed: Athletes' experiences with volleyball. Implementation: The athletes are brought into the classroom by the physical education teacher. The athletes are asked to write down on a piece of paper what their best and worst moments in volleyball have been. What they have written down is then presented and linked to the PBA. The way in which the PBA will impact performance is explained by the expert coach with the help of examples (Hanin, 2000).
3rd Day	Subject: Goal Setting Duration: 30 min Activity Performed: Provide examples and explanations of goal setting. Implementation: The physical education teacher brings the athletes into the classroom. It is explained how goal-setting will take place in the PBA and a sample goal-setting exercise called Success Plan (Hasırcı et al., 2018) is performed with the athletes. The athletes are asked to close their eyes and breathe calmly during the exercise. While their eyes are still closed, the athletes are asked to think about the goal they want to achieve in their sporting life. The athletes are then asked to open their eyes and write on paper the goals they want to achieve in the next ten years, five years, two years, six months, one month, one week, three days, and one day.

Data Collection Tools

Personal Information Form

The Personal Information Form, which athletes determines which athletes will participate in the study, contains information about athletes age and volleyball experience.

Athletic Coping Skills Inventory (ACSI-28)

The Athletic Coping Skills Inventory (ACSI-28) is a personal evaluation form initially developed by Smith et al. (1995) to measure the coping skills of athletes. It was adjusted for Turkish culture by Özcan and Günay (2017). The inventory has 26 items and seven subscales and is scored on a four-point Likert scale. The participants were asked to answer how often (almost never = 0, sometimes = 1, often = 2, almost always = 3) they experienced the related

instances. The seven subscales were not considered, and the scale was evaluated according to the total score. The total scale score ranges between 0 and 78, indicating the ability to cope with sporting problems. The Cronbach Alpha value, the internal consistency coefficient of the scale adjusted by Özcan and Günay (2017), varies between .62 and .80 in subscales. Since this scale was adjusted for junior high school students, we did a confirmatory factor analysis (CFA) with high school students to confirm its reliability and validity. As a result, Cronbach Alpha values ranged between .59 and .74 for this study group. The goodness of fit of the ACSI-28 based on the confirmatory factor analysis was as follows: Goodness of Fit Index (GFI) = 0.90, Adjusted Goodness of Fit Index (AGFI) = 0.88, Root Mean Square Error of Approximation (RMSEA) = 0.055, Standardized Root Mean Square Residual (SRMR) = 0.065, and Comperative Fit Index (CFI) = 0.95. Considering the statistical compatibility calculated by CFA, it was concluded that the collected data is coherent with the scale's previously determined structure.

Test of Performance Strategies (TOPS)

Test of Performance Strategies (TOPS) was developed by Thomas et al. (1999). It is a five-point Likert scale comprising 64 items originally designed to measure psychological skills and techniques used by athletes during both practice and competitions in a comprehensive field and their strategic uses. The points are determined as follows: 1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = always. TOPS was adjusted for Turkish culture by Özder (2017). TOPS comprises 52 items in seven subdimensions of competition and practice subscales. The subdimensions of the competition subscale are Goal-setting (4 items), Emotional Control (4 items), Imagery (4 items), Activation (4 items), Self-talking (4 items), Negative Thinking (4 items), Relaxation (3 items). The subdimensions of the practice subscale are Emotional Control (4 items), Imagery (4 items), Relaxation (4 items), Distractibility (4 items), Goal-setting (3 items), Activation (3 items), Self-talking (3 items). The Cronbach Alpha values of the competition and practice subscales were calculated as .78 and .86, respectively (Özder, 2017). The high scores indicate that psychological skill techniques/strategies are preferred more. This study evaluated eight sub-dimensions, namely, Goal-setting, Imagery, Relaxation, and Self-talking, which are only included in the competition and practice sub-dimensions.

Since the adjustment process of this test was carried out with adult athletes, we performed a confirmatory factor analysis (CFA) with high school students to confirm its reliability – and validity. As a result of CFA, it was found that the Cronbach Alpha values for the Goal-setting, Imagery, Relaxation, and Self-talking sub-dimensions ranged between .55 and .74. The TOPS scale was subjected to confirmatory factor analysis. The goodness of fit

indicators was as follows: Goodness of Fit Index (GFI) = 0.84, Adjusted Goodness of Fit Index (AGFI) = 0.81, Root Mean Square Error of Approximation (RMSEA) = 0.047, Standardized Root Mean Square Residual (SRMR) = 0.060, and Comparative Fit Index (CFI) = 0.95. Considering the statistical coherency calculated by CFA, it was concluded that the collected data was compatible with the scale's previously determined structure.

Data Analysis

To evaluate the data's normality, Z skewness and Z kurtosis values (ranging from -1.96 to +1.96) were examined with the Shapiro-Wilks test. After confirming that Coping Skills with Sportive Problems and Performance Strategies Preference values were normally distributed, a two-factor ANOVA test for mixed-up measurements was conducted to compare the mean scores of the experimental group (with PST) and the control group (without PST). The data were analyzed on SPSS 23.

RESULTS

To investigate the effects of PST on athletes' ability to cope with sportive problems and their preferred performance strategies; descriptive statistics and ANOVA results related to ACSI-28 scores, descriptive statistics and ANOVA results related to TOPS Competition subscale subdimensions, and descriptive statistics and ANOVA results related to TOPS Training subscale subdimensions are presented respectively.

Athletic Coping Skills Inventory (ACSI) Results

2 x 3 factorial ANOVA results indicated that there is no Group x Test interaction effect [$F_{(2,52)} = 1.17$, $p > .05$], Group main effect [$F_{(1,26)} = .054$, $p > .05$], and Test main effect [$F_{(2,52)} = 2.584$, $p > .05$] on ACSI-28 scores of the athletes. The mean scores of the ACSI-28 pretest, posttest, and follow-up tests are given in Table 3.

Findings of TOPS Competition Subscale

The results of 2 x 3 factorial ANOVA for mixed measurements indicated no Group x Test interaction effect [$F_{(2,52)} = .891$, $p > .05$], Group main effect [$F_{(1,26)} = .026$, $p > .05$], and Test main effect [$F_{(2,52)} = 1.962$, $p > .05$] on TOPS Competition Goal Setting scores (Table 3). The results of 2 x 3 factorial ANOVA for mixed measurements showed that the Group x Test interaction effect [$F_{(2,52)} = .242$, $p > .05$], Group main effect [$F_{(1,26)} = 1.491$, $p > .05$] and Test main effect [$F_{(2,52)} = 1.498$, $p > .05$] on TOPS Competition Imagery scores (Table 3). The results of 2 x 3 factorial ANOVA for mixed measurements showed that there is a Group x Test interaction

effect [$F_{(2,52)}$ = 4.014, p< .05], there is no Group main effect [$F_{(1,26)}$ = 3.002, p> .05]. There is a Test main effect [$F_{(2,52)}$ = 11.724, p< .05] on TOPS Competition Relaxation scores (Table 3). According to the results of the analysis, the pretest scores of athletes in Competition Relaxation ($\bar{X}$ = 2.44) were lower than the posttest ($\bar{X}$ = 2.88) and follow-up test scores ($\bar{X}$ = 3.12) (Table 3). The results of 2 x 3 factorial ANOVA for mixed measurements indicated that there is no Group X Test interaction effect [$F_{(2,52)}$ = 1.309, p> .05], Group main effect [$F_{(1,26)}$ = .112, p> .05] and Test main effect [$F_{(2,52)}$ = .222, p> .05] on TOPS Competition Self-Talk scores (Table 3).

Table 3
Test for Performance Strategy Preference of the Groups – Mean Scores and Standard Deviation Values of Competition and Practice Subscales

	Experimental						Control					
	Pretest		*Posttest*		*Follow-up*		*Pretest*		*Posttest*		*Follow-up*	
	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*
ACSI-28	36.79	7.15	43.50	9.54	43.50	9.71	39.64	11.35	40.71	12.12	41.21	11.10
TOPS Competition												
Goal Setting	2.89	.745	3.11	.691	3.36	.705	3.05	.816	3.05	.779	3.14	.586
Imagery	3.09	.949	3.25	1.09	3.48	.958	2.79	.930	2.91	1.05	2.96	.887
Relaxation [a, b]	2.40	.694	3.24	.646	3.36	.722	2.48	.637	2.52	1.02	2.88	.464
Self-Talk	3.05	.941	3.38	.864	3.41	.907	3.29	.790	3.14	.949	3.14	.813
TOPSPractice												
Goal Setting	2.71	.794	2.98	.647	2.95	.597	2.81	.894	2.93	.997	2.95	.738
Imagery [c]	3.10	.778	3.48	.811	3.55	.748	2.83	.958	2.64	.940	2.91	.818
Relaxation [a,c]	1.93	.485	3.13	.457	2.91	.744	2.21	.479	2.52	.917	2.71	.619
Self-Talk	3.31	.647	3.31	1.01	3.43	.831	3.33	.716	3.24	.852	3.31	.480

Note. [a] Group X Test interaction effect; [b] Test main effect; [c] Group main effect

Findings of TOPS Practice Subscale

The results of 2 x 3 factorial ANOVA for mixed measurements indicated that there is no Group x Test interaction effect [$F_{(2,52)}$ = .128, p> .05], Group main effect [$F_{(1,26)}$ = .004, p> .05], and Test main effect [$F_{(2,52)}$ = 1.166, p> .05] on TOPS Practice Goal Setting scores. The pretest, posttest, and follow-up test mean scores and standard deviation values for TOPS Practice Goal Setting are shown in Table 3. The results of 2 x 3 factorial ANOVA for mixed measurements showed that there is no Group X Test interaction effect [$F_{(2,52)}$ = 2.153, p> .05], there is a Group main effect [$F_{(1,26)}$ = 4.474, p< .05] and there is no Test main effect [$F_{(2,52)}$ = 1.835, p> .05] on TOPS Practice Imagery scores. According to the analysis results, the mean score of athletes in the

experimental group in Practice Imagery ($\bar{X}$= 3.38) was higher than the mean score of athletes in the control group ($\bar{X}$ = 2.80). The pretest, posttest, and follow-up test mean scores and standard deviation values for TOPS Practice Imagery are shown in Table 3. The results of 2 x 3 factorial ANOVA for mixed measurements showed that there is a Group X Test interaction effect [$F_{(2,52)}$ = 4.642, p< .05], there is no Group main effect[$F_{(1,26)}$ = 1.004, p> .05]. There is a Test main effect [$F_{(2,52)}$ = 17.227, p< .05] on TOPS Practice Imagery scores. on TOPS Practice Imagery scores According to the results of the analysis, the pretest scores of athletes ($\bar{X}$ = 2.07) were higher than the posttest scores ($\bar{X}$= 2.82) and follow-up scores ($\bar{X}$= 2.81) in Practice Relaxation. The pretest, posttest, and follow-up test mean scores and standard deviation values for TOPS Practice Relaxation are shown in Table 3. The results of 2 x 3 factorial ANOVA for mixed measurements indicated that there is no effect of interaction between Group X Test variables [$F_{(2,52)}$ = 0.95, p> .05], group variable [$F_{(1,26)}$ = .064, p> .05] effect, and Test variable effect also are not mentionable on TOPS Practice Self-Talk scores [$F_{(2,52)}$ = .162, p> .05]. The pretest, posttest, and follow-up test mean scores and standard deviation values for TOPS Practice Self-Talk are shown in Table 3.

DISCUSSION

According to the findings of this study, there was no difference between experimental and control groups in terms of coping skills, practice and competition goal setting, relaxation, self-talk, and competition imagery, while there was in practice imagery. The results of this study showed similarity with a part of the literature results; however, they were not similar to another part of it. Crocker et al. (1988) conducted a PST study with 16 – 18-year-old young volleyball players, including relaxation and self-talk techniques, and obtained a similar finding of coping skills with sportive problems. However, PST was ineffective in coping with anxiety. Walter et al. (2019) ran a PST study with young athletes who compete in areas such as swimming, calisthenics, handball, and volleyball and found that PST affected athletes positively in terms of coping with physical anxiety, self-confidence, and self-sufficiency; however, it was not as much effective on cognitive anxiety and the ability to act on their own will. Klien (2012) performed a PST study with college baseball and softball players, including self-talk techniques, and deduced that PST did not affect coping skills and self-sufficiency levels. Skvarla and Clement (2019) did a PST study with young college dancers, including imagery, relaxation, and self-talk. They found no difference between the PST group and the non-PST group in coping skills. One effective in coping with sporting problems may be the insufficient time spent with athletes in this study. Crocker et al. (1988) emphasized that the

programs for relieving anxiety, one of the coping skills, require a longer time to get an achievement. According to the study, before and during the competition, one could sometimes experience unexpected situations; thus, it is difficult to heal that mood in a limited time mentally. Another reason PST is inadequate in coping skills with sportive problems may be that young and semi-experienced athletes could be focusing too much on the biomechanics of the move. Hayslip et al. (2010) claimed that amateur golfers pay more attention to the biomechanics of the game due to their physical skill level compared to upper-level golfers; thus, they have difficulty using their psychological skills effectively. We had high school students with one year of experience in this study. None of the participants were upper-level athletes; they can have difficulty in using the sportive coping skills because one of the most effective most influential factors for psychological skills used is physical skills (Martens, 1987; Vealey, 1988, 2007; Weinberg & Gould, 2019).

There are also studies in the literature that with do not match our findings on coping skills with sportive problems. One of these studies was performed with young tennis players by Hatzigeorgiadis et al. (2008). They saw self-sufficiency and performance increased in young tennis players with PST, including self-talk. Elliott (2003), another incompatible study, observed that after PST with high school softball players, including goal setting, imagery, relaxation, and self-talk, participants' self-confidence increased, and cognitive anxiety decreased. Beauchamp et al. (1996) performed a PST study with amateur college golfers. They found, including stress management, relaxation, and concentration techniques, and that golfers' coping skills with sporting problems increased after PST. Mamassis and Doganis (2014) conducted a PST study with 14-year-old tennis players, including goal setting, imagery, relaxation, and concentration techniques, and they revealed that the players' anxiety levels related to competition decreased. Finally, Curry and Maniar (2003) studied young college players, including goal setting, imagery, problem-solving strategies, and techniques. They found that the PST group used performance strategies effectively and improved their coping skills with performance problems when they were under pressure. The different sample groups and differences in PST composition may cause the unsimilarity between our study and these studies. For example, Curry and Maniar (2003) used decision-making, time management, developing relationships, effective communication, and irregular nutrition unlike us.

We did not find any difference between the experimental and control groups in the TOPS competition and practice subscales except practice imagery scale in our study. There are few PST studies with high school players aiming to increase the use of psychological skills in

literature with similar TOPS findings. Leffingwell (2000) performed two PST studies with college sports players on different types of sports, and they came up with similar results: players' usage level of the performance strategies such as goal setting, relaxation, imagery, and self-talk did not change with PST. Wild (2001) ran a PST study with a high school male hockey team, including goal setting, imagery, and attention control, and did not find any difference after PST. This indifference may be due to the requirement for more training about PST's foundations and its effects on performance. The same comment was emphasized by Weinberg and Gould (2019) in the explanations made on the PST calendar, that a more extended preparation period may be needed for PST to be more effective on athletes. In the literature, research results that are not similar to the study's TOPS training and competition subscale findings are more common. These studies generally emphasize that athletes use their psychological skills and performance strategies effectively after PST. However, seeing the PST effect in all dimensions in these dissimilar studies is hard. Some of the studies show that PST is partly effective. First, taking studies conducted in Turkey as an example due to cultural proximity, a study conducted by Miçooğulları and Kirazcı (2016) involving young basketball players reported that a six-week PST program did not affect anxiety levels, but it did positively affect team cohesion and self-confidence in players. In another study conducted in Turkey, Urfa and Aşçı (2018) conducted a 10-week PST program with the participation of young football players. The results showed that young football players' self-confidence and attention levels increased, and there was no change in physical anxiety, anxiety, motivation, and shot accuracy scores. In another study conducted in Turkey, Urfa and Aşçı (2018) conducted a 10-week PST program involving young footballers. The results showed that young footballers' self-esteem and attention levels increased and there was no change in somatic anxiety, worry, motivation, and shooting accuracy scores.

Fulgham (1999) performed a PST study with high school female volleyball players, including imagery and goal-setting techniques, and presented that PST improved performance strategies about these two techniques. Horn et al. (2011) conducted a PST study with college softball players whose average age was 18, including goal setting, imagery, relaxation, and self-talk. At the end of the program, they found that players started using these performance strategies during competitions and daily life, and their competition performance was affected positively. Gilbert et al. (2007) did a PST study called UNIFORM (Goal setting, no mistake, imagery, entirely focusing, ultra-positivity, relaxation, stress control, routine preparations) with high school athletes from different sports, including playing games and watching movies. They found that athletes acquired the habit of using psychological skills

through PST. Papacharisis et al. (2005) conducted a PST study with 12-year-old female volleyball and male football players, including goal setting, problem-solving, and positive thinking. They observed that players improved their self-belief skills by using performance strategies effectively with the taught techniques. Megs and Chen (2019) ran a PST study with young swimmers, including goal setting and self-talk. As a result, they revealed that the swimmers used the performance strategies of both techniques effectively.

