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Core–Periphery Dynamics in Hungarian Handball: Regional Disparities and Gendered Patterns

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Abstract: This study examines the spatial structure of adult men’s and women’s handball championships in Hungary during the 2024/2025 season, focusing on regional disparities and gendered patterns. Based on data from 184 teams across three national divisions (NB I, NB I/B, NB II), the research applies a weighted scoring system, one-way ANOVA, and correlation analysis to explore territorial inequalities and their relationship with socioeconomic development. Spatial visualization and a robustness check using Moran’s I indicate a partially clustered pattern, confirming the dominance of central regions while highlighting the limited equalizing effect of lower divisions. The findings reveal significant spatial inequalities in both male and female competitions, with stronger concentration in women’s leagues. Team presence and regional development show a strong positive association, suggesting that infrastructural capacity, institutional resources, and cultural attitudes play a decisive role in shaping the sport’s geography. Comparative insights position Hungary within the group of partially centralized systems, contrasting with decentralized Nordic models and polycentric Western European structures. The study contributes to sports geography by linking spatial patterns to socioeconomic opportunity structures and offers policy-relevant recommendations for reducing territorial disparities, supporting women’s sport, and strengthening peripheral regions. These results underline the need for integrated sport and regional development strategies to promote equity and sustainability in team sports.

Keywords: sports geography; core–periphery; regional inequality; handball; gender

Introduction

The spatial distribution of sports has become a key focus in social geography research, as sport is not merely a recreational activity but also an economic, cultural, and identity-shaping factor. Geographical patterns of sports are closely linked to socioeconomic development, infrastructure accessibility, and the strength of local sport cultures. International studies have highlighted that the territorial concentration of sports clubs and core–periphery dynamics influence not only the functioning of competition systems but also equity in access to sport.

Handball is a particularly significant team sport in Europe, characterized by professional leagues and international success in several countries. However, the spatial structure of the sport varies considerably across nations, reflecting broader societal and economic conditions. Comparative research identifies four dominant organizational models shaping the geography of handball. In Scandinavian countries such as Denmark, Norway, and Sweden, decentralized and balanced systems prevail,

supported by nationwide club networks and youth development programs that ensure broad participation. In contrast, France, Germany, and Spain exhibit multicentric structures, where multiple regional hubs mitigate territorial concentration and foster deeper social embeddedness. Central and Southeastern Europe, including Croatia and Slovenia, typically follow partially centralized patterns, dominated by a few major urban centers while peripheral regions remain marginally integrated. Finally, specialized profiles characterize countries such as the Netherlands, Montenegro, and Portugal, where national strategies prioritize handball but maintain a narrower territorial focus, often resulting in strong international performance in one gender category.

These models demonstrate that sporting success is not solely a function of economic resources or population size but is strongly influenced by the geographical distribution of clubs and the level of societal support for the sport. Decentralized and polycentric systems tend to be more sustainable in the long term, as they reduce core-periphery disparities and provide a broader social base for participation. By contrast, partially centralized and specialized structures concentrate resources and visibility in a limited number of urban hubs, reinforcing territorial inequalities.

Against this international backdrop, the present study examines the spatial characteristics of a country with a partially centralized pattern, exploring how these structural features manifest in the adult handball league system and how they intersect with regional development disparities. Specifically, it analyzes the geographical distribution of men's and women's leagues across three divisions during the 2024/2025 season, with particular attention to core-periphery relations and gender-based differences. The objective is to explore the relationship between sport presence and socioeconomic development, contributing to the discourse in sports geography and providing a foundation for regional sport development strategies.

The map illustrates the top ten countries in the 2025 EHF ranking for both men's and women's handball, classified according to their dominant spatial organization model (European Handball Federation, 2025). Green represents decentralized and balanced systems, blue indicates multicentric structures, orange denotes partially centralized systems, and purple marks specialized profiles. The geographical patterns suggest that Northern European countries rely on nationwide, decentralized networks, Western Europe is dominated by multicentric, regionally embedded structures, while Central and Southeastern Europe exhibit a prevalence of centralized and specialized models.

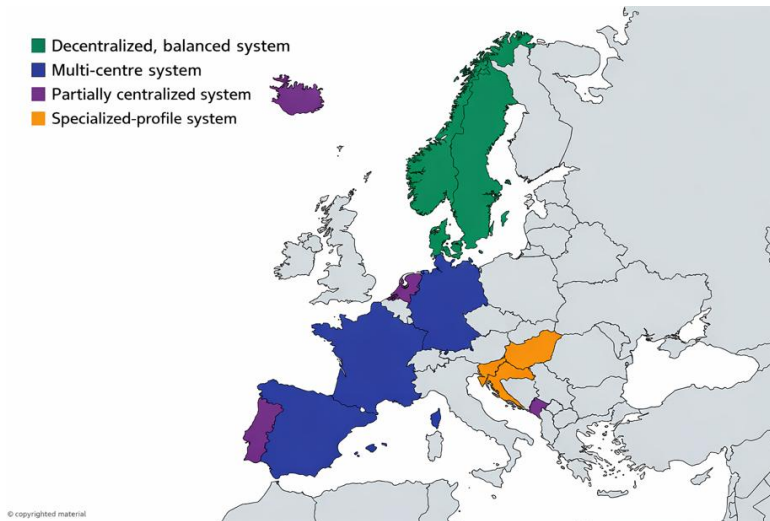


Figure 1. Spatial models of handball organization in the top 10 EHF-ranked countries in Europe

Four hypotheses guide the analysis: the spatial structure of the handball league system exhibits significant regional disparities; women’s leagues display stronger territorial concentration than men’s leagues, particularly at the top tier; there is a strong positive relationship between handball presence and regional socioeconomic development, which becomes more pronounced at higher league levels; and lower divisions partially mitigate spatial inequalities but cannot fully eliminate core–periphery differences. By addressing these hypotheses, the study aims to contribute to the discourse in sports geography and provide an evidence base for regional sport development strategies, with particular emphasis on supporting women’s sport and strengthening peripheral regions.

Literature review

Research on the geography of sport has long emphasized that the spatial distribution of clubs, facilities, and talent pipelines reflects—and often reinforces—broader socioeconomic structures. Early syntheses in sports geography argued that sport is not merely a recreational field but a complex socio economic domain embedded in urban systems, mobility patterns, and cultural identities (Bale, 2003; Horne, 2007). Within this perspective, the core–periphery dynamic features prominently: well resourced metropolitan centers typically host high performance organizations, while peripheral regions experience limited access and weaker institutional capacity (Grün & Troschke, 2014; Kozma & Süli Zakar, 2012).

A growing body of literature examines territorial concentration and its consequences for equity in access to sport. Studies of club distributions in different sports show that elite competition tends to cluster in developmentally advanced

regions, shaped by sponsorship markets, facility availability, and entrenched local sport cultures (Grün & Troschke, 2014; Hill, Vincent, & Curtner Smith, 2014). This concentration manifests in multiple spatial models—decentralized, multicentric, partially centralized, and specialized profiles—each associated with distinct policy legacies and institutional arrangements. Decentralized and multicentric systems often correlate with broader participation and more resilient pipelines, as they diffuse opportunity across regions; by contrast, partially centralized structures concentrate resources and visibility in a limited number of urban hubs (Ilieş & Caciora, 2020; Mitchell, Flight, & Nimmo, 2023).

In Central and Southeastern Europe, comparative work highlights the persistence of partial centralization: a few urban centers dominate league systems, while peripheral areas struggle to secure stable club presence and long term investment (Ilieş & Caciora, 2020; Feflea, Marinău, & Pop, 2021). These patterns align with evidence from urban studies and regional development, which show how infrastructural capacity, educational institutions, and industrial concentrations shape sport ecosystems (Kozma & Süli Zakar, 2012; Faragó, 2017). At the same time, specialized profiles—where one gender or a narrower territorial focus is prioritized—illustrate strategic choices that can yield international success without broad national coverage (Bale, 2003; Horne, 2007).

The literature also underscores gendered spatial dynamics. Women’s sport is often more sensitive to institutional support, cultural attitudes, and sponsorship conditions, producing stronger spatial concentration at higher competitive tiers (Dóczy, 2014; Zhou et al., 2024). International comparisons suggest that equitable development in women’s sport requires purposeful policy design—facilities, coaching capacity, and community engagement—especially in peripheral regions where institutional density is thinner (Dóczy, 2014; Grün & Troschke, 2014).

Methodologically, recent scholarship incorporates spatial statistical techniques to move beyond descriptive mapping. Applications of spatial autocorrelation (e.g., Moran’s I), rank correlations, and network analysis have been used to quantify clustering and to test relationships between sport presence and regional development indicators (Mitchell et al., 2023; Zhou et al., 2024). These approaches enable more robust inferences about opportunity structures—how infrastructure, human capital, and governance interact to produce observable spatial patterns (Hill et al., 2014; Ilieş & Caciora, 2020).

Within the Hungarian context, studies document the emergence of professional organization in handball and the uneven geography of sport infrastructures across urban hierarchies (Kovács, Magyar, & Gósi, 2022; Gömörei, 2012). National policy frameworks—such as the 2004 Sport Act and tax incentive regimes—have shaped investment logics and club sustainability, with

heterogeneous territorial effects (2004. évi I. törvény a sportról; 1996. évi LXXXI. törvény). Regional statistical bulletins further confirm persistent disparities in socioeconomic indicators relevant to sport (KSH, 2025; Faragó, 2017).

Taken together, the literature suggests three integrative propositions that inform the present study. First, spatial concentration is not a random phenomenon but structurally produced by institutional capacity, market conditions, and cultural embeddedness, as highlighted by Grün and Troschke (2014) and Kozma and Süli-Zakar (2012). Second, gendered effects tend to amplify territorial inequalities at elite tiers, making women's leagues particularly dependent on supportive ecosystems, a pattern emphasized by Dóczy (2014) and Zhou et al. (2024). Third, methodological triangulation—combining weighted league indicators, variance testing, correlation analysis, and spatial autocorrelation—enhances the reliability of inferences regarding sport–development linkages, as demonstrated by Mitchell et al. (2023) and Hill et al. (2014). By situating Hungary within the typology of partially centralized systems, this analysis contributes to ongoing debates in sports geography about how opportunity structures shape the presence of clubs across regions and genders, and what policy levers might promote equity and sustainability in peripheral territories (Ilieş & Caciora, 2020; Kovács et al., 2022).

Methodology

This study examines the spatial structure of the adult handball championship system in a Central European country, based on data from the 2024/2025 season. The analysis covers 184 teams across three divisions (NB I, NB I/B, NB II), disaggregated by gender, with the aim of exploring the geographical distribution of teams, identifying core–periphery relations, and statistically verifying the relationship between sport presence and regional socioeconomic development.

Data were obtained from the official registry of the national handball federation, including league classification and team location at the municipal level (Hungarian Handball Federation, 2025). Spatial analysis was conducted at the county level, corresponding to NUTS 3 units, ensuring international comparability. Socioeconomic development was measured using a composite index that incorporated county-level GDP, employment rate, educational attainment, and demographic indicators, based on official regional statistics published by the Hungarian Central Statistical Office (KSH, 2025).

To capture the hierarchical structure of the league system, weighted scores were assigned to each tier (NB I = 3, NB I/B = 2, NB II = 1). These scores were aggregated to calculate the sport value potential of regions and counties, enabling comparison across tiers and assessment of spatial concentration. Regional differences were analyzed using one-way ANOVA, applied separately for men's and

women's leagues across three macro-regions. The relationship between handball presence and socioeconomic development was examined using Spearman's rank correlation, as the data did not always follow a normal distribution. The significance level was set at $p \leq 0.05$, and statistical computations were performed with IBM SPSS Statistics 24.

Spatial patterns were visualized through custom maps showing team distribution by league tier and gender. To provide a robustness check, spatial autocorrelation was tested using Moran's I, allowing a more precise evaluation of clustering and concentration within the league system.

Results

The spatial structure of the men's NB I league exhibits a strongly concentrated pattern. (Fig.2) Most top-tier teams are clustered in a few economically advanced regions, while large parts of the country are entirely absent from the highest level of competition. In the 2024/25 season, the 14 NB I men's teams were located in only eight counties and the capital, clearly reflecting pronounced core-periphery dynamics. Five counties in the western region are represented, compared to only three in the eastern part of the country.

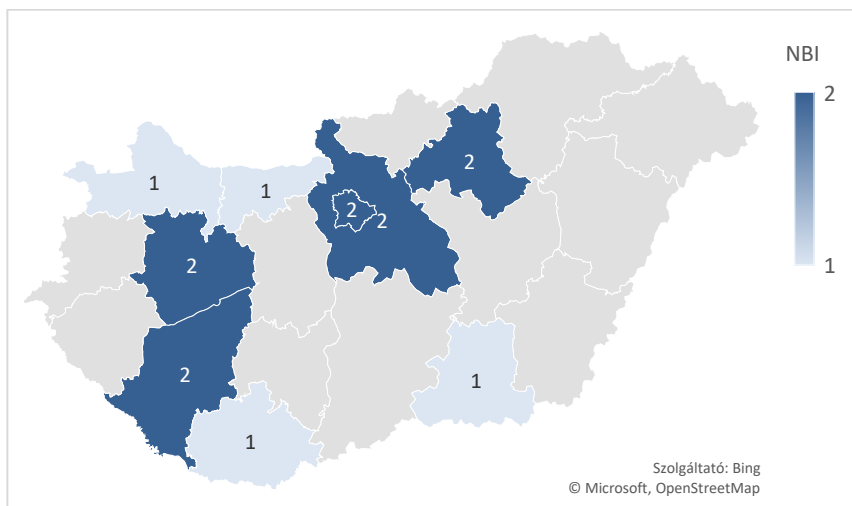


Figure 2. Spatial distribution of men's NB I teams by county in the 2024/25 season

This geographical concentration is not merely a sport-specific phenomenon but mirrors the spatial imprint of socioeconomic development: clubs typically operate in urban centers with advanced infrastructure, stable financial resources, and a strong sporting culture. The map visualization further confirms that, at the NB I level, handball presence is closely tied to economic hubs. Peripheral areas—

regions host more teams, indicating that the NB I/B level offers some opportunity for peripheral areas to participate, though its equalizing effect is limited.

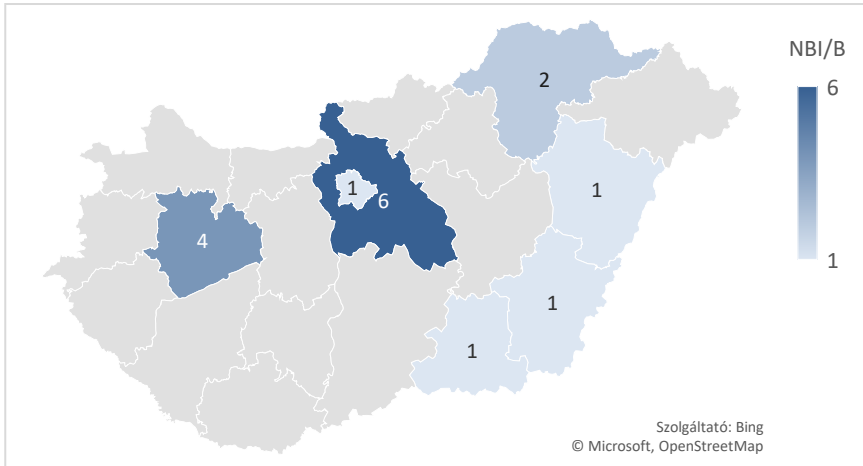


Figure 4. Spatial distribution of men's NB I/B teams by county in the 2024/25 season

The map visualization shows that NB I/B clubs typically operate in urban centers with adequate sports infrastructure and youth development bases. This pattern confirms that the second division is not independent of socioeconomic development: most clubs are located in industrial, educational, or regional hubs, while smaller and disadvantaged areas remain absent from the system.

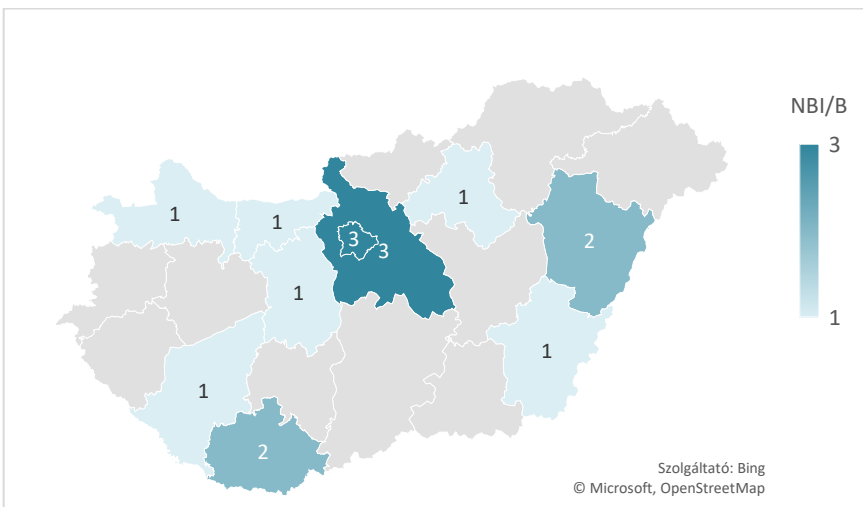


Figure 5. Spatial distribution of women's NB I/B teams by county in the 2024/25 season

The geographical pattern of the women's NB I/B league shows broader coverage compared to the top tier, yet territorial concentration remains significant. (Fig.5) Most teams are located in the Central Hungarian and South Transdanubian regions, while the Great Plain and eastern areas are underrepresented. This pattern suggests that the second division expands the spatial presence of women's handball to some extent but cannot fully eliminate core-periphery disparities.

The map visualization confirms that NB I/B women's clubs typically operate in urban centers with advanced sports infrastructure and stable institutional support. The absence of clubs in peripheral areas not only reduces the diversity of the competition system but also limits opportunities for youth development and social participation in women's sport. This concentration pattern aligns with international evidence indicating that the territorial distribution of women's sports is particularly sensitive to economic and cultural factors.

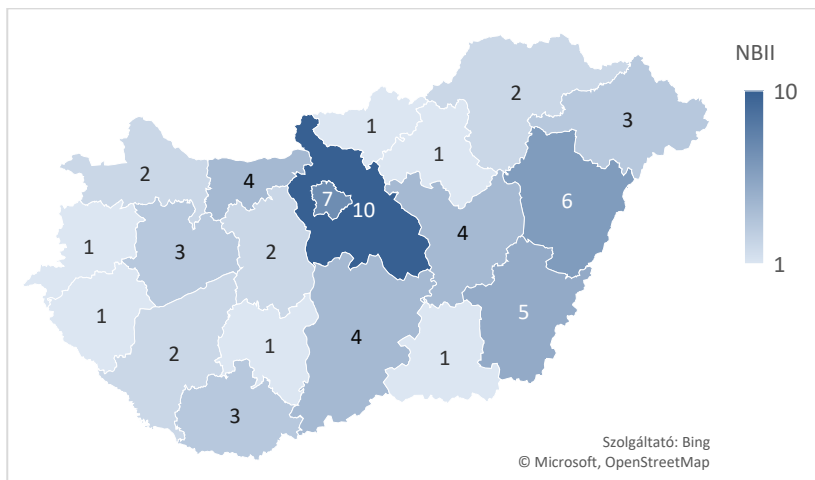


Figure 6. Spatial distribution of men's NB II teams by county in the 2024/25 season

The spatial structure of the men's NB II league provides substantially broader geographical coverage compared to the top tier and the second division. (Fig.6) Teams are present across almost the entire country, indicating that the NB II level plays a crucial role in maintaining the sport's social base. However, the map visualization shows that territorial inequalities have not disappeared: the capital and several more developed regions still exhibit a high concentration of teams, while peripheral areas remain less represented.

This pattern confirms that lower divisions create opportunities to expand access to the sport but cannot fully eliminate core-periphery disparities. Men's NB II clubs often operate on a voluntary basis with limited financial resources, making them highly vulnerable to the challenges of the socioeconomic environment.

The women's NB II league provides almost complete national coverage, which is particularly important for broadening the base of women's handball. (Fig.7) The map visualization shows that every county is represented by at least one team, indicating an expansion of social participation in the sport. However, compared to higher divisions, core-periphery disparities remain evident: the presence of eastern and southeastern regions is largely confined to the NB II level, while they are still absent from the top tier.

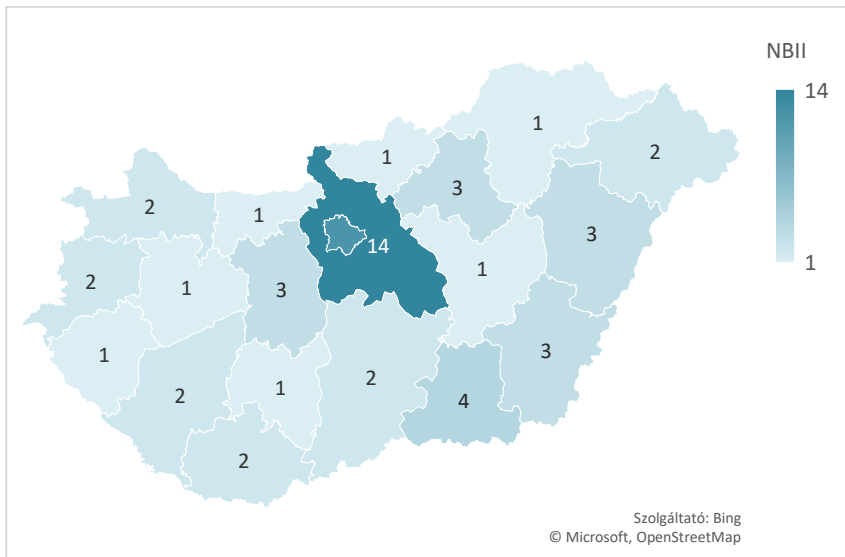


Figure 7. Spatial distribution of women's NB II teams by county in the 2024/25 season

This pattern highlights that NB II plays a key role in extending the territorial reach of the sport, but its long-term retention capacity is uncertain. Many clubs operate through civil initiatives and volunteer work, which limits stability and development prospects. Consistent with international evidence, this phenomenon suggests that achieving territorial balance in women's sport cannot rely solely on expanding lower divisions; targeted development strategies are required to strengthen infrastructure, institutional capacity, and sustainability in peripheral regions.

The value potential indicator, calculated based on weighted scores assigned to league tiers, provides a comprehensive view of the spatial concentration of men's handball teams. (Fig.8) The map visualization shows that although NB II ensures broader geographical coverage, the presence of the sport remains strongly tied to economic and infrastructural hubs. Pest County and Budapest exhibit outstanding value potential, reflecting the impact of metropolitan concentration and advanced sports infrastructure. High values are also observed in western regions, whereas

eastern areas display significantly lower potential despite hosting several NB II teams.

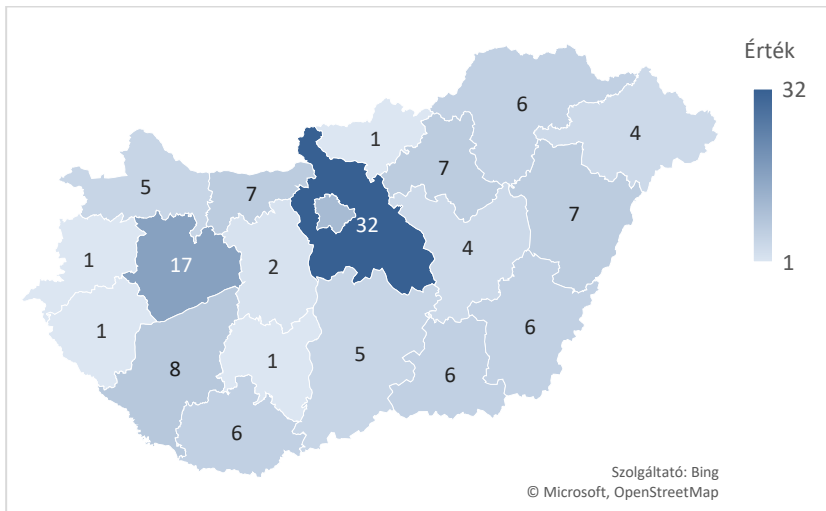


Figure 8. Value potential of men's handball in the 2024/25 season

This pattern confirms that the sport's focal points are shaped not merely by the number of teams but by the hierarchical structure of league levels and the resources associated with them. In men's handball, core-periphery disparities are partially mitigated by the expansion of lower divisions, yet the dominance of more developed regions persists. Consistent with international evidence, this suggests that reducing spatial inequalities in the sport cannot be achieved solely through horizontal expansion of the competition system; targeted development programs are needed to strengthen infrastructure and institutional capacity in peripheral areas.

The weighted value potential of women's handball reveals an even stronger territorial concentration than that observed in the men's league system. (Fig.9) The map visualization shows that Budapest and Pest County exhibit overwhelming dominance, complemented by a few western hubs such as the Győr region. In contrast, the eastern and southeastern regions display extremely low value potential, indicating that higher tiers of women's handball are almost entirely absent from peripheral areas.

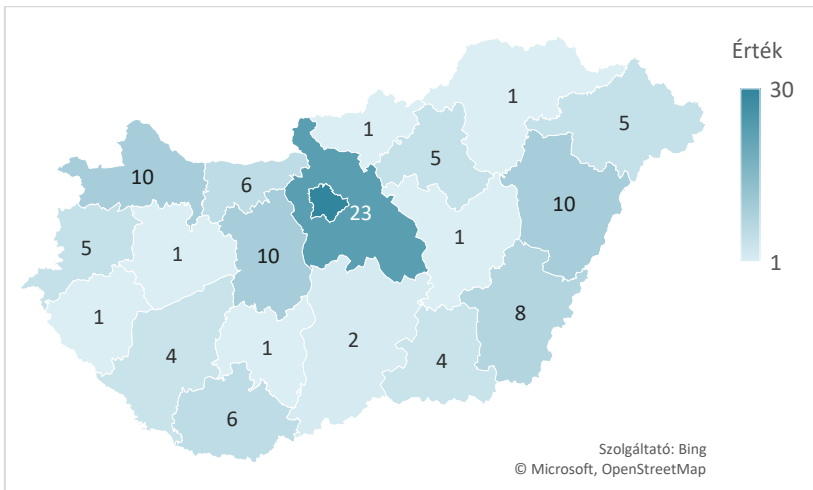


Figure 9. Value potential of women's handball in the 2024/25 season

This pattern is noteworthy in an international context, as the spatial distribution of women's sports is generally more sensitive to socioeconomic development and cultural attitudes. In women's handball, the dominance of central regions not only reduces the heterogeneity of the competition system but also limits long-term opportunities for youth development and social participation. Consistent with global evidence, this suggests that achieving territorial balance in women's sport cannot rely solely on expanding lower divisions; targeted development programs are required to strengthen infrastructure, coaching capacity, and community support in peripheral regions.

Statistical Results

The statistical analysis confirms the hypotheses formulated in the study. ANOVA tests indicate significant differences between regions for both genders, particularly in the top tier and the second division. In men's leagues, regional disparities were statistically significant at NB I ($F = 4.12$; $p = 0.029$) and NB I/B ($F = 3.85$; $p = 0.041$), while NB II showed weaker differences ($F = 1.92$; $p = 0.05$), suggesting partial equalization. In women's leagues, territorial disparities were even more pronounced: NB I ($F = 7.88$; $p = 0.003$) and NB I/B ($F = 5.47$; $p = 0.012$) exhibited significant regional variation, whereas NB II differences were not statistically significant ($F = 2.36$; $p = 0.099$), although a trend was observable.