Another study finding is the difference between groups regarding the TOPS practice imagery dimension. There are studies in the literature that support this result. Di Corrado et al. (2020) revealed that athlete students used imagery skills effectively after PST. Simonsmeier and Buecker (2016) stated that imagery positively affects physical skills development and competition performance for young athletes. The increase in imagery after PST may be related to the fact that amateur athletes pay attention to physical performance rather than psychological performance, as claimed by Goyen and Anshel (1998) and Hayslip et al. (2010). Because, as Martens (1987) and Weinberg and Gould (2019) stated, athletes can use imagery to improve their psychological performance and physical performance. Looking at the studies that do not agree with the findings of this research regarding imagery, the study conducted by Elçi et al. (2013) in Turkey with the participation of swimmers in the 9-13 age group can be cited as an example. Elçi et al. (2013) concluded in their study that imagery practice had no effect on skill development and emphasized that students under the age of 12 were particularly lacking in imagery practice, which had an impact on the results of the study.

CONCLUSION

In sum, this PST study was performed with high school volleyball team players to analyze the effect of PST on athletes' coping skills with sportive problems and their performance strategy preference. At the end of the 12-week PST program, we found that PST did not have any effect on teenage female volleyball players' coping skills with sportive problems and their performance strategies (goal setting, competition imagery, relaxation, and self-talk) except imagery. Considering the limited number of PST studies, some studies are showing the effect of PST on coping skills with sportive problems, while there are other studies indicating that PST is partly effective or not effective at all (Klien, 2012; Skvarla & Clement, 2019; Walter et al., 2019). The differences among these studies are thought to be caused by insufficient duration of PST, age-related characteristics of participants, and the difference between athletes' performance levels. Many PST studies revealed that PST increases the use of performance strategies by young athletes (Horn et al., 2011; Vealey, 2007; Weinberg &

Gould, 2019). However, Foster et al. (2016) showed that even though Vealey (2007) called to increase PST studies with young participants, the progress in recent years has not been enough. For that reason, it is essential to conduct a study that is designed as quasi-experimental research, including pretest, posttest, comparison groups, and follow-up test, and the results presented up-to-date information for sports psychology.

In other words, we can say that what researchers did in these studies was to take a snapshot (ignoring biopsychological features) without considering the qualitative developing differences and characteristics (i.e., Maturity level, personality, cognitive/social skills) of young participants, and this may affect the result (Foster et al., 2016; Visek et al., 2013). Considering the studies showing that less talented and more talented players can be affected by PST differently, and since there may be players from all levels in a school team, PST studies should be backed by individual programs. We see that the number of PST studies in Turkey is relatively low, so few were conducted with young people. Therefore, running PST studies, especially in schools, will help in the formation of programs that will contribute to young athletes' physical and psychological development. Since this study is quasi-experimental, the results cannot be generalized for the entire population.

PRACTICAL IMPLICATIONS

Based on the experience we had in this study, the possible suggestions for researchers those plan to do PST studies are as follows: i) PST content can be diversified according to age groups, ii) PST program can be prepared considering the team environment where there are both gifted and less gifted players together, iii) PST can be performed consistent with the cooperation of parents, trainer, and consultant, iv) if PST may last at least for the season, v) PST can be individualized according to the features of athletes, vi) PST studies should be done in several kinds of schools and sports**.**

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Authors' contribution

Both authors contributed conception and design of the study. Both authors contributed to drafting the manuscript, critical revisions, and review of the results.

Declaration of conflict interest

The authors declare that they have no conflict of interest.

Ethics Statement

In this study, research permissions were obtained from Mersin Governorship and Mersin Provincial Directorate of National Education, and Ethics Committee Approval was obtained from Mersin University Social and Human Sciences Ethics Committee (31.12.2018/017).

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Pamukkale J Sport Sci, 15(1), 188-202, 2024 Research Article

Variation in Match Physical Performance in Turkish Super League Soccer Players by Position Across Four Seasons

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ABSTRACT

This study examined variations in match physical performances of Turkish Super League soccer players over four consecutive seasons, considering playing position. Data were derived from 1224 different match indices for 17997 observations of 25 different teams. These data were collected over the four seasons from 2015–16 to 2018–19 utilizing a multi-camera computerized tracking system. Playing positions were categorized as follows: central defender (CD), external defender (ED), central midfielder (CM), external midfielder (EM), and forward (FWR). The data analysed covered total distance, as well as distances covered in the following conditions: high-speed running (HSR, 20-23.9 km.h^{-1}), sprinting (> 24 km.h^{-1}), high metabolic power (HMP; from 20 to 35 W ·kg^{-1}), elevated metabolic power (EMP; from 35 to 55 W ·kg^{-1}), and maximal metabolic power (MMP; > 55 W ·kg^{-1}). Players in the CM position were found to cover a significantly greater total distance, as well as significantly greater HMP and EMP distances than all other positions. In contrast, those in EM and ED positions engaged in significantly greater high-speed running and sprint distance than all other positions ($p<0.05$). Decreases were found in the distances covered in the different running speed zones and metabolic power zones for all positions over the seasons from 2015–16 to 2018–19. These findings show that the positional roles of the players entail different physical demands. Therefore, it is recommended that coaches consider the physical demands of the positions and seasonal variation when creating training programs for players.

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INTRODUCTION

Match performance in elite soccer is based on the players' different physical, mental, technical, and tactical capacities and cognitive skills (Brito Souza et al., 2020; Roca et al., 2013; Sarmento et al., 2018). The increase in the number of matches and high-intensity activities in soccer has made it necessary for players to be more physically developed. To improve physical capacities, it is necessary for coaches to accurately determine not just internal load (heart rate, blood lactate, and rating of perceived exertion) but also external load (distance covered in different speed zones) induced by matches and training. Thanks to new technologies such as GPS and multi-camera computerized tracking systems, it is straightforward to determine distances covered and estimated energy expenditure by players in matches and training (Buchheit et al., 2015; Carling, 2013). In this way, training plans can be created that align with the structure of matches and the consequent demands on players during matches.

Examining the demands of a match, it is important for soccer players to develop high levels of aerobic endurance, attributable to walking, jogging, low-intensity running, and overall playing time during matches, as well as anaerobic endurance needed for high-intensity activities such as running, jumping, sudden changes of direction, acceleration, deceleration, and sprinting (Morgans et al., 2014). Elite players cover an average distance of 8600–14200m during matches (Di Salvo et al., 2007; Rienzi et al., 2000; Rivilla-García et al., 2019). At least 10 % of the distance covered involves high-speed running and sprinting (Andrzejewski et al., 2016; Stølen et al., 2005). Distances also vary by position, with central midfielders, on average, covering greater total distances than central defenders, wide defenders, and attackers (Rampinini et al., 2007), while a greater proportion of the distance covered in matches by attackers involves sprinting compared to defenders and midfielders.

Although the traditional running speed-based approach (distance covered in high-speed running or sprinting) is considered valid for evaluating high-intensity activities in a match, it does not fully represent the physical demands of soccer, as it does not include acceleration phases, especially in high-intensity running and high-energy activities performed without reaching high speeds (Coutts et al., 2015; Kempton et al., 2015). For example, during a match, players also perform acceleration and deceleration activities around 500-700 times (Castagna et al., 2017). Therefore, to understand the demands of the players during the match, the distance of players have covered at different speed zones in the match as well as the metabolic power can be estimated. This estimate involves a theoretical model based on calculating metabolic power, estimation of energy consumption used in accelerations and

decelerations performed in a soccer drill or match (Coutts et al., 2015). Manzi et al. (2014) showed large to very large correlations between match metabolic power categories and aerobic fitness components in elite male soccer players. In recent years, this theoretical model has been used in team sports such as soccer (Hoppe et al., 2017; Venzke et al., 2023), rugby (Dubois et al., 2017), and hockey (Polglaze et al., 2018) to monitor training load.

Many studies in the literature have compared the distances covered by soccer players in different playing positions across different leagues including the English Premier League (Di Salvo et al., 2013; E. Rampinini et al., 2007), Serie A in Italy (Rampinini et al., 2009), the German Bundesliga (Andrzejewski et al., 2016), La Liga in Spain (Lago-Peñas et al., 2023; Rivilla-García et al., 2019), the French First League (Dellal et al., 2010), the Russian Premier League (Morgans et al., 2022) and the Chinese Super League (Gai et al., 2019). Only one study with small sample size, Akyildiz et al. (2022) compared the distance covered in running speed and metabolic power zones of players playing in different positions in two teams in the Turkish Super League. However, studies up to this point have not compared all players in the Turkish Super League. There is also no comprehensive study in the literature comparing metabolic power demands of soccer players in different playing positions, or from a longitudinal perspective over several seasons. The present study aimed to address the resulting lack in our knowledge by comparing the metabolic power demands and distances covered at different speed zones for different positions and to do this over four seasons to determine the extent of variation seen in Turkish Super League soccer players. It was hypothesized that there would be differences in metabolic power variables and distances covered at different speed zones according to position and that these might vary over the seasons.

METHODS

Participants

A computerized multiple-camera tracking system was used to evaluate the match physical performance. Match physical performance data were collected from the 2015-16 season (age: 27.3 ± 1.1 years; ball possession time: 51:22 ± 4:22 min), 2016-17 season (age: 27.4 ± 1.2 years; ball possession time: 52:26 ± 4:32 min), 2017-18 season (age: 28.1 ± 1.1 years; ball possession time: 53:48 ± 4:10 min), and 2018-19 season (age: 28.3 ± 1.2 years; ball possession time: 53:31 ± 4:47 min) of the Turkish Super League. Data were derived from 1224 different matches based on 17997 observations of 25 different teams. Data was only examined for players who played the full 90 minutes of the match, excluding those who were substituted or

were substitutes themselves. Playing positions were categorized as central defender, external defender, central midfielder, external midfielder, and forward (see Table 1). The study was approved by the Pamukkale University ethics committee (Number: 217385 and year: 2022).

Table 1
Number of Observations by Playing Position for Each Season

Positions	2015-2016 Season	2016-2017 Season	2017-2018 Season	2018-2019 Season	Total
Central Defenders (no)	1097	1115	1114	1045	4371
External Defenders (no)	1139	1057	1072	1108	4376
Central Midfielders (no)	1141	1304	1306	1356	5107
External Midfielders (no)	515	573	593	638	2319
Forwards (no)	448	478	416	482	1824
Total (no)	4340	4527	4501	4629	17997

Note. no: Number of Observations

Procedures

Match Analysis System

Match performance data were collected by using a computerized multiple-camera tracking system (Sentioscope®, Sentio, Turkey). This system uses two high-definition internet protocol cameras to record action on the soccer field; one camera is adjusted to capture the left half, and the other is adjusted to capture the right half. This system allows the collection of the data of all the players involved in the match. Baysal and Duygulu (2016) have demonstrated that Sentioscope® is an effective tracking system for examining soccer players' movement patterns on a soccer field.

Match Performance Parameters

The data were analysed according to total distance and 2 speed zones: High-speed running (HSR, 20-23.9 km.h^{-1}), and sprinting (> 24 km.h^{-1}). In addition, three metabolic power categories were defined: high metabolic power (HMP; from 20 to 35 W·kg^{-1}), elevated metabolic power (EMP; from 35 to 55 W·kg^{-1}), and maximal metabolic power (MMP; > 55 W·kg^{-1}; Osgnach et al., 2010).

Data Analysis

All data are reported as means and standard deviations. Before using parametric tests, the assumption of normality was verified using the Shapiro-Wilk test. A one-way analysis of variance (ANOVA) was performed on each dependent variable (total distance, HSR, sprinting, HMP, EMP, and MMP), including the objective measures of match running performance across the five playing positions and the four completed seasons. Where a significant difference was detected, the Tukey HSD post hoc test for pairwise comparisons was conducted. The level of statistical significance was set at $p < 0.05$. Effect size (ES) was also calculated to determine the meaningfulness of the difference, with magnitudes classified as trivial (<0.01), small (0.01), moderate (0.05), and large (> 0.15; Cohen, 1988).

RESULTS

Positional Differences in Match Distances

The total distances covered at different speed zones according to the different playing positions are shown in Table 2. The results show significant differences between the different playing positions in terms of total distances covered, HSR distances, and sprint distances ($F = 1876.3$; $p = 0.001$; large effect: 0.293; $F = 1819.3$; $p = 0.001$; large effect: 0.287; $F = 1481.2$; $p = 0.001$; large effect: 0.247, respectively). CM covered significantly higher total distance than EM, ED, FWR and CD (4.0%, 4.9%, 7.9% and 10.2% more, respectively). At the same time, EM covered significantly higher HSR distance than ED, FWR, CM, and CD (7.5%, 13.0%, 16.2%, 39.8%, respectively) as well as significantly higher sprint distances than ED, FWR, CM, and CD (11.1%, 17.0%, 33.7%, 46.3%, respectively).

Positional Differences in Match Metabolic Power Distances

Total covered distances at different metabolic power zones for various playing positions are also shown in Table 2. These reveal significant differences between the different playing positions in terms of distances covered at HMP ($F = 2225.6$; $p = 0.001$; large effect: 0.331), EMP ($F = 1608.7$; $p = 0.001$; large effect: 0.263), and MMP ($F = 1144.2$; $p = 0.001$; large effect: 0.202). CM significantly covered distance at higher HMP than ED, EM, FWR, and CD (13.6%, 14.2%, 22.7%, 25.4%, respectively) as well as significantly higher distances at EMP than EM, ED, FWR, and CD (4.3%, 5.7%, 12.1%, 26.5%, respectively). MMP distances, EM covered significantly more than FWR, ED, CM, and CD (6.7%, 8.6%, 18.1%, 31.3%, respectively).

Table 2
Mean Covered Distances at Different Speeds Zones and in Different Metabolic Power Zones for Each Playing Position

Variables	CD (1)	ED (2)	CM (3)	EM (4)	FWR (5)	POST HOC	ES
Total Distance (m)	9816.0±504.6	10399.2±596.1	10933.0±668.9	10494.6±756.1	10072.9±852.0	3> 1, 2, 4, 5; 4> 1, 2, 5; 2> 1, 5; 5>1*	0.293
High Speed Running (HSR) Distance (m)	503.4±139.5	773.4±194.6	700.6±188.8	836.1±198.0	727.3±178.2	4> 1, 2, 3, 5; 2> 1, 3, 5; 5>1, 3; 3>1*	0.287
Sprint Distance (m)	178.0±73.6	294.8±103.2	220.0±90.2	331.6±114.7	275.3±97.6	4> 1, 2, 3, 5; 2> 1, 3, 5; 5>1, 3; 3>1*	0.247
High Metabolic Power Distance (m)	1379.1±187.4	1596.3±249.1	1847.8±291.3	1585.5±275.3	1428.1±277.7	3> 1, 2, 4, 5; 2> 1, 5; 4> 1, 5; 5> 1*	0.331
Elevated Metabolic Power distances (m)	535.3±95.4	687.1±129.8	728.5±137.3	696.9±126.7	640.6±127.4	3> 1, 2, 4, 5; 4> 1, 2, 5; 2> 1, 5; 5> 1*	0.263
Max Metabolic Power distance (m)	300.4±80.1	399.6±93.3	358.1±95.1	437.4±101.3	407.9±103.2	4> 1, 2, 3, 5; 5> 1, 2, 3; 2 >1; 3> 1*	0.202

Note. Central Defenders: CD; External Defenders: ED; Central Midfielders: CM; External Midfielders: EM; Forwards: FWR; * $p<0.05$

Seasonal Variations in Match Distances

Figure 1 shows variations across the four seasons for the different playing positions examined in terms of total distance covered and distance covered in HSR and sprinting zones. If we consider this position by position, CD covered significantly higher total distance (F = 28.392, p = 0.001, small effect: 0.019), HSR distance (F = 51.597, p = 0.001, small effect: 0.034), and sprint distance (F = 27.182, p = 0.001, small effect: 0.018) in the 2015-16 and 2016-17 seasons compared to the 2017-18 and 2018-19 seasons.

Looking at the picture for ED, they covered significantly higher total distances (F = 5.031, p = 0.002, trivial effect: 0.003) in the 2016-17 season than in the 2015-16 and 2017-18 seasons. They also covered significantly higher HSR distances (F = 19.944, p = 0.001, small effect: 0.013) and sprint distances (F = 24.941, p = 0.001, small effect: 0.016) in the 2015-16 and 2016-17 seasons than in 2017-18 and 2018-19.

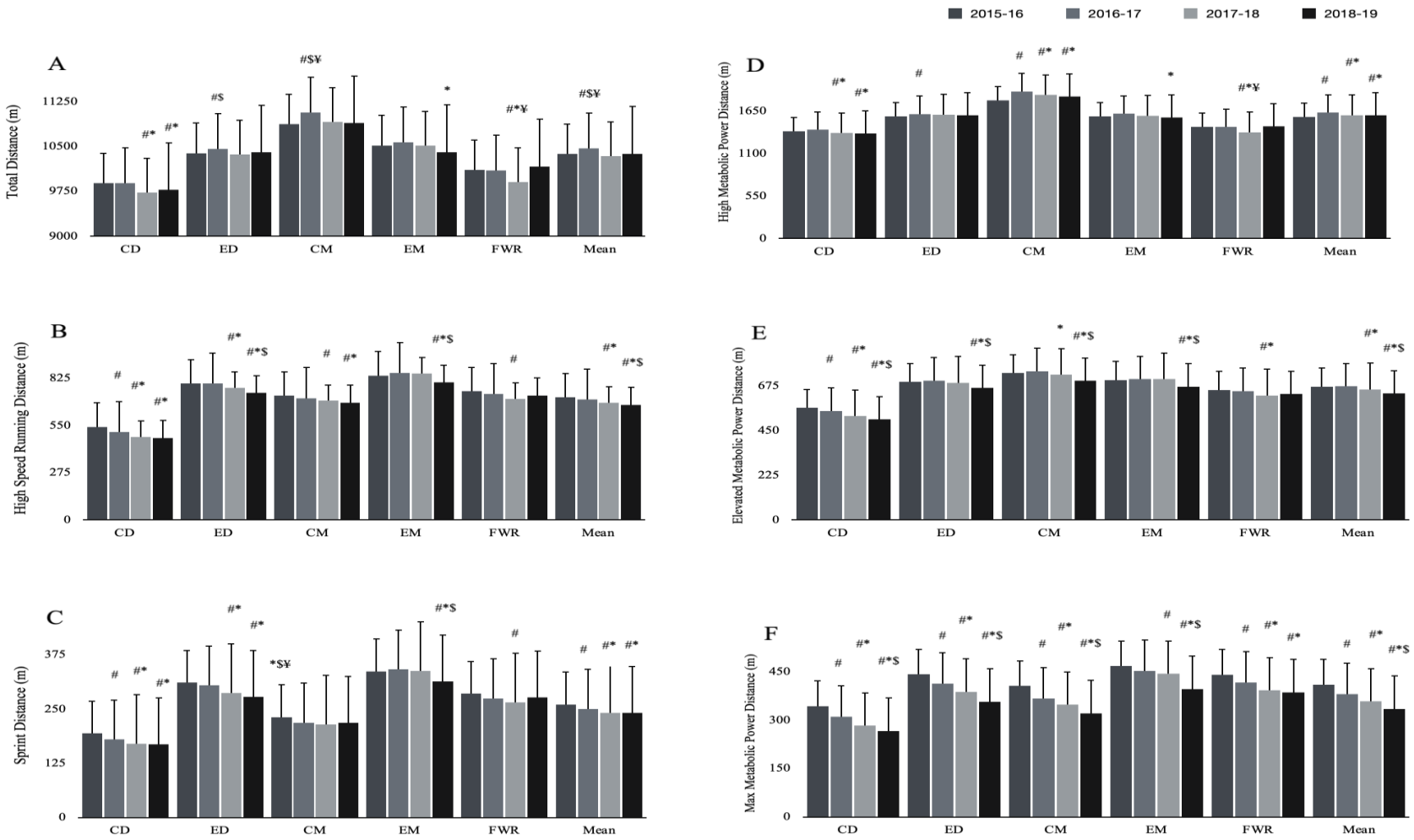
In terms of midfielders, CM covered significantly higher total distances (F = 24.158, p = 0.001, small effect: 0.014) in the 2016-17 season than the other three seasons. They also covered significantly higher HSR distance (F = 11.398, p = 0.001, trivial effect: 0.006) and sprint distance (F = 8.511, p = 0.001, trivial effect: 0.004) in 2015-16 than in both 2017-18 and 2018-19. As for EM, they covered significantly higher total distance (F = 4.914, p = 0.002, trivial effect: 0.006) in 2016-17 compared to 2018-19 as well as significantly higher HSR distances (F = 10.992, p = 0.001, small effect: 0.014), and sprint distance (F = 7.359, p = 0.001, trivial effect: 0.009) in 2015-16, 2016-17, and 2017-18 than in the 2018-19 season. Finally, FWR covered significantly higher total distances (F = 7.639, p = 0.001, small effect: 0.012), HSR distances (F = 4.470, p = 0.004, trivial effect: 0.007), and sprint distance (F = 3.245, p = 0.021, trivial effect: 0.005) in 2015-16 than in 2017-18.

Seasonal Variations in Match Metabolic Power Distances

Figure 1 also shows seasonal variations for the different positions in terms of HMP, EMP, and MMP distances across the four seasons considered here. The results for defenders show that CD covered significantly higher HMP distances (F = 14.146, p = 0.001, trivial effect: 0.009), EMP distances (F = 85.763, p = 0.001, moderate effect: 0.055), and MMP distances (F = 220.973, p = 0.001, moderate effect: 0.131) in 2015-16 and 2016-17 than in 2017-18 and 2018-19. Meanwhile, ED covered significantly higher HMP distances (F = 3.237, p = 0.021, trivial effect: 0.002) in 2016-17 than in 2015-16 and significantly higher EMP distance (F = 16.408, p = 0.001, small effect: 0.011), and MMP distance (F = 190.478, p = 0.001, moderate effect: 0.115) in 2015-16, 2016-17, and 2017-18 seasons covered than in 2018-19.

Figure 1

Variations by Season for Various Playing Positions in Terms of Distances Covered at Different Speeds and in Different Metabolic Power Zones



Note. Central Defenders: CD; External Defenders: ED; Central Midfielders: CM; External Midfielders: EM; Forwards: FWR; # Significant difference from 2015-2016 season; * Significant difference from 2016-2017 season; $: Significant difference from 2017-2018 season; ¥: Significant difference from 2018-2019 season

As for midfielders, CM covered significantly higher HMP distance (F = 33.391, p = 0.001, small effect: 0.019), and MMP distance (F = 1193.561, p = 0.001, moderate effect: 0.102) in 2015-16 and 2016-17 compared to 2017-18 and 2018-19 and significantly higher EMP distance (F = 31.689, p = 0.001, small effect: 0.018) in 2015-16, 2016-17 and 2017-18 than in 2018-19 season. Focusing on the EM position, they covered significantly higher HMP distance (F = 3.919, p = 0.008, trivial effect: 0.005) in 2016-17 than in 2018-19 while covering significantly higher EMP distance (F = 12.914, p = 0.001, small effect: 0.016), and MMP distance (F = 59.213, p = 0.001, moderate effect: 0.071) in 2015-16, 2016-17, and 2017-18 than in 2018-19. Finally, the results for FWR show that they covered significantly higher HMP (F = 7.503, p = 0.001, small effect: 0.012), EMP (F = 4.690, p = 0.003, trivial effect: 0.007), and MMP distances (F = 31.971, p = 0.001, moderate effect: 0.050) in 2015-16 and 2016-17 than in 2017-18.

DISCUSSION

This study investigated the seasonal variation in match physical performances of soccer players in different positions in the Turkish Super League from 2015-16 to 2018-19. The study's main findings are statistically significant differences in the distances covered by different playing positions at different running speeds and metabolic power zones both overall and, in some cases, between different seasons.

Our findings show that, as expected, there are differences between playing positions in terms of distances covered at different running speeds and overall distance covered. Unsurprisingly, players in the CM position were found to cover a statistically significantly greater total distance than all other positions. In contrast, those playing as CD covered the lowest total distance of all the positions. Interestingly, EM and ED covered statistically significantly greater high-intensity running and sprint distances than other positions. In contrast, CD covered the lowest distances in these speed zones. These results are in line with those of previous studies (Di Salvo et al., 2007; E. Rampinini et al., 2007; Rivilla-García et al., 2019). The differences between positions can be associated with each position's tactical role. CM players, for example, need to cover a more extensive area than other positions since their role is to contribute to defense and offense. EMs and EDs, meanwhile, need to perform more high-speed runs than other positions to get to the correct position in the match, both offensively and defensively.

However, the distances covered by players in various speed zones during a soccer match are insufficient to fully explain the metabolic demands imposed (Manzi et al., 2014). Therefore, this study is also important in that it provides findings regarding the metabolic

power distances for players during matches. These findings show that CMs cover the greatest distance at HMP and EMP, while CDs cover the lowest distance. In a similar study with a small sample size, Akyildiz et al. (2022) reported that the CD had the lowest values for the overall metabolic power distances, while the CM had the greatest distances in the Turkish Super League. Venzke et al. (2023) found results in line with current study findings in the German Bundesliga league. In addition, our study findings are consistent with those of Gaudino et al. (2013), who found in a 10-week observation of elite soccer players that CM covered higher HMP, EMP, and MMP distances in training than other positions. These findings demonstrate that the CM position requires more HMP activities than all other positions during the match.

The present study results showed a significant decrease in HSR distance (%6.4) and sprint distance (%8.4). In contrast, total distance did not change between seasons in the 2015-16 and 2018-19 seasons in the Turkish Super League. Partially parallel to the present study findings, Morgans et al. (2022) stated that although total distance (%6.1), HIR (%20.2) and sprint distance (%25.5) showed an increase from 2016–17 to the 2018–2019 season, total distance (%3.0), HIR (%9.8) and sprint distance (%9.3) showed a clear decrease between 2018–2019 and 2020-2021 seasons in the Russian Premier League. On the other hand, some of these findings are somewhat surprising when compared to the findings of Bush et al. (2015), which revealed significant increases in HSR distance (24–36%) and sprint distance (~ 50%), and only minor changes in total distance for all positions between 2006–07 and 2012–13 in the English Premier League. In another study, Lago-Peñas et al. (2023) showed that the number of HSR (%11.5) and HSR distance (%5.7) significantly increased between the 2012-2013 and 2019-2020 seasons in the Spanish La Liga. These results demonstrate that although the ball possession time has increased (from 51:22 to 53:31 min), the physical demands of the Turkish Super League decreased from 2015–16 to 2018–19 seasons, in contrast to the English Premier League and the Spanish La Liga. One of the reasons for these results may be that the average age in the Turkish Super League increased from 2015–2016 (27.3 years) to 2018–2019 (28.1 years). Sal de Rellán-Guerra et al. (2019) revealed that older professional soccer players showed significantly lower physical performance in total distance, number of HSR, and number of sprints than younger players. In addition, some technical parameters, such as the rhythm of the game and the speed of the ball during the ball possessions, may be one of the reasons for these results. Another reason for this result could be that the physical capacity of Turkish Super League players did not change from the 2015-16 to the 2018-19 season. Because previous studies have indicated that total, HSR and sprint distances covered in matches are strongly

related to the physical capacity of professional soccer players (Modric et al., 2021; Radziminski et al., 2020; Redkva et al., 2018).

This is the first study to examine the variation in the performance of soccer players in different positions over several seasons using the metabolic power approach. The present study shows significant decreases in EMP (excluding FWR) and MMP for all positions during four seasons, from 2015-16 to 2018-19 in the Turkish Super League. On the other hand, there are significant decreases for CD, EM, and CM in HMP, while the change in HMP is not significant for ED and FWR. These results may be that the coaches did not create training programs that considered the metabolic demands of the match. Therefore, coaches should remember that players should add drills in their training programs to increase their metabolic power distance and their traditional running-based distances.

The limitation of this study is that variables such as team formations, match outcome (win, draw, or loss), match location (home or away), and interactions between players were not examined. It should be noted that each of these variables can cause players to cover different distances in their positions.

CONCLUSION

The current study shows positional differences in the distance covered at different running speeds and metabolic power zones during matches. Our findings show in more detail than previously provided the extent to which the positional roles of the players entail different physical demands. Therefore, it is recommended that coaches consider the physical demands of different positions to recreate appropriate training loads.

Monitoring the variation in physical match data of a player, a position, or a team over a number of seasons can also provide information that can guide coaches to update their training programs. Our study shows that there was no consistent increase in the distances covered in the different running speed zones or in metabolic power zones of all positions across the 2015-16 and 2018-19 seasons in the Turkish Super League. Thus, it should be remembered that while creating their training programs, coaches should choose their training drills based on the tactical strategies, the playing positions, and the demand of players.

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Authors' contribution

The first and second authors have given the design of the manuscript, first and third authors to acquire, analyzed and interpret the data. All authors participated to drafting the manuscript, first and second authors revised it critically. All authors read and approved the final version of the manuscript.

Declaration of conflict interest

The authors have no conflicts of interest to report.

Ethics Statement

The study was approved by the Pamukkale University ethics committee (Number: 217385 and year: 2022).

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Team Performance Indicators That Predict Match Outcome in Rugby Union

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ABSTRACT

The aim of the study is to identify the most significant indicators of the national team's performance at the European Rugby Championships 15 and to design a model for predicting the outcomes of matches. Data was collected from teams' performance at the European Rugby 15 Championships 2021, 2022 and 2023 for the analysis. The total number of matches was 41. All indicators presented in the official reports were taken: 22 for the home and away teams. The analysis of the team results was carried out according to all indicators: mean value, standard deviation, and test were used to compare the performance indicators of the winning and losing teams. Machine learning techniques were utilized to develop a predictive model for match outcomes. On one hand, 15 indicators (68.2%) are higher for teams that won (winning teams). On the other hand, 7 (31.8%) indicators are higher for teams that lost. The difference between the teams' means varies from -56.46% (the minus indicates that this indicator is higher for the teams that lost) to 273.68%. Based on the results, the Random Forest Classifier and Extra Trees Classifier algorithms have the best prediction accuracy (0.92). The most significant indicators of team performance that affect the final result of the match are tries (196.3% – the difference between the average values of winning and losing teams), conversions (176.7%), missed tackles (-56.46%), offload (126.3%). Based on the data obtained, refining the team training process in Rugby 15 is possible.

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INTRODUCTION

Today, in the world of sports and sports games, the achievement of a competitive edge has become synonymous with understanding and harnessing the power of scientific prognostication and prediction. Managers, coaches, administrators, athletes, and analysts find themselves delving deeper into scientific methodologies to gain actionable insights and make data-driven decisions (Bompa & Buzzichelli, 2015; Veal & Darcy, 2014). Science has paved the way for precise analysis and prediction models. Currently, using science to predict outcomes in sports games and rugby, in particular, is common and typical for the scientific community (Bunker & Thabtah, 2019; Richter et al., 2021).

A sufficient number of studies are aimed at the analysis of data that are focused on various aspects of sports science (Travassos et al., 2013): anthropometric (Toselli et al., 2019) and physiological qualities (Jones et al., 2014; Romanenko et al., 2022); performance indicators of motor activity (Xu et al., 2023; Paolini et al., 2023); aspects of players selection (Till et al., 2011; Gabbett et al., 2011); relative age effect (Latyshev et al., 2022); predicting occurrence of injury during the game (Rizi et al., 2017), pre-season training as a factor in the occurrence of injuries during the season (Tee et al., 2016), predicting the development trajectory of athletes in rugby (Fontana et al., 2017).

As the review of publications shows, specialists are quite interested in various aspects of performance analysis, predicting and modeling in sports games (Hopkins et al., 1999; Latyshev et al., 2020; McGarry, 2009; Sampaio & Leite, 2013;). At present, predicting the outcomes of matches is one of the main areas among sports analysts. For many sports, such studies have been conducted (Bunker & Susnjak, 2022; Horvat & Job, 2020; Stekler et al., 2010; Wunderlich & Memmert, 2021), while for rugby, a limited number of publications has been observed. It is also essential that in rugby, there is a list of popular forms, which may have their peculiarities: Rugby union (rugby fifteens), Rugby sevens and Rugby league.

An effective approach to determining significant indicators for predicting match outcomes is the comparison of performance metrics between winning and losing teams (Jones et al., 2004; Ortega et al., 2009). Such analyses have been systematically carried out across diverse championships, spanning various years and competition tiers (Bennett et al., 2019; Bremner et al., 2013; Watson et al., 2017). The research underscores the pivotal role played by distinct indicators, their significance varying in accordance with the nature of the competition (Colomer et al., 2020).