Correlation analysis further supports the hypotheses. A strong positive relationship was found between the county-level distribution of women's teams and the composite socioeconomic development index ($r = 0.85$; $p < 0.001$), indicating that sport presence is closely linked to regional development. A similar pattern emerged in men's leagues: the correlation between team count and the development

index was $r = 0.81$ ($p < 0.001$), while the correlation between value potential and development index was $r = 0.74$ ($p < 0.001$). For both genders, the value potential indicator showed a strong association with the development index (women: $r = 0.77$; $p < 0.001$), confirming that higher-tier teams are concentrated in more developed regions.

To assess spatial clustering, Moran's I statistic was applied, measuring spatial autocorrelation based on regional value potential and adjacency relations. Using a simple contiguity matrix (West–Central–East) and aggregated weighted scores, the results yielded Moran's $I \approx 0.33$, indicating positive spatial autocorrelation, although the p-value (≈ 0.07) suggests the relationship is not significant at the 5% level. This means that high values tend to cluster (central dominance), but the pattern is not fully homogeneous, and the presence of lower divisions mitigates concentration.

Discussion

The findings of the analysis confirm the hypotheses formulated in the study and align with established insights in sports geography literature. The first hypothesis—that the spatial structure of the handball league system exhibits significant regional inequalities—was validated: regional differences proved statistically significant, particularly in the top tier and the second division. This observation is consistent with Bale (2003) and Hill et al. (2014), who emphasized that the geographical concentration of sports clubs is closely linked to socioeconomic cores, leaving peripheral areas underrepresented.

The second hypothesis, predicting stronger territorial concentration in women's leagues, was also supported: spatial disparities were more pronounced in the women's top and second tiers than in men's competitions. This finding corresponds with Dóczy (2014), who argued that institutional support and sponsorship for women's sport vary considerably across regions, limiting its presence in peripheral areas.

The third hypothesis, positing a strong relationship between sport presence and regional development, was confirmed by correlation analysis, which revealed robust associations between handball presence and socioeconomic indicators. This reinforces international evidence (Grün & Troschke, 2014; Kozma & Süli-Zakar, 2012) that sport participation and club sustainability depend heavily on economic resources and infrastructural capacity.

The fourth hypothesis—that lower divisions partially mitigate spatial inequalities but cannot fully eliminate core–periphery differences—was likewise validated. Although NB II ensures broader geographical coverage, Moran's I analysis indicates that central dominance persists, even if concentration is somewhat reduced. This finding is consistent with literature suggesting that the mere presence

of lower tiers is insufficient to overcome structural disparities (Mitchell et al., 2023; Ilieş & Caciora, 2020).

In an international comparative perspective, the Hungarian pattern resembles partially centralized systems observed in countries such as Croatia and Slovenia, where a few major urban centers dominate and peripheral regions play a limited role (Ilieş & Caciora, 2020). This contrasts sharply with decentralized Scandinavian models, characterized by balanced club networks (Bale, 2003), and multicentric systems in France, Germany, and Spain, which reduce territorial concentration (Grün & Troschke, 2014). Gender differences are even more pronounced, echoing global research that highlights the heightened sensitivity of women's sports to cultural and economic factors (Dóczy, 2014; Zhou et al., 2024).

Conclusions

The research confirmed that the spatial structure of the handball league system is not random but closely linked to socioeconomic development, institutional capacity, and cultural factors. The findings validated the hypotheses: regional differences are statistically significant; the women's league system exhibits stronger concentration; there is a strong correlation between sport presence and the development index; and although lower divisions expand geographical coverage, they cannot fully eliminate core-periphery disparities.

The Moran's I analysis indicates positive spatial autocorrelation, reflecting the dominance of central regions, although concentration is partially mitigated at the NB II level. This aligns with international literature, which suggests that the mere presence of lower tiers is insufficient to overcome structural inequalities.

In an international comparative perspective, the Hungarian pattern resembles partially centralized systems, where a few major urban centers dominate and peripheral regions play a limited role. By contrast, decentralized and multicentric models (e.g., Scandinavia, France, Germany) demonstrate that balanced club networks not only enhance sporting performance but also ensure broader social participation.

Limitations

This study is subject to several limitations that should be considered when interpreting the results. First, the analysis is based on data from a single championship season (2024/2025), which does not allow for the examination of temporal changes and trends. Longitudinal studies could provide valuable insights into the stability and dynamics of spatial patterns.

Second, the territorial analysis was conducted at the county level, which does not capture finer local differences (e.g., district or municipal level). While regional

comparisons are relevant, micro-scale analyses often offer a more accurate picture of access to sport in sports geography research.

Third, the composite index used to measure socioeconomic development is an aggregated indicator that cannot fully capture all relevant factors (e.g., cultural attitudes, local sport policy decisions). These aspects could be explored more effectively through qualitative methods.

Fourth, the spatial autocorrelation analysis (Moran's I) relied on a simple contiguity matrix, which limits the generalizability of the findings. Future research should employ more detailed spatial weight matrices and robust spatial statistical techniques.

Finally, the international comparison was primarily based on literature sources rather than primary data. Direct comparative analyses (e.g., mapping club networks across multiple countries) could further strengthen the international relevance of the study.

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The Making of South Africa's Seaside Resorts: Pleasure, Health and Sport in East London

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Abstract: Seaside resorts are widely researched in tourism studies of Europe, North America and Australia. Much less attention has been given to resort development and the evolutionary pathways of seaside resorts in other parts of the world. Using archival material and existing secondary sources this paper offers a novel contribution on the making of seaside resorts in South Africa. East London is the case study. It is demonstrated that East London took on many of the characteristics associated with British seaside resorts. In charting the development directions of the resort from the 1880s to 1939 an important role was played by 'local agency' in terms of municipal actions. Further, for building the tourism economy the production of publicity material and promotional efforts of the South African Railways and Harbours organisation raised both domestic and overseas awareness of East London's tourist assets. The initial anchors for tourist attraction were pleasure and health which were linked to sea-bathing. By the 1920s, a new focus is on sporting activities as an additional vital element of the touristic capital of this South African seaside resort.

Keywords: coastal tourism; resort development pathways; leisure; health; sport; East London; South Africa

Introduction

During the 1960s and early 1970s the coastal city of East London in South Africa was the focus of international attention for both sporting and political reasons. By the 1970s the city had become a world-renowned surfing destination, one of the Southern African 'hotspots', after being 'discovered' by international surf riders from the USA and Australia. The reputation of Nahoon Reef was that it "generated better waves than were available in Durban or anywhere else in southern Africa" (Bank, 2015: 255). East London therefore became a host city for local South African surf challenge events. The city's surf prowess saw a progression to attracting international surfing events, most notably the 'Gunston 500', in 1974, 1976 and 1978. The hosting of these international surfing events in East London with participants coming from up to six countries became a source of considerable political controversy as they took place at a time when international sports boycotts had been imposed on apartheid South Africa because of the country's racial policies of discrimination (Booth, 1998, 2003). Intense

scrutiny about the operation of such international sports events in East London was heightened because the surfing spectacles occurred close to the time of the 1976 Soweto uprising in Johannesburg as well as in an apartheid environment of struggles taking place against the racial segregation of beach spaces (Rogerson, 2017).

It is against this backdrop of international attention upon East London as a niche sports tourism destination that the aim in this paper is to offer an historical perspective on the city's development pathway as a seaside tourist destination. Saarinen (2004, p. 161) observed that tourism scholars "have for a long time been interested in tourist destinations, their identity and the changes occurring in them". Historical studies can reveal contextual elements that influence the present characteristics of tourism in places and further to understand how tourism works with localities and localities with tourism (Saarinen et al., 2017). As noted by Butler (2015, p. 22) the topic "of the development of coastal and other destinations is one of the oldest in tourism research". Walton (2011) makes clear that the seaside resort has been a central component of the spectacular rise of tourist industries since the eighteenth century. It is argued that the "seaside resort lives by the exploitation of a natural resource: a culturally-desirable maritime environment which promises health, scenic beauty, sociability and enjoyment to those who frequent it, grafting man-made attractions including distinctive architecture and entertainment on to the original lures of climate, bathing beaches, hills, coves and rock formations" (Walton, 2003, p. 73). Stock et al. (2021) put forward the concept of 'touristic capital' to capture the assets or capital of a geographical place such as a resort. It is evident that "what coastal resorts sell, and in a sense, 'manufacture', are experiences, sensations, health, well-being, sociability, pleasure and memory, in combinations that vary and change over time and between places" (Walton, 2011, p. 902).

Under scrutiny in this research is the historical period from the 1880s to 1939, which were formative years for the tourism economy of South Africa as a whole and especially for East London. Ferrario (1978) directs attention to the growth of seaside resorts as a component of the broader development of tourism in 20th century South Africa. The four-decade long study period is distinguished by the fact that visitor publicity for the city increasingly began to shift in focus and include advertising the locality's sporting assets. In this regard East London offers an example of the broader changes taking place in many South African coastal resorts with a pivot in marketing during the 1920s and 1930s to incorporate sport as well as local assets for pleasure and health. The development trajectory of coastal tourism destinations in South Africa has garnered only a small number of existing investigations (Gupta, 2015; Rogerson & Rogerson, 2020a, 2020b, & 2021). This paper therefore represents a novel contribution and provides insights of the varying development pathways of South African coastal resorts, a theme which has attracted some attention recently

from tourism geography scholars (Rogerson & Rogerson, 2020a, 2023). In addition, the paper demonstrates how sporting activities contributed to the development of tourism in colonial South Africa. Other documented examples are of sea angling (Rogerson & Rogerson, 2024a), trout fishing (Rogerson & Rogerson, 2024b), and the 'sport' of hunting as consumptive wildlife tourism (Rogerson, 2025; Rogerson & Rogerson, 2025)

Literature context

As observed by Stock et al. (2014, p. 4) the issue of resort development "is one of the most widely researched subject matters within tourism studies". Tourism resort developments have been investigated in a variety of international settings and shown to exhibit markedly different trajectories of development (Gilbert, 1939; Walton, 1979, 1981, 1983, 2002 & 2003; Worthington, 2003; Torres & Momsen, 2005; Barke et al., 2010; Walton, 2009, 2011 & 2013a, 2013b; Jarratt, 2019; Bal & Czaczyńska-Podolska, 2020; Burdett, 2023; Peirson, 2023; Soldatke et al., 2023; McLaughlin & Smith, 2024). Undoubtedly, however, as pointed out by Shoval and Cohen-Attab (2007, p. 235) "most investigations of seaside resorts have focused on North American, European and especially British seaside resorts". Walton (2009, p. 152) avers that "work on British destinations has dominated the historiography of seaside resorts and coastal tourism".

Arguably, an understanding of the evolution of English seaside resorts is critical in tourism scholarship as these spaces are regarded as the birthplaces of mass tourism. Peirson (2023) maintains that the period from the mid-nineteenth century to the early twentieth century is referred to by many observers as 'the golden age' of the English seaside. Burdett (2023) highlights that seaside visits and excursions became fashionable in Britain from the mid-18th century and as a consequence of the growth of urbanization which accompanied the Industrial Revolution. Initially sea bathing was a popular activity among the aristocracy and advocated by medical specialists from the early 18th century for its health-giving properties. Walton (2016) views sea-bathing as an English invention of the early to mid-18th century and locates its emergence to the Yorkshire seaside towns of Scarborough and Whitby. Indeed, Walton (2000) situates the birthing of coastal resorts to late 18th century Britain when the activity of organized and fashionable bathing developed and marked the institutionalisation of the beach. Brodie (2019, p. 13) records that by the mid-18th century in England "a number of small coastal towns were beginning to be transformed into seaside resorts, a consequence of the arrival of visitors seeking to bathe in the sea for the benefit of their health". According to Shaw and Agarwal (2007) the democratisation of leisure travel and holiday-making and the transformation of coastal resorts from the preserve of the wealthy elite to mass holiday locations

occurred into the second half of the 19th century and continued into the first decades of the 20th century.

The early rise of seaside resorts was an outcome of wealthy visitors seeking out coastal destinations on health grounds. According to Walton (2011, p. 69) “the essence of coastal resort development has been access to pure air and clean water in a physically attractive, if not always or necessarily picturesque setting”. Seaside resorts transitioned to become popular sites for recreational sea bathing and entertainment as well as for medical purposes (Burdett, 2023). Richard Butler (2015) points out that in Britain the development of the railway system was critical to early mass travel and boosting coastal resort development as it allowed large numbers of people to move easily, safely and cheaply beyond the limits of their residence. The railway companies “were quick to appreciate the market of leisure travellers and participated in the development of services for that growing tourism market” (Butler, 2015, p. 18). This said, in the experience of Britain it has been pointed out that whilst railways undoubtedly were significant for resort development the process was more nuanced and evolutionary than railways being the only determinant for the economic health of coastal resorts (Burdett, 2023). Railways must be considered as a vital contributory influence rather than sole factor or determinant force for change. Seaside resorts sometimes have tended to be viewed as essentially the creation of the railways. Arguably, whilst “there is no doubt that the scale and pattern of their development was strongly influenced by the new transport system” other factors also must be considered (Walton, 1979, p. 191). Guiver et al. (2023) pinpoint the constantly, changing political, economic and other circumstances that impact the historical trajectory of individual seaside resort development.

In understanding the evolution and growth of English seaside resorts Walton (1981, 2000) directs our attention to the importance of the reduction in working hours as well as greater prosperity among the working classes as contributing to the uneven development in the numbers and sizes of British coastal resorts. During the 19th century following the institution of public holidays as well as the extension of railways a growing proportion of the English population had the opportunity to enjoy daytrips or spend days at coastal resorts (Abell, 2023). Coastal areas afforded space and opportunities for relaxation and recreation away from the increasingly crowded British cities (Guiver et al., 2023). Walton (1978) views the emergence of the popular seaside resort in England as part of the wider experience of the working classes in industrial society. Indeed, he demonstrates that the agency of the working-class holidaymaker was foundational to the popularization of the seaside resort during the later stages of the nineteenth century (Walton, 1983). Blackpool in North-West England “has undisputable claims to the status of the world’s first working-class seaside resort in the sense that during the nineteenth century its tourism economy

came to be dominated by wage-earning industrial workers from the cotton mills, engineering workshops, coal mines and multifarious other industries of Lancashire (the first industrial region and society) and then from a wider area of northern and midland England" (Walton, 2009, pp. 151-152).

During the 20th century resorts and resort life consolidated as big business for residents and visitors and a highly significant aspect of British culture (Walton, 2000; Huggins, 2002). Historically the local demand for sea-bathing traditions had been associated with the healthy environment of coastal localities and "at the core of the original promotion of the seaside as a healthy and desirable destination" (Walton, 2003, p. 81). Yet, into the early 20th century, it could be observed that resort advertising in England continued to exhibit a strong association with the Victorian ethic of clean and fresh air with a focus upon visiting 'healthy' destinations (Page & Connell, 2025).

Overall, according to Walton (2000, p. 27) England evolved "a system of coastal resorts whose scale and complexity was unmatched anywhere else in the world". Some catered for social elites, others for working classes. The British seaside resort was the dominant destination for the annual Victorian or Edwardian holiday (Walton, 2013). Seaside resorts enjoyed a near monopoly of British popular tourism as the railway network directed people to well-connected leisure destinations. Similar resort developments occurred in several other coastal zones of the world (Walton, 2003; Abell, 2023). Illustratively, Lewis (2009, p. 44) records "by the end of the nineteenth century, a distinct urban form had evolved along the Atlantic coast of the United States". Further, "the popular seaside holiday resort provided residential accommodation for the middle and lower classes and more particularly entertainment for the visitor on a one day excursion from the city" (Lewis, 2009, p. 44).

Methodology

The study was pursued through the application of different research methods. First, a literature search and survey was undertaken of existing international scholarship concerning seaside resort development. As is apparent from the above section of material, the bulk of extant research relates mainly to cases of resort evolution and of early tourism development in the Global North in general and within Europe in particular. Most literature concentrates upon the classic destination development pathways of British seaside resorts. Beyond that body of research writing, the pool of literature on historical coastal resort development is viewed as extremely shallow.

Second, the research on the evolution of East London as a coastal resort applied the methods of historical geographers, which include the mining of primary source

materials from archives and the gathering of other evidence in secondary literature. The benefits of archival research for geographers have been pointed out by several observers (Beckingham & Hodder, 2022; Byron et al., 2024). Arguably, in tourism studies, descriptive historical research continues to have merit particularly as “the judicious use of primary resources creates a purposeful narrative review, creating a historical reconstruction” (Page & Connell, 2025, p. 4). Indeed, if used carefully, historical methods including archival research can unveil patterns of change over time (MacKenzie et al., 2020). This is assisted by the adoption of a chronological approach to the analysis as recommended by Worthington (2003).

The East London research utilizes primary documentary sources mainly secured from the collections housed at the South African National Library depot in Cape Town. This is supplemented by other documentary material which was accessed at the Western Cape Archives in Cape Town. At the National Library, material was sourced in terms of the guidebooks and promotional material produced by the South African Railways and Harbours (SAR & H) during the 1920s and 1930s. Looking at the history of tourism development in South Africa one of the watershed moments was the establishment in 1919 of the Publicity and Travel Department of the railways organization (van Eeden, 2011). The promotional activities of this department surrounded the provision of publicity material and guidebooks that might encourage overseas tourists as well as regional tourists from neighbouring territories (especially colonial Rhodesia) to holiday in South Africa (Foster, 2008). Importantly, as in the case of East London, the railways organization cooperated with local municipalities to develop publicity material that was targeted also to expand the domestic tourism market.

According to Foster (2008) and van Eeden (2011) the South African Railways and Harbours (the latter was incorporated into South African Railways in 1922) organization played a central role in fostering tourism expansion in South Africa both in terms of domestic travellers as well as of overseas tourists. This was achieved through connecting different spaces of South Africa and forging an infrastructure for travel which was encouraged by the enormous amount of publicity material that was organised by, or commissioned for, the agency. The expanding railway network and the publicity provided by SAR & H greatly assisted in familiarizing overseas visitors with the varied landscapes of South Africa (Foster, 2008). Moreover, its publicity material was deemed a vital catalyst for stimulating local rail passenger traffic and expanding the development of coastal holiday destinations across South Africa, including East London (van Eeden, 2011). The analysis of East London threads the archival material with the existing secondary sources on the historical development of the city (Nel, 1991; Minkley, 1994; Nel & Rogerson, 1995, 1996; Bank, 2011 & 2015; Breier, 2023).

Results

The context

In 1836 the port settlement of East London was founded to serve British soldiers engaged in the sixth frontier war (Nel, 1991; Minkley, 1994; Lester, 1998). During the early decades of the 20th century East London rose to prominence as a trading centre with economic activity concentrated upon its harbour, railway, merchant houses, processing and craft works (Bank, 2011). It was both a centre for regional hinterland trade and leading port for the export of wool mainly to the colonial power, Britain. By the 1920s the area's wool export trade was under threat and the locality began to exhibit signs of economic depression. From the 1930s began a period of economic change as new industrial parks were established which boosted the rise of secondary industry (Minkley, 1994). At the close of the Second World War (1945), East London recorded over 100 manufacturing establishments (Bank, 2011). Nevertheless, as is highlighted by Beinart and Bundy (2023, p. 828), for the first 40 years of the 20th century, East London "was deliberately and self-consciously a non-industrial town".

As compared to other major South African urban centres East London shared in neither the mining (Johannesburg and Kimberley) nor the import-substituting industries to supplement its port activities (Cape Town, Port Elizabeth and Durban) and nor did it have a major administrative role in South Africa as was the case of Pretoria, Bloemfontein or Pietermaritzburg. Instead, with wool from its hinterland as the major export, until the Second World War East London was essentially a colonial port. It was argued that "East London municipal authorities centred their energies on its role as a port and entrepôt, with an eye on tourism" (Beinart & Bundy, 2023, p. 828). A critical factor supporting the town's emergence as a tourist destination was the issue of 'local agency' and the pro-activity of East London local government in driving the directions of local development. Nel and Rogerson (1995, p. 1) argue in the pre-1945 period across several urban centres in the Eastern Cape there occurred high degrees of municipal involvement in urban economic activity through place entrepreneurialism and what might be termed 'incipient local economic development' approaches.

Early tourism development directions

Tourism began to enter the landscape of East London in the latter half of the 19th century. According to Bank (2015, p. 249) "the Eastern Cape coastline has enjoyed a special place in the imagination and identity politics of white English-speaking people who have looked to the coast as a critical space of relaxation, recreation and recuperation". Eastern Cape farmers, traders and townspeople travelled from the interior to the Eastern Cape coast for leisure purposes and

including to the beachfront of East London. Farmers from the inland districts used to trek down to East London with their families and camp out in their wagons on the grassy areas that fringe the beach, and “a fortnight or a month sped pleasantly by in such healthful and enjoyable pastimes as bathing and fishing” (South African Railways and Harbours, 1923, pp.101-102.). Although white settlers considered the Eastern Cape coastline, as wild, treacherous and unclaimed, they transformed coastline enclaves in East London into British style seaside resorts.

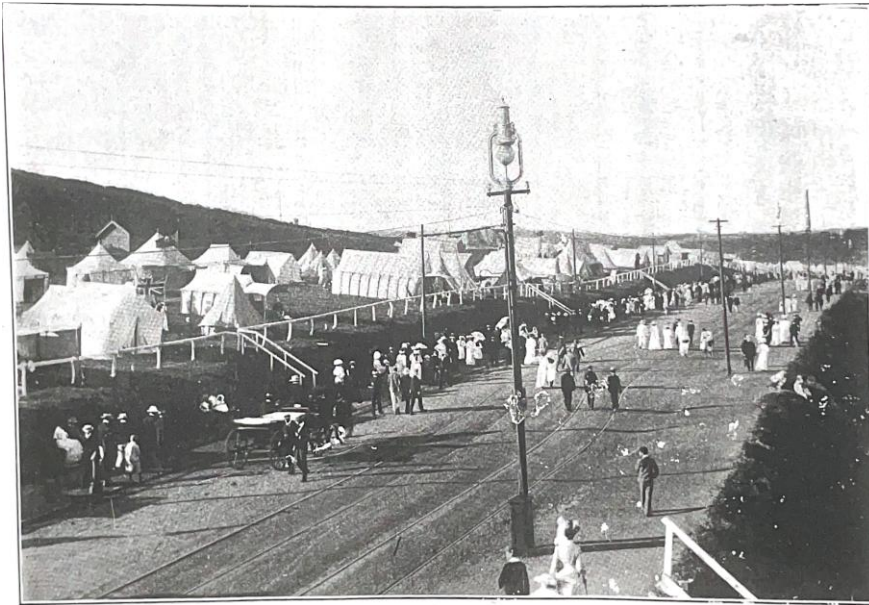


Figure 1. The East London Esplanade c. 1920 (Source: *Cape Times*, 1921)



Figure 2. The Beach Tea Pavilion, East London c. 1920 (Source: *Cape Times*, 1921)

As stated by Bank (2015, p. 249) during the first half of the nineteenth century “East London developed as a British seaside resort”. The transformation of the city’s beaches into tourist attractions and as places for middle-class recreation started in the 1880s with the construction of a road to link the city centre to what was called in 1906 ‘Oriental Beach’. An English-style pavilion and tearoom were built thus opening “up the Esplanade to the urban middle class for weekend tea outings and strolls along the coast” (Bank, 2015, p. 251). Figures 1 and 2 show respectively the East London esplanade and the beach tea pavilion. An important development for the beachfront development was the opening of a tramline connecting the city centre to the beach. In addition, the opening of the Beach Hotel, viewed as a stunning example of Edwardian architecture, was a further significant landmark property development as it established a stylish presence on the Esplanade (Figure 3). The touristification of East London continued in earnest at the turn of the twentieth century with the development of the mile-long esplanade for strolling, bathing and recreation on the eastern side of the Buffalo River (Bank, 2015, p. 250).

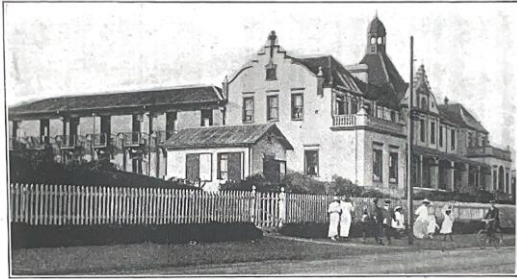
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Figure 3. Advertising East London’s Leading Hotel c 1920 (Source; *Cape Times*, 1

At the beginning of the 20th century East London saw the establishment of a number of colonial beach hotels. This raised considerable hopes that East London would consolidate its status as a major seaside destination for domestic white South African visitors as well as attract overseas tourists (Minkley, 1994). One early hotel and travel guide for visitors to South Africa described in 1920 as follows: "East London has during the last half century enjoyed an ever-increasing popularity, and at the present moment is one of the most up-to-date seaside resorts in South Africa. Its esplanades are without rival, affording in their course of about two miles an extensive and magnificent view of the Indian Ocean. East London, moreover, possesses a perfect stretch of sand, which is the delight of visitors, both young and old. One of the staple and natural attractions is the Buffalo River, the fascinations of which are many and various; here are facilities for boating, and some excellent rod and line fishing can be obtained" (Cape Times, 1921, p. 86).

In common with British Edwardian and Victorian seaside resorts, East London's Esplanade was constructed as a "domesticated city space of civility and innocence" (Bank, 2015, p. 252). Until the 1920s Victorian-style class and gender sensibilities and regulations prohibited men and women from bathing together and further required bathers to have costumes from the neck to knee. Following World War 1, however, changes occurring across the colonial world impacted the regulation of beach spaces in South Africa. Victorian style restrictions on dress and separate gender bathing were dropped and "by the 1920s, there was a new focus on tanning and exercise at the beach, as well as on beauty contests and surf lifesaving" (Bank, 2015, p. 252). During the 1920s East London began to reflect a transition from a seaside resort described by Minkley (1994, p. 106) as of 'elite coastal patronage' to a mass family seaside resort. This change was evident in its representation as a 'new' family haven with images of "famous beaches, glorious sea coast drives, ideal camping sites, a scenically endowed river and a reputation for keeping expenses within the limits available to the average wage earner" (Minkley, 1994, p. 106). Historically, East London had emerged as an early camping destination (Rogerson & Rogerson, 2021a). Despite the growth of commercial hotels, its traditional popularity for camping as a budget form of travel was retained. In 1924 it was observed: "East London has not lost its old-time characteristic of camping which is still a very special feature of the place" (South African Railways and Harbours, 1924a, p. 32). The municipal authorities preserved the old camping ground and for many residents in the Cape "Camptown is among the greatest attractions of East London for there one can lead the simple life and stroll from tent to beach in one's bathing dress" (South African Railways and Harbours, 1924a, pp. 32-33).