At the present stage, another significant direction for sports forecasting involves harnessing the capabilities of Artificial Intelligence and Machine Learning (Dindorf et al., 2022). Currently, there is a sufficient number of publications related to this field, spanning both specialized sports journals (Richter et al., 2021) and computer science publications (Bunker & Susnjak, 2022), underscoring the timeliness and relevance of this burgeoning field.

The history of attempts to predict the outcome of rugby matches goes a long way. For instance, in papers by (O'Donoghue & Williams, 2004; Reed & O'Donoghue, 2005) accuracy of human and computer-based methods of predicting have been compared. The first advances in predicting the outcome of the match for Rugby union have been presented, which amounted to an average of half of the matches predicted successfully. However, the authors state that the results suggested that the ability of machine learning methods to predict the outcome of matches has, for the first time, surpassed that of humans.

The results obtained in modern studies have a higher prediction accuracy (over 80%). The paper (Parmar et al., 2017) analyzes the 2012, 2013, and 2014 European Super League seasons and has achieved a prediction accuracy of 85.5% on the test data set. Also, a study by Bennett et al. (2019) examines the 2016-17 English Premiership rugby season, its aim was to identify the most effective method of data analysis (the method of data analysis), which has the highest accuracy, and based on it to design a prediction model.

Most research in analyzing and forecasting rugby outcomes are associated with national club championships or World Cup (Vahed et al., 2016). At the same time, there is a scarcity of analyses concerning continental-level competitions among national teams. Furthermore, there is a limited number of studies utilizing machine learning methods in rugby, especially for the analysis of the most significant performance indicators of team. Conducting such research will provide a broader insight into the significance of performance indicators of national team in the contemporary era for achieving success at the European level. This justifies the relevance of the study. The aim of the study is to identify the most significant indicators of the national team's performance at the European Rugby Championships 15 and to design a model for predicting the outcomes of matches.

METHODS

Data was collected from teams' performance at the European Men's Rugby 15 Championships 2021, 2022 and 2023 for the analysis. The selection was made based on the latest three championships to discern and analyze current trends in the field. Data were taken

from the official website of Rugby Europe. Rugby Europe is a Regional Association of World Rugby. As the association's website states, "Rugby Europe is the governing body responsible for the promotion, development, administration and management of international competitions for the 48 member unions across Europe". The overall number of analyzed matches amounted to 41 out of 44. The absence of official statistics for three matches is likely associated with the disqualification proceedings involving a specific team.

This study only used the utilized publicly available data from official sources without involving human participants or any form of personal data. However, the research was conducted in accordance with the ethical standards of the Khmelnytskyi National University and adhered to the principles outlined in the Declaration of Helsinki concerning ethical conduct in research. The authors took consideration to ensure that all data used from official sites, such as protocols of matches, were obtained and handled in a manner that respects the integrity of the data sources and the entities involved.

We of all the teams' indicators (22 in total) available on the official website of Rugby Europe. The data were sourced from official match protocols and statistical information provided on the federation's official website. The authors did not perform the initial collection of statistical data for each match but utilized ready-made official data for each match. The final collection of official statistics from the website was executed through an automated Python script, followed by the authors' manual verification of the data. No missing data were identified. In total, 22 indicators for the home and away teams were analyzed each (Table 1). The outcome yielded a data table comprising 41 rows (representing the number of matches) and 44 indicators. Additionally, such data as team names, match timing, and competition stage were collected; however, these particulars were excluded from the analytical framework. It is worth noting that different terminologies (indicators and features) are employed based on the industry context (the field of machine learning), while these are essentially the same team attributes.

Data Analysis

The mean value and standard deviation (SD) of the winning and losing teams indicators were measured. Also, a t-test was used to compare the performance indicators of the winning and losing teams' indices. The significance level has been taken to be equal to 0.05 (Thomas et al., 2022). Before employing the t-test, a normality check of the data distribution was conducted using two tests (Normality Test and Equal Variance Test). The majority of indicators met the specified criteria; however, the Mann-Whitney U test was employed in

cases where this was not observed. For statistical data processing, visualization, and machine learning model training, the Python programming language was used.

Machine Learning Models

Machine learning techniques were utilized to develop a predictive model for match outcomes, followed by a comprehensive analysis. The resulting model successfully forecasted match outcomes in two potential scenarios (victory for the home or away team) based on team performance indicators, essentially accomplishing a binary classification task. According to the plan, the final model construction unfolded in two sequential stages. The first stage aimed to identify a more accurate algorithm for forecasting match results. The first stage involved the following sequential steps. The dataset was partitioned into two segments: one for training the model and the other for testing the pre-trained model (to assess accuracy and prevent overfitting). The training sample was 78% of all data (32 matches), and the test sample was 22% (9 matches). The training dataset comprised 44 features (22 for each home and away team) across 32 matches. In the next step, we employed the PyCaret library to develop machine-learning models for comparison. Utilizing this library, we deployed 15 well-established machine learning algorithms to the dataset and compared the prediction accuracy for each algorithm. The following metrics of machine learning models were evaluated: accuracy, precision, and recall. In the concluding phase of this stage, an algorithm and learning hyperparameters with the highest accuracy were chosen for further construction of the predictive model.

Table 1
The List of Teams' Indicators and Their Brief Characteristics

Indicator	Description
Possession	ball possession by the team during the game, measured in percents
Passes	the number of passes made by a team during the game
Tries	the number of tries made by a team during the game
Defenders beaten	the number of insignificant defensive line breaks by opponents during the game
Clean breaks	the number of significant team's defensive line breaks
Offloads	the number of short passes made by a player after he was grabbed (one of the most spectacular components in modern rugby)
Turnovers conceded	the number of losses of the ball in an open game due to active play by the defenders (ball turnover, counter-attack, interception, etc.)
Tackles	the number of tackles aimed at stopping the opponent's forward progression
Missed tackles	the number of unsuccessful plays on defense against the opponent
Turnovers taken	the number of losses of ball possession due to active play by defenders
Kicks in play	the number of ball kicks
Conversions	the number of tries and their conversion (a shot on goal that results in 2 points)

Table 1 (Continues)

Indicator	Description
Conversions missed	the number of successful tries and a missed shot on goal
Penalty goals	the number of penalty shots (if successfully executed from the spot the rules were violated on, the team earns 3 points)
Penalty goals missed	the number of missed penalty shots
Drop goals	the number of successful plays (a player must shoot the ball bouncing off the ground) that results in 3 points
Drop goals missed	the number of successful plays by the opponents that results in their 3 points
Rucks won	the number of rucks standard play won
Rucks lost	the number of rucks standard play lost
Line outs lost	the number of bringing the ball back to play using a line of players after the ball has crossed the sideline
Scrums won	the number of scrums standard play won (formed at the pitch to resume the game after rules violation or game stoppage)
Scrums lost	the number of scrums standard play lost

The second stage involves constructing a predictive model for match outcomes and identifying key performance indicators. It is important to emphasize that the central aim of the study is to determine the more significant team's performance indicators rather than seek and construct a more accurate prediction model. The training of the final model involved using the complete dataset (41 matches) with hyperparameters that were determined in the previous stage. Following this, the contribution of each indicator to match outcome prediction was quantified in percentages.

RESULTS

The analysis of the team performance indicators has been carried out; the results of the calculations are presented in Table 2.

Table 2
Statistical Value of Team Performance Indicators

Indicators	Statistical indicators					
	Winning teams		Losing teams		Percentage difference, %	p-value
	Mean	SD	Mean	SD		
Possession	53.95	6.6	46.05	6.6	17.16	7.0e-07 *
Passes	125.12	43.2	95.95	28.0	30.40	5.4e-04 *
Tries	5.78	2.8	1.95	1.2	196.25	5.5e-11 *
Defenders beaten	17.93	11.8	8.24	5.8	117.46	1.6e-05 *
Clean breaks	6.56	5.4	2.46	2.1	166.34	3.5e-05 *
Offloads	8.83	4.8	3.90	2.7	126.25	3.3e-07 *
Turnovers conceded	14.39	6.8	12.76	4.7	12.81	2.1e-01
Tackles	102.51	29.4	111.63	34.1	-8.17	2.0e-01
Missed tackles	10.02	5.5	23.02	12.9	-56.46	2.1e-07 *
Turnovers taken	5.95	2.7	5.90	2.9	0.83	9.4e-01
Kicks in play	18.68	6.1	18.93	6.4	-1.29	8.6e-01

Table 2 (Continues)

Indicators	Statistical indicators					
	Winning teams		Losing teams		Percentage difference, %	p-value
	Mean	SD	Mean	SD		
Conversions	4.05	2.3	1.46	1.2	176.67	3.3e-08 *
Conversions missed	1.73	2.0	0.46	0.6	273.68	2.5e-04 *
Penalty goals	1.24	1.4	1.22	1.2	2.00	9.3e-01
Penalty goals missed	0.34	0.6	0.44	0.7	-22.22	5.1e-01
Drop goals	0.10	0.3	0.05	0.2	100.00	4.0e-01
Drop goals missed	0.05	0.2	0.05	0.2	0.00	1.0e+00
Rucks won	72.98	21.7	63.66	20.1	14.64	4.7e-02 *
Rucks lost	2.71	2.2	2.44	2.0	11.00	5.7e-01
Line outs lost	2.17	2.2	3.22	2.2	-32.58	3.2e-02 *
Scrums won	5.44	1.9	6.10	2.6	-10.80	2.0e-01
Scrums lost	0.49	0.6	0.68	0.8	-28.57	2.1e-01

Note. * – statistically significant differences between parameters of the losing and winning teams ($p < 0.05$) have been revealed.

The analysis of the team results was carried out according to 22 indicators. On one hand, 15 indicators (68.2%) are higher for teams that won (winning teams). On the other hand, 7 (31.8%) indicators are higher for teams that lost. The difference between the teams' means varies from -56.46% (the minus indicates that this indicator is higher for the teams that lost) to 273.68%. It should be noted that four (18.2%) indicators have differences of less than two percent, and only the mean results of one indicator (Drop goals missed) are equal for the losing and winning teams.

The analysis of statistical differences between the indicators of the teams showed that 11 (50.0%) indicators significantly differed statistically ($p<0.05$): nine of them were higher for the team that won and two for the team that lost. Also, eleven (50.0%) indicators did not have statistically significant differences ($p>0.05$): of these, six indicators were higher for the team that won, and five – for the team that lost.

Based on the training data, several models were designed for various machine learning algorithms. The PyCaret Python library was used to compare the accuracy of various machine learning algorithms. Table 3 lists ten algorithms and their metrics (accuracy, recall, precision) for the test sample. In total, over 15 machine-learning algorithms were tested.

Table 3
The List of Models of Machine Learning and the Accuracy of Their Predictions

Model (algorithm)	Abbreviation	Accuracy	Recall	Precision
Random Forest Classifier	rf	0.92	1.0	0.92
Extra Trees Classifier	et	0.92	1.0	0.92
K Neighbors Classifier	knn	0.87	0.85	0.87
Ridge Classifier	ridge	0.87	0.9	0.82
Extreme Gradient Boosting	xgboost	0.83	0.95	0.87
Gradient Boosting Classifier	gbc	0.83	0.95	0.87
Decision Tree Classifier	dt	0.82	0.85	0.82
Naive Bayes	nb	0.82	0.85	0.82
Ada Boost Classifier	ada	0.73	0.85	0.77
Light Gradient Boosting Machine	light gbm	0.55	1.0	0.55

Based on the results, the Random Forest Classifier and Extra Trees Classifier algorithms have the best prediction accuracy (0.92). Consequently, the resulting model gives the accurate outcome of the match in 92% of cases (win or loss of the team) in terms of the team performance at the end of the match.

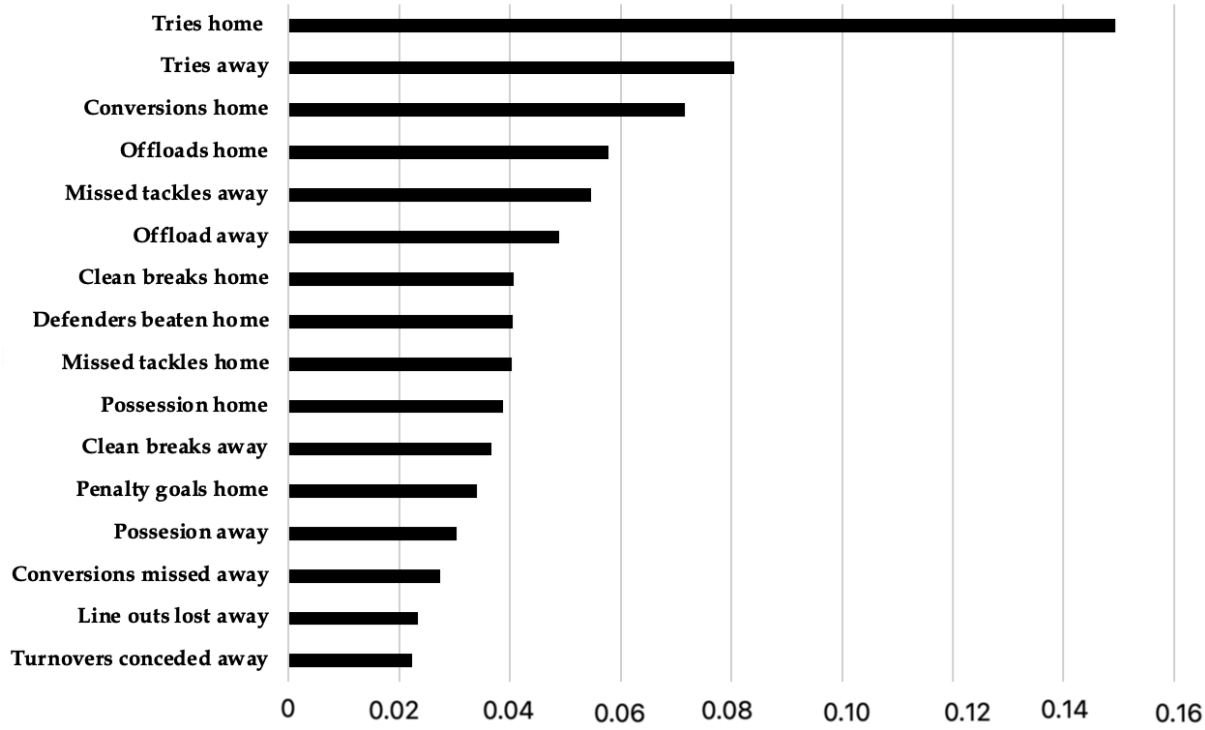
It should be noted that algorithms based on decision trees showed promising results. For further analysis and construction of the final model, the Random Forest Classifier algorithm was chosen. The model was designed based on all the data and the obtained hyperparameters.

The following important stage of the study is to determine the impact of each feature on the final prediction model. Based on the obtained machine learning model for predicting match outcomes, the features with the most significant impact have been identified. Figure 1 shows feature with more significant impact than 2% (0.02) in the final match prediction model. The words home and away characterize the features belonging to the home and away teams, respectively –44 features, 22 features each for the home and away teams.

Sixteen (36.4%) features in the model weight more than 2% (they account for 79.8% of the model's input). Also, 16 (36.4%) features contribute from 0.5% to 2%, and the remaining 12 (27.2%) parameters are less than 0.5%.

The following features have the largest impact (more than 5%) on the model: tries of home (14.9%) and away (8.1%) teams, conversions of home team (7.2%), offloads of home (5.8%) and missed tackles of away team (5.5%). The following features do not contribute to the model: the drop goals of the away team, the drop goals missed by the away team, and the drop goals missed by the away team.

Figure 1
Contribution of Team Performance Indicators to the Model of Match Outcome Prediction



DISCUSSION

The most significant aspect of the study for the practical coaching activity and training process is the analysis of the significance of indicators. Similar research for rugby has been conducted for various competition levels and temporal scopes (Colomer et.al., 2020; Sasaki et.al., 2007). Key performance indicators encompassed tries, conversions, possessions, tackles, and other indicators. Notably, experts examined indicators extending beyond the confines of our study (from the results of their research, it was evident that these indicators are important for achieving victory); for example, the first team scored quick rucks or average carry meters (Jones et al., 2004; Ortega et al., 2009; Parmar et al., 2017; Schoeman & Schall, 2019; Watson et al., 2017).

The obtained results, indicators such as tries (196.3% – the difference between the means of winning and losing teams), conversions (176.7%), missed tackles (-56.46%), offload (126.3%) are in the top five in terms of significance in the final model. The difference between the means of winning and losing teams on these five indicators is over 100%, except for one indicator (missed tackles). This indicator has the largest difference, with higher mean values for the losing team. Among the indicators in the top 10, the possession indicator should be pointed out: the difference between the mean values for this indicator is only 17.2% (all other

indicators have values above 100%, except for the one mentioned above). All of the previously mentioned indicators are statistically significantly different for winning and losing teams. The Conversions missed indicator stands out, having the largest difference (273.7%) between the means and a statistically significant difference, but at the same time, it is ranked 14th in terms of significance in the model. It should be noted that most of the indicators are important for both home and away teams, indicating the equivalence of these indicators. Based on these data, it is possible to refine the team training process in Rugby 15. The acquired data demonstrate contemporary trends within the performance indicators of national teams in the European Championships. Also, these data allow us to identify more significant indicators of competition activity during the season/game and pay more attention to these indicators during the game (as the opposing team during the analysis).

The accuracy of predictions obtained using our model exceeds the results obtained earlier. We obtained an accuracy of 91.7%, while in the study by Parmar et al. (2017) the accuracy of the prediction on the test set was 86.5% (the algorithms employed in the study included Logistic and Linear regression), and in the study by Bennet et al. (2019) – about 80% (Random Forest). In our study, Random Forest demonstrates the most superior result among machine learning algorithms. However, our study analyzed the team performance indicators obtained at the end of the match. These indicators characterize the completed match when the match's outcome is already clear and do not consider the dynamics of indicators during the match. Therefore, it is earlier incorrect to compare it with earlier studies – there, the prediction was made for future matches with no given information about them. This is due to the relatively high degree of accuracy (more than 90%) obtained in our study.

Additionally, the model can be used at certain points during the match, but the accuracy of such predictions is currently unclear. We did not conduct research during the match. It should also be noted that we conducted research for Rugby 15, while most of the research has been conducted for other types of rugby, and other indicators of competition activity have been used.

CONCLUSION

The analysis of the team performance at the European Rugby Championships 15 was done. Based on the indicators of the teams, a model for predicting the outcome of the match was designed. As shown by machine learning model design results, the most successful algorithms are Random Forest Classifier and Extra Trees Classifier. They have the best prediction accuracy (over 90%), higher than some indicators obtained in earlier research.

However, they have certain limitations in prediction. The most significant indicators of team performance that affect the final result of the match are tries of home and away teams, conversions, missed tackles, and offload. On the other hand, the indicators of least significance include penalty goals, penalty goals missed, drop goals missed, scrums won, and kicks in play. The obtained results overall confirm and expand upon the insights gleaned by experts in previous studies. Based on the data obtained, it is possible to refine the team training process in Rugby 15.

Authors' contribution

The first and second authors took responsibility for the research design, conceptualization, and referencing. All other authors contributed to the implementation of the research, data collection, data analysis, and the writing and editing processes.

Declaration of conflict interest

No conflict of interest is declared by the authors.

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Pamukkale J Sport Sci, 15(1), 217-233, 2024 Research Article

Development of A New Tool to Analyze Injury Risk: Turkish Get Up Injury Risk Tool

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ABSTRACT

Injury risk analysis is critical to preventing injuries' physical and psychological impact. The purpose of this study was to develop a new tool to evaluate the risk of injury particular to the Turkish get up (TGU) exercise. According to expert opinions, the Turkish Get Up Injury Risk Tool (TUGIR) is a biomechanical assessment tool developed based on the Turkish Get Up (TGU) movement. It evaluates the alignment and quality of movement during the exercise to assess the risk of injury. The upper and lower quarter Y balance tests (YBTs) and Functional Movement Screening (FMS) were performed to determine construct validity. A total of thirty- three wrestlers performed all the tests. Reliability was assessed by internal consistency determined with Cronbach's alpha coefficients and inter-rater reliability determined with Kendall's coefficient of concordance. The injury risk cut-off value was calculated according to the Angoff method. The internal consistency of the TUGIR was found to be 0.77 and 0.76, respectively, quite reliable for the right and left sides. Kendall's concordance coefficient of the total score was determined to be 0.998 for both sides. The injury risk cut-off value was found to be %72 for the overall TUGIR score. A low to moderate association was observed between TUGIR and YBTs—FMS. The TUGIR is a novel, reliable, and valid tool for assessing injury risk in sports. This tool offers several advantages, including being an easy-to-use, low- cost, and comprehensive method that can reflect sports-specific biomechanical characteristics. This research could lead to the use of this tool to assess the risk of injury in other sports branches.

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INTRODUCTION

Athletes are faced with the risk of non-contact injuries due to several factors, such as overuse, lack of eccentric strength, excessive bending-stretching, and torsional forces. Complex injuries can make recovery challenging and costly (Bussey, 2002). In addition, changes in the athletes' neuromuscular functions and psychological states increase the risk of re-injury (Brewer & Redmond, 2016). As a result, it's critical to assess the risk of injury on a routine basis. For this purpose, various injury risk analysis methods have been developed.

Biomechanical testing, such as motion analysis, is required to determine the risk of injury and thus implement injury prevention programs. Due to the high cost of research equipment in currently utilized test methods, the length of evaluation procedure, and the lack of practical use by clinicians, screening instruments such as Functional Movement Screen (FMS), Y balance tests (YBTs), landing error score system have been developed and has gained popularity, especially FMS (Padua et al., 2009; Shaffer et al., 2013; Teyhen et al., 2012). However, according to the research, it is controversial that existing test batteries can predict the risk of sports injury. For instance, the results of the meta-analysis published by Bunn et al. reported that individuals classified as “high risk” by the FMS were found to be 51% more likely to be affected by injuries than those classified as “low risk” (dos Santos Bunn et al., 2019). Recent studies suggest that FMS, which is a suitable evaluation method in terms of observing asymmetry in particular movement patterns or poor movement formation, will not provide a deep analysis in terms of the prediction of injury. These weaknesses’ have highlighted the need for a more comprehensive analysis system (Bishop, et al., 2015; Hoover et al. 2020; Moore et al. 2023; Vehrs et al., 2021). While numerous tests are available to measure athletes' physical abilities and exercise status (McGuigan, 2016), considering the risk of injury, sport-specific biomechanical needs, biomechanical stress, and the ability to cope with such stresses differ significantly. Athletes in various sports disciplines are exposed to different biomechanical stresses and distinct injury mechanisms. Therefore, there is a need for sport-specific tools to assess the risk of injury (Loudon et al., 2014; Takahashi et al., 2019). The Turkish Get Up (TGU) exercise has been named due to its origins in old Turkish wrestlers. The TGU exercise, which increases the stabilization and focuses on the shoulder, knee, and spine, requires whole-body integration (Liebenson & Shaughness, 2011). TGU has many advantages to be used for assessment in sports since it requires a good level of flexibility and mobility, includes contralateral and asymmetrical loading, eccentric load, and the torque forces (Collum et al., 2020). It is also a low cost, coordinative movement in all planes which combines open-closed

kinetic chain exercises and hasthe potential to create the injury scenario specific to sports (Leatherwood et al., 2014; Liebenson & Shaughness, 2011). Therefore, in this study, we aimed to create a new, comprehensive, and functional injury risk tool based on the TGU exercise.

METHODS

Participants

The athletes included in this cross sectional study were selected from the Turkish National Team camp and Wrestling Sports Club. Wrestling professionally for at least five years was set as inclusion criteria. Exclusion criteria were (a) any disease or surgery that could affect the normal function of the musculoskeletal system, (b) active injury.

All athletes gave written informed consent to participate in the study. Prior to scheduling their participation, each step of research was explained verbally. All athletes were informed about the experimental procedure to ensure that they qualified for the study. Athletes were allowed to withdraw from the study at any point. Written permission was obtained from the Ethics Committee of the Clinical Research Ethics Board of AYBU Education and Research Hospital (Approval No: 23.03.2018-94).

The ICC value as 0.85 was used to estimate the sample size when the number of raters was lower than 4 (Mukaka, 2012). Sample size calculation indicated that 31 participants were adequate to complete the study with an alpha error probability of 0.05 and power of 80%. The study was completed with a total of 33 professional wrestlers due to the possibility of dropouts.

Despite the common use of kettlebells among wrestlers, the Turkish Get Up (TGU) is not currently included in their training routines. The wrestling athletes were chosen for our research population considering its historical origins, being a contact sport, and requirement of the technical use of the whole body (Jang et al., 2009). The study included the expert committee members involved in the tool development and the wrestling athletes who performed the test. Wrestling athletes who performed the tests were also on the expert committee. The athletes were selected from the national team camp and an elite sports club. Wrestling professionally for at least five years was set as inclusion criteria. Exclusion criteria were (a) any disease or surgery that could affect the normal function of the musculoskeletal system, (b) active injury.

Procedures

The Delphi Method created the TUGIR tool (Niederberger & Spranger, 2020). An expert committee was formed, and we have collected expert-based judgments and used them to identify consensus. After completing the tool, 33 wrestling athletes were tested with the tool, FMS, and YBTs to demonstrate the validity and reliability.

Development of TUGIR Tool

Forming Expert Committee

The maximum diversity sampling method was used to form the expert committee. It comprised four physiotherapists specialized in athlete health, two statisticians, six athletic trainers, one biophysicist, three sports medicine physicians, and 33 wrestling athletes.

Construction of Tool Based on Turkish Get Up Exercise

The first draft of the tool was formed based on the 14-phase TGU exercise suggested by Onge et al. (St-Onge et al., 2019) and was sent to the expert committee. The feedbacks were received on several aspects, from the content of the draft to its scoring. The draft was revised several times due to the recommendations and divided into seven phases. Squat, which was not included in the first draft, was added in the final version, thus forming the tool in a total of eight phases. The phases were named as '*pelvis contact, pelvis raise, knee contact, standing up, squat, landing to knee contact, pelvis stabilization, landing to pelvis contact*' respectively. A certain number of parameters were created according to the content of each phase. The total number of parameters is 193, which varies between 19 and 35 for each phase. The final version of the TUGIR was included in the appendix (Appendix 1). The optimal weight of the kettlebell (KB) to be used during the exercise was determined as 15 % of the body weight by the athletes and expert committee.

A one-zero-point system for evaluating each parameter separately was chosen as the scoring system. The parameters are scored as 0 or 1 depending on whether the athlete performs the movement successfully or not. Each phase score was calculated by dividing the number of succeeded parameters by the total number of parameters in that phase. The same method was used for the overall TUGIR score. Comparing right and left side scores can determine functional asymmetry between sides.

Data Collection Tools

TUGIR

The athletes first completed the eight phases with the KB in the right hand, then repeated for the left side. Before the assessments, athletes were a) demonstrated the test (until

you learn), b) informed about the possible errors during the tests, c) allowed five minutes warm-up period (Since it is a whole-body movement, warming movements for all extremities were used to warm up the whole body), d) allowed make three trials (A 1-minute rest was given after each test.). The tests were performed in the same order, at the same time of day (mid-afternoon). Cameras were placed to record the athletes from the front, back, and lateral sides holding the KB. Scoring was made according to data obtained from camera recordings. Scoring was performed as described above. Additionally, an injury risk cut-off value was calculated by dividing the number of succeeded parameters by the total number of parameters and converted to percentage value for each phase separately and as a total. Thus, a person fully meeting all the parameters will score 100 points.

Y Balance Tests

The upper and lower quarters were tested using a Y balance test kit (Move2Perform, Evansville, IN, USA).

a) Lower Quarter Y-Balance Test (YBT-LQ)

The distal aspect of the stance foot was at the starting line as athletes stood on the middle footplate with both hands on their waist for the starting position. The athlete reached in the anterior, posteromedial, and posterolateral directions in reference to the stance foot with the free limb while maintaining single leg stance by pushing the indicator box as far as possible. The test was considered unsuccessful if the athlete received assistance from the equipment, touched the floor, or fell from the platform due to a loss of balance, and the test was repeated by returning to the starting position. For each reach direction, participants completed three trials in a row, and the best score was recorded (Shaffer et al., 2013).

The distance between the spina iliaca anterior superior and the medial malleolus was measured to calculate lower extremity length. A composite score was determined as reach distance divided by limb length, then multiplied by 100% to express reach distance as a percentage of limb length (Shaffer et al., 2013).

b) Upper Quarter Y Balance Test (YBT-UQ)

The athletes were in the push-up posture, with the stationary hand in the middle of the platform, the adducted thumb parallel to the red line, and the feet no more than shoulder width apart for the starting position of the test. The athlete's maximum reaching with the free hand in three directions (medial, superolateral, and inferolateral) with respect to the stationary hand was the focus of the test. If the athlete (a) fell off the stance platform or contacted the floor with the reaching hand, (b) failed to sustain reach hand contact with the reach indication

on the target area while it was moving (e.g., shoved the reach indicator), (c) gets stance support by transferring weight onto the reach indicator, (d) failed to return the reaching a hand to the beginning position under control or move either foot off the floor the session was invalidated and repeated. This procedure was repeated until each hand had completed three trials in each direction, and the best score was recorded (Westrick et al., 2012).

The distance between the C7 spinous process and the most distal tip of the right middle finger was measured to calculate upper extremity length. To normalize for limb length, a composite score was calculated as reach distance divided by limb length, then multiplied by 100% to express reach distance as a percentage of limb length (Westrick et al., 2012).

Functional Movement Screening

FMS test tool was used. Athletes were instructed to do a series of movements which are "Deep Squat, Hurdle Step, In-Line Lunge, Shoulder Mobility, Active Straight Leg Raise, Trunk Stability Push-Up, and Rotary Stability" according to the FMS authors' instructions (Teyhen et al., 2012). All the tests were completed without a pre-test warm-up. The evaluation was made with dual camera recordings from frontal and sagittal planes. Each movement is rated on a scale of 0 to 3 with a total score ranging from 0 to 21 points: If the athlete feels pain during the movement = 0, is unable to execute the correct movement = 1, executes the movement with compensations = 2 and executes the correct movement without pain or compensations = 3. Each athlete was able to perform each component test three times, with the highest result getting recorded. Asymmetry is assessed in five of the seven component tests by measuring the test bilaterally. If there are discrepancies between the left and right sides, asymmetry is noted and the lower of the two values is selected in the FMS composite score (Cook et al., 2006a, 2006b; Teyhen et al., 2012). The testing was administered by two investigators with experience using the FMS in daily practice, and the principal investigator graded the results

Data Analysis

Data analysis and calculations were conducted using IBM SPSS Statistics 22.0 (IBM Corp. Version 22.0. Armonk, NY) and MicroSoft-Excel 2016. An overall p-value of less than 0.05 was considered to show a statistically significant result. As TUGIR, Y balance tests, and FMS scores did not follow the normal distribution, non-parametric statistical tests were used.

Reliability and validity

The Angoff method, which is one of the standard methods based on expert opinions, was used to determine the injury risk cut-off points. Lower scores than the cut-off point

indicate that the athlete is prone to injury (Mills & Melican, 1988). The Cronbach's Alpha Coefficients were used to evaluate the internal consistency of the TUGIR for the right and left overall scores. Cronbach's Alpha values of 0.80-1.00 were accepted as high reliability, 0.60-0.79 as quite reliable, 0.40- 0.59 as low reliability, and 0.00-0.39 as non-reliable (Vaske et al., 2017). Kendall's Coefficient of Concordance was used to determine inter-rater reliability by three raters (sports physiotherapist, sports physician, and athletic trainer) who were also members of the expert committee. Raters examined the videos separately, and they were blind to each other's' scores. Face validity was assessed by gathering experts' opinions with backgrounds in sports science. *The construct validity* of the TUGIR was analyzed based on its correlation with FMS and Y balance tests (Ercan & Kan, 2004). The correlation values of 0.000 as no relationship, 0.001– 0.200 as very weak relationship, 0.201– 0.400 as weak relationship, 0.401– 0.600 as a moderate relationship, 0.601– 0.800 as strong relationship, 0.801– 0.999 as very strong relationship, and 1.000 as perfect relationship were accepted in the interpretation (Mukaka, 2012).

RESULTS

A total of 75 wrestlers were assessed for eligibility. Of these, 42 were excluded for various reasons; did not meet the inclusion criteria (n = 32), declined to participate (n = 7), discontinued tests (n = 3). Finally the study was completed with 33 male wrestlers, aged between 19-33. The study was completed with 33 male wrestlers aged 19-33. Table 1 shows the demographics of the athletes.