Pleasure and health

The evidence therefore is that during the early 1920s “the number of visitors has greatly increased, and this is due to the efforts of the municipal authorities to increase the attractions of the town and the beach” (South African Railways and Harbours, 1923, p. 102). The establishment by South African Railways of long-distance train services was the foundation of seasonal migrations of visitors from South Africa’s major cities of Johannesburg and Pretoria for leisure and for stimulating the rise of a suite of ‘fashionable’ coastal resorts, including East London (Foster, 2008; Rogerson & Rogerson, 2020, 2023). The marketing material produced and distributed by SAR & H conveyed positive promotional messaging of East London as a holiday destination, including for both domestic and overseas tourists. The health restorative benefits of a sojourn in this coastal resort frequently were flagged. For example, publicity material proclaimed that for “the last half-century or more East London has been a favourite holiday spot with the up-country resident anxious to enjoy the ozone-laden breezes from the ocean” (South African Railways and Harbours, 1923, p.101).

East London’s local ‘touristic capital’ was described as “richly endowed with natural advantages – a beautiful bay, a fine stretch of sandy beach, grassy turf running down almost to the edge of the sea, picturesque bush-clad sand-hills, a noble river, and an invigorating climate” (South African Railways and Harbours, 1923, p.102). In a narrative piece written with the overseas tourist as target audience it was stated that “East London has not the pretentiousness of Cape-town; it has not the prosperity of Port Elizabeth; nor does it rival Durban” but it boasts “magnificent river scenery, where the broad-bosomed Buffalo leisurely meanders between richly wooded banks such as one would look for on the English Wye or Dart” (South African Railways and Harbours, 1923, p.102). Above all “the outstanding delight of East London, from the point of view of the tourist, is the bathing to be had on the beach” which is safe, cool and health invigorating “unquestionably one of the finest sea-bathing grounds around the coast of South Africa” (South African Railways and Harbours, 1923, p. 104). It was concluded that “If a man were choosing his holiday rendezvous purely on account of the sea-bathing advantages, East London would be without a rival in South Africa” (South African Railways and Harbours, 1923, p.104). For mainly overseas visitors East London was further marketed as a tourist centre because of its proximity to the attractions of rural ‘Native life’ (Rogerson, 2022). Specifically, it was the gateway and access point to the Transkei, and thereby allowed excellent opportunities for “observing the characteristics of some of the native tribes in their wattle and daub villages” (South African Railways and Harbours, 1923, p.105).

Overall, Minkley (1994, p. 104) contends that “On a significant scale, a tourism ‘industry’ was only created in the post-1920 period, receiving much of its impetus

from existing commercial interests" in East London. Investment occurred in the development of hotels and was underwritten by commercial wholesale capital. The seafront/beachfront became the core of the "complex and extensive recreational and leisured social representation of place in the 1930s" (Minkley, 1994, p. 104). The main attraction was "the appeal of British-style holiday fun, compressed in an esplanade or beach-front and structured around hotels, bandstands, swimming pools and sheltered beaches" (Bank, 2015, p. 249). Arguably, until the Second World War East London's esplanade culture of the period was explicitly colonial and segregationist. Africans at the East London beaches were there essentially to serve white visitors, locals and holiday makers (Bank, 2015).

Although the largest flow of domestic visitors occurred in the summer months to East London, it was argued that "amongst its other outstanding characteristics it has the advantage over many of its rivals of being equally – if indeed, not more – pleasant for a holiday in winter" (South African Railways and Harbours, 1923, p.104). Potential visitors were assured that throughout the year "there is no lack of entertainment, theatrical performances, vocal and instrumental concerts, bioscope entertainments, and the social amenities of a popular and prosperous town being plentiful" (South African Railways and Harbours, 1923, pp.104-105). Nevertheless, there were critical voices that suggested a need to strengthen the locality's tourism asset base. For example, one local observer drew attention to the weakness of the night-time economy. The question was posed what are visitors to do in East London during evening?: "They may have spent a most enjoyable day – fishing, golfing, motoring or sea bathing – but when the shades of evening fall there is nothing for them to do but to sit in the lounge or bedrooms of their hotels" (Anon., 1925, p. 659). Suggestions made to boost the night-time economy included the establishment of more places of amusement including "a first-class theatre" (Anon., 1925, p. 659).

Further support to tourism development derived from the activities of the East London Publicity Association which was founded in 1925. The association recognized the importance of "making the advantages of East London known to many thousands of people throughout the Union and in Rhodesia" (East London Municipality, 1925). In 1929 the organization reported "many more visitors are being attracted to East London, especially from the Free State and Rhodesia". Among the initial activities of the publicity association were the production and distribution of 15 000 copies of a local visitor guide with copies "placed on all boats leaving Hamburg for South Africa, others distributed from the various tourist agencies including London and New York. Through the courtesy of the Union Castle Steamship Company, these are distributed amongst passengers on all mail boats arriving here, together with a special illustrated folder suggesting short trips ashore commensurate with the time at their disposal" (East London Publicity Association, 1929).

The strong association of East London with health continued in marketing promotion throughout the 1920s. For example, one publicity guidebook pinpointed “the delightful climate with its glorious beach, so that as a health resort it challenges many other extensively advertised resorts” (South African Railways and Harbours (1924b, p. 109). In 1927 publicity material issued under the joint auspices of the East London Municipality and South African Railways and Harbours the core messaging was of “East London for Health” (South African Railways and Harbours, 1927). The publicity booklet stressed the benefits of the “equitable climate” and the impact of sea bathing as “a most invigorating health restorer” (South African Railways and Harbours, 1927, p. 9). For people who were run down “no better health could be found than that which lies in the waves of the Indian Ocean at East London” (South African Railways and Harbours, 1927, p. 9). Specific focus was given to sufferers of bronchial complaints for whom “the humidity of the air, when combined with the purity of the atmosphere of the sea shore, is most beneficial and soothing; and cases of chronic renal disease also derive much benefit from such climatic conditions. Insomnia, and the many functional nervous diseases, improve under the sedative influence of a climate such as that of East London, whilst for the form of heart trouble, the resort is unrivalled” (South African Railways and Harbours, 1927, p. 11).

The embrace of sport to drive tourism

Colonial South Africa had long enjoyed a reputation in Britain for its health benefits of sunshine and clean air (Rogerson & Rogerson, 2021b). During the 1920s and 1930s, however, the country’s tourist image began to shift away from that of a health resort to “a more diversified and sophisticated travel destination” (Ferrario, 1978, p. 50). It was observed the country’s seaside resorts began to develop “to accommodate the increasingly large number of holidaymakers who descended, during the school vacations, from the Rhodesias and the Congo Copper Belt, as well as from the new conurbations of the Witwatersrand” which centred around Johannesburg (Ferrario, 1978, p. 50). East London was now described to potential visitors as “one of the most sporting towns in South Africa” (South African Railways and Harbours, 1924a, p. 111). One observable shift from the 1920s was the growing profiling of East London’s assets for health-giving sporting attractions. A turn is observable in the focus of place marketing of seaside resorts such as East London from a former emphasis on healthy and salubrious vacations to activities and sport. The health-giving impacts of indulging in forms of sport and recreation such as rowing and fishing were lauded. East London “affords many opportunities for indulging in good sport in the fresh air, which does so much to promote health of body and mind” (South African Railways and Harbours, 1927, p. 11).

Sea sports linked to the beach became significant products of local touristic capital. This was exemplified with attention given to surfing. In 1924 publicity it was stated that “East London “claims to be the home of the surf-board, and this sport has become very popular. It is an animated scene on a sunny day when swimmers make merry in the tumbling surf, the more expert riding the great breakers gaily ashore on their gaudy coloured boards, while the learners perchance are bowled over and rolled in the shallows. But the knack of surf-riding is soon learnt and in almost no time the visitor finds himself master of the exhilarating sport, and realizes that ‘Life is still a merry, merry things for those who make it so’ (South African Railways and Harbours, 1924b, pp. 31-32). In promotional material that appeared in 1929 East London’s tourism assets were described as follows: “Surf board riding on the long breakers that sweep up the Orient Beach, boating and fishing in the rivers and from the rocks along the sea front, a climate that is consistently invigorating, and the leafy glades of the woods and parks round the town, together make East London an excellent place for a temporary sojourn at almost any time of year” (South African Railways and Harbours, 1929, p. 29).

By 1930 the East London Publicity Association had amended the messaging focus from ‘East London and Health’ to East London as the “Home of the Surf Board – Where Sea and Sunshine Call” (East London Publicity Association, 1930). Beyond surfing, however, other recreational and sport activities were highlighted which linked to the Buffalo River. Most notable were boating and fishing. It was claimed that “in and around East London we can offer the finest fishing in South Africa” (Anon. 1925, p. 659). River sport activities were highlighted: “There are few more picturesque rivers than the historic Buffalo” where “a splendid rowing course has helped to develop the best oarsmen in Africa” (South African Railways and Harbours, 1924b, p 111). The town’s prowess for golfing was also indicated with reference to visits from British Royalty: “East London possesses one of the most beautifully situated golf links in the whole of South Africa, which was greatly enjoyed by the Prince of Wales during his recent visit” (Anon., 1925: 660). In railways publicity material the golf narrative was also repeated: the “Golf Course, 18 hole, is a real sporting one, kept in excellent condition” (South African Railways and Harbours, 1924a, p. 111). Once again, in a 1936 SAR & H publicity titled *Golf in South Africa: Play it in the Sunshine*, East London was profiled. It was stated that in its vicinity “the countryside is park-like, often bringing memories of England” (Grimsdell, 1936, p. 13). The town’s golfing attractions were much celebrated: “perfect golfing country, undulated and heavily wooded” and that the “fairways roll in a delightful manner, and charming views of the Indian Ocean add to the pleasures of the round” (Grimsdell, 1936, p. 13). Another 1936 guidebook for overseas visitors to South Africa proclaimed East London among ‘the wondersights of Southern Africa’. It describes:

“East London is a popular seaside resort and thousands flock to its fine Orient Beach during the summer season. The Buffalo River is the scene of a number of the Union’s most important regattas, while the other rivers in the vicinity are favourite picnic haunts for holiday-makers. The aquarium on the sea-front contains a fine collection of the marine species found round the South African coast,” (South African Railways and Harbours, 1936, p. 17).

The changing balance between tourism and industry

Arguably, by the 1930s tourism had become “East London’s ‘gospel’” (Minkley, 1994, p. 104). The tourism economy continued to record steady growth and by the 1940s there were more than 50 hotels and guest houses, many situated on the Esplanade, and attracting the estimated 15 000 tourists that visited the city each year. During the 1940s industrialization was advancing in East London and created local political tensions as to the future development of the city, whether as a coastal lifestyle city or as an industrializing centre (Minkley, 1994).

Local political conflict occurred between tourism commercial interests and those of manufacturing with the former favouring an anti-industrial axis for local development (Minkley, 1994). According to Bank (2015) the decision-makers in the City Council opted to pursue a dual pathway seeking to attract new industrial investment and at the same time maintaining the appeal of the city to tourists. Post World War 2 development in East London therefore witnessed the opening of a new chapter in its urban development trajectory as an accelerated path of local industrialization occurred alongside efforts to sustain the established reputation of East London as a place of pleasure, health and sport.

Conclusion

In researching the evolution of resorts Stock et al. (2014, p. 4) stress the relevance of “historical contextualisation”. The novel contribution of this study is a historical examination of the evolution of seaside resort development in a setting that has received minimal attention in international tourism scholarship.

The research has shown that the making of the South African coastal resort of East London was much in the style of British seaside resorts. East London’s seafront esplanade, its beach tearoom and the pleasurable activities of seabathers represented a model of several English seaside resorts which had been established in the 19th century. In promoting the development directions of the resort from the 1880s to the period of the beginning of the Second World War an important role was played by ‘local agency’ in terms of the municipality. Of critical significance also for the growth of the tourism economy was the production of publicity material and promotional efforts of the South African Railways and Harbours organisation in raising local and

international awareness of the tourist assets of East London. The initial anchors for tourist attraction to East London were pleasure and health. By the 1920s, however, a shift is evident for incorporating also a new focus on sporting activities as a further vital element of the touristic capital of this South African seaside resort.

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Exploring the Relationship Between Anthropometric Characteristics and Physical Performance in Football Players

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Abstract: Physical and mental health represents one of the main concerns of nowadays society, characterized by sedentarism, unhealthy food and unprecedented multimedia impact. Under these circumstances, sports are a sustainable alternative to overcome nowadays society's challenges, with social, economic and personal positive effects. Thus, the purpose of this study was to identify the relationships between the anthropometric and physical indicators, measures between 2022 and 2025, of the University of Oradea FC football team's players. The research methodology used was multicriterial analysis. In this respect, 9 indicators were analyzed, 4 anthropometric and 5 physical ones. The results showed the existence of strong negative relationships, followed by positive strong relationships, negative weak and positive weak relationships. The preponderance of strong negative relationships indicated the role of sports in children's harmonious and balanced development. Based on tendencies in the evolution of relationship types according to the differences between the values of -1 and 1, assumptions were made and some players were identified in need of personalized training programs, as well as players for whom it was necessary to depict external factors to make the training more efficient and to improve their athletic performance.

Keywords: anthropometric indicators, physical performance, football players, youth athlete development, training optimization

Introduction

Oradea is one of the large cities of Romania, being currently characterized by a process of accelerated spatial expansion in favor of cars and to the detriment of people, especially children. Given that physical activity is essential to a healthy and balanced society, the need for movement and sports represents an alternative to

combat sedentarism and to provide children with a pleasant, dynamic form of leisure, with medical, emotional, and intellectual benefits (Papp et al., 2019; Erdely et al., 2020; Ilieș & Caciora, 2020). This can be achieved through sports clubs, which, in addition to identifying and selecting future talent, also support athletic performance. The motivation for moving and practicing sports depends on a series of factors such as children's psychosocial status, their physical and physiological characteristics, type of sport, available time, costs, existence of specialized units and organizations, economic, social and political context.

Some children registered in clubs will attain a certain level of athletic performance. This can be also influenced by a series of factors, including physical and physiological features, level of motivation and psychosocial status (Koç et al., 2020; Podstawski et al., 2020; Podstawski & Marzec, 2021; Stanković et al., 2023). Bulz et al. (2024) concludes that the exposure to innovative activities during physical education and sports classes significantly increases children's inclination towards active participation and sustained exercise behavior. The way and share in which these factors are associated in establishing the athletic trajectory differs from one athlete to another, reason why a complex approach is required. There were instances in which coaches focused primarily and for an extended period on improving athletes' physical condition, without assessing their body composition (Popovic et al., 2014). Understanding physical and physiological characteristics is essential for enhancing athletes' performance, identifying talent, determining player positions, and designing appropriate training methods (Radaković et al., 2025). Șandra et al. (2022) said that physical training should be a primary objective in the development of young athletes, providing a strong foundation for their future athletic performance. The importance of athletes' anthropometric characteristics and motor skills in competition was also noted (Stanković et al., 2023). Thus, the advantages of body composition, height and weight were determined compared to the players' dynamic requirements (sprints, jumps and direction changes) (Popovic et al., 2014; Koç et al., 2020). Considering the same features, other studies have reported differences in athletic performance across various sports (Masanovic et al., 2019; Stankovic et al., 2023). Different exercises with diverse neuromuscular demands foster dynamic stereotypes that engage the body's major systems (Șandra et al., 2023a; Șandra et al., 2023b). Yet, most children registered in football clubs will not achieve remarkable athletic performances for various reasons, including the anthropometric and physical features. Under these circumstances, knowing the relationships between the anthropometric indicators and the physical ones shows how the club manages to guide children towards sports and physical exercises in an organized manner. The children's harmonious development by reaching a balance between the anthropometric indicators and the physical ones ought to be one of the main objectives of sports clubs, having effects on

social, emotional and psychological levels. The introduction of modern training tools and methods into the training process of children in the pubertal stage has a positive impact on their motor and psychomotor development as well (Bulz et al., 2023). Despite the large volume of studies and research, it can be noticed that studies focusing on establishing the relationship types between anthropometric and physical indicators, measured over a specific period, of young children football players, are scarce. In football, physical preparation is a central element of athlete development, underpinning performance outcomes in both training and competitive contexts (Şandra et al., 2023). Therefore, the purpose of the study was to identify and explore the relationships between anthropometric and physical indicators, measured between 2022 and 2025, of players from the Oradea University football team's 2012 generation.

In the literature, numerous studies have assessed the relationships between anthropometric and physical indicators and athletic performance (Bénéfice & Ndiaye, 2005; Staub et al., 2018; Yusni et al., 2025), optimized training (Norton et al., 1996; Brocherie et al., 2014; Althuwaini & Fahad, 2025; Kwon & Kim, 2025), identified talent (Mohamed et al., 2009; Boostani et al., 2011; Hume & Stewart, 2017; Sajjadipour et al., 2025), and established players' positions (Mahmoud et al., 2021; Piqueras et al., 2021; Arslan et al., 2025).

The novelty of the study lies in applying a multicriteria method to assess anthropometric and physical indicators at the level of a children's football team over 4 years (2022-2025). The obtained results may provide essential information regarding the children's balanced development, based on the anthropometric and physical features, the need to introduce personalized training, identification of children with exceptional ability and establishing the trajectory of the future athletes.

The study's research hypotheses dwell on the fact that on the level of the Oradea University FC football team, 2012 generation, there are strong relationships between the anthropometric and physical indicators and, as a result of constant training, in time, the evolution of the relationship indicator is positive, with values approaching 0, being conditioned by the evolution of the physical indicators.

The research questions are as follows: Do anthropometric and physical indicators change after participation in sports training? What kinds of evolutions are there? Are there any relationships between the evolution of the physical, respectively of the anthropometric indicators? What kind of relationships are there?

Materials and methods

The data used in this study were systematically collected annually from medical and functional assessments of the Oradea University FC team's players from the 2012 generation over four consecutive years (2022-2025). The measurements were made

in the month of May of each year, under the club's sports physician's coordination who performs an annual medical specialty check up to grant the yearly endorsement of athletic activity ("Fit for sports/football").

During these examinations, the research team, together with the sports physician, collected and recorded anthropometric and functional data with the informed consent of the children's parents (UE 2016/679 – GDPR Rule). All data were anonymized and used exclusively for scientific and educational purposes.

Table 1. Indicators and variables used

Assessment field	Variable / Test	Used instrument	Technical features / Precision
Anthropometrics	Height (cm)	Vertical stadiometer	Millimetric ruler, perpendicularly fixed; precision ± 0.1 cm
	Body weight (kg)	Digital scale	Pressure sensor; pre-test calibration; precision ± 0.1 kg
	Thoracic elasticity (cm)	Flexible anthropometric centimetre	Nonelastic material; measured in inhaling/exhaling; precision ± 0.1 cm
	Vital pulmonary capacity (ml)	Portable spirometer	According to ATS/ERS standards, selection of the best one out of three attempts
Physical testing	Speed (time at 50 m)	Digital timer; running track of 50 m	Timing at ± 0.01 s; flat, marked surface
	Resistance (distance in 8 minutes)	Digital timer; metric measuring tape	Precise timing; distances marked with precision ± 1 m
	Abdominal strength (sit-ups/30 sec)	Digital timer; gymnastics mattress	Timing ± 0.01 s; manual counting of correct repetitions
	Arms strength (push-ups/30 sec)	Digital timer; gymnastics mattress	Timing ± 0.01 s; standardized visual assessment
	Lower limbs strength (squats/30 sec)	Digital timer; marked testing area	Timing ± 0.01 s; manual counting of correct repetitions

The measurements were made within the club's sports facilities, under standardized temperature and training program conditions, to be able to compare data from different years. The same measurement procedures and instruments were used each time to ensure consistency and validity.

To collect the anthropometric data, standardized instruments were used, in accordance with the recommendations of the World Health Organization and International Institute of Applied Anthropometrics. All instruments were calibrated before measurements and the procedures were made under controlled conditions, respecting the somatic assessment specific methodology norms. Height was determined by using a vertical stadiometer with millimetric ruler, fixed on a rigid plane and perfectly perpendicular on the floor. The subject was positioned in orthostatism, with the heels, shoulder blades, and posterior aspect of the head in contact with the vertical surface, gazing into the Frankfurt plane. The measurement was recorded in centimeters, with a precision of ± 0.1 cm. Body weight was measured with an electronic scale with pressure sensor, calibrated before testing. The subjects

were weighed on wearing light clothing and no shoes. The values were expressed in kilograms, with an accuracy of ± 0.1 kg. Thoracic elasticity (thoracic expansion) was determined with the help of a flexible, nonelastic anthropometric measuring tape. Measurements were taken of the thoracic perimeter during maximal inhalation and maximal exhalation; the difference between the two values represent thoracic elasticity. The instrument allows a precision of ± 0.1 cm. Pulmonary vital capacity was assessed using a portable spirometer in accordance with ATS/ERS (American Thoracic Society/European Respiratory Society) standards. The subjects executed forced exhaling after a maximum inhale and the best out of three consecutive attempts was considered the reference value. The results were expressed in milliliters (Table 1).

The assessment of physical performance was made by means of a series of standardized test, using instruments specific to each test. All measurements were made under controlled conditions, on appropriate surfaces, and in accordance with the methodological protocol established for each motor skill. Speed was assessed over a 50 m distance, marked on a flat, level sports field. The execution time was measured with a digital timer with precision of ± 0.01 s. The start signal was given from a free position and the time was recorded from the moment the running started until the finish line was crossed. Aerobic resistance was assessed by continuous running for 8 minutes on a field marked with the respective distances, measured with a measuring tape. The digital timer was used to comply with the standard time and the distance was determined by reading the fixed marks at the end of the test. The instruments provide a precision of ± 1 m for distance, and ± 0.01 s for time. Abdominal muscle strength was assessed by the number of situps performed in 30 seconds. The exercise was performed on a standard gymnastics mat to ensure the subjects' comfort and safety. The number of correct repetitions was recorded using a digital timer, with a time precision of ± 0.01 s. The strength of upper limbs extension was tested by the number of pushups made in 30 seconds. The subjects made the exercise on a flat surface, using the mattress for comfort. The number of correct repetitions was visually monitored, and timing was performed using a digital timer with a precision of ± 0.01 s. Lowerlimb strength was assessed by the number of squats performed in 30 seconds. The test was carried out on a flat surface, delimited for safety and stability. Time was measured with a digital timer and the correctly made repetitions were manually counted by the examiner (Table 1).

The sports physician played a significant role in coordinating the datagathering process by verifying the accuracy of anthropometric, functional, and physiological measurements. Moreover, they helped interpret the obtained clinical values and completed the athletic skills medical charts, based on which the players received their annual medical endorsement to participate in competitions. By the constant

cooperation between the medical staff and the technical team, a longitudinal database was created, essential for monitoring the athlete children's growth and development, and for early identification of physical imbalances or deficits.

The annual monitoring of these indicators allows for a longitudinal tracking of young athletes' physical and functional development, essential aspect for: identifying the deviations from the standard growth curves; adjusting the training load according to biological age, not only chronological; preventing overexertion and injuries by adjusting effort to the child's real capacity; individualized planning of longterm physical training.

According to Piqueras et al. (2021), the anthropometric and physical assessment made at least once a year represents a minimum standard for the athletic formation academies, contributing to the optimization of young athletes' selection, progress and health. Thus, maintaining a longitudinal database regarding the anthropometric indicators, speed, resistance and strength is crucial for any sports structure which targets young football players' sustainable development.

Based on the gathered data, the variable values of the analyzed indicators were normalized (between 0 and 1) and the aggregate and synthetic values were calculated for the anthropometric and physical indicators. The analysis of players was tracked through the synthetic anthropometric and physical indicators to emphasize the situations and their concrete annual evolutions and over the analyzed period. The last stage of the study was represented by the calculation of the relationship indicator (between anthropometric and physical indicators) (Boc et al., 2022; Deac et al., 2023; Herman et al., 2024a; Herman et al., 2024b; Herman et al., 2025a; Herman et al., 2025b; Arslan et al., 2025) and the analysis of players based on this, emphasizing this way the relationship types between the anthropometric and physical indicators, the role of training and the evolution tendencies on team level and on individual, player level.

Results

Analysis of anthropometric indicators

The assessment of anthropometric and functional indicators represents a fundamental component of monitoring young athletes, being directly correlated with performance potential and injury prevention.

To identify and explore the synthetic anthropometric indicator for each player (18 players), member of the Oradea University FC football team, information was gathered once a year, between 2022-2025, regarding height, body weight, thoracic elasticity and vital pulmonary capacity.

The first measurement of anthropometric indicators for each player showed varied nominal values, thus, for the height indicator, in 2022, at the age of 10, they

were between 132 cm, player 8, and 155 cm, player 3. The nominal difference between the tallest player's height and the shortest player's height was 23 cm in 2022. In 2023, the players were 11 then, the smallest height was measured for player 8, similarly to the previous year, 135 cm, growing 3 cm since then. The maximum height measured was 158 cm, player 3, just as the prior year, growing also 3 cm, so the height difference between minimum and maximum remained of 23 cm. The following year, 2024, player 3 was once again the tallest in the team, 160 cm, with a growth of 2 cm, however, the shortest player that year was not player 8 anymore (143 cm), who grew 8 cm, but player 18 (140 cm), who grew 2 cm in the first year and 3 cm in the 2nd one. The difference between the minimum, maximum values, was 20 cm. The measurements in 2025 showed the same trend regarding maximum and minimum values, thus, player 3 was the tallest (166 cm), a 6 cm growth compared to the previous year, and the shortest player was player 8, 144 cm, with a growth of only 1 cm. The difference between the two values was 22 cm.

As expected, all players grew in height during the studied period, between 1 cm per year (player 7, from 10 to 11 years; player 8 from 12 to 13 years) and 11 cm per year (player 7 from 11 to 12 years). During the entire period, player 16 recorded a growth of only 7 cm, 2 cm in the first year, 3 cm in the second and 2 cm in the third, while player 12 recorded a growth of 24 cm in total, being noticeable a constant, yet significant growth from year to year of 8, 9, respectively 7 cm.

Players' body weight in 2022, at age 10, ranged from 25 kg (player 18) to 39 kg (player 14), with a 14 kg difference between the two values. The following year, the minimum weight was 28 kg, player 15, while the maximum weight was 44 kg, player 14. In 2024, player 18 had again the smallest weight, 30 kg, and player 14, the most significant weight, 48 kg. The following year, players 18 and 2 had the smallest weight, 39 kg, and the maximum value, of 55 kg, was recorded for player 1 and player 12.

Analyzing the evolution of body weight nominal values, none of the players lost weight, the growth rhythm, however, being different from player to player and from one measurement to the next one. From the 2022 measurement, when the players were 10 years old, to the 2023 measurement, 11 years old, players 2, 4, 6, and 15 gained the least weight, 2 kg each, while player 17 gained the most weight, 7 kg. The other players gained between 3 and 6 kg. In 2024, player 18 was 1 kg heavier than the previous year, recording the smallest gain over that year, while players 10, 12 and 13 gained 8 kg each. The maximum gain weight in 2025 was recorded for player 1, who gained 15 kg and the minimum value of weight gain was 2 kg, player 2. The other players gained between 4 and 9 kg. It can be noticed the maximum growth value of 15 kg as being significant and unique within the football team.

At the age of 10 (2022), the football players' thoracic elasticity ranged from 4 cm (players 9 and 16) to 9 cm (players 7, 8, and 18). The following year, 2023, the

minimum value was also 4 cm, but the number of players with this value increased (players 2, 3, 5, 12 and 14). The maximum thoracic elasticity value was 10 cm for players 7, 8 and 10. The minimum and maximum values, of 4 cm, respectively 10 cm, were maintained in 2024 as well, player 4 recording the minimum value and player 9, the maximum value. In the subsequent measurement, 3 players recorded the minimum value of 5 cm (players 5, 6, and 7), and 1 player recorded the maximum value of 10 cm (player 11).