Table 1
Demographics of Athletes

Variables	Median [IQR25 – IQR75]
Age (year)	21.00 [19.00 – 23.00]
Sports year (year)	10.00 [7.00 – 14.50]
BMI (kg/m²)	25.61 [22.79 – 28.34]

BMI: Body Mass Index

Table 2 shows the descriptive istatistic of the TUGAR. The right and left side score were the lowest in phase 5 and the highest in phase 8. The relationship between TUGIR, FMS and YBT's scores are given in Tables 4 and 5, respectively. In order to determine the correlation level between TUGIR scores and FMS scores, the relationship between the subscores of these two scales was examined using the Spearman Rank Correlation coefficient. A positive relationship was observed between the right side of Phase 4 and Rotation Stability ($p<0.05$). A significant negative relationship was observed between the right side Phase 6 and the right

Hurdle Step ($p<0.05$). A positive, moderately significant relationship was observed between Right Phase 7 and Shoulder Mobility in right-side external rotation ($p<0.05$). A significant negative relationship was observed between the left F7 and the left foot supported Hurdle Step movement ($p<0.05$). A positive significant relationship was observed between Left Phase 2 and Shoulder Mobility movement in left side shoulder external rotation ($p<0.05$). A positive significant relationship was observed between Left Phase 4 and the left-supported Rotational Stability movement ($p<0.05$). A significant positive relationship was observed between Left Phase 6 and the left foot-supported Deep Squat movement ($p<0.05$). A positive, moderately significant relationship was observed between Shoulder Mobility movement in Left Phase 7 left side shoulder external rotation ($p<0.05$). No significant relationship between the TUGIR total score and the FMS total score for the right and left sides could be detected. In addition, apart from the parameters listed, it was determined that there was no relationship between the other phases of the TUGIR test and the FMS subparameters (Table 4).

Table 2
Descriptive Statistics of TUGIR

Side		Min-Max	X ± SD	Skewness 0.41	Kurtosis 0.80
Right	**P1**	0.500-0.950	0.824±0.100	-1.068	1.424
	P2	0.565-1.000	0.792±0120	0.145	-0.410
	P3	0.543-0.971	0.729±0.120	0.382	-0.683
	P4	0.474-1.000	0.716±0.150	-0.029	-1.242
	P5	0.357-0.857	0.644±0.110	-0.556	0.562
	P6	0.444-0.963	0.760±0.120	-0.677	0.281
	P7	0.476-0.952	0.750±0.110	-0.216	0.267
	P8	0.650-1.000	0.900±0.110	-1.310	0.838
	Total	0.533-0.899	0.764±0.080	-0.504	0.337
Left	**P1**	0.500-1.000	0.820±0.110	-1.136	1.825
	P2	0.565-1.000	0.769±0.120	0.232	-0.785
	P3	0.486-0.967	0.699±0.120	0.483	-0.160
	P4	0.526-0.895	0.740±0.090	-0.030	-0.878
	P5	0.357-0.857	0.633±0.110	-0.329	0.385
	P6	0.444-0.963	0.741±0.130	-0.250	-0.386
	P7	0.476-0.952	0.745±0.120	-0.059	-0.394
	P8	0.600-1.000	0.861±0.130	-0.516	-0.920
	Total	0.533-0.899	0.751±0.080	-0.490	0.120

P: Phase, P1: Phase 1, P2: Phase 2, P3: Phase 4, P5: Phase 5, P6: Phase 6, P7: Phase 7, P8: Phase 8

Spearman Rank Difference Correlation coefficients were examined for the relationship between TUGIR scores and Y balance test scores. A weak relationship was detected between the right phase 8 and the lower extremity right anterior reaching score (r = -0.368). A moderately weak correlation was detected between right phase 3 and upper extremity right lateral reaching (r = -0.419). Weakness between right phase 4 and upper extremity right supero-medial reach score relationship was detected (r = 0.377).

A weak correlation was detected between the left side Phase 4 and the lower extremity left postero-lateral reach and left postero-medial reach score (r = 0.400, r = 0.351). No significant relationship between the TUGIR total score and the Y balance total score for the right and left sides could be detected. In addition, apart from the parameters listed, no relationship could be detected between the other phases of the TUGIR test and the sub-parameters of the Y balance test (Table 5).

Table 3 lists cut-off points for each phase separately and as a total. Cronbach's Alpha values for TUGIR (from P1 to P8 and total) were found to be 0,772 and 0,769, respectively, quite reliable for the right and left sides. Kendall's concordance coefficient of the total score was determined as 0,998 for both sides.

Table 3
Cut off points

Phase	Cut off points (%) ± SD
Phase 1	78.00±6.37
Phase 2	75.90±5.61
Phase 3	72.00±5.29
Phase 4	69.75±6.40
Phase 5	69.31±6.46
Phase 6	73.36±6.52
Phase 7	70.63±6.70
Phase 8	75.00±4.89
Total	72.81±6.55

Table 4
Relationship Between Scores of TUGIR and FMS

		RIGHT							LEFT						
		HS	**DS**	**ILC**	**SM**	**RS**	**ASLR**	**Total Score**	**HS**	**DS**	**ILC**	**SM**	**RS**	**ASLR**	**Total Score**
RIGHT	**P1**	0.106	-0.013	0.090	0.139	0.254	0.116	0.241	0.223	-0.013	0.165	-0.024	0.164	0.116	0.214
	P2	-0.124	0.133	-0.092	0.256	0.107	0.087	0.167	-0.299	0.133	-0.103	0.122	0.175	0.087	0.049
	P3	-0.036	0.248	-0.197	0.280	0.308	-0.094	0.241	-0.127	0.248	-0.223	0.172	0.316	-0.094	0.142
	P4	-0.250	-0.083	-0.197	0.054	**0.381***	0.000	-0.008	-0.268	-0.083	0.010	0.118	**0.459***	0.000	0.095
	P5	0.021	-0.039	-0.220	-0.105	0.135	-0.074	-0.094	0.014	-0.039	-0.211	-0.059	0.221	-0.074	-0.038
	P6	**-0.378***	-0.120	0.230	0.007	-0.004	-0.067	-0.011	-0.176	-0.120	**0.407***	0.177	0.129	-0.067	0.189
	P7	-0.217	0.022	0.133	**0.358***	-0.104	-0.034	0.154	**-0.362***	0.022	0.156	0.263	-0.004	-0.034	0.061
	P8	-0.219	0.014	0.199	0.089	-0.244	0.083	0.047	-0.270	0.014	0.257	0.145	-0.124	0.083	0.066
LEFT	**P1**	0.180	0.013	0.229	0.197	0.158	0.136	0.321	0.175	0.013	0.297	0.075	0.038	0.136	0.253
	P2	0.013	0.304	-0.033	**0.356***	0.067	0.168	0.338	-0.228	0.304	-0.137	**0.360***	0.141	0.168	0.202
	P3	-0.087	0.083	-0.135	0.267	0.233	0.054	0.172	-0.335	0.083	-0.130	0.228	0.245	0.054	0.059
	P4	0.032	0.269	-0.192	0.167	0.325	0.095	0.266	-0.210	0.269	-0.178	0.233	**0.428***	0.095	0.230
	P5	0.092	-0.004	-0.089	-0.040	0.122	-0.075	0.027	0.003	-0.004	-0.114	0.020	0.218	-0.075	0.045
	P6	**-0.350**	-0.132	0.237	0.087	-0.072	-0.007	0.003	-0.299	-0.132	**0.395***	0.303	0.050	-0.007	0.156
	P7	-0.135	0.083	0.072	**0.433***	-0.170	0.054	0.182	**-0.349**	0.083	0.040	**0.397***	-0.104	0.054	0.055
	P8	-0.145	0.110	0.102	0.189	-0.153	0.122	0.132	-0.303	0.110	0.111	0.253	-0.042	0.122	0.097
TOTAL	**Right**	-0.278	0.033	-0.003	0.207	0.142	0.000	0.117	-0.302	0.033	0.103	0.175	0.239	0.000	0.130
	Left	-0.122	0.083	0.033	0.300	0.098	0.093	0.226	-0.326	0.083	0.046	0.327	0.173	0.093	0.158

HS: *Hurdle Step,* ***DS:*** *Deep Squat,* ***ILC:*** *In-line lunge,* ***SM:*** *Shoulder Mobility,* ***RS:*** *Rotary Stability,* ***ASLR:*** *Active Straight Leg Raise,* ***TSP:*** *Trunk stability push-up,* ***P:*** *Phase, P1: Phase 1, P2: Phase 2, P3: Phase 4, P5: Phase 5, P6: Phase 6, P7: Phase 7, P8: Phase 8, *: p <0,05*

Table 5
Relationship Between Scores of TUGIR and YBTs

		RIGHT						LEFT					
		Lower Extremity			Upper Extremity			Lower Extremity			Upper Extremity		
		L	**PL**	**PM**	**L**	**SM**	**IM**	**L**	**PL**	**PM**	**L**	**SM**	**IM**
RIGHT	**P1**	-0.305	-0.175	0.108	0.111	0.200	0.176	-0.222	0.010	-0.044	0.052	0.251	**0.109**
	P2	-0.279	0.018	0.051	-0.275	0.000	0.036	-0.157	0.095	-0.032	-0.147	0.076	**-0.048**
	P3	-0.158	0.161	0.168	**-0.419***	0.166	0.045	-0.121	0.069	0.171	-0.252	0.192	**0.040**
	P4	-0.088	0.038	0.063	0.135	**0.377***	0.038	-0.084	0.121	0.183	0.079	0.051	**0.265**
	P5	-0.137	-0.009	-0.005	0.308	0.246	-0.158	-0.035	0.037	0.019	0.260	0.041	**-0.021**
	P6	-0.250	-0.067	-0.252	-0.027	0.323	-0.036	0.126	-0.048	-0.116	-0.129	0.067	**-0.036**
	P7	-0.213	-0.004	0.104	-0.043	0.096	0.296	0.008	0.169	0.068	-0.045	0.134	**0.008**
	P8	**-0.368***	-0.191	-0.144	0.068	0.038	0.089	-0.097	0.043	-0.168	0.118	0.069	**-0.112**
LEFT	**P1**	-0.129	-0.102	0.080	0.077	0.224	**0.390***	-0.053	0.149	-0.054	-0.028	0.278	**0.221**
	P2	-0.085	0.163	0.200	-0.316	-0.045	0.271	-0.124	0.319	0.094	-0.155	0.067	**0.078**
	P3	-0.245	0.319	0.158	-0.291	-0.065	0.088	-0.134	0.195	0.065	-0.235	-0.044	**0.117**
	P4	0.130	0.207	0.215	0.073	**0.399***	0.193	0.046	**0.400***	**0.351***	0.083	0.176	**0.283**
	P5	-0.098	0.101	0.035	0.251	0.270	-0.062	0.089	0.160	0.061	0.214	0.052	**0.042**
	P6	-0.265	0.041	-0.158	-0.036	0.153	0.112	0.088	0.032	-0.183	-0.132	0.023	**0.041**
	P7	-0.136	0.107	0.171	-0.142	-0.029	**0.358***	0.012	0.242	0.052	-0.130	0.067	**0.063**
	P8	-0.298	-0.092	-0.033	-0.071	-0.092	0.146	-0.147	0.128	-0.099	0.012	0.034	**-0.087**
Right Total		-0.315*	-0.047	-0.004	-0.062	0.235	0.042	-0.085	0.097	0.015	-0.084	0.100	0.012
Left Total		-0.276	0.072	0.076	-0.173	0.128	0.220	-0.104	0.191	-0.040	-0.122	0.095	0.117

***P:** Phase, P1: Phase 1, P2: Phase 2, P3: Phase 4, P5: Phase 5, P6: Phase 6, P7: Phase 7, P8: Phase 8, **PL**: Posterio-Lateral reach, **PM:** Posterio-Medial reach, **L:** Lateral reach, **SM:** Supero-medial reach, **IM**: Inferio-Medial reach *: p <0,05*

DISCUSSION

This study was conducted to create an effective tool for current need to determine the injury risk of athletes. The TUGIR, developed for this purpose, was shown as a novel, reliable, and valid test method capable of performing injury risk assessment.

There are different methods used for functional evaluation in athletes, such as FMS, jump tests, and core tests. These tests should also be able to determine the sports-specific biomechanical needs since athletes are exposed to various biomechanical stresses with variable injury mechanisms in different sports branches. While some functional movements in FMS may overlap with the sport-specific nature, some movements may not be effective for use to determine injury risk. For example, the study of Silva et al., which was conducted with surf players, stated that "Trunk Stability Push" may be a more effective tool in determining physical function rather than the FMS total score (Silva et al., 2017). Similarly, "Deep Squat" and "Hurdle Step" were shown to give better results in determining the risk of injury in basketball players (Silva et al., 2017). Therefore, there is a need for a comprehensive functional test tool to address biomechanical dynamics specific to various sports.

Our study demonstrated the reliability and validity of TUGIR. The internal consistency of our tool, which was found to be quite reliable, was similar to the value stated for FMS (Smith et al., 2013). The reliability of FMS scoring has been discussed in many studies which suggest that there may be a difference between inexperienced and experienced raters, and therefore the education of the evaluators is highly important (Moran et al., 2016). Conversely, TUGIR may provide a straightforward scoring system to the evaluator with the parameter scoring within each phase, thus reducing the margin of error that may occur during scoring. The near-perfect concordance between raters shows that the TUGIR is an appropriate test for scoring reliability. However, it should be noted that the inter-rater reliability may have been found to be quite high since the evaluation was performed by individuals who were specialized in the area and also participated in the expert committee that formed the tool.

The injury risk cut-off determined by the Angoff method in our study was approximately %72 for a total score. Athletes who scored below the cut-off value may be at risk for injury. In our study, all scores of the athletes were over the cut-off value, and athletes demonstrated good functional performance. According to the injury risk cut-off value determined for FMS (FMS total score<14), there was no risk of injury for athletes either (Bonazza et al., 2017). The fact that the athletes were above the cut-off value in both of these risk analysis systems indicates that the two test methods are compatible.

Different methods can be used to validate a functional movement instrument, such as face validity and factor analysis. Both face validity and factor analysis were used in the study of Butowicx et al., in which a comprehensive movement system screening tool for athletes was developed (Butowicz et al., 2019). The nine-test battery developed by Frohm et al. was also standardized in line with expert opinions (Frohm et al., 2012). Since removing any phase from the TUGIR would disrupt the integrity of the movement and cause problems in the transitions between phases, face validity, which was performed by applying expert opinion, was used as a validation method in this study. Therefore, biomechanical deficiencies at any phase can be easily determined. Since there is no test tool specific to sports branches, FMS, and YBTs, which are frequently preferred to determine the risk of injuries, have been chosen to test the convergent validity of our tool.

TUGIR has several advantages that overlap with the important features in sports such as head control, focus on shoulder and asymmetrical movements. Our tool has the capacity to provide information about head control and eye tracking of athletes since the athlete must hold eye contact with KB from the starting position to the end of the movement in all phases of the TGU. Shoulder injuries play a considerable part in sports injuries in athletes (Kraan et al., 2019). These injuries may recur, as in usually for shoulder dislocations, or may be severe, requiring surgery and causing the athlete to stay away from sports (Peterson & Renstrom, 2016). For these reasons, the shoulder should be especially focused on most athletes. The TGU exercise differs from the movements in the FMS by focusing on the shoulder. During the trunk movement in three different planes, the lower extremity and upper extremity joints must perform the movement under different stresses and joint angles. Since asymmetry and compensations are associated with a high risk of injury, their identification is important (Kiesel et al., 2014). Studies indicate that the presence of asymmetry rather than the total FMS score is more effective in showing the risk of injury (Chalmers et al., 2017). In TUGIR, all phases are calculated separately for the right and left sides. The asymmetrical nature of the TGU motion, on which the TUGIR is based, is sufficient to detect asymmetries and weaknesses (Leatherwood et al., 2014).

The study's limitation is that it only included male athletes who were not injured. Future studies may focus on the effectiveness of this tool in detecting injuries or determine how much right and left asymmetry in the TUGIR phases is in the pathological border. In addition, the effectiveness of this test battery in various sports branches should be investigated.

CONCLUSION

Due to the multifactorial nature of sports injuries, injury risk assessment tools must also be multifactorial. For this reason, evaluating the risk of sports injury is important of a tool that identifies specific injury risks and is developed with a multidisciplinary perspective may be helpful for the optimal management of risk analysis in the sport. For this purpose, TUGIR, which was developed by this study, is a novel, reliable, and valid test method that may determine the injury risk of athletes. It is a compelling tool that can analyze an athletes' whole biomechanical chain in a continuous cycle of motion with an external stress. This study can lead to the use of this tool in various sports branches.

Authors' contribution

The first author who contributed to this research carried out the conceptualization and design of the study. The first author also carried out the data collection and analysis, as well as the writing of the original draft. The second author contributed to consist of the validation of the methodology governing this study, the supervision and critical reviewing of the original draft, as well as the approval of the final draft. Other authors both played roles in conceptualizing the study and reviewing and editing the manuscript. These collective efforts were integral to the development and refinement of the study.

Declaration of conflict interest

The authors declare that there is no conflict of interests.

Ethics Statement

Written permission was obtained from the Ethics Committee of the Clinical Research Ethics Board of AYBU Education and Research Hospital (Approval No: 23.03.2018-94).