Although the minimum and maximum values recorded over the studied period were similar or with a difference of 1 cm, the thoracic elasticity evolution during the 4 years was oscillating, with increases and decreases of nominal values in case of each player from one year to the next one.

The vital pulmonary capacity measured at age 10 (in 2022) had a minimum of 900 ml for players 11 and 12 and a maximum of 1900 ml for player 4. In 2023, the vital pulmonary capacity increased in the case of most players, the minimum value was 1100 ml, player 11, and the maximum value was of 2400 ml, player 1. The measured values in 2024 ranged from 1200 ml (player 11) to 2700 ml (player 1). At the final measurement, in 2025 (at the age of 13), the minimum vital pulmonary capacity value was 1800 ml, players 2, 7, 10, 15 and 16, and the maximum value was 2900, player 1.

The vital pulmonary capacity evolved in a consistent upward trend from one measurement to the next. For each player, the highest increase was recorded at the measurements in 2024 and 2025, of 800 ml, for player 11 who, in 2022, had the minimum value for that year, of 900 ml, 1200 ml in 2024 and reaching 2000 ml in 2025.

The anthropometric indicators of height, body weight and vital pulmonary capacity showed increase in value from one measurement to another and for each player. The only anthropometric indicator which oscillated from year to year either increased or decreased, without following a certain ascendent or descendent trend, was the thoracic elasticity indicator.

Based on the nominal values of the assessed anthropometric indicators, the synthetic values of these indicators were calculated for each football player, for each year when they were evaluated (Figure 1).

In 2022, for 13 of 18 football players, the synthetic values were between 0 and 0.5, with the nominal values of these indicators ranging from the minimum toward the average. The other 5 players had synthetic values between 0.51 and 1, with nominal values for their anthropometric indicators near the maximum. The synthetic value closest to 0 was that of player 15 (0.1146), with nominal values for his anthropometric indicators at the upper end of the range, or even at maximum values. The synthetic values of the anthropometric indicators obtained for 2023 (age 11)

place 12 players within the 0 and 0.5 range. In the case of those with a smaller synthetic value (closer to 0) by comparison to the previous year, for example, players 2, 15, 18, the nominal values of their anthropometric indicators increased, yet were still in the lower part of the range in 2023 as well. The other 6 players had synthetic values between 0.51 and 0.75, with no player exceeding 0.75. In 2024, the situation was similar to that in 2023, 10 players had synthetic values between 0 and 0.5 and the values of 8 players were between 0.51 and 1. It can be noticed the overpassing of the 0.5 threshold by players 1, 12 and 13, whose indicators had nominal values in the lower part of the range for 2023, values which increased significantly by the 2024 measurements. In 2025, there were also 10 players with synthetic values between 0 and 0.5, and 8 players with values between 0.51 and 1. The value of player 9 decreased under 0.5 and the value of player 11 increased by over 0.51. No player had a synthetic value higher than 0.75. Out of the total of 18 players, 8 of them had a synthetic value between 0 and 0.5, and the nominal values of their anthropometric indicators were in the lower part of the range in all measurements from all 4 years. Player 7 stands out with a low synthetic value (0.0994), between 0 and 0.25, with nominal values that increase by a constant yet small amount across all 4 measurements.

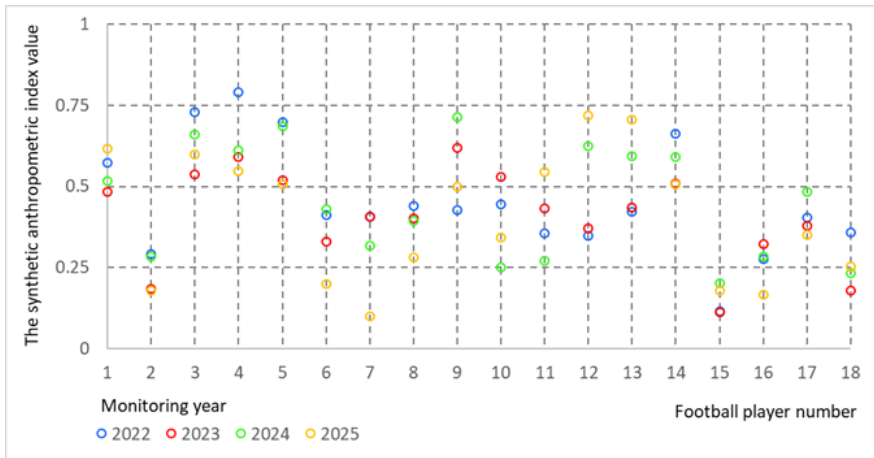


Figure 1. Distribution of synthetic values of the anthropometric indicators for each player

Analysis of physical indicators

Tourism To identify and explore the synthetic physical indicator, information was used regarding speed, resistance, abdominal strength, upper and lower limbs strength of the target group (Figure 2).

Football is a very dynamic sport and the speed of players (time achieved at 50 m sprint) is very important for the efficacy of the players' training, as well as for their performance during the game. The players' speed measurements at age 10 (in 2022)

ranged from 9.98 s/50 m (player 12) to 11.3 s/50 m (player 3). At the second measurement, it was noticed an increase of speed for all players, except player 12, in his case, speed decreased from 9.98 s/50 (the lowest in 2022) to 10.13 s/50 in 2023. For the 11-year-old players, speed ranged from 9.59 s/50 to 10.54 s/50. The increasing trend was maintained in 2024 as well, with values ranging from 8.96 s/50 (player 4) to 10.25 s/50 (player 7). In the case of 2 players, decreases in speed were observed: player 11 from 9.68 s/50 in 2023 to 9.83 s/50 in 2024, and player 17 from 9.86 s/50 in 2023 to 9.83 s/50 in 2024. All the other players were characterized by increase in speed. At the 2025 measurements, 3 of the players showed decrease of speed value: player 7, from 9.1 s/50 in 2024, to 9.25 s/50 in 2025; player 9, from 9.08 s/50 in 2024, to 9.18 s/50 in 2025, and player 14, from 8.97 s/50 in 2024, to 9.23 s/50 in 2025. The other players' speed increased in 2025, by comparison with 2024. The maximum speed recorded in 2025 was 8.37 s/50, player 10, while the minimum was 9.58 s/50, player 6.

The football players' resistance was assessed by measuring the distance they covered over 8 minutes. The first measurement, taken in 2022 (at age 10), yielded values ranging from 1,002 m/8' (player 13) to 1,380 m/8' (player 10). In 2023, the nominal values were between 1,211 m/8' (player 9) and 1,485 m/8' (player 18). The tendency was of increase, except 4 players, in cases of whom resistance decreased in 2023 by comparison with 2022: player 9 (from 1,211 m/8' in 2022 to 1,101 m/8' in 2023); player 11 (from 1,380 m/8' to 1,249 m/8'); player 12 (from 1,280 m/8' to 1,247 m/8'). The nominal resistance values for 2024 were between 1,239 m/8' and 1,510 m/8'. Six of the players showed tendencies of resistance decrease while the other 12, of increase. The most important decrease was in player 18's case, from 1,485 m/8' in 2023, to 1,302 m/8' in 2024. The value range for 2025 was between 1,377 m/8' and 1,615 m/8', the general tendency being of increase by comparison with the previous year, except 4 players: player 3 (from 1,430 m/8' to 1,424 m/8'); player 4 (from 1,510 m/8' to 1,490 m/8'); player 13 (from 1,478 m/8' to 1,385 m/8') and player 15 (from 1,434 m/8' to 1,405 m/8'). Resistance increased from the first measurement (2022) to the last one (2025) for all players, even though from one year to the other, decreases in resistance were recorded in some players' cases.

To assess players' abdominal strength, it was considered the number of sit-ups accomplished within 30 seconds. In 2022, the minimum number of sit-ups made in 30 seconds was 13 (4 players), while the maximum was 16 (4 players). In 2023, the minimum number was 15/30/sec (1 player) and the maximum, 20/30/sec (3 players). All players managed to accomplish a higher number of sit-ups, compared to the previous year. The following year, 4 players accomplished 19 sit-ups/30/sec, the minimum number that year, and other 4 players made 23 sit-ups/30/sec the maximum number for 2024. This year, all players increased the number of sit-ups

performed in 30 seconds compared with the previous year. In 2025, the minimum number of sit-ups/30/secs was 22 (3 players), while the maximum was 27 (player 18). The evolution of sit-up number accomplished in 30 seconds was ascendant, both from 2024 till 2025 and from the beginning of the assessment period until its end.

To assess the upper limbs' strength, the players made push-ups and it was considered the number of push-ups made in 30 seconds. In 2022, the minimum number of push-ups made in 30 seconds was 5 (player 3) and the maximum number was 10 (players 10, 11 and 14). The following year, the minimum number was 8 push-up/30/sec (players 3, 6 and 13), and the maximum was 13 (player 5). Except 3 players, the others managed to accomplish a higher number of push-ups/30/secs compared to the previous year. Those 3 made an equal number of push-ups with those made the year before: player 3 – 8 push-ups; player 13 – 8 push-ups and player 14 – 10 push-ups. In 2024, the minimum number of push-ups made in 30" increased to 11 (players 1 and 7), and the maximum number increased to 15 (players 10, 16 and 17). All players performed more push-ups than in the previous year. At the final measurement (2025), the minimum number of push-ups was 13 (player 1) and the maximum was of 17 (players 4, 11, 15 and 17). It can be noticed that in 2025, there were more players (4) who accomplished the maximum number of push-ups. All players made a higher number of push-ups in 30", compared to 2024.

The squat was the exercise with which the strength of lower limbs was assessed, more specifically, the number of squats made in 30 seconds. Thus, the minimum and maximum values for 2022 were 17 (player 1), respectively 22 (player 14). In 2023, the minimum number of squats/30/secs was 20 (player 3), while the maximum was 26 (player 17). The evolution of accomplished squats number, and implicitly of lower limbs' strength, was ascendent for all players. In 2024, the minimum number of squats accomplished was 25/30/secs (player 3), and the maximum number was 31 (players 11 and 17). The evolution of lower limbs' strength was also ascendent in the cases of all players. In 2025, a minimum number of 28 squats/30/secs were made (player 13) and a maximum of 34 (player 16). The ascendent trend was maintained.

After measuring the nominal values of the football players' physical indicators over the study period, the synthetic values of these indicators were calculated for each player at each measurement (Figure 2). Thus, in 2022, 10 players had synthetic values between 0 and 0.5, and 8 had values between 0.51 and 1. The best placed player in 2022, from synthetic value viewpoint, was player 1 (0.1763), whose nominal values for the physical indicators were in the middle section of the range. The player with the synthetic value farthest from 0 was player 14 (0.8632), whose nominal values were near the maximum of the range. In 2023, 8 players had synthetic values for their physical indicators between 0 and 0.5, whereas the other 10 had values between 0.51 and 1. The player with the lowest synthetic value was player 3 (0.2344), with average-

to-small nominal values, and the player with the highest synthetic value was player 10 (0.8519), whose nominal values were medium-to-high. In 2024 (at the age of 12), for 7 players, the synthetic values were between 0 and 0.5, respectively for 11, the values were between 0.51 and 1. Player 1 was, once again, the player with the lowest synthetic value (0.1962), with nominal average, towards small, nominal values. The player whose synthetic value was farthest from 0 was player 17 (0.8229), with nominal values close to the maximum, or even at the maximum, for some physical indicators. In 2025, 5 players had synthetic values between 0 and 0.5, while all the other players had synthetic values between 0.51 and 1. Player 1 remained the player with the synthetic value closest to 0 in 2025 (0.0694), with average-to-minimum nominal values for his physical indicators. The highest synthetic value was player 17 (0.849). Players 1, 3, 12, and 13 had synthetic values between 0 and 0.5 throughout the study period, whereas players 5, 10, 11, and 14 had synthetic values between 0.51 and 1 at all measurements (Figure 2).

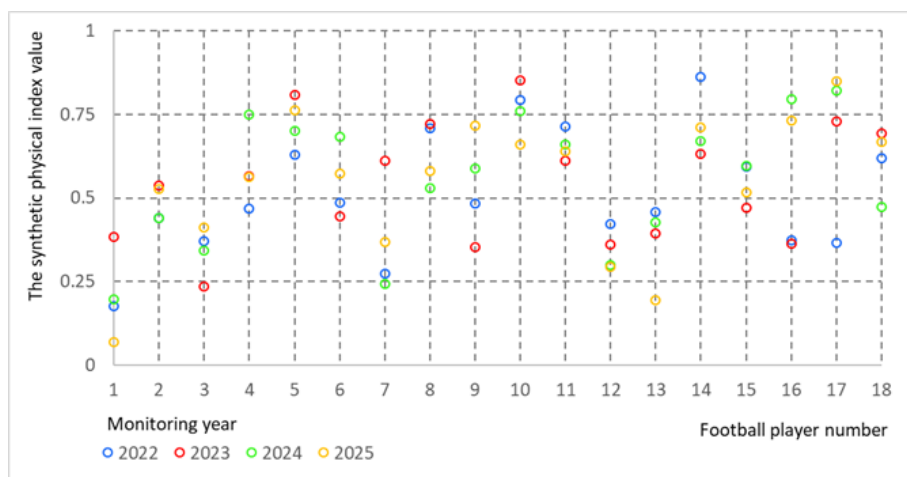


Figure 2. Distribution of synthetic values of the physical indicators for each player

Analysis of relationship types between anthropometric and physical indicators

Being a result of associating anthropometric and physical indicators, the relational indicator does not show the athletes' performance but rather provides information regarding the children's harmonious and balanced development after participating in trainings. After analyzing the relationships between anthropometric and physical indicators on the level of the target group studied (18 children registered in the football team, 2012 generation) during 2022-2025, based on the analyzed variables, it was revealed the existence of the following relationship types:

(1) Weak negative relationships, characterized by values of the relational indicator between -1 and -0.5, were established in 6 cases (8.3%), 1 case in 2022, for player 15, 2 cases in 2023, players 15 and 18, 1 case in 2024, player 10 and 2 cases in 2025, players 7 and 16. This type of relationship is characterized by synthetic values of anthropometric indicators that are lower than those of physical indicators. Thus, the relational indicator for player 15 in 2022 was -0.677, based on the synthetic values of the anthropometric indicator (0.115) and the physical indicator (0.594) (Figure 3).

(2) Strong negative relationships, with values of the relational indicator between -0.50 and 0, were identified in 44 cases (61.1%), 11 in 2022, 10 in 2023, 11 in 2024 and 12 in 2025. This relationship type is characterized by values of anthropometric indicators that are lower than those of physical indicators. Thus, for player 2, in 2022, the synthetic value of the anthropometric indicator was 0.291, while the synthetic value of his physical indicator was 0.441 (Figure 3).

(3) Strong positive relationships, with values of the relational indicator between 0 and 0.5, were identified in 21 cases (29.2%), 5 in 2022, 6 in 2023, 6 in 2024 and 4 in 2025. This relationship type is characterized by higher values of anthropometric indicators than of physical indicators. Thus, for player 17, in 2022, the synthetic value of his anthropometric indicator was 0.404, while that of his physical indicator was 0.367 (Figure 3).

(4) Weak positive relationship, with values of the relational indicator between 0.5 and 1, were identified in only 1 case (1.4%), player 1 in 2022. This relationship type is characterized by higher values of anthropometric indicators than of physical indicators. Thus, for player 1, in 2022, the synthetic value of his anthropometric indicator was 0.573, while that of his physical indicator was 0.176 (Figure 3).

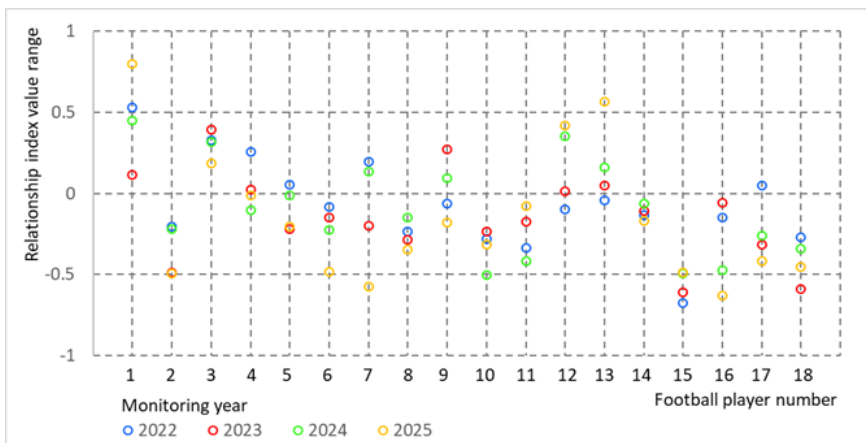


Figure 3. Distribution of relationship types between the synthetic anthropometric and physical indicators for each player

The strongest negative relationships between anthropometric and physical indicators were observed among the following players: player 13 (2022), player 5 (2024), and player 4 (2025). These were the negative relationships which emphasized the role of physical indicators in relation to the anthropometric ones. Thus, player 13 had a relationship indicator value of -0.040 in 2022, conditioned by the synthetic values of the anthropometric indicator (0.422) and the physical indicator (0.457). The strongest positive relationships were observed for players 17 (2022), 4 (2023), and 12 (2023). These were the positive relationships which emphasized the role of anthropometric indicators, in relation to physical ones. For example, for player 17, in 2022, the relationship indicator was of 0.049, being conditioned by the synthetic values of the anthropometric indicator, of 0.404, and the physical one, of 0.367 (Figure 3).

The weakest negative relationships between anthropometric and physical indicators were observed among players 15 (2022 and 2023), 18 (2023), and 16 (2025). These were the negative relationships which emphasized the role of physical indicators in relation to the anthropometric ones. Thus, for player 15, in 2022, the value of the relationship indicator was -0.677, being conditioned by the synthetic values of the anthropometric indicator, of 0.115, and that of the physical indicator, of 0.594. The weakest positive relationships were observed for players 1 (2022, 2024, and 2025), 13 (2025), and 12 (2025). These were the positive relationships which emphasized the role of anthropometric indicators, in relation to physical ones. For example, for player 1, in 2022, the relationship indicator was of 0.529, being conditioned by the synthetic values of the anthropometric indicator, of 0.573, and that of the physical one, of 0.176 (Figure 3).

The analysis of relationship indicator evolution for each player emphasized certain defining features regarding the relationship between the evolution of anthropometric and physical indicators, being closely related to training and its characteristics. Thus, it was noticed the existence of four evolution categories: positive, when the value of the relationship indicator is close to 0 (players 3, 11 and 15); negative, when the value of the relationship indicator is farther from 0 (players 1, 2, 8, 10, 14, 16 and 18); positive-negative, when the value of the relationship indicator is under 0, towards -1 (players 12 and 13); negative-positive, when the value of the relationship indicator is above 0, towards 1 (players 3, 11 and 15). How far or close to 0 the value of the relationship indicator was, was conditioned by the oscillations of the synthetic anthropometric and synthetic values which, in turn, were determined by their defining variables. Between the analyzed variables, there are interconditioned relationships, thus the anthropometric indicators can be influenced both by the physiological particularities and characteristics and age specific to each

child, and by the physical indicators. In contrast, physical indicators can be influenced by anthropometric indicators and the particularities specific to training and lifestyle (Figure 3).

The analysis of tendency of relationship types (according to the value range -1 and 1), for each player showed the following typologies: constant tendency (7 players, 38.9%), ascendant tendency (4 players, 22.2%), descendent tendency (3 players, 16.7%) and oscillating tendency (4 players, 22.2%).

The analysis of relationship evolution between anthropometric and physical indicators of the target group members during 2022-2025 showed the existence of a relatively constant situation, characterized by small oscillations caused by the increase and decrease of physical and anthropometric indicators' values of the analyzed players (Figure 4).

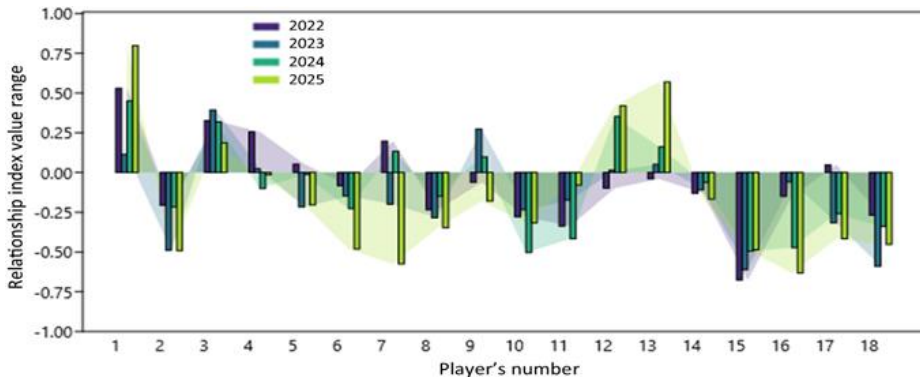


Figure 4. Evolution of relationships between anthropometric and physical indicators, for each player

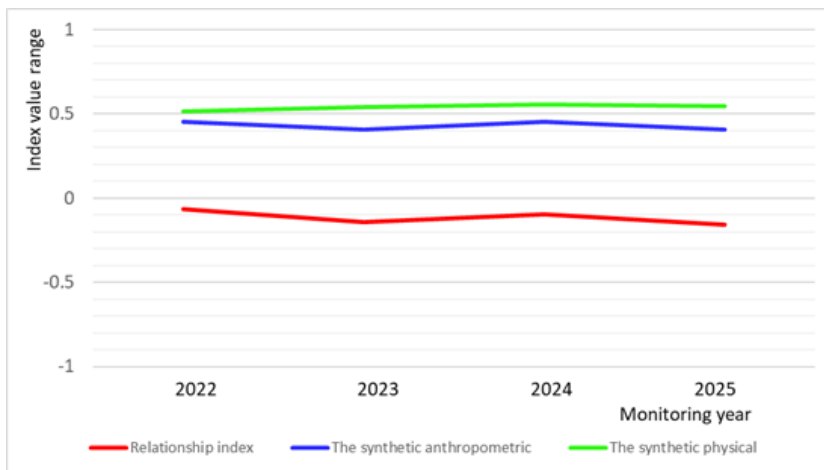


Figure 5. Evolution of average values of relationships between anthropometric and physical indicators, on team level

The analysis of the average values of relationship indicators on target group level, 2022-2025, showed the existence of certain values specific to strong negative relationships, which shows the importance of physical indicators in relation to the anthropometric ones. This is also explained through the role and importance of training carried out in the 2022–2025-time interval (Figure 5).

Discussion

The identification and exploration of relationships between the anthropometric and physical indicators in case of children is a complex and, at the same time, necessary approach. The complexity derives from the physiological characteristics specific to the analyzed age (from 10 to 13). In contrast, necessity derives from the importance of practicing sports for health (with implications on the anthropometric indicators) and achieving athletic performance.

According to Malina & Bouchard (2004), the anthropometric indicators – especially height, weight and mass-height ratio – reflect biological maturity level, a crucial element in selection and training planning of children and teenagers. Reilly & Doran (2003) point out that, in football, body proportions influence the type of preferential effort and players' specialization on positions: players with euhomomorphic somatic indicators show advantages in speed and agility, while players with a stronger mesomorphic component excel in duels and physical endurance. Carter & Heath (1990) demonstrated that the analysis of body composition and growth indicators allows the individualization of training programs, optimization of muscle development and decrease of overload risk.

Physical performance is directly dependent on the body's capacity to transform and use energy (Bompa et al., 2019). Measuring speed, resistance and strength provide objective data about training efficiency and motor training level. According to Bangsbo (1994), the speed and resistance parameters are crucial in modern football where it is estimated that a professional player performs between 1,000 and 1,500 direction changes per game, and over 90% of the actions last under 6 seconds – aspects which require constant monitoring of anaerobic and aerobic capacity. Reilly (2007) recommends the periodical assessment of strength and resistance indicators of young athletes, emphasizing that the functional muscle strength development contributes not only to performance, but to injury prevention, as well, on knee and ankle level.

The obtained results add to the specialty literature, emphasizing the importance of trainings in improving athletes' metabolic and cardiovascular functions (Foster et al., 2015; Laursen & Buchheit, 2019; Kunz et al., 2019), in developing resistance and team performance (Manuel Clemente et al., 2021; Chen et al., 2022).

The methodology and the limitations of the indicators used conditioned the results. Amongst the strong points, the observation period stands out (between 2022 and 2025), while amongst the weaknesses, we mention: the limited number of variables (4 variables for the anthropometric indicators and 5 for the physical ones); the limited number of accomplished measurements (once a year); the lack of information regarding players' consistency in trainings, motivation for practicing sports, life style (nutrition, rest, other aspects).

Our results confirm the importance of sports training, the average value of the relationship indicator for the players, during the 4 years analyzed, was within the 0 and -0.5 range, which shows the existence of strong negative relationships, with the preponderance of the physical indicators' values. There were also noticed oscillations and deviations from the average, for each player being conditioned by the evolution of analyzed indicators' variables which, in turn, can be conditioned by other factors, not included in the study.

Considering all these aspects, new approaches are required in the future, regarding the necessity of accomplishing some comparative studies by extending the target group to children who do not practice sports; extending the studies regarding the relationship between anthropometric and physical indicators by including new indicators; analysis of motivation, satisfaction and perception of sports in society, school and of each player, etc.

Conclusion

Sport is an activity with beneficial effects on health and harmonious body development and motor skills. The performance obtained from practicing sports is determined by anthropometric indicators (height, body weight, thoracic elasticity and vital pulmonary capacity) and physical ones (speed, resistance, abdominal strength, upper limbs' strength and lower limbs' strength of the studied group). Amongst these indicators, interconditioning relationships develop, so as each of them influences and is influenced.

In this context, the results obtained from the study confirm the research hypothesis regarding the existence of strong relationships between the anthropometric and physical indicators in 65 cases during the analyzed period, 2022-2025, (90.3%), while only in 7 cases (9.7%) were preponderant the weak relationships. Of the 65 cases, 44 showed strong negative relationships, in which the physical indicators' values were higher than those of the anthropometric indicators. Other very important analyzed aspects were the evolution of the relationship indicator for each player and the tendency of relationship type depending on the value range -1 and 1, on player level, which provided crucial information regarding the characteristics of the anthropometric and physical indicators' evolution. Based on this

information, evolution predictions can be made and the training can be personalized according to the players' individual needs, to improve sports performance. Therefore, considering the tendency of relationship types depending on the difference between values within the -1 and 1 range, it is recommended: a personalized training approach for the players defined by negative tendency (44.4%); maintaining the training type for the players with positive tendency (16.7%); identifying the factors which can lead to a more efficient training and performance improvement for players with oscillating tendencies (38.9%).