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Pamukkale J Sport Sci, 15(1), 234-252, 2024 Research Article

Mediolateral Postural Sway Velocity as a Possible Indicator of Ground Reaction Force-Derived 180⁰ Turn Performance in Male Soccer Players: A Cross-Sectional Study

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ABSTRACT

The main aim of the study was to investigate the relationship between ground reaction force (GRF) derived postural sway and 180° turn performance in soccer players on the axis of dominant and non-dominant legs. Twenty-seven male soccer players (mean age 22.45 ± 2.7 years) from the same league level agreed to participate in the study. The participants underwent GRF-derived postural sway and 180º turn tests using a force plate in separate sessions, with at least 24-hour intervals between sessions. Postural sway was assessed in anteroposterior and mediolateral directions during a single-leg stance, while the 180° turn performance was evaluated through GRF-derived turn time and turn sway. The correlation, multiple regression, and group differences were computed to test study hypotheses. Positive correlations were observed between postural sway measures and 180º turn time for dominant and non-dominant legs (r-range from 0.384 to 0.550). No measure of postural sway was significantly related to the 180º turn sway ($p > 0.05$). Multiple stepwise regression analysis indicated that mediolateral sway velocity explained 30% and 17% of the variance of 180º turn time for dominant and non-dominant legs, respectively. No statistical inter-limb differences were noted for 180º turn and postural sway parameters. The results suggest that improving single-leg postural performance may enhance male soccer players' 180° turn performance. Therefore, unilateral stability in the mediolateral direction should be considered a potential indicator of change of direction-based performances.

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INTRODUCTION

Soccer is a team sport based on space-time interaction patterns in which two teams frequently use dynamic movements to dominate each other (Folgado et al., 2014). Players should be able to adjust maneuvers with and without the ball in line with the varying conditions during the competition (Travassos et al., 2012). Using unpredictable and creative movement patterns impacts reactions to defensive (i.e., preventing the dribbling or passing of attackers) and offensive (i.e., scoring situations) actions (Coutinho et al., 2018; Faude et al., 2012; Sasaki et al., 2015). In relation to the change in the form of the soccer game over the years, linear speed, explosive and high-intensity maneuvers (i.e., jump, acceleration, and deceleration), change of direction (COD), and functional mobility are considered prominent concepts for performance optimization (Falces-Prieto et al., 2022). COD ability is an important component of movements based on multidirectional changes at high speed and intensity. It is a parameter whose value increases, especially in the critical moments of the competition (Taylor et al., 2019). However, the variability of the criteria for determining the COD ability should be accepted as a factor that limits the interpretation of this information.

The 180^0 turn, which has a similar movement sequence to the COD speed, is among the crucial characteristics in sports where versatile movement patterns are used intensively (Dos'Santos et al., 2019). In soccer, one of the primary sports that fit this definition, the essential reflections of the 180^0 turn movement are defensive-offensive transitions (and vice versa) and sudden maneuvers to beat the opponent (Dos' Santos et al., 2021). When examined in biomechanical terms, sequential formations such as 180° change in the direction of movement, the horizontal momentum approaching zero, body rotation, horizontal braking, and re-acceleration take place (Jones et al., 2017). In this case, the player must perform speed and mechanical tasks optimally and support this movement sequence using their physical capacity (Dos' Santos et al., 2021; Spiteri et al., 2015). Moreover, unlike other COD and agility-modeled field tests, the 180° turn movement is closer to the actions in actual game conditions (Jordet, 2005). Falch et al. (2019) reported that time-domain evaluations conducted using electronic photocells usually obtained a COD-based ability with a complex structure. However, such an evaluation causes COD, an essential athletic and sport-specific performance criterion, to be interpreted from a single perspective. The 180^0 turn movement is generally interpreted as a combination of start and forward movement, turn, and finally finishing, which is a problematic approach. In fact, the most crucial segment of the 180^0 turn is the exact turning moment in terms of velocity and postural control. Furthermore, the performance outputs of

the dominant and non-dominant legs during the turning moment cannot be fully explored. Contrary to this approach, the 180^0 turn movement, which can be tested as ground reaction force (GRF)-derived data obtained from a force plate (Rezaei et al., 2021), represents various data, including horizontal propulsive force, horizontal braking, and faster approach to the center of mass point (Dos' Santos et al., 2021; Schrier et al., 2014). On the other hand, this sudden turn movement suggests that postural control may affect the turn performance.

The dynamic nature of soccer enables COD-based movements and motor coordination skills to come to the fore (Alesi et al., 2015). In this respect, postural control is considered one of the most fundamental elements of motor coordination. As expected, keeping the body in balance during a dynamic task can increase the movement's effectiveness (Holden et al., 2014). Accordingly, it has been reported that postural evaluations performed unilaterally are helpful in terms of identifying possible lower-limb asymmetries instead of bilateral assessment (Yalfani & Raeisi, 2022). Additionaly, postural stability assessment on a single-leg stance is considered more accurate than a double-leg stance as many sports skills are performed on one leg, for competitive athletes (Meiners & Loudon, 2020). Furthermore, it has been emphasized that balance and stability exercises increase control in the knee area (frontal plane) during static and dynamic tasks (Waldén et al., 2012). The aforementioned information makes it worth examining the relationship between postural control and COD in producing a dynamic task. This phenomenon has been tested in a recent study, indicating that COD is associated with the asymmetry index (Trecroci et al., 2020). Sekulic et al. (2013) reported similar results, stating that balance might be an agility predictor for trained adult males. However, an all-round postural analysis (i.e., sway path, velocity, and area) specific to the dominant and non-dominant legs seems necessary to obtain more explicit findings on this possible relationship.

Due to the increasing use of force plates in sports sciences in recent years, valid and accurate axial force-centered biomechanical and posturographic data can be obtained (Beckham et al., 2014). Owing to GRF-derived measurements to be performed in laboratories, postural sway measures will be evaluated in anteroposterior and mediolateral directions. Moreover, a time and postural sway-oriented evaluation will be possible by focusing only on the moment of turn, not all segments of the 180° turn movement (Schrier et al., 2014). To our knowledge, this is the first trial to evaluate GRF-derived 180^0 turn performance in male soccer players. Therefore, the main aim of the study was to investigate the relationship between GRF-derived postural sway and 180° turn performance in soccer players on the axis of dominant and non-dominant legs. Moreover, we also aimed to determine the potential inter-limb differences of athletes in postural sway and 180^0 turn measurements. We hypothesized that

GRF-derived postural sway parameters would correlate with 180° turn performance (hypothesis 1), and dominant/non-dominant leg GRF-derived postural sway and 180° turn performance parameters would not significantly differ (hypothesis 2).

METHODS

Participants

Twenty-seven uninjured male trained soccer players (mean age 22.45 ± 2.7 years, ranging from 18 to 24; n = 24 right-limb dominant; n = 3 left-limb dominant) from the same league level (regional category) voluntarily participated in the study. All players were familiar with the study measurements. The preferred leg during shooting and/or passing a ball was determined as the dominant limb (van Melick et al., 2017). All participants attended team training sessions five times per week, plus one competitive match at the weekend. Table 1 contains the baseline characteristics of the study participants.

The inclusion criteria were determined as follows: being aged ≥ 18 years, having a personal competitive experience for a minimum of 3 years, not smoking, having no musculoskeletal injury and neurological, orthopedic, or cardiovascular diseases in the six months before the tests. The exclusion criteria were as follows: experiencing severe pain in the lower extremity during athletic tests and not participating in ≥ 80% of weekly training sessions. All participants were fully informed about the study procedures (i.e., athletic performance tests and sessions) and potential risks (Makaracı et al., 2021). The participants provided verbal and written informed consent before the study procedures. All procedures were in accordance with the Declaration of Helsinki and were approved by the clinical research ethics board at Karamanoğlu Mehmetbey University, Türkiye (Document no: 10-2022/14; Date: 08.11.2022).

Table 1
Demographic Characteristics of the Study Participants

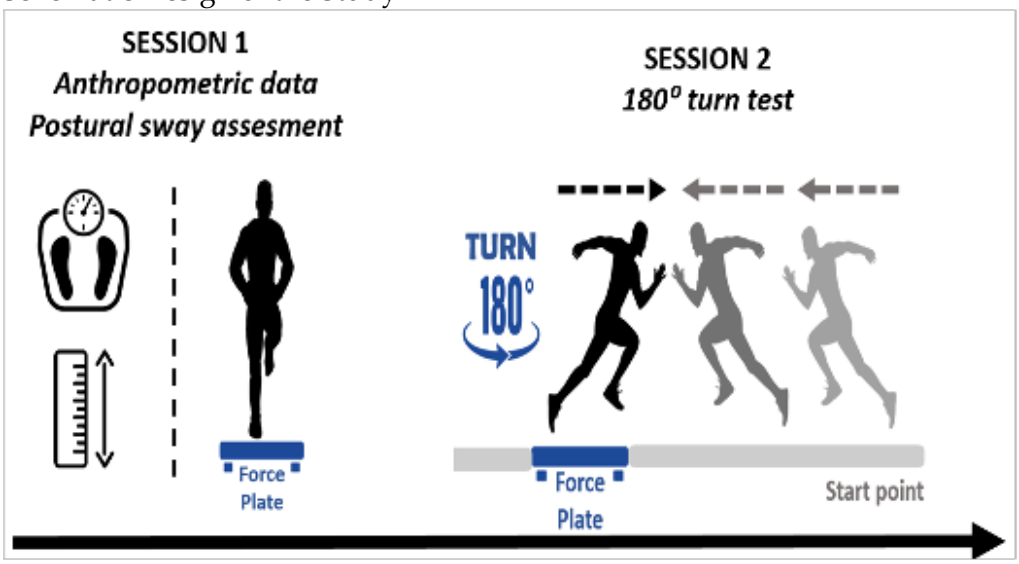
Variables	N = 27
Age (years)	22.45 ± 2.17
Body mass (kg)	72.33 ± 5.15
Body height (m)	1.79 ± 0.16
Body mass index (kg/m^2)	22.65 ± 3.07
Sports experience (years)	7.85 ± 1.64

Procedure

This cross-sectional study explored the correlation between GRF-derived single-leg postural sway and 180^0 turn performance on both legs. All tests were conducted during the in-season period. The study participants have not attended any training session and competition during the tests. The participants completed two testing sessions separated by at least 24 hours. Anthropometric and postural sway data were measured during session 1. Following an individual warm-up before the postural sway assessment, players performed practice trials for both legs to become familiar with the task. The warm-up was followed by at least five minutes of rest. The postural sway measures were then taken on the dominant and non-dominant legs, respectively.

The participants underwent a 180^0 turn test separately for each limb (dominant and non-dominant) during session 2. Before the test trials, the players carried out a standardized warm-up consisting of 5 minutes of low-to-moderate speed running, dynamic stretching, and submaximal pre-planned right and left-limb turns, lasting 10 minutes (Fletcher & Monte-Colombo, 2010). All testing procedures (5 p.m. to 7 p.m.) were carried out at the same time of the day and supervised by the same researchers. All athletes' clothing was typical soccer players' wear during the athletic tests. Figure 1 shows the experimental design of the study.

Figure 1
Schematic Design of the Study



Data Collection Tools

The GRF-derived postural sway and 180^0 turn were sampled at 1000 Hz from a portable force plate (Kistler, Winterthur, Switzerland; type 9260AA6; 600x500x50 mm). A 16-ch data acquisition system (type 5691A; Switzerland; USB 2.0) and BioWare software were

used to send the force plate signals to a personal laptop computer (HP Probook 450 G6 with Core i7) and then exported to Excel (version 2016, Microsoft Corp., Redmond, WA, USA). Kistler MARS software (Kistler MARS, S2P Ltd., Ljubljana, Slovenia) was used to analyze the quantified test parameters related to single-leg postural sway and 180^0 turn performance (Šarabon, 2011).

Anthropometrics

Before the first test trial, the force plate measured body mass with light clothes and without shoes. A portable calibrated stadiometer (seca 220, Seca, Hamburg, Germany) was used to measure body height. The body mass index was calculated as weight/height squared (kg/m^2).

Assessment Of Postural Sway

The single-leg postural sway measures through the center of pressure (CoP) data were recorded in the anteroposterior and mediolateral directions of sway. Postural sway measures were conducted for dominant and non-dominant leg stances with closed eyes using the protocol performed by Makaracı et al. (2021). During the postural sway assessment, the participants were asked to stay as still as possible and avoid any postural movements and talking. During the measurements, participants wore their running shoes and standardized ankle-height athletic socks (Barrons & Heise, 2020). The trials for each stance lasted 10 seconds due to the difficulty of testing. The players were tested consecutively in dominant and non-dominant leg stances, and the average of the three repetitions was used for further analysis.

The postural sway-related parameters obtained from MARS were computed for further analysis: Total Sway Path (TSP), Anteroposterior Sway Path (APSP), Mediolateral Sway Path (MLSP), Total Sway Velocity (TSV), Anteroposterior Sway Velocity (APSV), Mediolateral Sway Velocity (MLSV), Total Sway Area (TSA), Anteroposterior Sway Area (APSA), Mediolateral Sway Area (MLSA), and Ellipse Area 100% (EA 100%; Kozinc et al., 2021; Makaracı et al., 2021).

180^0 Turn Test

COD or changing locomotion is a widespread movement in different sports based on agility and quickness (Dos'Santos et al., 2019). 180^0 turn is a GRF-derived clinical test carried out on an anti-slip textured finish force plate, unlike the traditional field test measurement procedures. All participants underwent a standardized 180^0 turn test protocol on an anti-slip textured force plate fixed on a flat, rigid floor. A rubber gym flooring was used to ensure

alignment between the running track and force plate, effectively preventing potential slip on the force plate (see Figure 1). Participants were positioned at least two steps away from the force plate (start point) while in an unloaded state (zero offset) before commencing the measurement.

During the test, participants were instructed to run forward for at least two steps ("running mode" as the gait type on the setup panel). They were then prompted to perform a sudden 180^0 turn on the force plate using a single leg (the tested leg), following the online instructions provided by MARS. Subsequently, after the turning movement, participants were required to run back to the start point using a minimum of two steps to obtain GRF-derived data with a natural movement pattern (Rezaei et al., 2021). The measurement automatically terminated upon the proper completion of the test. If a trial was not performed according to the test procedure (i.e., without contact with the plate or an incomplete 180^0 turn), the device software deemed it invalid. The trials were performed for the dominant and non-dominant legs, respectively. Each participant completed the 180^0 turn test three times, allowing for one minute of rest in between, and the average of three repetitions was recorded for analysis. Participants utilized their running shoes in all trials.

The GRF-derived 180^0 turn test parameters obtained from Kistler MARS included the following: turn time (the time required to perform the 180^0 in-place turn on the force plate) and turn sway (the average CoP velocity during the turn time refers to postural stability and is measured in millimeters per second; Rezaei et al., 2021).

Data Analysis

Data was analyzed using SPSS software (SPSS Inc., Chicago, IL, USA). The Kolmogorov-Smirnov test was used to determine data normality. After normal distribution, Pearson's correlation coefficient was used to establish correlations between postural sway and 180^0 turn performance. The magnitude of the correlation (r) between the test parameters was interpreted as follows: ≤0.1, trivial; 0.1–0.3, small; 0.3–0.5, moderate; 0.5–0.7, large; 0.7–0.9, very large; and 0.9–1.0, almost perfect, respectively, in line with the guidelines (Hopkins et al., 2009). Scatter plots were produced for the selected postural sway and 180^0 turn performance parameters. Subsequently, the stepwise multiple regression analysis was used to determine the best predictor model for 180^0 performance for both limbs. To determine the significance of the correlations, crude and adjusted coefficients of determination (R^2) were utilized. The players' inter-limb differences in postural sway and 180^0 turn performances were tested by the independent sample t-test. Effect sizes (ES) for the *t*-test were calculated using the

thresholds as suggested by Cohen (1988), where 0.2–0.49 is a small effect, 0.5–0.79 is a moderate effect, and ≥ 0.8 is a large effect. The level of significance was set at $p < 0.05$.

RESULTS

Correlations

A positive (moderate to large) correlation was found between postural sway measures and 180^0 turn time for both dominant and non-dominant legs ($p < 0.05$). No measure of postural sway was significantly related to the 180^0 turn sway for both legs ($p > 0.05$). Table 2 presents a correlation matrix for the dominant and non-dominant leg measures.