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The impact of the environment on women's participation in physical activities and sports clubs

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Abstract: The environment in which we live provides us with all the principles and ideas we acquire throughout our lives. In Arab society, women's participation in sports is subject to numerous standards and obstacles. There is significant apprehension surrounding women's involvement in sports, whether due to traditions, religion, or the patriarchal nature of society. Therefore, this study aims to determine the extent to which the environment influences women's participation in physical activities and their involvement in sports clubs. A descriptive approach was used, relying on questionnaires and the Mann-Whitney and Kruskal-Wallis tests to identify variables that generally influence women's participation in sports, such as sport type, age, and educational level. We also explored the relationship between indicators of women's interest in sports and indicators of their living environment. The study concluded that there is a correlation between women's interest in sports and their living environment, whereas the variables of sport type and age have no effect. Educational level influences women's interest in sports, while the same variables are also influenced by women's surrounding environment.

Keywords: environment, women, physical activities and sports, sports clubs

Introduction

It is self-evident that human behavior (movement, action, thought) is always acquired from the environment (subjective, external) surrounding him. Where the environment (community, family, school, etc.) works to provide its members with a set of ideas, principles, and even backgrounds to practice one job over another. Likewise, we find that women's practice of sports has been and still is the subject of question in many research and studies to this day, some of which have found that the family and society are the two social factors that most influence the choice of the type of sports (Mateo et al., 2021). Some have found that external factors, including the sports environment, educational context, social support, stereotypes, and gender roles in sports, influence adolescent girls' continued participation in, or cessation of, physical activity and sports in general (Moreno et al., 2024).

The environment is not just a well-defined concept, but a comprehensive, multi-faceted term that includes all conditions, factors, situations, and stimuli, the internal and external aspects that surround a person and are a cause and motivation for any behaviour he takes in his life. Thus, the environment becomes the space that encompasses the whole and, in one way or another, influences human behaviour: the family, the school, the university, the media, etc. Therefore, women's practice of sports nowadays remains hostage to the environment in which they live. This means that the characteristics of any environment are reflected in the behaviors we engage in in general, such as the difference between the characteristics of the secondary stage environment and the university environment. It was found that the university environment created difficulties and obstacles for girls, in particular, in practising physical activity and sports compared to the secondary stage environment, due to new characteristics of the university environment, such as cost (Arumi et al., 2025). Also, a study (Hanlon et al., 2019) concluded: "Characteristics of the physical environment on female participation in sports."

The impact of the environment on the extent to which women practice sports is clear on the one hand and hidden on the other hand. The environment is like the subconscious, meaning it affects, in one way or another, any decision, idea, or project we make. Thus, we find that the environment supporting women's practice of sports differs, of course, from the environment opposing their practice of sports, which is what many studies have reached, including the study that concluded that: "The environment supporting female students stimulated their determination to participate in sports and played a role in practice" (Iqra et al., 2020). Which has an infrastructure (moral or physical) for practicing sports will of course be the opposite of the environment it lacks, as confirmed by the study (Hazir & Raza, 2021): She found that cultural discourses, such as considering women's involvement in sports as reducing their femininity, are among the most important obstacles that discourage young women from practicing sports and also restrict and limit their participation by producing a prevailing traditional form of femininity through their choice and participation in specific sports and physical activities. Also, a study (Jannatul & Abdul, 2025) revealed that family expectations, religion, and stereotypes based on diversity and social class are among the most important social factors that hinder women's participation in sports. For the above reasons, in this study we aim to determine the extent to which the environment affects women's participation in physical sports and their involvement in sports clubs, according to the variables of type of sport, educational level, and age.

This study will begin with the following problem statement: To what extent does the environment influence women's participation in physical activities and sports, and their involvement in sports clubs?. To explore this problem, we will

address the following questions: Is there a correlation between indicators of girls' interest in sports and indicators of the environment in which they live? Also, what's the impact of the type of sport practised, educational level, and age on girls' participation in sports activities in general and their joining sports clubs, as well as the relationship between these factors and the surrounding environment in relation to women's participation in sports?. Therefore, this study's hypotheses are based on two main hypotheses for each variable: one null and one alternative. Our partial hypotheses relate to the three basic variables: the type of sport, the educational level, and finally, age.

Materials and methods

We will adopt a descriptive approach, which studies phenomena as they exist in reality. This approach focuses on accurately describing the phenomenon and expressing it qualitatively or quantitatively. We will choose the survey method, particularly because it saves time and effort, allowing us to study phenomena that are too large or complex for our current capabilities. Furthermore, the survey method allows us to generalise results to the population with similar characteristics to the sample.

For these reasons, our study sample consists of 21 girls enrolled in active sports clubs at the "Badji Mokhtar Complex" in Souk Ahras, Algeria. Table 1 shows their description.

Table 1. The statistics of the study sample

Variables and classifications		by level		Σ Each classification	Σ Each variable
		Secondary (12)	University (9)		
By sport	Athletics	06	01	07	21
	Football	03	03	06	
	Rhythmic dance	03	05	08	
By age	Under 20 years	10	02	12	21
	Under 30 years	02	04	06	
	Under 40 years	00	03	03	

Regarding the research instrument, we will rely on a questionnaire in this study. It is well known that any researcher's creation of a form or test does not occur in a vacuum but rather results from extensive research, including a review of previous work on the same topic. Therefore, after reviewing several similar studies, we developed a set of questions that represent and measure the indicators related to our topic among respondents. The questionnaire comprises 17 statements: 3 questions on the main study variables (type of sport, age, and skill level), 7 on indicators of interest in sports participation, and 7 on indicators of the environment surrounding women's participation in sports.

Results

The Kruskal-Wallis test for the first sub-hypothesis:

The variable for the type of sport practised, which likely includes more than two events (e.g., athletics, football, rhythmic dance), was used due to the data's abnormality. After entering the data into SPSS version 20, the results are shown in Table 2.

Table 2. Kruskal-Wallis test regarding the answers & the type of sport variable

Axis or Section	Sport Type	N	Rang moyen	Test de Kruskal-Wallis		H ₀	H ₁	Result
				Sig	Sig Description			
Indicators of interest in practice	Athletics	7	11.64	.067	>0.05	Accept	Reject	No differences
	Football	6	12.21					
	Rhythmic dance	8	11.00					
Environmental Indicators	Athletics	7	7.69	.010	<0.05	Reject	Accept	There are differences
	Football	6	14.67					
	Rhythmic dance	8	9.58					

Table 2 presents the Kruskal-Wallis test for differences among respondents in indicators of interest in sports practice and in indicators of the environment surrounding women's sports practice, by sport type (athletics, football, rhythmic dance). We find that the significance level for the "Indicators of Interest in Practice" section was 0.67, which is greater than 0.05. This means rejecting the alternative hypothesis H1 and accepting the null hypothesis H0, which states that there are no statistically significant differences between respondents in indicators of interest in sports practice attributable to the type of sport. Also, the significance level for the "Indicators of Environment" section was 0.10, which is less than 0.05. This means rejecting the null hypothesis H0 and accepting the alternative hypothesis H1, which states that there are statistically significant differences between respondents in indicators of the environment surrounding women's sports practice attributable to the type of sport.

The preceding results indicate that girls generally share similar interests in sports, meaning that the type of sport does not influence their responses, as they all have similar interests in participating. Conversely, the type of sport affected girls' responses to environmental indicators. Specifically, the environmental indicators surrounding girls' participation in sports differ by sport. This suggests that the environment surrounding women's participation in sports may have underlying biases or reservations about certain sports practised by girls, such as football (as evidenced by the sample's responses favouring football).

Kruskal-Wallis Test for the Second Sub-Hypothesis

For the age variable, which has more than two possible outcomes (less than 20 years, less than 30 years, less than 40 years), and due to the abnormality of the study data, we will use the Kruskal-Wallis test to test the second sub-hypothesis. After entering the data into SPSS version 20, we obtained the results shown in Table 3.

Table 3. Kruskal-Wallis test regarding the answers according to the age variable

Axis or Section	Age	N	Rang moyen	Test de Kruskal- Wallis		H ₀	H ₁	Result
				Sig	Sig Description			
Indicators of interest in practice	Under 20	12	11.71	.732	>0.05	Accept	Reject	no differences
	Under 30	6	9.58					
	Under 40	3	11.00					
Environmental Indicators	Under 20	12	8.83	.027	<0.05	Reject	Accept	There are differences
	Under 30	6	7.08					
	Under 40	3	12.50					

Table 3 presents the results of the Kruskal-Wallis test for differences among respondents in indicators of interest in sports practice and in indicators of the environment surrounding women's sports practice, by age group (under 20 years, under 30 years, under 40 years). The results show that the significance level for the "Interest Indicators" section was 0.732, which is greater than 0.05. This means rejecting the alternative hypothesis H₁ and accepting the null hypothesis H₀, which states that there are no statistically significant differences among respondents in indicators of interest in sports practice attributable to age. Also, the significance level for the "Environment Indicators" section was .027 which is less than 0.05. This means rejecting the null hypothesis H₀ and accepting the alternative hypothesis H₁, which states that there are statistically significant differences among respondents in indicators of the environment surrounding women's sports practice attributable to age.

The preceding results indicate that age does not affect girls' interest in sports or their participation in sports clubs; in other words, their interest is similar. Conversely, age does influence girls' responses regarding the environmental factors surrounding women's participation in sports. Specifically, this influence is greater among younger girls (the sample's responses favoured those under 40), as this age group tends to have stronger attitudes and interests than other younger groups. In other words, the environment surrounding women's participation in sports has a greater influence on younger girls' participation, and this influence diminishes as

they get older. This can be explained by the girls' determination to participate in sports despite the influence of their surrounding environment.

The Mann-Whitney test was used to test the third sub-hypothesis

Since we will be testing for differences in indicators of interest in sports and indicators of the environment surrounding women's sports participation, based on the educational level variable (which includes only two possible events: secondary school, university level), and due to the abnormality of the study data, we will use the Mann-Whitney test to test the third sub-hypothesis. After entering the data into SPSS version 20, we obtained the results shown in Table 4.

Table 4. Mann-Whitney test results & the educational level variable

Axis or Section	educational level	N	Rang moyen	Kruskal-Wallis Test		H ₀	H ₁	Result
				Sig	Description			
Indicators of interest in practice	Secondary	12	13.13	.047	<0.05	Reject	Accept	There are differences
	University	9	8.17					
Environmental Indicators	Secondary	12	10.88	.917	>0.05	Accept	Reject	no differences
	University	9	11.17					

Table 4 presents the results of the Mann-Whitney test for differences between respondents on indicators of interest in sports participation and indicators of the environment surrounding women's sports participation, by educational level (secondary, university). The results show that the significance level for the "Interest Indicators" section was 0.47, which is less than 0.05. This means rejecting the null hypothesis H₀ and accepting the alternative hypothesis H₁, which states that there are statistically significant differences between respondents in indicators of interest in sports participation attributable to the educational level variable. On the other hand, the significance level for the "Environment Indicators" section was .917 which is greater than 0.05. This means rejecting the alternative hypothesis H₁ and accepting the null hypothesis H₀, which states that there are no statistically significant differences between respondents in indicators of the environment surrounding women's sports participation attributable to the educational level variable.

The preceding results indicate that, first, the educational level variable affects the degree of interest in sports participation. Second, the educational level variable does not affect the girls' responses in the environmental indicators section. The meaning is that interest in practising sports is subject to the educational level variable, and conversely, the environmental indicators are identical among girls and are not subject to the educational level variable, meaning that the environment

surrounding women's practice of sports has no apprehension or background regarding women's practice of sports according to the educational level variable.

Testing the main hypothesis

Since we will be measuring the correlation between indicators of girls' interest in sports and indicators of their environment, we will use Pearson's correlation coefficient to test the main hypothesis. After entering the data into SPSS (version 20), we obtained the result shown in Table 5:

Table 5. Correlation between indicators of interest in sports and indicators of the environment surrounding women's participation in sports

Description		Indicators of interest in participation	Indicators of the environment surrounding women's participation in sports
Indicators of interest in participation	Corrélation de Pearson	1	.787**
	Sig		.000
Indicators of the environment surrounding women's participation in sports	Corrélation de Pearson	.787**	1
	Sig	.000	

Table 5 presents Pearson correlation coefficients indicating the degree of correlation between indicators of interest in sports participation and indicators of the environment surrounding women's participation in sports among respondents. We find that: The Pearson correlation coefficient between the two indicators is 0.787, indicating a strong correlation between the two indicators. The significance level is 0.00, which is less than 0.05. This means rejecting the null hypothesis H0 and accepting the alternative hypothesis H1, which states there is a correlation between indicators of interest in sports participation and indicators of the environment surrounding women's participation in sports among the respondents.

Based on the above, and since the Pearson correlation coefficient is greater than 0.05 indicating a correlation between indicators of interest in sports participation and indicators of the environment surrounding women's participation in sports among the respondents, and since the significance level is less than 0.05 this means rejecting the null hypothesis H0 and accepting the alternative hypothesis H1, which states: There is a statistically significant correlation between indicators of girls' interest in sports participation and indicators of the environment in which they live. The preceding results indicate a strong correlation between women's participation in sports and their living environment. The environment surrounding a woman's participation in sports significantly influences whether or not she chooses to participate.

Discussion

On the one hand, we found that the variables of sport type and age do not affect indicators of interest in, or lack thereof, sports participation. This means that a woman's participation in and interest in sports are entirely unrelated to the type of sport or age. In other words, a woman is simply interested in participating in sports, regardless of the sport she plays or her age. Women's interests when participating in sports naturally differ from men's, as confirmed by the study (Soares, 2013). The results show that boys tend to prefer competitive activities, driven by a desire to win and gain popularity. Girls, on the other hand, tend to prefer health and fitness activities, driven by a desire to make friends. Based on this, we find that there are other factors that may influence women's interest in or lack thereof in sports. These factors have been identified in numerous studies, some of which found that societal expectations and traditional norms are major obstacles restricting women's participation in sports. These obstacles include issues related to dress and physical appearance, a lack of dedicated sports facilities, and limited mobility due to cultural and religious norms (Irfan & Aqsa, 2025). Other studies have found that economic barriers, a lack of infrastructure and sports culture, limited job opportunities, insufficient knowledge, and social and cultural obstacles are all fundamental reasons limiting women's participation in both sports and society (Debashree et al., 2025). Furthermore, findings indicate that the ethics of physical education, gender issues, religion and culture, and the conflict between religion and feminism are among the obstacles to female participation in sports (Rizwan et al., 2025).

Contrary to the above, the type of sport and age influence the indicators of the environment surrounding women's participation in sports. This means that the environment surrounding women's participation in sports, in its broadest sense, varies in perspective depending on the sport and the woman's age. Society and family permit women to participate in sports at a certain age, while prohibiting it after a certain age. For example, the Arab family's perspective on women playing football differs radically from their perspective on women playing swimming because football is perceived as more masculine. This masculinity does not mean that the Arab family accepts sports with a feminine character; rather, other factors and constraints come into play, further limiting Arab women's participation in sports. For instance, the Arab family and society do not accept the idea of women practising rhythmic dancing due to the rules of this sport, which are considered incompatible with religion and social customs, such as dress codes. Therefore, the support women receive for participating in sports is a crucial factor in their decision to do so, as confirmed by the study by Iqra et al. (2020), which found that a supportive environment, including coaches, parents, and peers, significantly motivates female students to participate in sports. This aligns with the findings of Jannatul & Abdul (2025), who identified family expectations, religious conservatism,

and gender stereotypes as key social factors hindering women's participation in sports. Indeed, this encompasses all elements of the environment, regardless of their specific definition. Just as a woman's participation in sports is influenced by the family as her immediate environment, it is also affected by society as a larger environment, by education as a framework for this environment, and by religion and laws as broader environmental frameworks, and so on. This is the conclusion reached by the study (Joanne et al., 2025).

The environment, in its general sense, is closely related to the practice of sports activities in general, as specialized literature in the two fields (geography and sports) has led to the conclusion that "sports geography" has taken two main directions: the geography of sports categories (where it studies the preference for some sports in different regions), the geography of sports infrastructure (where it identifies the locations of sports clubs, stadiums, sports facilities, etc.), and the geography of sports events (the venues for organizing sports events and their requirements)(Chirazi, 2019). This relationship between the environment and sports includes all practitioners, male and female, as many studies have proven the result that training in different environmental conditions may be a motivator for athletes to engage in their sporting activities, especially those effects that touch the physiological and biochemical aspects of athletes(Paul et al., 2017). This relationship can even create barriers that limit women's participation in sports, much like the existence of environments characterised by sexism and stereotypes that diminish women and their sport, reproducing restrictive gender norms for women, and even being structurally embedded in women's sports environments. This extends to official sports governing bodies, which, in one way or another, limit women's participation in sports. A European Commission report confirms that statistics show the number of active men exceeds that of women. Women in leadership positions in sports remain a minority and face numerous obstacles. On average, women hold only 14% of senior leadership positions in sports federations across EU member states (European Commission, 2022).

Regarding the results obtained for the third sub-hypothesis, we found that the educational level variable influences indicators of interest in, or lack thereof, sports participation. This means that a woman's educational level is a determining factor in her participation in sports. The higher a woman's educational level, the more natural her participation in sports becomes; the lower her educational level, the more difficult it is for her to participate. It is as if, in this context, a woman with a higher level of education is more inclined to participate in sports, and vice versa. While it is commonly believed that girls nowadays have ample opportunities to participate in sports and that those who do not simply choose not to because they are not interested (Cheryl, 2009), this perspective is entirely incorrect. A woman's

lack of participation in sports does not necessarily mean that she has chosen not to participate of her own free will. Rather, it is due to countless factors and variables that deprive women of sports, including family, school, society, friends, and the media. However, educational level often remains a crucial factor in women's participation in sports, as confirmed by numerous studies. One such study highlighted the impact of educational attainment on athletic practice, finding changes in health behaviours and sports practices between high school and university, as well as factors such as institutional infrastructure, teacher attitudes, and social influence (Marianna, 2019).

Our main hypothesis is that there is a statistically significant correlation between girls' interest in sports and the environment in which they live. This means that an environment conducive to women's participation in sports will undoubtedly be supportive and encouraging, and vice versa. An environment that provides women with opportunities to participate in sports will, in one way or another, encourage them to do so. One study found a relationship between participation in traditionally male-dominated sports and gender role beliefs related to the abilities and interests of women and men. Women who participated in at least one traditionally male-dominated sport during elementary or secondary school exhibited more gender-neutral attitudes (Andréanne & Richard, 2025). This suggests that providing women with opportunities to participate in sports is itself a motivating factor, encouraging them to view sports more neutrally rather than negatively due to their exclusion. And like depriving her of media coverage, which in one way or another reduces the size of women's participation in sports, as confirmed by the study (Beth, 2023), whose results showed increases in neutral sports and sports practised by males at the expense of sports practised by women.

Also, many studies have shown that the problem of the lack of women's participation in sports in our contemporary time is mainly due to the influence of the environment in which we live, which does not allow women to practice sports simply, whether it is society or the sports system itself, which works to exclude women from practicing sports in a fair and transparent manner, such as the case of gender inequality in sports, which many studies have concluded, including the study (Selçuk, 2022), which acknowledged the existence of gender stereotyping in sports and its impact on success in team sports, and its results indicated that the impact of gender inequality varies in size and direction according to the type of sport.

Conclusion

Despite the level of modernity and progress we witness in our contemporary lives across all fields, many taboos and prejudices persist in today's societies. The topic of women's participation in sports is one such issue that remains confined by

traditions and prejudices instilled in individuals by their societies. Changing these misconceptions is perhaps not solely within the power of women themselves, but rather a collective responsibility of all social institutions (family, school, media, etc.), each of which must work to ensure that women's participation in sports is a guaranteed right, not a point of contention. Through this study, we arrived at the following conclusion: the type of sport and age do not affect girls' interest in sports in general. Conversely, we found that sport type and age affect indicators of the environment surrounding women's participation in sports. Also, educational level affects girls' interest in sports in general. Conversely, we found that educational level does not affect indicators of the environment surrounding women's participation in sport.

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The role of fitness and wellness activities in the lifestyle of university students. A geographical analysis of their impact on health and academic performance

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Abstract: Regular physical activity is an important component of a healthy lifestyle and may contribute to improved well-being, reduced stress, and better academic outcomes among university students. This study aimed to analyze the relationship between physical activity levels, perceived health, energy, stress, and academic performance among students from the Faculty of Physical Education and Mountain Sports. A quantitative, cross-sectional research design was used. The sample consisted of 141 university students, including 76 females and 65 males. Data were collected using the International Physical Activity Questionnaire – Short Form (IPAQ-SF), together with additional items assessing perceived health, energy level, stress, grade point average, and concentration. Descriptive statistics, Pearson correlation analysis, and independent samples t-tests were applied. The results showed that most participants reported moderate to high levels of physical activity, with a mean value of 2146.39 MET-min/week. Physical activity was positively correlated with perceived health, energy level, GPA, and concentration, and negatively correlated with perceived stress. Stress was negatively associated with both academic performance and concentration. Gender comparisons indicated that female students reported significantly higher stress levels than male students, while no significant gender differences were found for physical activity, perceived health, energy, GPA, or concentration. These findings suggest that physical activity is closely connected with students' physical and psychological well-being and may support academic performance by reducing stress and improving energy and concentration. Conclusions: The study highlights the need for university programs that promote fitness and wellness activities as part of student development strategies.

Keywords: physical activity, university students, wellness, stress, academic performance

Introduction

Physical activity plays an essential role in maintaining health and well-being across all age groups, with strong evidence supporting its benefits for both physical and mental health (Warburton et al., 2006; WHO, 2020). In young adults, particularly university students, regular engagement in physical activity contributes to improved cardiovascular fitness, body composition, and psychological functioning (Bize et al., 2007; Keating et al., 2005). The university period represents a critical

stage in the development of lifestyle behaviors. During this time, students often experience significant changes in daily routines, academic demands, and social environments, which can influence their physical activity patterns and overall well-being (Irwin, 2004; Haase et al., 2004). Research shows that many students reduce their level of physical activity after entering university, which may negatively affect their health and academic performance (Bray & Born, 2004). At the same time, university students frequently report high levels of stress, mainly due to academic pressure, time constraints, and adaptation to new environments (Pascoe et al., 2020; Bayram & Bilgel, 2008). Elevated stress levels can impair concentration, reduce academic performance, and negatively impact mental health (Saleh et al., 2017). Identifying factors that can reduce stress and improve coping mechanisms is therefore essential in the academic context.

Physical activity has been identified as an effective strategy for reducing stress and improving psychological well-being. Regular exercise is associated with lower levels of anxiety and depression, as well as improved mood and cognitive function (Salmon, 2001; Gerber & Pühse, 2009). These benefits are particularly relevant for students, who must maintain both physical and mental balance to achieve academic success. In addition to its effects on health, physical activity has been linked to academic performance. Studies indicate that students who engage in regular physical activity tend to achieve better academic results, likely due to improved concentration, memory, and executive function (Castelli et al., 2007; Singh et al., 2012; Donnelly et al., 2016). These findings support the integration of physical activity into educational strategies aimed at enhancing student outcomes.

The concept of wellness extends beyond physical activity and includes factors such as perceived health, energy levels, and stress management. A balanced lifestyle that combines physical activity with wellness practices can support both academic performance and long-term health (Biddle & Asare, 2011; WHO, 2020). In this context, assessing multiple dimensions of student life provides a more comprehensive understanding of their well-being (Onea et al., 2018).

Students enrolled in faculties of physical education and mountain sports represent a unique population. Due to the nature of their academic programs, they are expected to engage in more physical activity than other students. However, variability still exists within this group, influenced by individual motivation, lifestyle, and academic demands (Troost et al., 2002). Exploring these variations can provide insights into how physical activity interacts with other factors such as stress and academic performance.

Geographical context also plays a role in shaping physical activity behaviors. Access to natural environments, such as mountainous areas, can encourage outdoor activities, recreation, and active lifestyles (Pretty et al., 2005; Thompson Coon et al.,

2011). For students studying in regions with access to such environments, opportunities for engagement in physical activity may be enhanced, contributing to improved well-being.

Despite the growing body of literature on physical activity and student health, there is still a need for studies that integrate multiple dimensions, including fitness, wellness, stress, and academic performance, within a specific educational context. Understanding these relationships in students of physical education can provide valuable insights for both academic institutions and public health strategies.

Therefore, the aim of this study is to analyze the relationship between physical activity levels, perceived health, energy, stress, and academic performance among students of the Faculty of Physical Education and Mountain Sports. The study seeks to identify patterns that can support the development of effective interventions aimed at improving both well-being and academic outcomes.

Methodology

The study employed a quantitative, cross-sectional design, aiming to analyze the relationship between physical activity, fitness-related behaviors, and selected health and academic indicators among university students. Data collection was conducted over a period of four weeks, during the second semester of the academic year, between 09.02 and 10.03.2026.

The sample consisted of 141 participants, of whom 76 were female and 65 male. All participants were students of the Faculty of Physical Education and Mountain Sports. The selection was carried out through convenience sampling, based on participants' availability and willingness to participate. Of the total number, 76 participants were female, representing 53.9%, and 65 were male, representing 46.1%. The distribution by year of study was balanced, with 47 students enrolled in each academic year, corresponding to 33.3% for Year 1, Year 2, and Year 3, respectively. The mean age of the participants was 20.4 years, with a standard deviation of 1.2, indicating a relatively homogeneous age group.

Data collection was conducted using a structured questionnaire that included the International Physical Activity Questionnaire, short form, IPAQ-SF, a standardized and internationally validated instrument. The IPAQ-SF assessed the frequency and duration of vigorous physical activity, moderate physical activity, walking, and sedentary behavior over the last seven days.

In addition to the IPAQ-SF, the questionnaire included supplementary sections. The questionnaire was structured into several sections. The first section included socio-demographic data, such as age, gender, and year of study. The second section focused on physical activity and was based on the International Physical Activity Questionnaire, short form (IPAQ-SF), assessing vigorous and moderate

physical activity, walking, as well as sedentary behavior, in terms of frequency and duration. The third section addressed perceived health status and daily energy levels, including self-evaluation of general health and fatigue. The fourth section examined perceived stress, including the frequency of stressful situations, the ability to manage stress, and perceived academic pressure. The final section targeted academic performance, including grade point average, level of concentration during study, and self-perceived academic efficiency. The IPAQ data were processed according to official scoring protocols, and results were expressed in MET (Metabolic Equivalent of Task) -minutes per week. Physical activity levels were classified according to IPAQ scoring guidelines into low, moderate, and high categories. MET-min/week represents the total volume of physical activity calculated based on frequency, duration, and intensity of activities performed during the last seven days. Based on these values, participants were classified into three categories of physical activity levels, low, moderate, and high.

Data analysis were computed in IBM SPSS v.26 and included descriptive statistics, means and standard deviations, as well as Pearson correlation analysis to examine relationships between physical activity levels and the selected variables. The level of statistical significance was set at $p < 0.05$. Although the Shapiro-Wilk test indicated deviations from normality ($p < 0.05$), parametric tests were applied due to the relatively large sample size ($n = 141$), which allows strength of parametric methods under non-normal conditions.

This study respects ethical standards for research involving human participants. Participation was voluntary and based on informed consent obtained before data collection. Participants received clear information about the purpose of the study, the type of data collected, and their right to withdraw at any time without consequences. All responses were collected anonymously, and no personal identifiers were recorded, which ensured confidentiality and data protection. The data were used only for scientific purposes and stored securely. The study followed the ethical principles of the Declaration of Helsinki for research involving human subjects. Ethical approval was obtained from the institutional Ethics Committee under document no. 443/05.02.2026.

Results and discussion

The The results from Table 1 show that the sample is homogeneous in terms of age, with a mean of 20.51 years and a low variability, $CV = 6.74\%$. The narrow confidence interval confirms the consistency of this variable. Physical activity presents the highest variability, with a mean of 2146.39 MET-min/week and a very high CV of 78.75%. This indicates large differences between participants, from very

low to very high activity levels. The wide confidence interval supports this dispersion.

Table 1. Descriptive statistics of main study variables

Variable	X	SD	(95% CI)		CV%	Kurtosis	p
			LL	UL			
MET-min/week	2146.39	1690.31	1867.74	2425.04	78.75	-0.38	< 0.01
Perceived health (1-5)	3.82	0.95	3.66	3.98	24.78	-0.95	< 0.01
Energy level (1-5)	3.82	1.00	3.65	3.99	26.21	-1.02	< 0.01
Perceived stress (1-5)	2.96	1.16	2.77	3.15	38.97	-0.79	< 0.01
GPA (1-10)	8.07	1.00	7.90	8.24	12.37	-0.31	< 0.01
Concentration (1-5)	3.96	0.89	3.81	4.11	22.58	-0.74	< 0.01

Note. X = Mean; SD = Standard deviation; LL = lower limit of the 95% confidence interval; UL = upper limit of the 95% confidence interval; CV% = coefficient of variation; MET, Metabolic Equivalent of Task; GPA = Grade Point Average; p = Statistical significance threshold.

Perceived health and energy levels show similar mean values, 3.82, with moderate variability. This suggests that most students report a relatively good health status and energy level. The kurtosis values indicate a slightly flattened distribution. Perceived stress has a lower mean, 2.96, but a higher variability, CV = 38.97%. This shows that stress levels differ considerably among students. Academic performance is relatively high, with a mean GPA of 8.07 and low variability, CV = 12.37%. This indicates consistent academic results across the sample. Concentration levels are also relatively high, mean 3.96, with moderate variability.

The Shapiro-Wilk test shows p values below 0.05 for all variables. This indicates that the data are not normally distributed. This result supports the use of non-parametric tests or careful interpretation of parametric analyses.

Table 2. Physical activity levels based on IPAQ

Variable	Category	n	%	Mean ± SD
Physical activity level	Low	42	29.8	-
	Moderate	56	39.7	-
	High	43	30.5	-
Total physical activity	MET-min/week	-	-	2146.39 ± 980.3

Note: n = number of subjects; % = percent of total number of subjects.

The distribution of physical activity levels indicates in Table 2 that most students reported a moderate level of physical activity, accounting for 39.7% of the sample. A similar proportion of participants showed high levels of physical activity (30.5%), while 29.8% were classified in the low activity category. These results suggest that a large part of the sample maintains an active lifestyle, which aligns with the specific profile of students enrolled in a Faculty of Physical Education and Mountain Sports. The relatively balanced distribution across the three categories

highlights variability in activity patterns, even within a population expected to be physically active.

The mean value of total physical activity, 2146.39 MET-min/week, indicates an overall moderate to high level of physical engagement. This value exceeds the minimum thresholds recommended for health benefits, which supports the assumption that most participants achieve adequate levels of physical activity. The absence of missing data strengthens the reliability of the results and allows for accurate interpretation of the distribution.

Table 3. Pearson correlations between physical activity, health, stress, and academic performance

Variable	1	2	3	4	5
1. MET-min/week	1				
2. Perceived health	0.52**	1			
3. Energy level	0.55**	0.61**	1		
4. Perceived stress	-0.48**	-0.53**	-0.57**	1	
5. GPA	0.41**	0.46**	0.49**	-0.44**	1
6. Concentration	0.45**	0.50**	0.54**	-0.47**	0.58**

Note. MET = Metabolic Equivalent of Task; ** = $p < 0.01$; GPA = Grade Point Average.

The results from Table 3 show several significant relationships between physical activity, health, stress, and academic performance. Physical activity, expressed in MET-min/week, is positively correlated with perceived health, $r = 0.52$, and energy level, $r = 0.55$. This indicates that students who are more physically active report better health and higher energy. At the same time, physical activity is negatively correlated with perceived stress, $r = -0.48$, which shows that more active students tend to experience lower stress levels.

Perceived health is strongly associated with energy level, $r = 0.61$, and negatively associated with stress, $r = -0.53$. This suggests that students who feel healthier also report higher energy and lower stress. Energy level shows a strong negative correlation with stress, $r = -0.57$, indicating that higher energy is linked to lower perceived stress. Energy is also positively correlated with academic performance indicators, including GPA, $r = 0.49$, and concentration, $r = 0.54$. Perceived stress is negatively correlated with GPA, $r = -0.44$, and concentration, $r = -0.47$. This shows that higher stress is associated with lower academic performance and reduced ability to concentrate. GPA is positively correlated with concentration, $r = 0.58$, indicating that better academic results are associated with higher levels of focus during study.

All correlations are statistically significant at $p < 0.01$. The results support the idea that physical activity plays an important role in improving both well-being and academic outcomes among students.

Table 4. Differences in physical activity, health, stress, and academic performance by gender

Variable	Mean \pm SD (F)	Mean \pm SD (M)	t	p
MET-min/week	1985.30 \pm 1620.45	2335.60 \pm 1755.20	-1.21	0.228
Perceived health (1-5)	3.75 \pm 0.97	3.90 \pm 0.92	-0.98	0.329
Energy level (1-5)	3.70 \pm 1.02	3.96 \pm 0.95	-1.54	0.126
Perceived stress (1-5)	3.15 \pm 1.12	2.73 \pm 1.18	2.16	0.032
GPA (1-10)	8.12 \pm 0.95	8.01 \pm 1.05	0.64	0.523
Concentration (1-5)	3.88 \pm 0.91	4.05 \pm 0.86	-1.12	0.264

Note. Values are expressed as mean \pm standard deviation. t = Independent samples t-test value; SD = standard deviation; MET = Metabolic Equivalent of Task; GPA = Grade Point Average; p = statistical significance threshold.

The results show that most variables do not present statistically significant differences between female and male students. Physical activity levels are higher in male students, mean 2335.60 MET-min/week, compared to females, 1985.30 MET-min/week, but the difference is not statistically significant, $p = 0.228$. This suggests similar activity patterns between genders within this specific academic context. Perceived health and energy levels are slightly higher in male students, but the differences are not significant, $p > 0.05$. Both groups report comparable levels of well-being. A statistically significant difference appears in perceived stress, $p = 0.032$. Female students report higher stress levels, mean 3.15, compared to males, mean 2.73. This indicates that gender influences stress perception in this sample. Academic performance, measured through GPA, shows no significant difference between groups, $p = 0.523$. Both female and male students achieve similar academic results. Concentration levels are slightly higher in male students, but the difference is not statistically significant, $p = 0.264$ (Table 4).

These findings indicate that gender has a limited influence on most variables, with the exception of stress, where female students report higher levels.

The present study analyzed the relationship between physical activity, health status, stress, and academic performance among students enrolled in the Faculty of Physical Education and Mountain Sports. The findings highlight several relevant patterns that contribute to understanding the role of active lifestyles in a university context. The results indicate that most participants reported moderate to high levels of physical activity. This finding aligns with previous research showing that students enrolled in sport-related programs tend to maintain higher activity levels compared to the general student population (Keating et al., 2005; Irwin, 2004). The mean value of MET-min/week further supports the presence of an active profile within the sample, exceeding minimum thresholds recommended for health benefits (Craig et al., 2003).

A significant positive association was identified between physical activity and perceived health, as well as energy levels. These findings are consistent with earlier studies demonstrating that regular physical activity improves both physical and psychological well-being (Warburton et al., 2006; Bize et al., 2007). Students who engage in higher levels of physical activity tend to report better overall health and increased vitality, which supports the role of exercise as a key factor in maintaining well-being in young adults. The negative relationship between physical activity and perceived stress observed in this study is also supported by existing literature. Regular exercise has been shown to reduce stress levels through physiological and psychological mechanisms, including improved mood regulation and reduced cortisol levels (Salmon, 2001; Gerber & Pühse, 2009). The present findings reinforce the idea that physically active students are better equipped to cope with academic and daily stressors.

Energy level emerged as an important variable (Teris et al., 2024), showing strong positive correlations with both health and academic performance. This result is in line with previous research indicating that higher energy and vitality contribute to improved cognitive functioning and academic engagement (Castelli et al., 2007; Donnelly et al., 2016). Students with higher energy levels tend to concentrate better and achieve higher academic results. Perceived stress showed a significant negative association with both GPA and concentration. This finding confirms that stress can negatively affect academic performance, reducing focus and efficiency (Pascoe et al., 2020). Students experiencing higher stress levels may struggle to maintain consistent academic outcomes, which highlights the importance of stress management strategies within academic environments.

The analysis of gender differences revealed that female students reported significantly higher stress levels compared to male students. This result is consistent with previous studies that indicate higher perceived stress among female university students (Bayram & Bilgel, 2008; Saleh et al., 2017). However, no significant differences were observed in physical activity, health, or academic performance, suggesting that both genders maintain similar functional outcomes despite differences in stress perception. The lack of significant gender differences in physical activity contrasts with some studies that report higher activity levels in males (Troost et al., 2002; Badau et al., 2019), but it can be explained by the specific profile of the sample. Students enrolled in physical education programs are more likely to engage in structured physical activity regardless of gender.

Academic performance, measured through GPA, showed positive associations with both physical activity and concentration. These findings support previous research suggesting that physical activity contributes to improved academic outcomes through enhanced cognitive function and mental health (Singh et al.,

2012; Álvarez-Bueno et al., 2017). The strong relationship between concentration and GPA further emphasizes the role of cognitive engagement in academic success. The high variability observed in physical activity levels suggests that, even within a specialized academic context, students adopt different lifestyle patterns. This variability has also been reported in other studies focusing on university populations (Haase et al., 2004), indicating that individual differences remain important even among physically active groups.

The findings support the idea that physical activity plays a central role in promoting health, reducing stress, and supporting academic performance. The integration of fitness and wellness practices into student life appears to offer measurable benefits across multiple domains.

The study has several limitations that should be considered when interpreting the results. The sample includes students from a single faculty, which limits the generalization of the findings to other student populations. The specific profile of students in physical education may influence the high levels of physical activity observed.

Data were collected using self-reported questionnaires. This approach may introduce bias, as participants can overestimate or underestimate their physical activity, health status, or academic performance. The use of IPAQ, although validated, still relies on subjective reporting.

The cross-sectional design does not allow causal relationships to be established. The results show associations between variables, but it is not possible to determine directionality. For example, higher physical activity may lead to better academic performance, but it is also possible that more organized students are both more active and more successful academically.

Another limitation is the absence of objective measurements, such as wearable devices for physical activity or official academic records. Including such data would increase accuracy.

The results provide clear directions for application in the university context. Promoting regular physical activity among students can improve health, increase energy levels, and support academic performance. Universities can integrate structured fitness programs into the curriculum or offer accessible recreational activities.

The strong relationship between physical activity and reduced stress suggests that exercise can be used as a strategy for stress management. Universities can develop wellness programs that include physical activity, relaxation techniques, and time management training.

The higher stress levels reported by female students indicate the need for targeted interventions. Support services can focus on stress reduction strategies adapted to this group.

Academic staff can also use these findings to encourage active lifestyles as part of student development. Short physical activity sessions, outdoor activities, or sport-based initiatives can be integrated into student life.

These actions can contribute to improving both well-being and academic outcomes, while also supporting long-term healthy behaviors.

Conclusion

The results of this study show that physical activity plays a central role in the lifestyle of students from the Faculty of Physical Education and Mountain Sports. Most participants reported moderate to high levels of activity, which reflects the specific academic profile and supports the idea that this group maintains an active routine.

Physical activity is positively associated with perceived health, energy level, and academic performance. Students who are more active report better health status, higher energy, and improved concentration and academic results. At the same time, physical activity shows a negative relationship with perceived stress, indicating that active students experience lower stress levels.

Stress emerges as a key factor influencing academic performance. Higher stress levels are associated with lower GPA and reduced concentration. Female students report significantly higher stress compared to male students, although no differences appear in physical activity or academic outcomes.

These findings highlight the importance of integrating fitness and wellness strategies into the academic environment. Promoting regular physical activity can support both physical and mental health, while also improving academic performance. Universities can use these results to develop targeted interventions that encourage active lifestyles and reduce stress among students.

Limitations and future directions

The study has several important limitations. The sample included only students from the Faculty of Physical Education and Mountain Sports, which limits the generalization of the results to other groups of students. The participants' profile may explain the high levels of physical activity observed.

The cross-sectional design allows the identification of associations between physical activity, perceived health, stress, and academic performance, but it does not establish causal relationships. The data were collected through self-reported questionnaires, which may involve memory errors or socially influenced responses.

The academic average was also self-reported and was not verified through official documents.

Future research should include larger and more diverse samples, longitudinal studies, and objective measurements, such as accelerometers, fitness tests, official academic data, and standardized psychological scales. It would also be useful to analyze factors such as sleep, nutrition, motivation, social support, and screen time.

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Stakeholder Views of Mega-Event Infrastructure Legacies and Tourism Development Imperatives in Emerging Economies

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Abstract: This study explores the post-event realities of mega-event stadia through a dual lens of infrastructure legacy contestations and tourism development imperatives. Focusing on the DHL Stadium, Cape Town and Mbombela Stadium, Nelspruit, which were both constructed for the 2010 FIFA World Cup, the study draws from data collected through 22 semi-structured interviews with municipal officials, stadium operators, tourism stakeholders, and community representatives. Guided by a conceptual framework integrating legacy theory, resilience thinking, and tourism development strategy, the findings reveal persistent tensions between initial legacy narratives and actual long-term outcomes. Both stadia, while structurally intact, suffer from underutilisation, limited tourism integration, and fragmented governance arrangements. Respondents consistently emphasised the absence of anticipatory legacy planning, institutional fragility, and weak stakeholder coordination as key factors undermining legacy resilience and tourism leverage. The study argues that in the Global South, mega-event infrastructure legacies are not only uncertain but politically and economically contingent. Realising long-term value requires a recalibration of legacy discourse from celebratory symbolism to grounded functionality and sustained investment in governance, community access, and tourism system integration. The study contributes to a more critical and context-sensitive understanding of legacy dynamics, with implications for future mega-event infrastructure planning and post-event sustainability in emerging contexts.

Keywords: Infrastructure development, infrastructure legacy, mega-event stadia, tourism development

Introduction

This study considered contested infrastructure legacy impacts of mega-events and tourism development imperatives in the Global South, with a specific focus on South Africa's 2010 stadia in Cape Town and Nelspruit. Sport mega-events such as the FIFA World Cup and Olympic Games are a crucial component in promoting developmental agendas and have featured prominently on the agendas of countries of the Global South in the last few decades, with contemporary discourse indicating robust engagements by these countries in the mega-event complex. Such mega-events are often postured as catalysts for infrastructure transformation, economic development and international visibility (Bama & Tichaawa, 2016; Bama, 2018). Furthermore, the prime intention of such sport mega-events is to leverage their

catalytic infrastructure development impetus for their tourism development agendas (Preuss, 2015, 2018; Koch & Valiyev, 2016; Stewart & Rayner, 2016; Hemmonsbey & Tichaawa, 2018, 2019; Bama & Tichaawa, 2020, 2021; Bama, 2025). A central component of this narrative is the promise of long-term infrastructure legacies, among which purpose-built stadia are the most visible and resource-intensive investments; often justified through their perceived utility for tourism, sport and community use. Alegi (2008) therefore avers that, in the run-up to South Africa's hosting of the 2010 FIFA World Cup, it was projected that the country stood the chance of presenting itself as a modern, technologically advanced, business-friendly, tourist destination. South Africa, in 2010, hosted the FIFA World Cup, the first ever hosted on the continent since its inception (Swart & Bob, 2012; Bama, 2018, 2025). In preparations for the hosting of the event, many stakeholder factions held the view that hosting of the event stood the chance of fast-tracking developmental projects, often related to stadia, transport and telecommunications, and by implication, that it would transform the image of the cityscape with the resultant effect of attracting increased tourism (Kassens-Noor & Kayal, 2016; Bama, 2025; Ribeiro et al., 2025). Yet in practice, the realisation of these legacies remains contested, uneven, and deeply context-dependent. Specifically, in the case of the 2010 stadia, contentions that enormous resources, both financial and physical, had been committed to ensuring their readiness for the events were rife. In this regard, Bama (2018) contends that South Africa spent around R17 billion in constructing and upgrading stadia, a figure which Molloy and Chetty (2015) assert constituted the largest portion of the financial investment for the 2010 FIFA World Cup event preparations.

Legacy outcomes in the Global South context are often shaped by limited institutional capacity, fragile urban governance, and volatile development priorities. To this end, mega-event legacy discourse highlights that while considerable scholarly enquiry has explored infrastructure and economic impacts of mega-events from the perspective of the Global North, few studies have systematically explored how such legacies are perceived and managed in post-event emerging economy contexts, particularly through local stakeholders' perspectives (Bama, 2018; Preuss, 2018; Bama & Tichaawa, 2021). The case of South Africa's 2010 FIFA World Cup is emblematic in this regard: While the country gained global visibility and some infrastructural gains, scholars remain sceptical about the sustainability and inclusivity of those outcomes (Tomlinson et al., 2011; Preuss, 2018). These perspectives are important for understanding how infrastructure of this nature performs in practice, how it connects with tourism systems, and how communities interpret their relevance over time. Consequently, integrated strategies are needed to maximise the legacy outcomes of such events. By adopting selected stadia across

South Africa that were constructed for the hosting of the 2010 FIFA World Cup, this paper considers stakeholder views in relation to the debates surrounding the legacy impacts of mega-event stadia in the context of the Global South while paying attention to issues around their sustainability. Among these, the DHL Stadium in Cape Town and the Mbombela Stadium in Nelspruit exemplify contrasting legacy trajectories shaped by differing urban scales, governance contexts, and post-event utilisation patterns. Drummond and Cronje (2019) opine that the DHL stadium in Cape Town is often cited as a high-profile example of stadium 'white elephant' risks, having been expensive to build and struggling with consistent use and cost recovery in the post-event years, until the DHS Stormers moved in as anchor tenants in 2023 (Molloy Chetty, 2015; Cape Town Stadium, 2024). Meanwhile, Mbombela Stadium was intended to serve as a premier large-capacity venue for the Mpumalanga province (City of Mbombela, 2009), something critics have questioned as to whether it has achieved sustained tourism, sporting, or community integration commensurate with its cost (Freschi, 2011; Street et al., 2014).

Furthermore, there seems to be mounting evidence which challenges the ability of sport mega-events to produce sustainable, positive legacies, prompting further research on whether legacy is indeed mutable in the context of stadium infrastructure development (Bama, 2018; Brittain et al., 2018; Sroka, 2021). Following calls for mega-event legacy impact research to be conducted over time, this study considers the stadium infrastructure contestations and tourism development legacy dimensions with specific reference to both of these aforementioned stadia. Fifteen years after the 2010 event, both stadia face widely differing utilisation patterns, management challenges and integration into local tourism economies. In pursuing this objective, the study is structured in the following manner: The literature review and theoretical underpinning put mega-event legacy in context for the study concerned, while it discusses key concepts around legacy within a developing context, particularly in the context of stakeholder reflections on infrastructure legacy, institutional resilience, and tourism development imperatives. By so doing, the study anticipates a contribution towards influencing a more grounded and context-sensitive understanding of post-event infrastructure legacies in emerging economy settings, where the stakes of investment and risks of obsolescence are often magnified. The study's qualitative multi-case study methodological framework is highlighted in the subsequent section, and, thereafter, a descriptive and thematic presentation of the study's findings is elaborated upon and discussed, based on in-depth analysis of the data. Lastly, the study's implications are outlined before the study concludes with remarks and recommendations for future research.

Literature review

Stakeholder theory

Stakeholder theory serves as a critical lens for understanding the divergent interests, expectations, and power dynamics among actors involved in mega-event infrastructure projects. Originally expounded by Freeman (1984), the theory has evolved into a core analytical tool for evaluating how discussions impact and are shaped by a broad constellation of stakeholders beyond shareholders, including communities, government institutions, private developers, and tourism actors (Harrison & Wicks, 2013). Contemporary scholarship suggests that stakeholder theory, as a concept, has been applied in the domain of tourism in relation to strategic planning and sustainability imperatives of managing tourism destinations (Hardy & Beeton, 2001; Hall, 2012). In the context of mega-events, stakeholder interests can range from financial returns and political capital to community well-being and long-term urban value creation. Misalignment among these interests can exacerbate legacy failure (Preuss, 2015). Particularly in the case of emerging economies like South Africa, stakeholder salience is relevant given the potential weaknesses of institutional processes and the often top-down state-driven approaches to legacy planning (Bob & Swart, 2010; Bama, 2025).

Stakeholder theory provides a diagnostic and normative basis for assessing how inclusive, accountable, and sustainable mega-event infrastructure outcomes are negotiated and implemented towards tourism development imperatives. As defined by Bourne (2016), stakeholder engagement was implemented through stakeholder identification, prioritisation, visualisation, and engagement through effective communications. Additionally, such stakeholders' engagement was aimed at establishing their views, perceptions and indications, as well as assessing their interests regarding their perceptions of the sustainability trajectory of the stadia infrastructure deployment and management in the context of tourism development imperatives (Bama & Tichaawa, 2021; Sroka, 2021). The key stakeholders in the current study included the residents, stadium tenants, stadium management, municipalities involved in stadium management, and the government departments within the host cities of Cape Town and Mbombela.

Mega-event legacy and stadium infrastructure

The hosting of mega-events, it has been stipulated, comes with the need to invest in the creation of infrastructure that is required for the hosting of the event, such as stadia (Groothuis & Rotthoff, 2014). Preuss (2007) defines legacy as all planned and unplanned, positive and negative, tangible and intangible structures created by and for a sports event that remain after the event. Legacy, as a concept, particularly within the mega-event complex, has gained prominence and attracted

critique for its ephemeral nature of economic booms associated with such events. Stadium infrastructure, while often celebrated for its symbolic value, faces increasing scrutiny for post-event underutilisation, often dubbed the 'white elephant syndrome' (Baade & Matheson, 2016). In emerging economies, these risks are intensified due to constrained public resources, overestimated demand projections, and weak urban integration strategies (Pillay & Bass, 2008). For example, while Cape Town Stadium was envisioned as a legacy anchor for urban renewal and tourism, debates over cost recovery, event regularity and access persist more than a decade and a half after the event. Comparative case studies have shown that unless stadia are embedded within broader urban development and community engagement plans, their utility and value diminish rapidly (Gaffney, 2014). The concept of legacy remains dangerously easy to manipulate in host city discourse (Centre for Events & Festivals [CEF], 2022). While such body of work has addressed infrastructure, tourism and urban development more broadly, fewer studies focus clearly on the stadium asset and its long-term legacy in tourism development, promotion and emerging-economy contexts.

Sroka (2021) acknowledges the existence of a relatively vibrant literature on infrastructure investments and legacies in a mega-event context. Some focus directly on infrastructure and cost overruns (Matheson, 2013; Flyvbjerg et al., 2016), economics (Baade & Matheson, 2016) or mega-events as a broader phenomenon and systemic problem (Davies & Mackenzie, 2014; Müller, 2017). These mega-events have been justified as catalytic in terms of their ability to engender urban transformation and other tourism-related legacy benefits (Müller & Gaffney, 2018; Hemmonsby & Tichaawa, 2019; Kim et al., 2019). Conversely, Sroka (2021) argues that even where stadiums have viable post-event use, the public return on investment is generally poor, with sporting tenants brought in on attractive lease terms and often without the revenue-generating power to match the scale of construction costs, as well as being a poor fit for hosting a more diverse portfolio of events. Extant academic literature asserts that stadiums fail to create economic growth in a city or region (Coates & Humphreys, 2008; Humphreys, 2019). Event proponents have been noted to use the hosting of mega-events along four integral dimensions, in relation to which scale should be considered: Visitor attractiveness (tourism development); mediated reach; cost, and transformative impact (Müller, 2017; Hemmonsby & Tichaawa, 2018, 2019). Consequently, stadium infrastructure legacy should, therefore, be considered as a high-risk strategy for justifying exorbitant expenditures on sport mega-events with no dedicated focus on research that informs the existence and process through which sport mega-events enhance the attainment of legacies (Zimbalist, 2017; Byers et al., 2019). Such literature, related to sport event legacies suggest that stadium-related legacy planning should

be adopted at the inception stage of the events and that legacy implementation teams be constituted and funded post-event to ensure that the legacy plan is executed and monitored in the events' aftermath, especially legacy considerations around infrastructure linked to stadia (Bama & Tichaawa, 2020; Vronidou, 2022; Reis et al, 2023).

Mega-event boosters have often provided positive legacy projections of their intentions towards hosting mega-events, particularly in relation to the infrastructure investments anticipated (Reis et al., 2023). Infrastructural development contestations and tourism development imperatives are, therefore, gaining prominence among participants seeking to deliver sustainable mega-events (Preuss, 2015; Humphrey & Fraser, 2016). To this end, opponents have variously indicated that such infrastructure investments sometimes come with huge financial burdens. For example, Hlabane (2012, cited by Bama & Tichaawa, 2021, 10) avers that figures presented by Sturges and Brady (2006, 28), for the FIFA World Cup event co-hosted by Japan and Korea in 2002, indicate "a combined sum of US\$ 4.5 billion was spent on stadia alone". official figures placed the total expenditure for the event in South Africa at R37 billion, with the lion's share of the amount, an estimated R24 billion, having been spent on the stadia and precinct programmes, comprising two-thirds of the total spend (Cottle, 2010; South Africa 2011; Molloy & Chetty, 2015). Such contentions suggest that the sums allocated for building stadia have been increasing, and that these numbers are expected to rise in the future (Sroka, 2021). Additionally, a plethora of studies have indicated that the impacts of sport stadia on local economies, particularly related to the infrastructure-tourism development nexus, have not been in alignment with related theory (Alm et al., 2012; Groothuis & Rotthoff, 2014; Byers et al., 2019; Kassens-Noor et al., 2019; Kim et al., 2019; Bama, 2025). To situate the discussion and debates in context, the perspectives on mega-event stadia, legacy, and tourism development are discussed next.

Mega-event stadia legacy and tourism development

Mega-event hosting necessitates investment into the creation of infrastructure such as stadia (Groothuis & Rotthoff, 2014). Contemporary mega-event hosts have been known to erect multipurpose facilities in a bid to leverage multisectoral usage to engender the usability of the stadia. The hosting of the 2010 FIFA World Cup in South Africa was the first of the first-order mega-events to be staged on African soil within the context of the developing economies (Bama & Tichaawa, 2016). Among the multitude of studies that have focused on examining the concept of legacy, the majority concur that mega-event legacies are the outcomes that could be linked not only to the permanent sequel, but also to the adaptations to, changes or

readjustments to normality as a function of the outcomes of the event (Chappelet & Junod, 2006; Black, 2007; Cornelissen, 2007; Preuss, 2007, 2011, 2013; Smith & Fox, 2007; Cornelissen et al., 2011; Cashman & Horne, 2013; Bama & Tichaawa, 2015; 2016; 2020; 2021; Hemmonsbey & Tichaawa, 2019; Reis et al., 2023; Bama, 2025). Tourism development has been highlighted as a key legacy objective of mega-event infrastructure. Stadia are envisioned as multipurpose venues that drive tourism flows through sport, concerts, and heritage branding (Sroka, 2021). Despite the mounting evidence that many of the stadium-linked legacies have failed to materialise, the perennial sport-event-cycle has continued, with little policy learning taking place (Girginov, 2011; Leopkey & Parent, 2012; Tomlinson, 2014; Grix & Brannagan, 2017). According to Smith (2014), while some facilities catalyse increased visitation, local business opportunities, and urban branding when integrated with complementary attractions and mobility infrastructure, others, by contrast, become isolated assets disconnected from tourism value chains with weak linkages to broader tourism circuits.