Table 2
Correlations Between Postural Sway Measures and 180^0 Turn Test

Parameters	Limb		TSP (mm)	APSP (mm)	MLSP (mm)	TSV (mm/s)	APSV (mm/s)	MLSV (mm/s)	TSA (mm2)	APSA (mm*s)	MLSA (mm*s)	EA 100% (mm2)
Turn time (s)	DL	r	0.536	0.435	0.538	0.548	0.424	0.550	0.492	0.056	0.441	0.311
		p	0.004*	0.023*	0.004*	0.003*	0.028*	0.003*	0.009*	0.781	0.021*	0.114
	NDL	r	0.384	0.211	0.501	0.383	0.197	0.506	0.383	0.334	0.129	0.306
		p	0.049*	0.291	0.007*	0.048*	0.325	0.005*	0.049*	0.089	0.522	0.120
Turn sway (mm/s)	DL	r	0.170	0.088	0.199	0.152	0.077	0.207	0.157	-0.012	0.350	0.217
		p	0.397	0.663	0.319	0.449	0.703	0.300	0.435	0.955	0.073	0.277
	NDL	r	-0.107	-0.102	-0.093	-0.111	-0.089	-0.097	0.013	-0.081	0.294	0.132
		p	0.595	0.611	0.645	0.580	0.658	0.630	0.950	0.688	0.137	0.512

Notes. TSP: Total Sway Path; APSP: Anterior-Posterior Sway Path; MLSP: Medial-Lateral Sway Path; TSV: Total Sway Velocity; APSV: Anterior-Posterior Sway Velocity; MLSV: Medial-Lateral Sway Velocity; TSA: Total Sway Area; APSA: Anterior-Posterior Sway Area; MLSA: Medial-Lateral Sway Area; EA 100%: Ellipse Area; DL: Dominant Leg, NDL: Non-Dominant Leg; *Denotes significant difference ($p<0.05$).

For the dominant leg, all postural sway parameters, except for APSA and EA 100%, were significantly correlated with turn time ($p < 0.05$; r-range from 0.424 to 0.550). TSP, MLSP, TSV, and MLSV were largely correlated (r = 0.50 - 0.70). For the non-dominant leg, TSP, MLSP, TSV, MLSV, and TSA were significantly correlated with turn time ($p < 0.05$; r-range from 0.384 to 0.506). MLSP and MLSV were largely correlated (r= 0.50 - 0.70). No correlation was detected for APSP, APSV, APSA, and MLSA ($p > 0.05$). The scatter plots for the correlations between postural sway measures and 180^0 turn time with large magnitudes (r values) for the dominant and non-dominant legs are presented in Figure 2.

Figure 2
Correlation of Mediolateral Sway Path and Mediolateral Sway Velocity with 180^0 Turn Performance

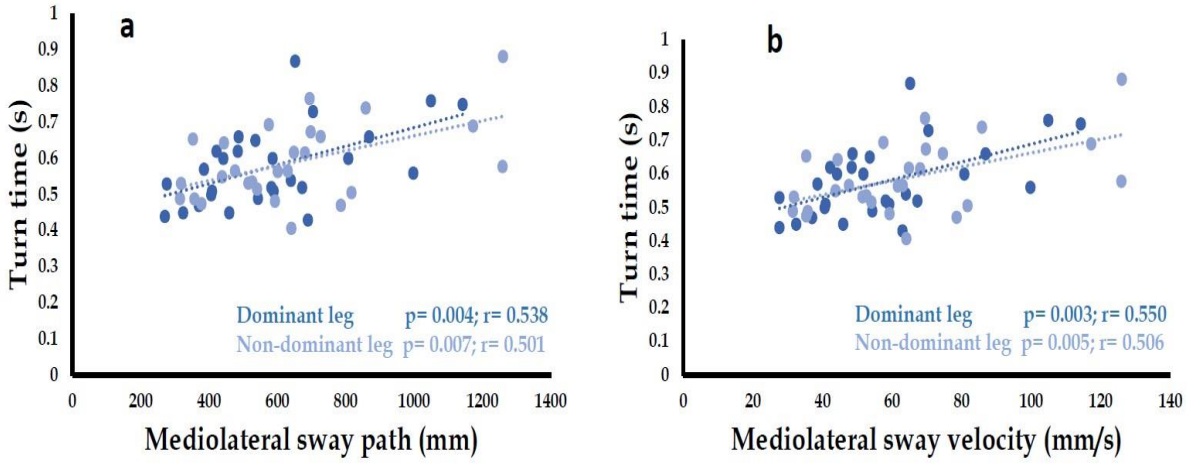


Figure 2 shows the correlation of MLSP and MLSV with 180º turn performance for both legs. MLSP was positively correlated with turn time for both dominant (Figure 2a; r= 0.538) and non-dominant leg (Figure 2b; r= 0.501). MLSV was also positively correlated with turn time for both dominant (r= 0.550) and non-dominant leg (r= 0.506).

Multiple regression

The best-fitting equation for 180° turn time included only MLSV for both dominant and non-dominant leg measures. In the dominant leg 180° turn time, MLSV explained 30% of the variance (R^2= 0.302), while non-dominant leg MLSV explained 17% of the variance (R^2= 0.172) in the dominant leg 180° turn time. Table 3 contains stepwise multiple regression analysis results for MLSV.

Table 3
Stepwise Multiple Regression Analysis Results of Postural Sway Measures that Affected the Turn Time

Limb		Model	Unstandardized Coefficients		Coefficients Beta	t	*p*	R^2 (adjusted R^2)
			B	S.E.				
Turn time (s)	DL	(Constant)	0.425	0.050	0.550	8.495	0.000	0.302 (0.374)
		MLSV (mm/s)	0.003	0.001		3.290	0.003*	
	NDL	(Constant)	0.494	0.050	0.415	9.901	0.000	0.172 (0.139)
		MLSV (mm/s)	0.002	0.001		2.281	0.031*	

Note. DL: Dominant Leg, NDL: Non-Dominant Leg; MLSV: Medial-Lateral Sway Velocity. *significant difference (p<0.05)

Comparisons

No statistical inter-limb differences were observed for the athletes during 180^0 turn and postural sway measures ($p > 0.05$). Table 4 presents the independent sample t-test results for detailed information.

Table 4
Inter-Limb Differences of 180^0 Turn Test and Postural Sway Measures

Parameters	Limb	Mean	S.D.	95% Confidence Interval	t	*p*	Effect size
Turn time (s)	Dominant	0.58	0.11	0.54 to 0.62	-0.738	0.464	0.19
	Non-dominant	0.60	0.10	0.56 to 0.64			
Turn sway (mm/s)	Dominant	1,065.0	599.2	839.0 to 1,291.0	-0.035	0.973	0.01
	Non-dominant	1,072.6	975.7	704.6 to 1,440.6			
TSP (mm)	Dominant	919.3	305.3	804.1 to 1,034.8	-0.761	0.450	0.20
	Non-dominant	982.3	302.9	868.1 to 1,096.5			
APSP (mm)	Dominant	588.6	174.0	523.0 to 654.2	-0.157	0.875	0.04
	Non-dominant	595.7	161.9	534.6 to 656.8			
MLSP (mm)	Dominant	584.6	229.1	498.2 to 671.1	-0.836	0.407	0.23
	Non-dominant	640.4	260.3	542.2 to 738.6			
TSV (mm/s)	Dominant	91.4	30.4	79.9 to 102.9	-0.815	0.419	0.22
	Non-dominant	98.2	30.5	86.7 to 109.7			
APSV (mm/s)	Dominant	59.2	17.5	52.6 to 65.8	-0.077	0.939	0.02
	Non-dominant	59.6	15.7	53.7 to 65.5			
MLSV (mm/s)	Dominant	58.0	22.8	49.4 to 66.6	-0.907	0.369	0.27
	Non-dominant	64.1	26.1	55.0 to 73.2			
TSA (mm^2)	Dominant	5,913.5	4,521.6	4,208.0 to 7,619.0	0.030	0.975	0.01
	Non-dominant	5,880.4	3,518.4	4,553.3 to 7,207.5			
APSA (mm*s)	Dominant	108.2	84.2	76.4 to 140.0	0.904	0.373	0.24
	Non-dominant	93.0	24.1	83.9 to 102.1			
MLSA (mm*s)	Dominant	107.2	39.7	92.2 to 122.2	-0.596	0.554	0.16
	Non-dominant	114.0	43.3	97.7 to 130.3			
EA (100%) (mm^2)	Dominant	590.7	562.1	378.7 to 802.2	0.418	0.678	0.11
	Non-dominant	537.4	353.2	404.2 to 670.2			

*Notes. T*SP: Total Sway Path; APSP: Anterior-Posterior Sway Path; MLSP: Medial-Lateral Sway Path; TSV: Total Sway Velocity; APSV: Anterior-Posterior Sway Velocity; MLSV: Medial-Lateral Sway Velocity; TSA: Total Sway Area; APSA: Anterior-Posterior Sway Area; MLSA: Medial-Lateral Sway Area; EA 100%: Ellipse Area.

DISCUSSION

The main originality of this study lies in the novel investigation of GRF-derived 180° turn performance on both lower limbs, a critical aspect for soccer-specific actions, specifically among male soccer players (Tang et al., 2018). In accordance with the study hypothesis, our findings demonstrated significant correlations (ranging from moderate to large) between most of the measured postural sway parameters (related to sway path, velocity, and area) with the 180^0 turn time using both the dominant and non-dominant legs. Additionally, MLSV was determined as a possible indicator of the 180° turn performance in the time context. We did

not observe inter-limb differences for single-leg postural sway and 180° turn performance parameters.

Although the GRF-derived 180^0 turn test is a movement in COD form, it is biomechanically different. The COD performance is mainly evaluated in a time-specific manner, focusing on linear acceleration (Nimphius et al., 2017), while 180° turn requires reducing horizontal velocity to zero or close to it (Jones et al., 2017). Thus, it is impossible to interpret COD and 180° turn mechanics from the same perspective. Furthermore, GRF-derived COD protocols and the center of mass velocity, could be a more accurate and practically accessible method for a holistic and kinematic analysis of the 180° turn movement (Spiteri et al., 2013). The braking movement performed horizontally is critical for the turn time; therefore, we used an anti-slip textured finish force plate for the 180° turn movement. Our results showed that most of the GRF-derived postural sway parameters for both the dominant and non-dominant legs were correlated with the turn time (see Table 2). The GRF-derived postural sway parameters are CoP-based data in the anteroposterior and mediolateral directions. The body sway in the anterior direction is linked to increased knee flexion (Jiang et al., 2023) and ankle plantar flexion, especially during dynamic postural control in a single-leg stance (Nyland et al., 2002). Conversely, posterior sway corresponds to increased hip flexion (Lewis & Sahrmann, 2015) and ankle dorsiflexion (Amin & Herrington, 2014). Therefore, the correlation between anteroposterior sway (i.e., sway path and sway velocity) and 180° turn time may be attributed to the potential involvement of the hamstring and gastrocnemius muscles in the anterior direction and the iliopsoas and tibialis anterior muscles in the posterior direction. These muscles likely contribute to stabilizing the pelvic joint and facilitating the turn maneuver (De Ridder et al., 2014; Rouissi et al., 2018). A review study demonstrated that balance-based training could improve motor skills, although not as much as resistance training, resulting in increased power outputs (Hrysomallis, 2011). Overall, it can be interpreted that the lower limbs' postural control and explosive movements of the lower limbs may be correlated.

Unlike other studies, our study revealed the correlation between postural sway and 180° turn performance in dominant and non-dominant leg measures. Considering the strong correlation between lower-limb asymmetry and athletic performance in soccer players (Mala et al., 2020), the reflection of the 180° turn performance (i.e., time and velocity) on both legs is a noteworthy finding. Notably, we observed relatively higher correlation values in the dominant leg measures compared to the non-dominant leg (see Table 2), which is not surprising since the dominant leg is used in most movements and techniques in soccer-specific

actions (Clemente et al., 2022). Two recent studies have investigated the relationship between COD ability, balance, and/or postural control. These findings are similar to ours, although no analysis has been performed from the unilateral perspective. Falces-Prieto et al. (2022) stated that the cross-hop test used as an indicator of dynamic balance was correlated with the 505 COD test (r= .440). Likewise, Ahmed, Saraswat, and Esht (2022) revealed that core strength, which is directly related to postural stability, and agility (t-drill) were negatively correlated (-0.579). However, when interpreting the correlation findings related to GRF-derived turn performance (i.e., time) and postural sway, it's essential to consider factors such as non-standard approach velocity to the turning point and the sole thickness and structure of the shoes used in the measurements for future studies. These factors could impact the results and contribute to a more comprehensive understanding of the relationship between GRF-derived turn performance and postural sway.

A different study reported balance ability as the strongest indicator of agility in male athletes from various team sports (Sekulic et al., 2013). Specifically, a deviation of the CoP along the x-axis indicates mediolateral sway (Zemková, 2014). Our multiple regression analysis revealed that MLSV was identified as the best predictor for 180° turn time in both the dominant and non-dominant legs (R^2= .302 and R^2= .172, respectively; see Table 3). This suggests that enhancing single-leg postural performance in the mediolateral direction could be an effective strategy to optimize the 180^0 turn performance of male soccer players. While the hip abductor and adductor muscles control mediolateral sway (Winter et al., 1993), the precise factors influencing this mechanism were unclear based on previous literature. Based on our findings, it should be noted that there is a correlation between postural stability and COD ability. This suggests a need for future research to explore postural performance in a unilateral form to obtain more precise and specific results related to COD and agility.

Although the primary aim of our study is to explore the correlation between postural sway and 180° turn performance, identifying a possible inter-limb difference should be considered a crucial aspect of the result interpretation. In this respect, GRF-derived postural measurements are among the most accurate analysis methods of inter-limb asymmetry (Newton et al., 2006). We did not observe a limb difference in the parameters obtained from 180° turn performance and postural sway parameters (see Table 4). Most soccer-specific drills (i.e., shooting, passing, and stopping) are realized with the effective use of the dominant leg (Bigoni et al., 2017). Zouhal et al. (2018) stated that the 180° turn movement was performed mostly with the support of the dominant leg. Like in many sports, in soccer, inter-limb asymmetry influences athletic performance adversely and is also expressed as a strong

indicator of disability (Atkins et al., 2016). Furthermore, dynamic balance problems in soccer players are a factor that increases the risk of soccer-specific injury compared to the strength ratio between muscles (H/Q ratios; Behan et al., 2018). López-Valenciano et al. (2018) reported that dynamic balance-based training programs could reduce the risk of injury in female and male soccer players. Therefore, the absence of statistical inter-limb difference (postural sway and turn performance) for athletes in our study indicates that the participant group had a low risk of injury. Additionally, the determined partial bilateral balance can be considered a factor supporting the correlation findings discussed in detail above.

The study indeed presents valuable insights for the coaches and practitioners, yet several limitations must be acknowledged. The inability to measure the athletes' approach velocity until the turning moment during the 180^0 turn test and the lack of standardized shoe soles, even when striving to use similar ones, are significant constraints. Moreover, as the GRF-derived 180^0 turn test in our study was conducted for the first time in a trained group, comprehensive discussions about the obtained data are challenging, and generalizing the results is currently impractical, given the limited number of studies utilizing GRF-derived COD tests. While the study's outcomes are particularly relevant to soccer players, caution should be exercised when extending these findings to athlete profiles in other team sports. Furthermore, considering the dissimilarities in lower-limb movement patterns between female and male athletes (Bailey et al., 2015), a gender-based evaluation is essential for future studies.

CONCLUSION

In conclusion, a positive correlation was found between postural sway measures and 180^0 turn time for dominant and non-dominant leg measures. MLSP and MLSV were positively correlated with turn time for both legs. Furthermore, MLSV was determined as the possible indicator of 180^0 performance in the context of "time." This result may suggest that improving single-leg postural performance in the mediolateral direction could optimize the 180^0 turn performance of male soccer players. In addition to postural sway, associated with the 180° turn performance, different body stability assessments should also be considered in future studies.

PRACTICAL IMPLICATIONS

Our findings suggest that enhancing unilateral stability can improve agility and change of direction skills. Including unilateral stability exercises in training programs can help

athletes develop better control and stability in one leg at a time, which is crucial for executing sudden turns and direction changes in dynamic situations. These exercises can target muscles and motor control specific to the mediolateral plane, improving the ability to maintain balance and control during lateral movements. Therefore, fitness coaches should assess individual athletes for deficits in mediolateral stability and design training programs targeting these areas.

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Authors' contribution

The first author contributed to the conception and design, analysis and interpretation, and original draft writing of the manuscript; the second author contributed to reviewing the conception and design, interpretation of the data, critical review, and editing; the third author contributed to reviewing the conception and design, data collection, interpretation of the data, critical review, and editing; the fourth author contributed to reviewing the conception and design, data collection, interpretation of the data, critical review, and editing; and the fifth author contributed to reviewing the conception and design, data collection, interpretation of the data, critical review, and editing. All authors have read and approved the final version of the manuscript.

Declaration of conflict interest

No potential conflict of interest was reported by the authors.

Ethics Statement

The study protocol was approved by the clinical research ethics board at Karamanoğlu Mehmetbey University, Türkiye (Document no: 10-2022/14; Date: 08.11.2022).

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