Additionally, it has also been noted, variously, that the provision of stadium infrastructure also portends positive and negative legacy impacts on the host communities of mega-events post-events. For example, legacy infrastructures such as stadia, in the aftermath of mega-events, are considered capable of generating positive outcomes for hosts, such as image enhancement, urban regeneration, increased awareness, and tourism resource development. Conversely, the negative stadium infrastructure legacy outcomes could include, for example, the high costs for stadium maintenance, negative socio-economic impacts, and societal and cultural problems (Almeida et al., 2014; Grix & Brannagan, 2017; Reis et al., 2023). This points to a critical need for resilient tourism planning, destination integration, and stakeholder alignment to ensure sustainable infrastructure utilisation (Lu & Lin, 2021; Sroka, 2021). Tourism literature emphasises that mega-events offer host cities the opportunity to enhance their attractiveness, media exposure and visitor flows (Knott & Tinaz, 2022; Alshikhy et al., 2025; Bama, 2025). Research on sport tourism destination attractiveness, particularly in emerging economies, identifies key drivers such as event legacy, facility quality, and stakeholder collaboration (Daniels & Tichaawa, 2024; Moradi & Norouzi Seyed Hossini, 2025).

Cezne (2014) contends that, historically, mega-events have managed to transmit powerful messages, playing a multitude of both explicit and implicit roles. The heightened consideration of such potential is encapsulated by Erten and Özfiliz (2006, 525) in their analysis and commentary in relation to the potential of mega-event stadia when they state that “[S]tadia have always been significant urban elements for many reasons like the extent of the area that they occupy in a city, their size, their function, the spatial relations they motivate.” Extant scholarship contends

that the development of stadia in the mega-event literature is pursued based on the critical component of the legacy infrastructure and tourism that are associated with the hosting of such mega-events (Sroka, 2021; Vrondou, 2022; Reis et al., 2023). In the case of the 2010 FIFA World Cup hosted in South Africa, a plethora of researchers postulate that the stadia were extremely costly to build, with costs rising from the initial estimates of R2.5 billion to R8.4 billion, and then, finally, to over R10 billion by the time of their completion (Desai & Vahed, 2010; Jory & Boojihawon, 2011; Maharaj, 2011; Tichaawa & Bama, 2012), with final assessments indicating that stadium construction and upgrades programme for the 2010 FIFA World Cup cost the South African government R16.16 billion (Hlabane, 2012).

In this era of global urbanism, the intricate relationship between capital accumulation and urban spatial transformation in the context of mega-events remains contested and uncertain (Lin & Xu, 2019). Specifically, infrastructure legacy debates and tourism development-related discourses linked to stadia constructed for such events are scant. For instance, according to Ren (2017), existing studies do not venture enough into the complex elements of institutional contexts that underpin the structure of event-driven urbanisation and its outcomes. While the extant literature on mega-event infrastructure legacies provide contentious and competing interpretations (Lin & Xu, 2019), the current study delves into these conundrums and provides fresh insight into how these stadium-related infrastructure legacies could be comprehensively identified by future host communities, within the developing context, but more importantly how these could be harnessed in the context of the tourism development impetus they portend.

Methodology

In examining the perceptions of stakeholders in relation to mega-event stadia development and their tourism development implications, the study adopted a qualitative approach for data collection, analysis and interpretation. The study was based on the DHL Stadium located in Cape Town and the Mbombela Stadium located in Nelspruit. Figure 1 presents an illustration of the geographic representations of all nine host cities of the 2010 FIFA World Cup, also noting the case study areas under investigation. The justification for purposively choosing these stadiums was based upon the premise that they capture variations in urban and tourism contexts within the same national legacy framework. Cape Town's DHL Stadium, located in a major metropolitan tourism hub, and Mbombela Stadium, in a smaller regional city, provide a contrast in terms of scale, tourism market maturity, event volumes and infrastructure embedding. Moreover, these stadiums were newly constructed for the purpose of the event and drew sharp criticism in terms of their choice of location (Swart & Bob, 2009). Such contrast enables the identification of how legacy

resilience and tourism imperatives are conditioned by local context, institutional capacity and urban characteristics (Bama, 2018). Primary data were collected between the months of May and September 2025 via semi-structured virtual interviews with 22 [10 based in Cape Town and 12 based in Mbombela] key resource persons within municipal government structures, stadium management authorities, tourism representatives, local business representatives and resident organisations. To facilitate the interviews, an interview guide consisted of structured questions around four domains: (1) perceptions of infrastructure legacy, (2) infrastructure resilience and institutional adaptability, (3) tourism development outcomes and mechanisms, and (4) stakeholder coordination and governance roles.



Figure 1. Geographical location of the 2010 FIFA World Cup host cities and case study areas (adapted from Bama & Tichaawa, 2020).

Each interview lasted between 40 and 60 minutes, conducted via video conferencing on Microsoft Teams or Zoom technology, given the scheduling and travel limitations. Interviews were recorded with participants' informed consent. The collected data were subsequently transcribed verbatim from the interviews. Thereafter, the transcripts were imported into the NVivo qualitative analysis software for systematic coding. An inductive-deductive approach was adopted whereby initial open coding identified emergent themes from the data, after which codes were mapped to the conceptual framework's dimensions. Through iterative coding, category refinement and cross-case comparison, patterns within the two stadia contexts were identified. Throughout the process, the transcripts and themes

were constantly checked against the recordings and the notes made by the researcher, to ensure transferability, credibility and confirmability (Bama & Tichaawa, 2021; Abrahams & Bama, 2023). Key findings emanating from the interviews are discussed below. The findings, as collated, are elaborated upon both in terms of the thematic annotations. Discussions accompany these presentations, looking at the potential implications of the responses collated.

Results

Following the content analysis of the interview transcripts, the data were grouped according to the varying conceptual categories and discussed in line with the emergent themes. The analysis generated four overarching themes relevant to the conceptual framework: (1) infrastructure legacy outcomes, (2) institutional and operational resilience, (3) tourism development linkages, and (4) stakeholder engagement and community perception. Themes are illustrated using verbatim excerpts from interview participants and, where relevant, triangulated with the conceptual framework. Key differences and similarities between the two stadia are highlighted to foreground how local context shapes legacy trajectories in emerging economy settings.

Demographic profiles of respondents

The study drew on semi-structured interviews with 22 key informants (KPI001–KPI022) purposively selected across two South African cities, Cape Town and Mbombela, each of which hosted 2010 FIFA World Cup stadia.

Table 1. Summary of profile of the interview participants (*n*=22)

No.	Participant ID	City	Stakeholder Category
1	KPI001	Cape Town	Municipal Official
2	KPI002	Cape Town	Stadium Management
3	KPI003	Cape Town	Tourism Authority
4	KPI004	Cape Town	Local Business Representative
5	KPI005	Cape Town	Community Leader
6	KPI006	Cape Town	Sports Federation Representative
7	KPI007	Cape Town	Event Organiser
8	KPI008	Cape Town	Municipal Finance
9	KPI009	Cape Town	Tourism Practitioner
10	KPI010	Cape Town	Urban Development Advisor
11	KPI011	Mbombela	Municipal Official
12	KPI012	Mbombela	Stadium Management
13	KPI013	Mbombela	Tourism Authority
14	KPI014	Mbombela	Local Business Representative
15	KPI015	Mbombela	Community Leader
16	KPI016	Mbombela	Sports Federation Representative
17	KPI017	Mbombela	Event Organiser
18	KPI018	Mbombela	Municipal Finance

19	KPI019	Mbombela	Youth Representative
20	KPI020	Mbombela	Cultural Sector Stakeholder
20	KPI021	Mbombela	Tourism Practitioner
22	KPI022	Mbombela	Urban Planner

Participants were drawn from diverse stakeholder categories, including municipal officials, stadium managers, tourism authority representatives, local business leaders, sports federation members, event organisers, community leaders, youth representatives, and cultural sector actors. This diversity ensured a multi-perspective understanding of post-event legacy processes. Eleven participants were based in Cape Town and 11 in Mbombela, allowing for balanced city-level comparisons. Stakeholders also varied in terms of institutional affiliation (public, private, and civil society sectors) and operational scope (strategic, operational, or community interface roles). The sample was purposively aimed to capture both governance-level insights and grassroots community perspectives, particularly on how the infrastructure has been repurposed, managed, and integrated into tourism and local development strategies 15 years after the 2010-event.

Stadium and infrastructure legacy perspectives

Several studies considering the legacy impacts of mega-event stadia have highlighted the duality of expectations and outcomes that they usually portend. Such studies suggest both positive and negative outcomes, particularly in the emerging economy context (Molloy & Chetty, 2015; Ray, 2017; Bama & Tichaawa, 2021). Outcomes from the data collected highlighted that stakeholder perspectives across both case study areas revealed divergent patterns in the material and symbolic legacy of the stadia. In Cape Town, for instance, participants noted that the stadium remains structurally sound and visually iconic, often cited as a landmark in the city's urban landscape. Furthermore, participants stipulated that the stadium is largely integrated into the fabric of the city, as it has been used for promotional and marketing purposes. To this end, a stadium management official (KPI002) from Cape Town stated:

The stadium provides a tool for the promotion and marketing of the city and country as a whole... the amount of advertising the city gets out of the Rugby Sevens tournament, for example, is simply phenomenal, and makes the stadium a powerful tool for positioning the city as a preferred tourism and events destination.

Infrastructure creation for sport mega-events is a unique publicity platform and opportunity for place marketing, as well as an outstanding branding opportunity for nations (Berkowitz et al., 2007; Knott, 2014; Knott et al., 2012; Knott et al., 2015). In this regard, some participants concurred with the highlighted potential of utilising stadium infrastructure for strategic purposes. For instance, the positioning of the DHL stadium between the iconic Table Mountain and the Atlantic Ocean supports this view. One of the participants (KPI009) stated that:

The location [of the stadium] in front of Table Mountain, the Atlantic Ocean, the surroundings and, as the results show, it is a marvellous place

and makes the stadium a powerful tool for positioning the city as a preferred tourism and events destination.

As such, Allen et al. (2013) assert that sport mega-events are increasingly recognised as powerful agents in the imaging, re-imaging and branding of cities and nations. While such an agreement was noted, literature on public stadium subsidies generally undermines arguments for economic benefits (Sroka, 2021); some of the key participant informants nonetheless highlighted that the utilisation of the stadium has not matched previous expectations. Participant noted that while it has hosted occasional international sporting fixtures, concerts, and cultural events, the stadium still operates below capacity for most of the year.

As noted by one of the participants (KPI006) regarding the DHL Stadium in Cape Town:

The [stadium] infrastructure is world-class, but the volume and frequency of events are far lower than what was projected back before 2010. Additionally, the cost of maintaining that level of facility is enormous.

This response highlighted a common theme across participants, representing a major challenge in terms of the operational and maintenance of these stadia, as encapsulated by another participant, who, in their observation, highlighted the issue of resilience. Participant (KPI012) observed that:

We've not fully succeeded in that yet. Certainly, the income does not cover the cost of operations. And, essentially, the reason for that is that we don't yet have enough usage of the stadium for high-income-producing events. We have the structure and the city support, but the model is not self-sustaining. The constant pressure to justify the cost, especially when events don't break even.

Institutional and operational resilience here considers the stadium governance structures, funding models, and operational mechanisms to support ongoing utilisation and maintenance. Until as recently as 2021, the DHL Stadium in Cape Town was owned and managed by the municipality. As such, some respondents [perhaps unfamiliar with the changing management model] noted that persistent tensions were a fixture among political leadership, operational teams, and commercial partners.

Given efforts at establishing public-private partnerships, even though short-lived or transactional rather than strategic, respondents described operational processes as reactive rather than adaptive, with few mechanisms in place for long-term scenario planning or multi-stakeholder governance coordination. As such, participants noted that institutional weaknesses were more pronounced in Mbombela, highlighting a lack of dedicated stadium management personnel, unclear accountability structures, and a minimal events portfolio, with no standalone strategic plan or budget. To this end, one of the stadium officials (KPI016) stated that:

No one really owns the stadium. It is in our books, yes, but there's no long-term strategy or even a dedicated manager with the mandate to reposition it. There were some viability considerations, but only at a superficial level, because that wasn't really driving the decision-making.

Sustainability planning and the implications for post-event utilisation were lacking. And so, the viability was not tested... It was simply assumed that it could be viable, [and] that there would be enough use afterwards.

Consequently, funding for maintenance and refurbishment was identified as inconsistent, with deferred maintenance a growing concern, particularly for Mbombela. Respondents' views further confirmed concerns about the absence of institutional memory, frequent turnover in city management, and limited interdepartmental collaboration, all of which weakened the adaptive capacity of the stadium institutions to respond to shifting post-event realities (Mosime, 2016). Humphrey and Fraser (2016) note that the hosting of the 2010 FIFA World Cup in South Africa led to an oversupply of stadia, when considered in the context of the stadium's capacity, and the attendance and utilisation figures, suggesting that from a sustainability and resilience perspective of stadium infrastructure, appropriate strategies are required.

Feedback of this nature corroborates and concurs with previous studies on mega-event infrastructure sustainability in South Africa, which established that the costs of operations and maintenance of stadia in South Africa (DHL in Cape Town, Moses Mabhida in Durban, and Nelson Mandela in Gqeberha) ranged between R55 and R80million in annual costs. These figures explain perhaps why, in the pre-event context, there were huge contestations in both the media and academic circles as to the sustainability of these facilities (Bama, 2018; Bama & Tichaawa, 2021). Some of the participants from Mbombela noted that the stadium is sometimes referred to as a 'white elephant' given its minimal usage beyond sporadic local football matches and government events (Molloy & Chetty, 2015). In particular, the location of the Mbombela Stadium, nestled in the periphery of a smaller city with limited commercial event demand, was cited as a key barrier to sustained use. As such, a municipal official (KPI011) from Mbombela observed that:

Construction of the stadium was never just about the hosting of a tournament, but rather about building a legacy - a legacy in terms of, amongst others, infrastructure development, ... Nonetheless, we struggle to justify the facility's upkeep. It is not well integrated into the tourism offering, and most event planners often bypass us for better-connected cities.

These findings support suggestions that legacy planning has often been viewed as a peripheral issue, and that in this case, legacy was considered minimal or retrospective as there was little evidence of structured post-event programming strategies, anchor tenants, or financial sustainability planning at the time of construction, corroborating prior scholarship on the issue (Baumann & Matheson, 2018). From a longitudinal perspective, previous research on the Nelson Mandela Stadium in Gqeberha has also highlighted similar concerns, where it was found that legacy planning was more superficial than integrated into the planning of the stadium construction (Bama & Tichaawa, 2020). Such absence of long-term alignment was frequently mentioned as a missed opportunity to convert the infrastructure into a sustainable legacy asset in the long-term. Hints at stakeholder consultation were therefore evident because stakeholder voices have the potential

to offer insights into the successful planning of future mega-event stadium infrastructure legacies.

Infrastructure legacy and tourism development linkages

Tourism is closely related to the branding and marketing of destinations, with certain types of events noted to possess potential for encouraging repeat visitations through the positive images of the destination's legacy infrastructure often being broadcasted during the period of the event as well as through the number of visitors that are attracted by the allure of the event itself (Swart & Bob, 2009). To this end, stakeholder views on the tourism development contributions of the stadia revealed a gap between aspirational legacy narratives and actual integration into the tourism economy. From an aspirational standpoint, one was reminded of the words of the then CEO of the South African Rugby Union, who noted in relation to the stadia infrastructure allure that:

Iconic venues in iconic locations – whether it be on the fringes of the Kruger National Park, in the vibrant heart of the country in Gauteng, or in the Mother City of Cape Town – South Africa will offer visitors an unrivalled experience in a country that will guarantee a tournament like no other. Our stadia allow us to place more tickets on sale than ever before; a South African Rugby World Cup would make available 2.9 million seats – 400 000 more than the highly successful England 2015 tournament.

This contention was consistent with current strategies and provided positive linkages with the suppositions of the proponents of the stadium projects, that the edifices could be used to leverage future mega-events.

Across both study areas, respondents noted that the stadia were justified, in part as tourism assets which, in their views, mostly remained underexploited. For instance, with the respondents from Cape Town, the symbolic and branding value of the DHL Stadium has been sustained, particularly through panoramic imagery of the stadium in promotional materials, which Drummond and Cronje (2019) consider as a 'soft' benefit of the stadium. Nonetheless, respondents highlighted that tourism-related programming such as stadium tours, event packaging, or regular sporting and event fixtures remained sporadic, concurring with rhetoric that there was no consistent plan regarding leveraging the tourism potential of the stadia in the long term. As such, with regard to the DHL Stadium in Cape Town, one of the residents (KPI008) noted that:

The stadium is iconic, no doubt. But tell me what the legacy was other than infrastructure. There was no real legacy planning... no integration with community priorities.

In concurrence, another participant (KPI015), from the community around the Mbombela stadium, noted that:

The stadium is iconic, yes. But from a tourism point of view, it is not leveraged in a consistent or strategic manner. Most visitors [only] see it from afar.

According to Bama (2018), in the case of the stadia, events hosted in the stadia were themselves tourist attractions, and, if properly leveraged, packaged and distributed, such could engender positive outcomes for both event organisers and facility owners alike.

Furthermore, local tourism stakeholders pointed to the lack of integration between event calendars, tour operators, and destination marketing initiatives. The absence of a dedicated sport tourism strategy was repeatedly identified as a missed opportunity. In the instance of Mbombela, the situation was more acute. Most participants indicated that the stadium has failed to contribute meaningfully to tourism development. Limited international visitation, weak destination branding and lack of event infrastructure coordination were cited as barriers. A participant (KPI013) from the local tourism bureau in Mbombela remarked that:

It's not even on our list of tourism sites anymore. There's nothing happening there that draws visitors, and it does not fit into the region's tourism strategy.

Across both study areas, the findings suggest that even though stadia are physically present, they remain peripheral in local tourism systems, particularly in Mbombela, without an anchor tenant. Participants linked this disconnect to governance fragmentation, lack of post-event-tourism planning, and weak institutional collaboration between sport, tourism, and urban development, which aligns with extant literature that often planning was superficial in substance (Drummond & Cronje, 2019). According to Azzali (2017), it is imperative to adopt a change of perspective, putting legacy and the post-event use of stadia in the foreground by instituting the careful planning of infrastructure usage, with a conscious focus on integration and convergence from both a physical and a social perspective.

Stakeholder engagement and community perception

Stakeholder engagement and perceptions of local community value emerged as cross-cutting issues affecting both stadium legacy and future sustainability. Across both case study areas, participants expressed concern that initial consultations during the planning and construction phases were limited, top-down, and largely symbolic. Post-event, this pattern has persisted, with minimal community involvement in legacy planning or ongoing stadium development and usage. In Cape Town, for example, respondents noted some attempt at community programming and limited access for local sport groups, but these efforts were described as intermittent and under-resourced. Several community representatives expressed ambivalence about the stadium's presence, with one of them (KPI004) noting that

It's beautiful, but it doesn't feel like it belongs to the communities around it. We don't use it unless there's a major event, even then, it's usually priced out of reach.

For Mbombela, the discontent appeared more deep-seated and entrenched. Local business owners and community leaders described that stadium as physically and socially removed from the urban core, with little visibility or integration into

everyday life. A community leader from the local community (KPI020) noted that:

We were told it would bring jobs, tourism, and events. But after the 2010 [FIFA World Cup], it has been mostly quiet. Most people or visitors don't know what happens here now, if anything at all.

The lack of sustained stakeholder dialogue and participatory planning mechanisms was seen as a key constraint on stadium-legacy realisation, tourism development impediment and resilience building. Participants stressed that without meaningful engagement, particularly with the local tourism stakeholders and surrounding communities, efforts to reposition the stadia as long-term public assets would remain futile. Moreover, a sense of symbolic disconnection has undermined local ownership, further weakening the infrastructural legacy potential and social resilience capacity of the stadia.

Discussion

The study examined the infrastructure legacy and tourism development imperatives of mega-event stadia in an emerging economy context, using the DHL Stadium in Cape Town and the Mbombela Stadium in Mbombela as case studies. The study's outcomes emphasise the need to extend beyond singular interpretations of legacy as static or universally beneficial. Conversely, findings highlight that legacy outcomes are contingent on the spatial context, institutional adaptability, and integration with broader tourism and development systems. From an infrastructure resilience and tourism development perspective, even though both stadia remain intact more than a decade and a half after the 2010 showpiece, their functional integration into the urban and tourism fabric is limited. These findings concur with Preuss' (2007) legacy framework, which in the study context distinguishes between planned and unplanned stadium infrastructure legacies, and between tangible infrastructure and its long-term tourism development impact. The consistent underutilisation of Mbombela Stadium, and the sporadic programming of activities at the DHL Stadium, reflect a disconnect between initial aspirations and the lived post-event reality, an observation consistent with critiques by Bama and Tichaawa (2021) and Knott et al. (2022) confirming that the absence of clearly defined long-term legacy objectives, coupled with limited legacy governance structures, undermine the stadia's ability to achieve their tourism development objectives, foster infrastructure resilience, and evolve into everyday functional public assets.

Though not a core objective of the enquiry, an emergent thrust related to the application of a stadium infrastructure resilience lens sharpened the distinction between physical and institutional sustainability. Although the stadia remain operational, the exhibition of low adaptive capacity in terms of their management structures is consistent with Gao (2025), who avers that the resilience in infrastructure systems relating to stadia requires governance coherence and resource flexibility. In both case study contexts, weak intersectional coordination, fragmented mandates, and budgetary strain limited the venues' ability to respond to changing post-event conditions. Mbombela Stadium's reliance on ad hoc management and the absence of dedicated anchor tenants personnel exemplify what Baumann and Matheson (2018) described as infrastructure lag in emerging

contexts: Assets that survive physically but stagnate institutionally.

Despite being positioned as catalysts for long-term tourism, the stadia remain peripheral to local tourism systems. This concurs with Li and McCabe's (2012) argument that legacy should be assessed not only in terms of infrastructure delivery, but also in terms of the integration of that infrastructure into the destination experience and branding strategies. The lack of stadium-based tourism products, such as tours and event packages, limited collaboration with tourism stakeholders, and low visibility (particularly in Mbombela) in destination promotion all reflect a missed opportunity to embed the venues into the tourism economies where the tourism economy may be otherwise strong, as in the instance of Cape Town.

Perhaps the most consistent cross-case finding was the limited stakeholder engagement and lack of community integration. This finding undermines both institutional capacity and the social legitimacy of the infrastructure. Community perceptions of disconnection, exclusion, and symbolic alienation, particularly in Mbombela, echo concerns raised in post-event literature about mega-projects reinforcing urban inequalities rather than resolving them (Swart & Bob, 2012; Bama, 2025). Without a participatory planning approach or community co-ownership, legacy stadium infrastructure risks becoming not only underused but also politically and socially fragile. These findings validate the conceptual integration of legacy, resilience, and tourism development as a framework for analysing post-event infrastructure. They also highlight that in emerging economies, the successful convergence of these domains depends on anticipatory governance, cross-sector collaboration, and community anchoring. Legacy is not simply what is left behind, but what is actively maintained, adapted, and embedded over time.

Conclusion

The study examined the infrastructure legacy outcomes, institutional resilience and tourism development linkages of two mega-event stadia in South Africa, 15 years after the 2010 FIFA World Cup. Using semi-structured interviews with key stakeholders, and predicated on the conceptual framework integrating legacy theory, resilience thinking and tourism imperatives, the study highlights significant lacunae between initial expectations and long-term realities.

While the stadia remain physically intact and symbolically present in their respective urban landscapes, their practical contribution to post-event tourism development and sustained public value has been limited. Consequently, the findings underscore the importance of moving beyond a static conception of legacy and adopting a more dynamic understanding centred on institutional adaptability, stakeholder engagement, and tourism system integration. To enhance the long-term value of mega-event stadia in emerging economies such as South Africa, legacy planning must be embedded from the outset of the project lifecycle. Rather than treating legacy as a retrospective concern, infrastructure initiatives should include detailed legacy-use scenarios, transition strategies, and repurposing plans during the design and planning phases. This should be supported by dedicated budget lines

for post-event operations, allowing for smooth handover and long-term continuity. Furthermore, multi-level governance structures must be strengthened to improve coordination across stadium management entities, tourism authorities, and community stakeholders. Fragmented governance has been shown to undermine both institutional resilience and tourism integration. As such, establishing a lead legacy agency with a mandate for infrastructure legacy and tourism development would enhance accountability, foster strategic coherence, and improve operational efficiency.

The absence of long-term planning mechanisms, weak governance structures, and limited alignment with local tourism strategies have constrained the stadia's ability to function as resilient, tourism-enabling infrastructure. Mbombela Stadium in particular, illustrates the vulnerabilities of legacy infrastructure in secondary cities with limited demand, capacity and political prioritisation. Community anchoring and access should be prioritised. Programmes that encourage community participation, such as access for local sport clubs, events and cultural initiatives, can help foster a sense of shared ownership. This not only improves the social legitimacy of the infrastructure but also ensures that the stadium contributes to local well-being and public value beyond elite events. In addition, tourism programming must be purposefully integrated into stadium operations, including stadium tours, multi-event packaging, and collaborative marketing with nearby tourism attractions to maximise their contribution to the visitor economy. From an emergent thematic perspective, investment in adaptive capacity is also critical to infrastructure resilience, including the ability to adjust to evolving community needs and fluctuating fiscal resources. Diversified revenue streams, flexible partnership models, and mechanisms for periodic reassessment of stadium use will enable these facilities to remain relevant and functional over time. Ultimately, this study contributes to the literature on legacy by demonstrating that in emerging economies, infrastructure legacy is shaped as much by institutional and governance conditions as by physical design. For mega-event investments to yield long-term tourism and development value, legacy resilience must be planned, not presumed.

Limitations and future directions

While the study contributes useful insights into stakeholder perceptions of mega-event stadium infrastructure legacies and tourism development imperatives in emerging economies, several limitations should be acknowledged. The study adopted a qualitative multiple case-study approach focussing on the DHL Stadium in Cape Town and the Mbombela Stadium in Nelspruit. Although these stadia provided valuable contrasts in terms of urban scale, governance arrangements and tourism integration, the findings cannot be generalised to all 2010 FIFA World Cup host

cities or other mega-event contexts beyond South Africa. Furthermore, the study relied on semi-structured interviews with 22 purposively selected stakeholders, generating rich and context-sensitive insights from actors involved in stadium management, tourism governance, and community structures. However, the findings remain dependent on participant perceptions and retrospective reflections which may have been shaped by institutional positions, personal experiences and differing interpretations of legacy outcomes over time.

Conducted fifteen years post the hosting of the 2010 FIFA World Cup posed challenges relating to institutional memory and access to archival operational records. Some actors involved during the planning and implementation phases of the event were no longer directly associated with the stadium projects, limiting access to accounts of detailed legacy planning processes. Additionally, the study predominantly centred stakeholder narratives and did not incorporate quantitative indicators such as tourism arrival statistics, stadium financial performance data, or longitudinal economic measures linked to stadium utilisation. Future studies should therefore focus on longitudinal and mixed-methods approaches across multiple host cities to generate broader comparative insights into the sustainability and adaptive resilience of mega-event infrastructure in emerging economy contexts.

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Multidimensional Performance Profiles in Modern Football: From Physical Attributes to Psychological Competencies

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Abstract: The evolving demands of modern football require players to integrate physical, technical, tactical, and psychological competencies in order to perform at elite levels. This study aimed to construct a multidimensional performance model of professional footballers, analysing a dataset of nearly 18,000 players from major international databases (FIFA, Instat, WyScout, Football Manager). Players were categorised by nationality and playing position and evaluated across key attributes, including acceleration, sprint speed, strength, stamina, agility, vision, and composure. Descriptive statistics, ANOVA, Pearson correlations, and cluster analysis were employed to examine inter-group differences and latent performance typologies. Results revealed significant national differences: Iberian players excelled in agility and balance, German players in strength and reactions, while Romanian players showed competitive acceleration and stamina but lower technical stability. Position-specific profiles confirmed that defenders rely on strength and aerial ability, wingers on explosive acceleration, and midfielders on balanced endurance and vision. Correlation analysis identified redundancies (e.g., sprint speed and acceleration, $r = .93$) and highlighted the importance of reaction time in overall player rating ($r = .86$). Cluster analysis yielded four latent profiles: Explosive Wingers, Physical Defenders, Complete Midfielders, and Clinical Forwards. These findings underscore the importance of moving beyond unidimensional assessments toward integrative, data-driven models that account for both physical and cognitive performance. Practical implications include more effective talent identification, position-specific conditioning programs, and the inclusion of psychological indicators in player development, particularly in Romania.

Keywords: Infrastructure development, infrastructure legacy, mega-event stadia, tourism development

Introduction

Over the last few decades, football has undergone a profound transformation in terms of athletic, tactical, psychological, and developmental demands placed on players. What once could suffice as elite-level performance in terms of endurance or technical consistency now must increasingly incorporate multidimensional qualities, including rapid acceleration, complex decision-making, mental resilience, and adaptability to varying tactical systems (Folgado et al., 2019). In recognition of this complexity, the notion of a modern football player needs to transcend unidimensional metrics and embrace a more holistic framework that addresses physical, technical, tactical, psychological, and educational components (Săvescu et al., 2024).

The shift to multidimensional perspectives in football science. Traditional research in football sciences has often focused on separate domains: biomechanics

and physical conditioning, technical skill proficiency, or tactical patterning. Yet, growing empirical evidence indicates that interactions among domains are essential. For example, performance in small-sided games is sensitive to pitch orientation, indicating that physical and tactical constraints modulate technical decisions (Folgado et al., 2019; Rahmoune et al., 2025). Further, integrative models that combine player tracking, event data, and contextual features (e.g., PlayeRank) aim to produce role-aware, multidimensional performance evaluations (Pappalardo et al., 2018; Leyhr et al., 2025).

Moreover, the predictive validity of combined multidimensional indicators (e.g. anthropometry, physical tests, psychometric scores) has been demonstrated in youth settings: Leyhr et al. (2025) report that integrating such data outperforms single-domain assessments in forecasting future success. In parallel, Sieghartsleitner et al. (2019) showed that combining coach assessments with multidimensional metrics enhances predictability over either alone. These studies underline that performance is emergent from synergistic interactions rather than additive sums of abilities (Sieghartsleitner et al., 2019; Huțanu et al., 2024; Leyhr et al., 2025). According to Bulz et al. (2026), the assessment of football performance should not rely solely on isolated physical tests but on an integrated analysis of anthropometric and functional indicators, as these variables jointly contribute to the athlete's performance profile (Savescu & Sandra, 2021; Herman et al., 2026).

Role of domain interactions and latent profiling. To move beyond simplistic “top performers” ranking, latent profile or clustering techniques allow researchers to classify athletes into performance typologies, revealing subgroups with distinct balance among dimensions (Seri et al., 2025). Such soft-membership models acknowledge that players can partially belong to multiple profiles, an important nuance in high-level sports where hybrid roles are common. These typologies then allow comparisons of the extent to which each dimension (e.g., psychological coping, technical consistency) contributes to profile differentiation.

In football, position-specific demands further complicate the picture. Recent studies show that wide players tend to accumulate more high-speed and sprint metrics, while central midfielders cover greater total distance (Schuth et al., 2015). Position-aware analyses thus need to embed domain interactions: e.g. a winger's explosiveness is more valuable if coupled with decision-making under pressure and spatial awareness.

Contextual and national perspectives: Romanian and regional research. While international sports science steadily moves toward integrated, big-data approaches, the Romanian context is less represented in multidimensional football research. Some local studies address discrete domains: Gherghel et al. (2021) implemented training programs to optimise explosive force in Romanian footballers, showing gains in physical capacity. Other works compare motion indicators between Romanian and Polish youth players in small-sided games, revealing national training differences (Jastrzębski et al., 2015; Gherghel et al., 2021; Șandra et al., 2022). That said, there is a notable research gap regarding holistic, statistically grounded models of the footballer in Romania.

In related domains, Romanian scholars have also examined quality of life and psychological well-being among athletes (Erdely et al., 2020; Giurgiu et al., 2023; Predoiu et al., 2024), signalling growing attention to the “soft” side of athlete development. Incorporating such perspectives into performance profiling is valuable and reinforces the call for multi-dimensional frameworks in local sports science.

Given the evolving demands of elite football and the scarcity of integrative modelling in the Romanian (and regional) context, this study proposes developing a multidimensional performance profile of the modern football player. Specifically, by applying clustering and soft-membership statistical techniques to a heterogeneous sample of footballers, we aim to:

Identify latent performance profiles that organically emerge when physical, technical, tactical, psychological, and educational dimensions are considered jointly.

Determine which dimensions most discriminate among those latent profiles. Explore how these constructed profiles might inform practical implications in training design, talent identification, and athlete development pathways, especially in the Romanian/regional context.

By anchoring the research in both international frameworks and regional particularities, this article contributes to bridging local gaps in sports science and advancing the paradigm from unidimensional indicators to data-driven integrative modelling.

Methodology

Study Design

This study employed a quantitative, cross-sectional design to analyse multidimensional attributes of professional football players. The primary aim was to identify performance profiles across physical, technical, tactical, and psychological domains using large-scale secondary data sources. The methodological framework followed recommendations from applied sport science research regarding multidimensional profiling (Thomas & Nelson, 1996).

Sample and Inclusion Criteria

The dataset was compiled from publicly available databases and scouting platforms widely recognised in football performance analysis, including FIFA, Football Manager, Instat, WyScout, and Transfermarkt. These platforms provide standardised, continuously updated player evaluations based on match performance, expert assessments, and algorithmic modelling.

The initial dataset included over 18,000 active male professional players across more than 100 nationalities, with ages ranging from 16 to 40 years ($M = 25.1$ years, $SD = 3.9$). Only outfield players (defenders, midfielders, forwards) were considered for the main analysis, given the highly specific nature of goalkeepers' profiles. Players were categorised by official positions: central defenders (CB), full-backs (LB, RB), defensive midfielders (CDM), central midfielders (CM), attacking midfielders (CAM), wingers (LW, RW), and strikers (ST, CF). This ensured representation of all functional roles in modern football (Reilly et al., 2000).

Players registered with professional clubs in the first or second divisions worldwide. Availability of complete standardised attribute ratings (1–100 scale) across the four main dimensions (physical, technical, tactical, psychological). Active status in the 2023–2024 season.

Exclusion criteria were: Incomplete data on key performance attributes. Retired or inactive players. Goalkeepers (in analyses where attributes were non-comparable).

Variables and Dimensions

Attributes were grouped into four multidimensional categories, following both FIFA/Instat classifications and academic precedent (Stølen et al., 2005): physical: acceleration, sprint speed, stamina, strength, agility, balance, jumping. Technical: dribbling, ball control, passing (short and long), finishing, volleys, curve, free-kick accuracy. Tactical: positioning, interceptions, vision, tactical awareness. Psychological/Mental: composure, reactions, aggression, decision-making.

These categories reflect the multifactorial model of football performance, emphasising the interaction of motor, cognitive, and psychosocial elements (Weinberg & Gould, 2019).

Statistical Analyses

Data analyses were conducted using IBM SPSS Statistics (v.26) and Python (scikit-learn package). Four complementary techniques were applied: descriptive statistics, including means, standard deviations, and minimum and maximum values for each variable across positions and nationalities (Field 2013). ANOVA (Analysis of Variance): To test for significant differences in attributes across positions and nationalities. Significance was set at $p < .05$; Pearson's Correlation Coefficient (r): To examine linear relationships among physical and performance-related variables; Cluster Analysis (K-means): To identify latent player typologies based on multidimensional similarity. The optimal number of clusters was determined by the elbow method and silhouette coefficients.

Ethical Considerations

All data were secondary and publicly available in anonymised form, with no personally identifiable information collected. The study adhered to the ethical standards of the Declaration of Helsinki. Since no direct interventions with human participants were conducted, formal institutional ethics approval was not required, consistent with guidelines for secondary data research in sports sciences (Harriss & Atkinson, 2015).

Results

Physical Profiles Across European Nationalities

Descriptive statistics for the main physical attributes across selected European nationalities are presented in Table 1. Clear differences emerged between countries, consistent with both cultural playing styles and training traditions.

Descriptive statistics for the main physical attributes by nationality are presented in Table 1.

Table 1. Descriptive statistics of physical attributes by nationality

Nationality	N	Acceleration	Agility	Balance	Jumping	Reactions	Sprint speed	Stamina	Strength
<i>Belgium</i>	262	63.8	63.8	63.1	65.5	63.5	64.2	60.2	65.0
<i>England</i>	1658	64.9	63.3	64.5	64.8	58.5	64.7	63.1	64.1
<i>France</i>	925	64.8	62.8	63.9	65.2	62.6	64.9	62.6	66.3
<i>Germany</i>	1199	63.4	62.3	62.3	65.1	62.1	63.8	62.6	66.8
<i>Italy</i>	655	63.5	63.2	63.2	65.4	64.7	63.5	62.2	65.2
<i>Netherlands</i>	441	64.3	62.0	62.0	66.1	63.4	64.4	62.6	66.6
<i>Portugal</i>	335	67.2	68.2	66.7	66.1	68.4	66.6	65.5	64.4
<i>Romania</i>	52	67.8	66.5	66.9	62.0	66.5	66.1	66.6	67.7
<i>Spain</i>	1070	63.8	64.1	64.7	64.9	65.5	63.6	63.4	63.5

Values represent group means for each attribute. N = number of players included per nationality. The table presents mean values of selected physical attributes (range 0–100) for professional players across nine European nationalities. Attributes include acceleration, agility, balance, jumping ability, reactions, sprint speed, stamina, and strength. Higher values reflect better performance in each dimension.

Portuguese players exhibited the highest mean values for acceleration (M = 67.2), agility (M = 68.2), and reactions (M = 68.4), reflecting the importance of explosiveness and quick decision-making in Iberian football. Similarly, Romanian players scored highest in acceleration (M = 67.8) and stamina (M = 66.6), suggesting that endurance-based training models continue to influence their player development system.

By contrast, German and Dutch players demonstrated superior strength (M = 66.8 and 66.6, respectively) and jumping ability (M = 65.1 and 66.1), aligning with their long-standing emphasis on physical duels and aerial dominance. Italian players displayed balanced profiles, particularly in balance (M = 63.2) and reactions (M = 64.7), which may support their tactical and defensive traditions.

Interestingly, English players showed relatively lower reaction scores (M = 58.5), which contrasts with their overall competitive level in international football and may indicate differences in how perceptual-cognitive skills are represented in rating systems. Spanish players, in turn, performed strongly in balance (M = 64.7) and reactions (M = 65.5), reinforcing their reputation for technical stability and anticipation.

These results highlight that national player profiles are not homogeneous but instead reflect a blend of genetic predispositions, football culture, and training methodologies. The Iberian nations (Portugal, Spain) emphasise agility and reaction, while Central and Northern Europe (Germany, Netherlands) excel in physical robustness, and Romania stands out in acceleration and stamina despite its smaller sample size (N = 52).

Position-Specific Physical Profiles

Descriptive statistics by playing position are summarised in Table 2. A visual comparison of sprint speed across positions is presented in Figure 1

Table 2. Descriptive statistics of physical attributes by playing position. Values represent group means; N = number of players in each positional role

Position	N (players)	Acceleration	Sprint Speed	Stamina	Strength	Jumping
CB	3084	57.4	59.3	64.4	75.8	70.1
LB	1324	72.3	72.2	71.6	63.9	67.6
RB	1342	72.8	72.8	72.3	64.8	68.1
CDM	1386	62.3	61.8	72.5	69.8	67.1
CM	2155	66.3	65.3	69.7	62.9	63.2
CAM	1046	71.4	69.7	63.4	55.6	59.8
LW	378	78.5	77.3	64.1	56.1	60.4
RW	356	78.9	77.9	64.8	55.1	59.2
ST	2516	69.2	70.2	64.6	69.5	68.2
CF	88	75.3	73.7	66.8	57.3	64.2

Values represent mean scores (0–100 scale). N = number of players per position. CB = central defender; LB = left back; RB = right back; CDM = central defensive midfielder; CM = central midfielder; CAM = central attacking midfielder; LW = left winger; RW = right winger; ST = striker; CF = centre forward.

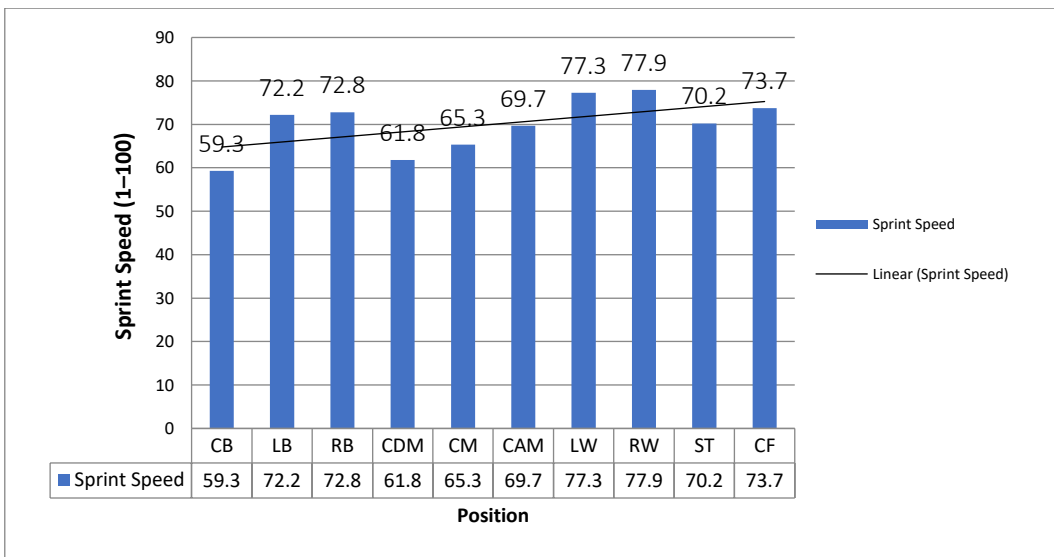


Figure 1. Comparison of mean sprint speed across different playing positions

Clear positional trends were observed. Central defenders (CB) displayed superior strength (M = 75.8) and jumping ability (M = 70.1), supporting their role in aerial duels. Full-backs (LB/RB) had the highest sprint speed (M ≈ 72.5) and stamina (M ≈ 72.0), consistent with the modern demand for overlapping runs. Central midfielders (CM/CDM) showed balanced profiles, with defensive midfielders excelling in stamina (M = 72.5). Wingers (LW/RW) achieved the highest acceleration (M ≈ 78.7) and sprint speed (M ≈ 77.6), crucial for one-on-one offensive situations. Forwards (ST/CF) combined strength (M ≈ 69.5) with above-average finishing-related physical attributes, reflecting their mixed demands for duels and quick scoring actions.

These results confirm that physical requirements are role-dependent. Wide players emphasise speed and agility, central defenders rely on power, and midfielders balance endurance with tactical intelligence.

Correlations Between Physical and Performance Attributes

Pearson correlation coefficients for selected variables are presented in Table 3, while figure 2 provides a graphical representation of these relationships.

Table 3. Pearson correlation coefficients between selected physical and performance variables

Variable Pair	r	p-value	N
<i>Stamina ↔ Age</i>	0.1	<0.001	17954
<i>Strength ↔ Jumping</i>	0.29	<0.001	17954
<i>Sprint Speed ↔ Acceleration</i>	0.93	<0.001	17954
<i>Balance ↔ Agility</i>	0.77	<0.001	17954
<i>Overall ↔ Reactions</i>	0.86	<0.001	17954

r = Pearson correlation coefficient; *p* = significance level; *N* = number of players; all correlations significant at $p < .001$.

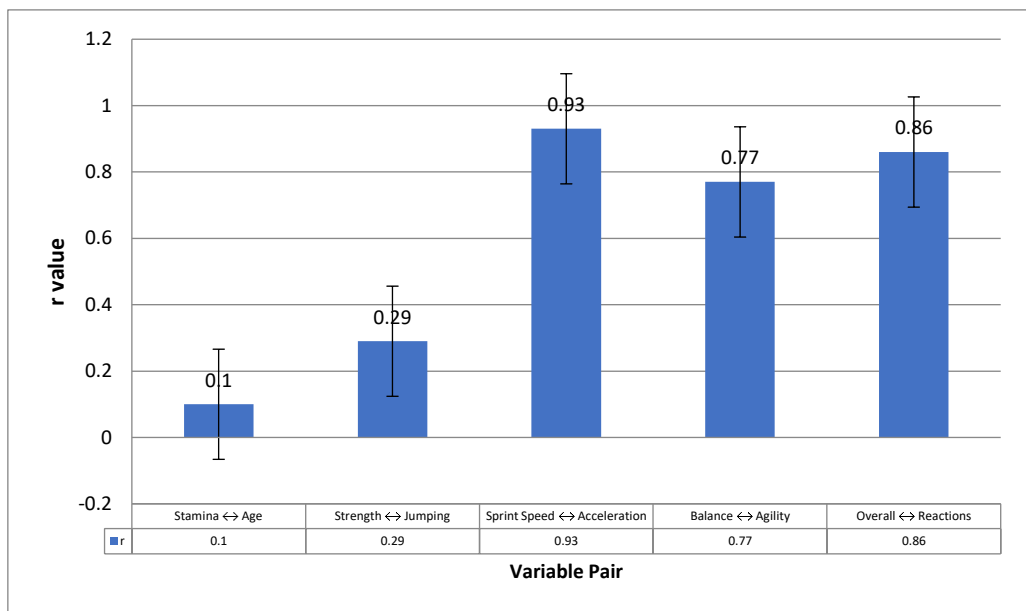


Figure 2. Pearson correlation coefficients (*r*) for selected physical and performance variables

Strongest association was observed between sprint speed and acceleration ($r = .93$, $p < .001$), indicating that these two indicators are almost inseparable in defining explosive performance. Balance and agility also correlated strongly ($r = .77$, $p < .001$), supporting the idea that motor coordination and stability are interdependent. Strength and jumping showed a moderate correlation ($r = .29$, $p < .001$), underscoring the importance of muscular force in vertical performance while also suggesting other contributing factors (e.g., timing, technique). Finally, overall rating correlated strongly with reactions ($r = .86$, $p < .001$), highlighting the central role of perceptual-cognitive speed in overall player valuation.

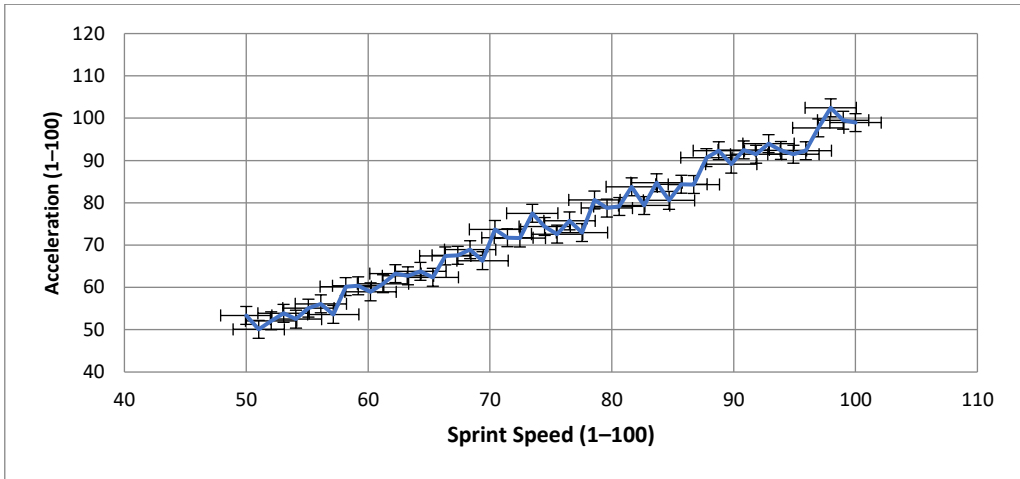


Figure 3. Scatterplot illustrating the relationship between sprint speed and acceleration

Interpretation: These results suggest that some variables (e.g., acceleration and sprint speed) are redundant when included simultaneously in predictive models, whereas others (e.g., strength vs jumping) offer complementary insights. The heatmap (Figure 4) clearly illustrates the spectrum of correlations, from weak to strong, allowing easy identification of performance clusters.

Cluster Analysis of Player Profiles

K-means clustering ($k = 4$, determined by the elbow method) identified four latent multidimensional profiles: Explosive Wingers – characterised by extreme acceleration, sprint speed, and dribbling. Physical Defenders – strong in strength, jumping, and aggression, with lower agility. Complete Midfielders – balanced across physical, technical, and psychological metrics, with superior stamina. Clinical Forwards – combining positioning, reactions, and finishing ability with physical robustness.

These clusters transcend positional boundaries, highlighting that performance typologies in modern football are multidimensional constructs rather than simple role-based categorisations.

Discussion

The present study aimed to construct multidimensional performance profiles in modern football, analysing nearly 18,000 players across positions and nationalities. Results confirmed that physical, technical, tactical, and psychological attributes interact in complex ways, shaping both positional requirements and emergent player typologies.

The finding that Portuguese and Spanish players scored highest in agility, acceleration, and balance, while German players excelled in strength and reactions, aligns with prior evidence that national football cultures emphasise distinct developmental pathways. For example, Reilly and Williams (2003) noted that Iberian football traditions prioritise technical coordination and quickness in confined spaces,

while Central European systems historically emphasise physical robustness (Reilly, 1995; Reilly et al., 2003; Șandra et al., 2023). Similarly, analyses of international tournaments show that sprinting and agility differentiate successful teams, particularly in attacking transitions (Di Salvo et al., 2007). Romanian players' relative strengths in stamina and acceleration may reflect the legacy of endurance-based training emphasised in Eastern European countries during the late 20th century (Rață, 2012).

Our results confirm established position-specific demands. Central defenders rely on strength and jumping, wingers on explosive speed, and midfielders on balanced endurance and vision. These patterns are consistent with previous time-motion analyses (Stølen et al., 2005; Bradley et al., 2013). The finding that full-backs rank highly in both sprinting and stamina reflects the modern evolution of these roles: overlapping runs require a blend of repeated high-intensity sprints and sustained aerobic conditioning (Castagna et al., 2009).

Notably, the cluster analysis revealed that these demands are not absolute but multidimensional. For instance, some forwards cluster with wingers (explosiveness) or midfielders (vision and reactions), echoing the concept of "hybrid roles" in contemporary tactical systems (Carling, 2010).

The very strong correlation between acceleration and sprint speed ($r = .93$) suggests redundancy when both are included in predictive models. This supports arguments for dimensional reduction in performance analytics, where overlapping indicators are merged to avoid collinearity (Pappalardo et al., 2018). By contrast, moderate correlations (e.g., strength and jumping) indicate that distinct physiological or biomechanical components contribute to performance in aerial duels (Wisløff et al., 1998).

The strong link between overall rating and reaction time ($r = .86$) is particularly noteworthy. It reinforces recent evidence that cognitive-perceptual abilities (decision-making speed, anticipation) are increasingly valued in talent identification (Sieghartsleitner et al., 2019). This finding aligns with broader sport psychology literature emphasising the role of mental attributes in elite performance (Weinberg & Gould, 2019).

For practitioners, these results have several implications: talent identification: National scouting systems should recognise cultural biases (e.g., Iberian technical agility vs Eastern European endurance) and ensure that multidimensional evaluation compensates for potential blind spots. Training design: Position-specific conditioning should be tailored to: strength and jumping for defenders, repeated-sprint ability for wide players, and balanced endurance and tactical vision for midfielders. Data-driven profiling: Given the redundancy in some metrics, clubs should prioritise integrative indicators that capture essential variance (e.g., composite "explosiveness" metrics instead of separate acceleration and sprint speed). Holistic development: Psychological and cognitive factors, often underrepresented in traditional scouting, should be integrated into developmental programs, especially in Romania, where physical conditioning has historically dominated.

Conclusions

This study proposed and tested a multidimensional framework for profiling modern football players, integrating physical, technical, tactical, and psychological attributes across a large international sample. Several key findings emerged: national differences confirm that cultural and training traditions shape specific physical and technical advantages (e.g., Iberian agility vs Central European strength). Positional requirements highlight that full-backs and wingers prioritise speed and stamina, central defenders rely on power, and midfielders balance endurance with vision. Correlation analysis revealed redundancy among some metrics (e.g., sprint speed and acceleration), while others provided complementary insights (e.g., strength and jumping). Cluster analysis identified four latent performance typologies—Explosive Wingers, Physical Defenders, Complete Midfielders, and Clinical Forwards—demonstrating that multidimensional evaluation transcends rigid positional categories.

Practical implications include the need for talent identification systems to use integrated metrics, for training programs to be role-specific yet multidimensional, and for psychological attributes to be systematically included in player evaluation. For Romanian football in particular, these results underscore the need to move from endurance-dominated traditions toward holistic player development that values technical, tactical, and cognitive skills equally.

Future research should validate this multidimensional model in longitudinal settings (e.g., youth academies) and expand analyses with machine learning tools to predict performance trajectories more accurately.

In conclusion, the modern football player cannot be reduced to isolated abilities. Success emerges from the synergy of multiple dimensions, and adopting such integrative models represents both a scientific and a practical step forward for football development worldwide.

Limitations and Future Directions

Although this study analysed a large sample, several limitations remain. First, the reliance on secondary databases (e.g., FIFA ratings, scouting platforms) introduces subjectivity, as these ratings combine observational data with algorithmic estimates. Second, psychological and educational dimensions were limited to available metrics; future research should incorporate validated psychometric instruments and longitudinal tracking. Finally, goalkeepers were excluded; future multidimensional models should address their unique requirements.

Future directions include expanding the integrative framework to machine learning models that can predict success based on multidimensional interactions and validating these models in prospective cohorts of youth academies.

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